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Further evaluation of programs for promoting daily activities and indoor orientation and travel in persons with moderate Alzheimer's disease

Giulio E. Lancioni[1], *Maria F. De Caro*[2], *Nirbhay N. Singh*[3], *Mark F. O'Reilly*[4], *Jeff Sigafoos*[5], *Floriana De Vanna*[6], *Cristian Spinelli*[7], *Anna Santoruvo*[8], *Serafino Buono*[9] & *Grazia Trubia*[10]

Abstract

These two studies extended the assessment of programs recently developed for promoting activity and orientation in persons with moderate Alzheimer's disease. Specifically, Study I pursued a new evaluation of a program, in which pictorial instructions of activity steps are presented on a computer screen at preset intervals. Study II pursued a new evaluation of a program using music and strobe lights (emitted at the destinations) as spatial cues to support indoor orientation and travel. Six participants were included, three per study. The results of Study I showed that the participants reached high percentages of correct steps in each of the two activities targeted. The results of Study II showed that the participants had high percentages of correct orientation and travel within their day care context. The results of both studies were in line with

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[1] University of Bari, Italy. E-mail: giulio.lancioni@uniba.it
[2] University of Bari, Italy. E-mail: maria.decaro@uniba.it
[3] Medical College of Georgia, Georgia Regents University, Augusta, USA. E-mail: nirbsingh52@aol.com
[4] University of Texas at Austin, TX, USA. E-mail: markoreilly@mail.utexas.edu
[5] Victoria University of Wellington, New Zealand. E-mail: jeff.sigafoos@vuw.ac.nz
[6] Memory Drops Day Center, Giovinazzo (BA), Italy. E-mail: florianadevanna@libero.it
[7] Villa Maria Martina Care Center, Valenzano (BA), Italy. E-mail: christian.sp@libero.it
[8] Villa Maria Martina Care Center, Valenzano (BA), Italy. E-mail: anna.santoruvo@libero.it
[9] IRCCS Oasi Maria SS. Troina, Italy. E-mail: sbuono@oasi.en.it
[10] IRCCS Oasi Maria SS. Troina, Italy. E-mail: gtrubia@oasi.en.it

Correspondence to: G. E. Lancioni, Department of Neuroscience and Sense Organs, University of Bari, Via Quintino Sella 268, 70100 Bari, Italy

the data of previous studies in these areas. The practical implications of these results for helping participants with moderate Alzheimer's disease manage activity engagement and orientation/travel are discussed.

Keywords: Alzheimer's disease; Daily activities; Indoor orientation; Technology.

1. Introduction

The Alzheimer's disease is a neurodegenerative condition whose prevalence increases as the population becomes older (Melrose, Ettenhofer, Harwood, Achamallah, Campa, Mandelkern *et al*., 2011; Ambrose, 2012; Bernick, Cummings, Raman, Sun, & Aisen, 2012; Wilson, Segawa, Boyle, Anagnos, Hizel, & Bennett 2012; Perry, Monaco, Fadda, Caltagirone, & Carlesimo, 2014). The persons affected by the disease gradually lose their abilities to, among others, (a) take care of relevant personal issues, such as finances and medication (Marson, Sawrie, Snyder, McInturff, Stalvey, Boothe *et al.*, 2000; Campbell, Boustani, Skopeljia, Gao, Unverzagt, & Murray, 2012), (b) use communication devices for interacting with persons not directly present, such as the telephone (Perilli, Lancioni, Laporta, Paparella, Caffò, Singh *et al.*, 2012; Perilli, Lancioni, Singh, O'Reilly, Sigafoos, Cassano *et al.*, 2013), (c) carry out daily activities, such as self-help tasks and house chores (Lancioni, Singh, O'Reilly, Sigafoos, Tatulli, Rigante *et al*., 2010; Martyr & Clare, 2012), and (d) find the way within familiar contexts and even indoor areas, such as the home or day center (Lancioni, Perilli, O'Reilly, Singh, Sigafoos, Bosco *et al*., 2013; Caffò, Hoogeveen, Groenendaal, Perilli, Damen, Stasolla *et al.*, 2014).

In spite of the extensive research focus on the disease, no preventive measures exist that could ensure against its onset and/or development (Tayeb, Yang, Price, & Tarazi, 2012; Konrath, Passos Cdos, Klein, & Henriques, 2013). Pharmacological and behavioral interventions have been used as efforts to slow down the participant's deterioration and maintain his or her basic adaptive skills for a possibly longer time (Popp & Arlt, 2011; Kurz & Perneczky, 2011; Boller, Jennings, Dieudonné, Verny, & Ergis, 2012; Levy, Lanctôt, Farber, Li, & Hermann, 2012; Rive, Aarsland, Grishchenko, Cochran, Lamure, & Toumi, 2012; Small, 2012; Takeda, Tanaka, Okochi, & Kazui, 2012; Ferris & Farlow, 2013).

Behavioral interventions have traditionally involved strategies such as reality orientation training, memory training and stimulation enrichment (Arkin, 2007; Boller *et al*., 2012; Cotelli, Manenti, Zanetti, & Miniussi, 2012; Small, 2012; Takeda *et al*., 2012). More recently, technology-aided programs for promoting independent performance of daily activities and indoor orientation and traveling have also been presented (Lancioni, Perilli, Singh, O'Reilly, Sigafoos, Cassano *et al*., 2012; Lancioni, Perilli *et al*., 2013; Caffò *et al*., 2014). Programs for promoting daily activities have varied in terms of instructions and activity arrangement. For example,

Lancioni *et al.* (2010) ensured that the participants received verbal instructions for each of the activity steps, which consisted of taking activity items from a table and using them on a second table where the activity was performed. The tables were adjacent and participants moved between them. Instructions were presented automatically in relation to preset time intervals and participants' behavior (i.e., arrival at one of the tables). Lancioni, Singh, *et al.* (2013) reported the use of pictorial instructions for the steps. The participants sat at a table, which contained a computer screen showing the instructions as well as the activity items. Instructions were presented automatically at preset intervals. Positive results were reported with both types of programs and variations of them (Lancioni *et al.*, 2012; Lancioni, Singh, O'Reilly, Sigafoos, Renna, Ventrella *et al*., 2013; Lancioni, Singh, O'Reilly, Sigafoos, Renna, Pinto *et al*., 2014).

Studies targeting indoor orientation and traveling have generally relied on sound/verbal or visual cues emitted by small technical devices available at the destinations (Lancioni, Perilli, Singh, O'Reilly, Sigafoos, Bosco *et al*., 2011; Lancioni, Perilli *et al*., 2013; Caffò *et al*., 2014). For example, the participants could receive a voice cue (i.e., calling/encouraging them) or a musical/light cue from the destination that they had to reach and, with the help of that cue, they were to orient themselves and travel to the destination (Lancioni, Sigafoos, O'Reilly, & Singh, 2013). The calls/encouragements occurred at intervals of 5-10s while music and lights occurred uninterruptedly until the participants reached the destination. The results of the studies were highly promising.

The present two studies extended the assessment of the above mentioned programs for supporting activity and orientation in persons with moderate Alzheimer's disease (i.e., to gather new relevant evidence about those programs' dependability) (Kennedy, 2005; Barlow, Nock, & Hersen, 2009). Specifically, Study I pursued a new evaluation of the program with pictorial instructions occurring at preset intervals (Lancioni, Singh *et al.*, 2013; Lancioni *et al*., 2014). Study II pursued a new evaluation of the program using music and light cues to support indoor orientation and travel (Lancioni, Singh *et al.*, 2013). Three participants were involved in each of the two studies.

2. Study I

2.1. Method

2.1.1. Participants

The participants (Mildred, Nadine, and Aisha) were 67. 82, and 75 years of age, respectively. They were diagnosed with moderate Alzheimer's disease and had scores of 19, 20, and 17, respectively, on the Mini-Mental State Examination (Folstein, Folstein, & McHugh, 1975). Pharmacological treatment for the Alzheimer's condition, at the time of the study, was available only for Aisha and involved the use of memantine. They had been losing the ability to perform daily activities (e.g., making coffee and preparing or serving a snack) considered important for their occupational engagement and functional role within the daily context. Their decline was considered largely related to their problems in remembering the steps involved in the activities and/or the step sequences. In fact, they appeared capable of performing the single steps if verbally instructed to carry them out. They were also capable of discriminating pictorial representations and photographs of step-related material and seemed interested in using such photographs/representations as cues for carrying out activities. Staff and families supported their involvement in a program promoting activity engagement. The families had also provided informed consent for this study, which was approved by a scientific and ethics committee.

2.1.2. Setting, activities, and data recording

The study was carried out in the day center that the participants attended. Two activities were available for each of them (i.e., making tea and preparing a snack (Mildred and Nadine), and preparing fruit salad and arranging it in glasses on a tray (i.e., to be served) (Aisha). These activities were similar to those described in previous studies in this context and included 20 to 28 steps (see Lancioni *et al*., 2010, 2012; Lancioni, Singh *et al.*, 2013). The participants sat at a table where the activity was to be carried out and had the items for the activity on a cart located to their left.

Data recording concerned the participants' performance of the activity steps. A step was considered correct if it matched the related instruction and occurred independent of prompting from research assistants (see below). Inter-rater agreement (assessed in about 20% of the activity trials, by

dividing the number of steps in which the raters' scoring coincided by the total number of steps and multiplying by 100) was within the 80-100% range, with means of about 95%.

2.1.3. Technology with pictorial instructions

The technology used for the intervention program included a portable computer fitted with Pinnacle Studio software that allowed the research assistant to build files with photos serving as instructions for activity steps. The photos were shown on the computer screen (in front of the participant) for specific times (e.g., between 5 and 25 s), which were programmed by the research assistant, based on observations of the participant's performance of the related steps (see Cohen-Mansfield, Creedon, Malone, Parpura-Gill, Dakheel-Ali, & Heasley, 2006; Lancioni, Singh *et al.*, 2013). Longer exposure times were programmed for the instructions of more laborious (time-demanding) steps, and vice-versa. The times could be regularly readjusted in line with the participant's progress. Every change of instruction on the screen (occurring at the end of the preprogrammed time interval) was indicated by a 3-s sound signal, which was to alert the participant and eventually direct his or her attention.

2.1.4. Experimental conditions

A multiple probe design across activities (Barlow *et al*., 2009) was used for each participant. Baseline trials were initially carried out on the two activities available. Then intervention started on one activity. When a clear improvement had occurred on this activity, new baseline trials and intervention occurred on the other activity. During intervention on the second activity, intermittent trials on the first were maintained. Verbal and physical prompting/guidance from the research assistant occurred if the participant (a) asked for help or failed to carry out any step for 20-30 s (baseline) or (b) failed to carry out a step correctly in relation to the matching instruction or alongside the performance of the next two steps (intervention). At the end of each baseline and intervention trial, the research assistant praised the participant (see Lancioni, Singh *et al*., 2013).

- *Baseline.* During each baseline trial, the participant was asked to carry out the activity scheduled, but no instructions were available. A trial ended if the participant carried out all the steps or failed to proceed in spite of four or five instances of prompting/guidance by the research assistant (see Lancioni *et al*., 2014).

- *Intervention.* The intervention on each of the activities was preceded by six to eight practice trials during which the research assistant used prompting/guidance to ensure that the participant followed the pictorial instructions and performed the activity steps without errors. These trials were followed by regular intervention trials involving pictorial instructions and prompting/guidance as described in the *Experimental conditions*.

2.2. Results

Figures 1-3 summarize the data for Mildred, Nadine, and Aisha, respectively. The white bars refer to making tea (Mildred and Nadine) and preparing fruit salad (Aisha); the gray bars refer to preparing a snack (Mildred and Nadine) and arranging fruit salad in glasses on a tray (Aisha). The bars represent mean percentages of correct steps per activity trial computed over blocks of activity trials. The number of trials included in each block is indicated by the numeral above it.

Figure 1 - *Mildred's data. The white and gray bars refer to making tea and preparing a snack, respectively. The bars represent mean percentages of correct steps per activity trial computed over blocks of activity trials. The number of trials included in each block is indicated by the numeral above it.*

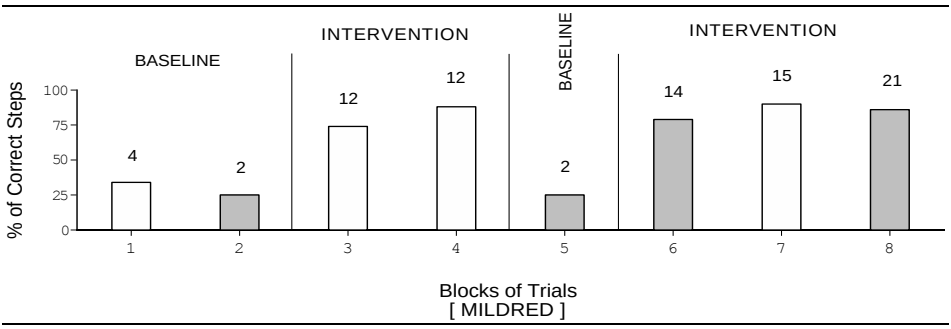


Figure 2 - *Nadine's data plotted as in Figure 1.*

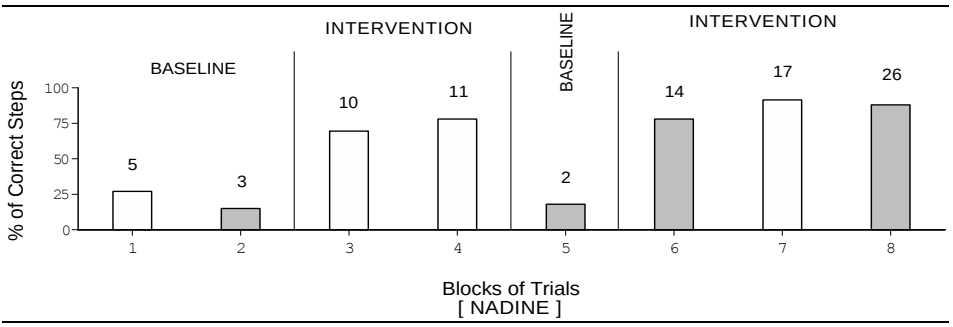
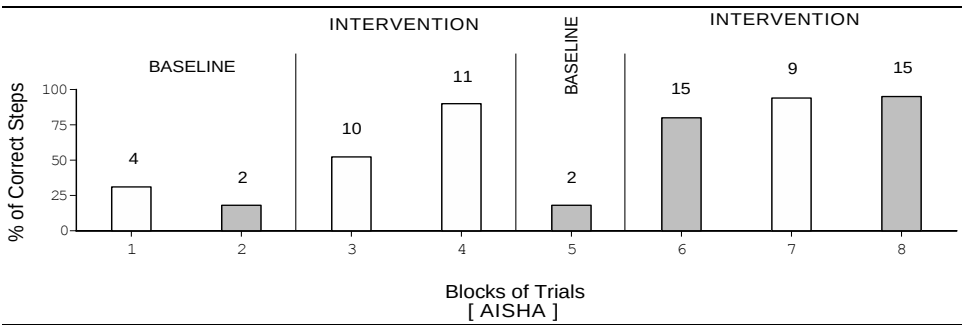


Figure 3 - *Aisha's data for preparing fruit salad (white bars) and arranging it in glasses on a tray (gray bars) plotted as in Figure 1.*



Mildred and Nadine's mean percentages of correct steps during the initial baseline phase (i.e., four or five trials on making tea and two or three trials on preparing a snack; see the first two bars of Figures 1 and 2) were below 35. The intervention on the first activity (i.e., the 24 and 21 trials represented by the third and fourth bar of Figures 1 and 2) increased Mildred and Nadine's percentages, which reached means of nearly 90 and 80 over the fourth bar. The subsequent baseline trials on the second activity (see the fifth bar of Figures 1 and 2) showed no changes in performance. The intervention on this activity (see the last two gray bars of Figures 1 and 2, including totals of 35 and 40 trials, respectively) increased correct responding to mean percentages exceeding 85 over the last gray bar. The percentages on the first activity improved to about 90 for both participants (see the last white bar of Figures 1 and 2, including 15 and 17 trials). Aisha's data (reported in Figure 3) showed improvements in the two activities available for her (i.e., preparing fruit salad and arranging it in glasses on a tray) comparable to those of the previous participants.

3. Study II

3.1. Method

3.1.1. Participants

The participants (Eddie, Margot, and Pat) were 78, 78, and 84 years old, respectively. They were diagnosed with moderate Alzheimer's disease and had scores of 19, 16, and 16 on the Mini-Mental State Examination (Folstein *et al*., 1975). They did not receive specific pharmacological treatment for the Alzheimer's condition. All three were reported to have orientation and travel problems within the day center they attended (i.e., problems in finding the rooms/areas they needed to reach), and frequently required guidance from staff. They were able to follow sound and light cues and were interested in using them to improve their performance. Staff and families considered the use of those cues relevant because it would allow the participants more opportunities to move, increasing their success rates and limiting the embarrassment of failure. Their families had provided informed consent for this study, which was approved by a scientific and ethics committee.

3.1.2. Setting and sessions

Several areas of the day center that the participants attended served as destinations for their orientation and travel (e.g., living room, rest room, and activity area). During each session, the participants were to reach five of those destinations to engage in self-care activities (e.g., wash their hands) or bring some material to a member of the staff working within the center (see Lancioni *et al*., 2011; Lancioni, Singh, *et al*., 2013).The distances to cover to reach the various destinations varied between about 5 and 12 m with means of about 8 m.

3.1.3. Orientation technology

The technology used for promoting the participants' orientation during the intervention phase of the study consisted of an inexpensive, wireless doorbell system (for Eddie and Margot) and a variation of such system (for Pat). The two solutions involved a receiver that was located at the destination and a transmitter that was used by the research assistant. The receiver ensured music emission combined with strobe light flashes. The

transmitter allowed the research assistant to operate the receiver from a distance, without interfering with the participants' orientation. At the start of each travel occasion, the participants were informed about the destination to reach and the person to meet or the activity to perform. Sometimes, they also received material to bring along. Subsequently, the research assistant activated the receiver at the destination. This device remained active until the participants reached the destination.

3.1.4. Data recording and reliability

Recording concerned the number of destinations reached correctly (i.e., without any guidance from the research assistant). Interrater reliability, which was assessed in about 15% of the sessions, was close to 100%.

3.1.5. Experimental conditions

A non-concurrent multiple baseline design across participants was used for the study (Barlow *et al*., 2009). The baseline phase (during which the orientation technology was not used) included three, five, and seven sessions for the three participants, respectively. The intervention phase included 101, 80, and 116 sessions. The participants received positive verbal and physical attention at their arrival at the destinations. The research assistant intervened with guidance if the participants took a wrong direction or did not make progress for about 20 s.

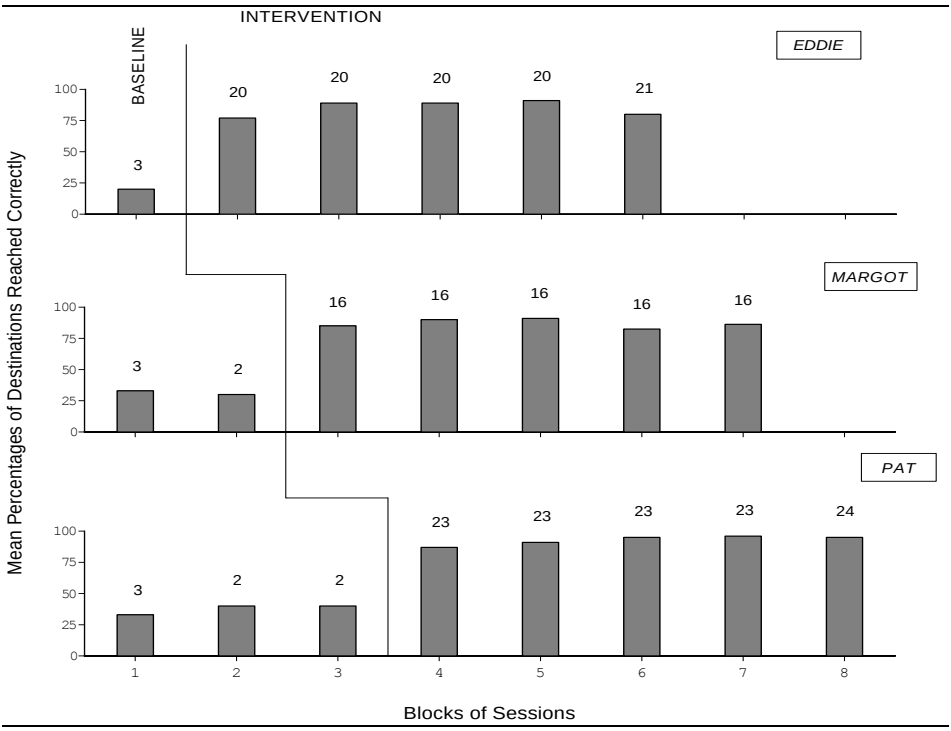
- *Baseline.* During the baseline sessions, the participants were to reach the destinations without the orientation technology. All other conditions were as described in the *Orientation technology and Experimental conditions* sections.
- *Intervention.* The intervention phase was introduced by five practice sessions, during which the research assistant used the guidance needed to ensure that the participants oriented to the cues and reached the destinations. During the intervention sessions proper, the research assistant used guidance as described in the *Orientation technology* section.

3.2. Results

The three panels of Figure 4 summarize the baseline and intervention data for the three participants, respectively. The bars represent mean percentages of destinations reached correctly (i.e., without any guidance

from the research assistant) per session, over blocks of sessions. The number of sessions included in each block is indicated by the numeral above it. During the baseline phase, the participants' mean percentages of destinations reached correctly were below 40. During the intervention phase, the mean percentages increased to about 85 (Eddie and Margot) or above 90 (Pat). The slight performance deterioration shown by Eddie toward the end of the intervention phase seemed related to a visual problem that affected him and for which he was eventually treated.

Figure 4 - *The three panels summarize the baseline and intervention data for Eddie, Margot, and Pat, respectively. The bars represent mean percentages of destinations reached correctly per session, over blocks of sessions. The number of sessions included in each block is indicated by the numeral above it.*



4. General discussion

The results of the two studies indicate that the programs reported for supporting activities and orientation and travel were quite effective, thus adding to previous positive evidence in these areas (Mihailidis, Boger,

Canido, & Hoey, 2007; Lancioni *et al.*, 2010, 2012, 2014; Lancioni, Singh, *et al.*, 2013). The levels of improvement, the relative simplicity of the technology solutions adopted, and their fairly modest costs are three relevant points that may deserve specific consideration (Gitlin, Winter, Burke, Chernett, Dennis, & Hauck, 2008; Graff, Adang, Vernooij-Dassen, Dekker, Thijssen, Hoefnagels *et al*., 2008; Hubbard Winkler, Vogel, Hoenig, Cowper Ripley, Wu, Fitzgerald *et al*., 2010; Dahlin & Rydén, 2011).

The clear improvement in the participants' activity performance indicates that the program of Study I was adequate for promoting the skills targeted. These data together with those of recent studies using an equivalent approach (Lancioni, Singh *et al*., 2013; Lancioni *et al*., 2014) could be taken to suggest that a relatively simple picture-instruction program may be sufficient to help persons with moderate or mild Alzheimer's disease recapture basic daily activities. General statements on this point may need to await (a) confirmation of the results from new replication studies, and (b) comparisons of this program with more sophisticated ones used previously (e.g., Lancioni *et al*., 2012; Lancioni, Perilli *et al*., 2013).

The results of Study I can be considered relevant also in view of the relative simplicity of the program per se and its modest cost (i.e., it involves only a portable computer and a commercial software of about US $50,00). These two aspects can add significantly to the acceptability and ultimate use of the program within daily contexts (De Joode, van Heugten, Verhey, & van Boxtel, 2010; Scherer, Craddock, & Mackeogh, 2011; Lancioni, Singh, *et al*., 2013; Lancioni *et al*., 2014).

The program used in Study II was effective in promoting fairly high percentages of orientation and travel for all participants. These results are very encouraging, although a certain level of caution needs to be used in view of the fact that only few participants were involved in this study and previous ones (Lancioni *et al*., 2012; Lancioni, Perilli *et al*., 2013; Caffò *et al.*, 2014). Enabling these participants to orient and travel within their daily context successfully could have important consequences. First, it would allow the participants a higher level of physical activity, which could be beneficial for their general condition and mood (Williams & Tappen, 2007, 2008; Sunderland, Catalano, & Kendall, 2009). Second, it would facilitate the participants' opportunities to interact with the environment and meet other persons with beneficial effects for their cognitive/behavioral engagement, their social interactions, and possibly, their quality of life (Gibson, MacLean, Borrie, & Geiger, 2004; Moore, Delaney, & Dixon, 2007; Brown, Schalock, & Brown, 2009). Third, it would provide the participants a better social image with positive implications in terms of

respect from the environment (Wood, Harris, Snider, & Patchel, 2005; Lancioni, Singh *et al*., 2013).

In conclusion, the two studies provided encouraging data that would need further confirmation before one can determine their generality (Kennedy, 2005; Barlow *et al*., 2009). Consequently, the most immediate goal of new research in this context could involve efforts to replicate the studies reported here with additional participants and across different contexts and research groups (Barlow *et al*., 2009). An additional goal for research could include assessment of the participants' mood during the activity and the orientation and travel time and during other (non-engagement) times of the day (Moore *et al*., 2007; Lancioni, Singh, O'Reilly, Zonno, Flora, Cassano *et al*., 2009). The presence of higher levels of positive mood during engagement (activity and travel) time would further underline the importance of identifying/using technology solutions to help the participants manage these engagement objectives (Moore *et al*., 2007; Lancioni, Singh, O'Reilly, Sigafoos, Pangrazio, Megna *et al*., 2009).

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