Comparing self-monitoring and differential reinforcement of an alternative behavior to promote on-task behavior by three children with cerebral palsy: a pilot study

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Abstract

We compared two behavioral strategies (i.e., self-monitoring [SM] and differential reinforcement of an alternative behavior [DRA]) to promote on-task behavior by three children with cerebral palsy and developmental disabilities during classroom activities. The first objective of the study was to evaluate the effectiveness and the suitability of each strategy individually within a school setting, and make their systematic comparison. A second aim of the study was to assess the effects of the intervention on participants' mood as an outcome measure concerning the quality of life. The third objective was to assess the preference checks for each participant. Finally, a social validation procedure, involving 24 teachers as raters, was conducted for corroborating the clinical validity and providing the study with a formal endorsement by sensitive and expert professionals. The study was carried out according to an alternating treatment embedded in a non-concurrent multiple baseline

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reversal design across participants. Furthermore, a maintenance phase, three months after the end of the intervention, was realized. Results showed that both interventions were successful, increasing on-task behavior for all participants involved, as well as improving their mood. All participants preferred self-monitoring during preference checks. Raters involved in the social validation assessment considered SM as more positive than DRA. Clinical, educational, psychological and rehabilitative implications of the findings were discussed.

Keywords: Cerebral palsy; Self monitoring; DRA; On-task behavior; Indices of happiness; Developmental disabilities; Social validation; Quality of life.

1. Introduction

Cerebral Palsy (CP) defines a group of permanent disturbances concerning the posture and movement, caused by a non-progressive neuro-developmental disorder due to prenatal, perinatal or postnatal brain injuries. The motor impairments are frequently associated with seizures, sensorial difficulties, behavioral, cognitive, communication and perceptual abnormalities (Bax, Goldstein, Rosenbaum, Leviton, Paneth, Dan *et al*., 2005; Rosenbaum, Paneth, Leviton, Goldstein, & Bax, 2007). Moreover, children with CP are described as having learning problems, lack of motivation, limited participation in daily activities, low constructive engagement during academic tasks (Arnfield, Guzzetta, & Boyd, 2013; Chen, Chen, Shen, Liu, Kang, & Wu, 2013; Weierink, Vermeulen, & Boyd, 2013). Furthermore, due to their pathology, those children present limited capacities concerning executive functions and lack of bimanual coordination, as a consequence of the loss of whole body control (Hung & Gordon, 2013; Hung & Meredith, 2014). Beside the aforementioned difficulties, one of the main compromised abilities is the on-task behavior (Olson & Moulton, 2004; Petrarca, Zanelli, Patanè, Frascarelli, Cappa, & Castelli, 2009; Ducharme & Ng, 2012). In light of the above, their clinical conditions may seriously hamper their social image, status and desirability with negative consequences on their quality of life (Felce & Perry, 1995; Ivancic & Bailey, 1996; Cheong & Johnston, 2013; Braun-Ferreira, Cimolin, Costici, Albertini, Oliveira, & Galli, 2014; Stasolla, Caffò, Damiani, Perilli, Di Leone, & Albano, 2015).

The crucial characteristic of quality of life is happiness. It includes constructs like pleasure, well-being and contentment, particularly difficult to detect among non-verbal individuals with severe to profound developmental disabilities (Felce & Perry, 1995; Brown, Schalock, & Brown, 2009). As consequence of the above-mentioned difficulties, researchers refer to behavioral expressions linked to the aforementioned components, labeling them as "indices of happiness". Specifically, they include smiling, laughing, energized arm and leg movements with or without vocalizations (Lancioni, Singh, O'Reilly, Oliva & Basili, 2005; Lancioni, Singh, O'Reilly, Oliva, Smaldone, Tota *et al*., 2006).

Among behavioral strategies used to improve on-task behavior and quality of life of children with developmental disabilities, two basic forms of interventions are a) differential reinforcement of an alternative behavior (DRA) and b) self-monitoring (SM) (Wolfe, Heron, & Goddard, 2000; Lee,

McComas, & Jawor, 2002; Marchand, Marchand, Landry, Letarte, & Labrecque, 2013). The DRA procedure aims to extinguish the problem behavior (e.g., off-task behavior) by ignoring it, and to promote an alternative behavior (i.e., adaptive behavior) by reinforcing it (Vollmer, Roane, Ringdahl, & Marcus, 1999; Petscher & Bailey, 2008). That is, during an intervention phase with a DRA strategy, participants receive a reinforcement (at the end of each time interval) if they, simultaneously, exhibit the adaptive behavior free of the challenge behavior (i.e., its absence), for the whole interval (Pipkin, Vollmer, & Sloman, 2010; LeGray, Dufrene, Mercer, Olmi, & Sterling, 2013; Flynn & Lo, 2016). SM procedures expected the participants to monitor and track their own behavior. Thus, during a phase of intervention with SM, participants are provided with a two-column grid and acoustic cues that mark each interval. Listening to each cue, they are invited to report on their own if they have been on-task or eventually off-task during the previous interval (Noell, Gansle, Mevers, Knox, Mintz,, & Dahir, 2014; Stasolla, Perilli, & Damiani, 2014; Wills & Mason, 2014).

Literature concerning the aforementioned strategies is robust (Amato-Zech, Hoff, & Doepke, 2006; Lannie & Martens, 2008; Robinson, Goddard, Dritshel, Wisley, & Howlin, 2009), and their suitability in school settings has proven to be strong (Selznick & Savage, 2000; Nabors, Little, Akin-Little, & Iobst, 2008; Rafferty & Raimondi, 2009), for improving the on-task behavior during academic activities, even for children who present a wide range of developmental disabilities (e.g., autism spectrum disorders, attention deficit, hyperactivity disorders). However, studies regarding the implementation of such strategies with children with CP seems to be lacking (Keawutan, Bell, Davies, & Boyd, 2014) as well as studies exploring their comparison for those children (Shikako-Thomas, Shevell, Lach, Law, Schmitz, Poulin *et al*., 2013; van Schie, Siebes, Dallmeijer, Schuengel, Smits, Gorter *et al*., 2013; Chang, Chiariello, Palisano, Orlin, Bundy, & Gracely, 2014; Franki, De Cat, Deschepper, Molenaers, Desloovere, Himpens *et al*., 2014).

2. Aims of the study

In light of the above, the rationale of the current pilot study is a systematic comparison between two different forms of behavioral interventions, aimed at promoting on-task behavior during classroom sessions and their extension to three new participants with CP and severe

developmental disabilities. That is, a basic form of differential reinforcement of alternative behavior with the mediation of a caregiver, and a crucial form of self-determination (self-monitoring), where the child himself tracks his own behavior (Stasolla *et al*., 2014).

Specifically, the present study pursues four objectives: (a) to compare the effectiveness and the suitability of DRA and SM by promoting on-task behavior (see method section with the definition of target behaviors reported below) during classroom activities of three new children with CP and developmental disabilities, (b) to monitor the effects of the intervention on participants' mood (i.e., through indices of happiness recorded during the sessions as an outcome measure of the quality of life) (Lancioni *et al*., 2006), (c) to carry out a preference check phase concerning the participants on one hand and a social validation assessment involving 24 teachers as raters on the other, and (d) to assess the consolidation of the intervention over time by a maintenance phase, after three months from the end of the program. The critical aforementioned goals constitute what the contribution would add to the existing literature. That is, none of the studies available in the current literature within this framework have focused either on a systematic comparison between both techniques or on considered indices of happiness and social validation assessment with external raters as an outcome measure of participants quality of life and/or support to the intervention clinical validity respectively. Moreover, the current investigation would provide a replication and a further extension of the existing literature within this framework.

3. Method

3.1. Participants and Setting

The participants (Bruce, Kevin, and Peter) were 9, 8, and 10 years old at the beginning of the study, respectively. They all presented extensive motor disabilities. All had some awareness of their sphincter control, although they always needed caregivers' assistance. Moreover, all presented dystonic movements of both hands, incapacity of trunk control, lack of speech although they were all capable to communicate their needs to caregivers, and inability of ambulation responses. Intellectual quotient scores were, respectively, 72, 70, 68 at the beginning of the study, as reported by the psychologist working in the school attended by the participants, obtained through the *Wechsler Intelligence Scale for Children* (WISC-IV) (Wechsler,

2004). Specifically, Bruce standard scores to the four domains (i.e., verbal comprehension, perceptual reasoning, working memory, and processing speed index) were 74, 70, 71, and 72 respectively. Kevin standard scores to the four domains above reported were 70, 69, 71, 70. Finally, Peter standard scores recorded were 70, 68, 69, 68. Moreover, their mental age, measured through the *Vineland Adaptive Scale* (second edition) (Sparrow, Cicchetti, & Balla, 2005) administrated to their parents and teacher, at the beginning of the study, was about 8, 7, and 9, respectively. Consequently, they were all considered to be borderline between normal and mild range of intellectual disabilities. They lived at home with their parents and attended regular classes with special training.

Kevin attended a social-medical center, where he received speech sessions twice per week, while Bruce and Peter were provided with physiotherapy sessions at home three times per week. The study was conducted in the school setting, during classroom activities, for each participant. All children had available, on their own 140x60 cm bench, the teaching material necessary for conducting the classroom activities, during all the experimental phases (see below). Moreover, a laptop, positioned behind this material was available during SM phases. Furthermore, within SM sessions, the children were provided with a pressure sensor, placed on their right, necessary for self-monitoring. The support teacher was always present on the participant's right side (see below *experimental conditions*).

They were recruited by their neurologist to the research team, in accordance with their teacher and their families, who considered the rehabilitation program highly desirable. Specifically, including criteria were (a) a diagnosis of cerebral palsy, (b) more than 70% of the day at home spent with off-task behavior (e.g., isolation, withdrawal, passivity, with no constructive and/or positive engagement dealing with academic performance observed), and exhibiting stereotypic behaviors with different objects surrounding them, as reported by their parents (c) the presence of learning difficulties during classroom, as reported by the school team, and (d) at least of 70% of off-task behaviors during the academic activities proposed by the teacher; excluding criteria concerned (e) sensorial impairments (i.e., visual and/or auditory disabilities), (f) moderate and severe to profound intellectual disabilities, (g) severe to profound communication impairments, and (h) a diagnosis of autism and/or other developmental disorders. The parents signed-up a formal consent for the participation of their children to the study, which was approved by the institutional board and by a local ethic

and scientific committee. The whole study was performed in accordance with the Helsinki Declaration and its later amendments.

3.2. Target Behaviors

The first step concerning both procedures (i.e., DRA and SM) was the definition of target behaviors (i.e., on-task and positive mood). All children were considered *on-task* when they: (a) listened to the teacher's explanation (i.e., eye gaze oriented to the teacher for the whole observed interval), (b) kept their gaze on the sheet in front of them for the whole interval, (c) seated on their wheelchair correctly (i.e. without any postural abnormalities), (d) performed their academic activities without suspend them, as documented by their teacher, and (e) achieved their goal as reported by the teacher to research assistants. For the latter points (d) and (e), the participants were requested to complete basic academic tasks as designing, coloring, writing short sentences and performing basic math operations as suggested by their teacher (Stasolla, Perilli, Boccasini, Caffò, Damiani, & Albano, 2016). The three boys were estimated with *positive mood* when they were (f) smiling, (g) laughing, and (h) showing excited body movements with or without vocalizations (Stasolla, Caffò, Picucci, & Bosco, 2013). Since the on-task and the off-task behaviors were mutually exclusive, the off-task behavior was considered irrelevant. Accordingly, it was not defined. Preliminary and informal clinical observations with their support teachers, parents, and research assistants were carried-out previously in the rehabilitative program in order to assess whether the aforementioned target behaviors were exhibited by each participant. Furthermore, a functional assessment carried-out prior to both baseline and intervention phases revealed that for all participants involved the off-task behavior was maintained by an automatic reinforcement (i.e., body rocking, hand clapping and objects mouthing) (Lancioni, Singh, O'Reilly, Sigafoos, & Didden, 2012).

3.3. Sessions and Data Collection

Sessions lasted 10 minutes and were video-recorded to allow data analysis. Typically, 3 to 5 sessions per day, 5 days per week, were carried out for each participant. Each session was separated from the others by a rest interval of 15-20 minutes, according to participants' availability. Overall, 148, 156, and 164 sessions were performed for Bruce, Kevin and Peter respectively, by the time of the study. The investigation lasted

approximately 8 months (including the rest interval between the end of the intervention and the maintenance phase). Sessions included 20 seconds intervals of observation for the recording of the aforementioned target behaviors (i.e., on-task and indices of happiness). Sessions included academic activities proposed by the support teacher, such as coloring, listening to novels, execute basic math operations, and other computer-aided tasks. The on-task behavior was recorded according to a total interval recording system. Thus, participants had to be on-task for the whole observed interval to be codified as "on-task". On the other hand, the indices of happiness were recorded according to a partial interval coding system with 20 seconds of observation, at the end of the intervals and were coded ex-post based on video-recorded sessions, by two independent research assistants. That is, each session included 30 observations for the performance (i.e., on-task behavior) and for the positive mood (i.e., indices of happiness) (Lancioni Singh, O'Reilly, Sigafoos, Chiapparino, Stasolla *et al*., 2007). The reliability for each dependent variable was carried out by two independent raters (i.e., research assistants) who observed all the video-recorded sessions independently and simultaneously. The mean percentage, resulting by dividing the numbers of agreements by the numbers of agreements added to the numbers of disagreements and multiplying by 100, was 97% for the on-task behavior (range 87-100%), and 96% for the indices of happiness (range 90-100), considered interval by interval singly (Lancioni, Singh, O'Reilly, Sigafoos, Oliva, Smaldone *et al*., 2010; Stasolla Damiani, Perilli, D'Amico, Caffò, Stella *et al*., 2015). An agreement was recorded once both research assistants reported the correct achievement of academic tasks for the whole observed interval for the on-task behavior. Moreover, an agreement was registered once both research assistants detected at least a sign of happiness within an observed interval, even if not identical. Otherwise, for both cases, a disagreement was outlined.

3.4. Selection of Stimuli

A formal screening of preferences concerning the primary reinforcements was performed (Crawford & Schuster, 1993), preceded by an informal interview with parents and teachers, prior the baseline sessions. That is, 5 10-minutes sessions were carried out, where a presentation of 8-10 seconds for each stimulus were followed by a 15-20 seconds rest-interval, with a total of 15 presentations for each session. According to three main criteria (i.e., alerting, orientation and smile) stimuli that were preferred at least for

70% of the presentations were retained. For all the children involved, preferred song, video, cartoons, leisure activities, beverages and food were selected. As secondary reinforcements, a token economy procedure for both DRA and SM sessions was adopted (Stasolla *et al*., 2014). Specifically, when the children collected at least one token at the end of each day, they would receive a social reinforcement by the support teacher. Moreover, when children collected at least 10 tokens, they would play, listen to music and enjoy themselves for 5 minutes at the end of the day, while if they collected at least 20 tokens they would receive academic credits for the following day. Finally, when they collected at least 30 token, they would receive a higher motivating reward (e.g., preferred CD and DVD), according to teachers and parents guidelines.

3.5. Experimental Conditions

The study was carried-out according to an alternating treatment embedded in a non-concurrent multiple baseline reversal design across participants, for ensuring trend stability among the three participants during baselines and for emphasizing experimental control between participants (Barlow, Nock, & Hersen, 2009; Caffò, Hoogeveen, Groenendaal, Perilli, Damen, Stasolla *et al*., 2014), with a different length of the baseline phases. That is, during each of the two baseline phases, 4, 8, and 12 sessions were collected for Bruce, Kevin and Peter respectively, followed by an alternating treatments phase, where both treatments were systematically and randomly alternated. After three months from the end of the second alternating treatment phase, a maintenance phase, identical to the previous alternating phase, was carried-out in order to verify the consolidation of the learning abilities by the participants. Subsequently, a preference checks phase in which each session was carried-out with the strategy chosen by each participant was conducted. At the end of each day, participants would receive a primary reinforcement corresponding to the number of collected tokens, according to the aforementioned token economy procedure.

3.5.1. First Baseline

During the baseline sessions, the support teacher was equipped with a walkman connected with a headset, which provided her with acoustic cues each 20 seconds. Thus, she recorded the on-task behavior during academic activities she proposed (see above *sessions and data collection*). No environmental consequences were provided if participants performed a

whole observed interval with the presence of the on-task behavior. Indices of happiness were coded ex-post by research assistants on the video-recorded sessions. The mean percentage of inter-raters agreement was 96 (i.e., see above sessions and data collection). Baseline phase lasted 1 day for Bruce, 2 days for Kevin, and 3 days for Peter, with 4, 8, and 12 sessions collected, respectively.

3.5.2. First alternating treatments phase (Intervention 1)

Experimental Conditions were identical to those of the baseline, but for the environmental consequences. Thus, participants were explained what was to be considered as an on-task behavior. Consequently, for each observed interval with the whole presence of the on-task behavior they would have received a token (for both intervention strategies) from the support teacher, who continued to monitor the on-task behavior. The indices of happiness were subsequently carried out on the video-recorded sessions by research assistants. Overall, 40 sessions were collected for each participant (twenty sessions for each treatment procedure) systematically and randomly alternated across the days. Five familiarization sessions prior the regular sessions were carried-out, where research assistants and support teacher explained to the participants each intervention and what they were expected to do within each strategy. This phase lasted approximately one month.

The rationale to implement such strategies (i.e., DRA and SM with a laptop and a microswitch) was to provide the students (and the teachers) with two basic behavioral strategies (one which required the teacher's mediation and one aimed at promoting participants' self-determination) to be implemented in daily contexts depending upon personal and environmental characteristics (Kazdin, 2001). Eventually, two basic differences discriminated the strategies: (a) participants tracked their behavior by themselves, and (b) during SM sessions a token was provided once both recordings (i.e., participant and teacher) were identical, even if an off-task behavior occurred. Every afternoon, support teacher and research assistants discussed the video-recorded sessions of the day at participants' homes with their parents.

3.5.3. DRA sessions

During the DRA procedure, participants were only requested to perform their academic activities. They received a token for a whole each interval performed with the presence of the on-task behavior and the simultaneous

absence of the off-task behavior. It was classified as a DRA since an off-task behavior was extinguished and at the same time an alternative (adaptive or on-task behavior) was positively reinforced (Kazdin, 2001).

3.5.4. SM sessions

During SM sessions, participants were requested to follow the same rules regarding on-task as in the DRA phase, and additionally to record and track their behavior by themselves. Since they were all unable to manage a pencil or a traditional computer keyboard, they were all provided with a laptop equipped with Clicker 5 software package (Crick House, Moulton Park, Northampton, UK), an adapted two columns grid (i.e., with on-task on the left column and off-task on the right column) automatically scanned each second, a pressure sensor (i.e., a colored circular button of 12 centimeters of diameter) and an interface connecting the pressure sensor to the laptop. By activating the sensor, participants could select the on-task or the off-task behavior for each observed interval. Furthermore, they were all equipped with the walkman and the headset with the acoustic cues, as disposed for the research assistants. All the technology and the materials adopted did not interfere with the regularity of academic activities, as they were selected in accordance with both parents and teachers. In order to avoid the anticipation of the recordings, in this phase the acoustic cues were elapsed by the system with irregularity, with an average of 20 seconds. All participants were then reinforced with a token if their responses were identical to those of the support teacher, who coded simultaneously the target behaviors in order to assess the participant's honesty.

3.5.5. Second baseline

Once participants consolidated their performance on both procedures, a new baseline occurred. Experimental conditions were identical to those of the first baseline and 4, 8, 12 sessions were collected for Bruce, Kevin and Peter during one, two and three days respectively. Once their performance decreased, a new intervention phase was implemented.

3.5.6. Second alternating treatment phase (Intervention 2)

At the end of the second baseline, a new alternating treatment phase occurred for all participants. Experimental conditions were identical to the first intervention phase. Overall, 40 sessions were collected within one month.

3.5.7. Maintenance

After three months from the end of the second intervention phase, a maintenance phase occurred, in order to corroborate the improvement of participants' performance. Thus, experimental conditions were identical to those of the previous alternating treatment phases, where both strategies were systematically and randomly alternated across days. Overall, 40 sessions were collected (twenty for each intervention procedure) during one month.

3.5.8. Preference Checks phase

At the end of the maintenance phase, a preference check phase was assessed. Thus, at the beginning of each session, a support teacher asked the participants whether they preferred to work on DRA or SM procedure, through a double combined (i.e., verbal and pictorial) instruction cue. That is, matched to a verbal question, a support teacher presented two different pictures within her hands. In a first picture a boy equipped with headset in front of a laptop was presented, while in the second picture a teacher providing a student with a token was presented. The order of the presentations (i.e., left or right) were systematically and randomly inverted across sessions. Participants were request to respond and select the preferred procedure by orienting their gazing for at least 5 seconds on one picture. An inter rater agreement between two research assistants was carried out on all the collected sessions. The mean value was 99% (range 98-100). Consequently, sessions were carried out with the strategy chosen by participants within each session. Overall, within 15 days, 20 sessions were collected for each participant.

3.5.9. Social Validation

Twenty four teachers (mean age of 36.64, range 24-56 years, and standard deviation of 7.28) were involved in a social validation assessment. The rationale was to corroborate the investigation clinical validity and provide the study with a formal endorsement by sensitive and expert professionals who were not directly involved in the investigation (Lancioni, Singh, O'Reilly, Sigafoos, Renna, Pinto, *et al*., 2014; Stasolla, Caffò, Perilli, Boccasini, Stella, Damiani, *et al*., 2017; Stasolla, Perilli, Caffò, Boccasini, Stella, Damiani, *et al*., 2017). The teachers represented a convenience sample among professionals who were interested in the field of developmental disabilities (Pedhazur & Schmelkin, 1991). In fact, all of them were familiar with general educational and rehabilitative programs for

persons with developmental disabilities and some of them had also been involved in research activities with persons with intellectual and multiple disabilities. Their opinion was considered to be valuable because they represented a social group expected to be sensitive to the issue and independent in their perception/perspective and judgment. They were all females. Before watching the videotapes, they were informed that they would see a child with developmental disabilities in two different educational conditions involving a DRA or a SM procedure. Research assistants explained to them the goals of both intervention programs proposed. They were equally divided in 3 groups (i.e., 8 raters for each participant), and watched 2 video-clips of one participant involved in the study. Each video-clip lasted 6 min, and showed a regular (i.e., standard) session of the DRA and SM phase, respectively. The order of video-clips presentation was counterbalanced across raters. That is, each group was equally divided in two conditions: a first group watching an A-B sequence (i.e. DRA versus SM) and a second group watching a B-A sequence, (i.e. SM versus DRA). After watching each video-clip, they were asked to score it on a five items questionnaire (see Tab. 1) and to provide a score 1-5, which indicated the least and most positive ratings, respectively.

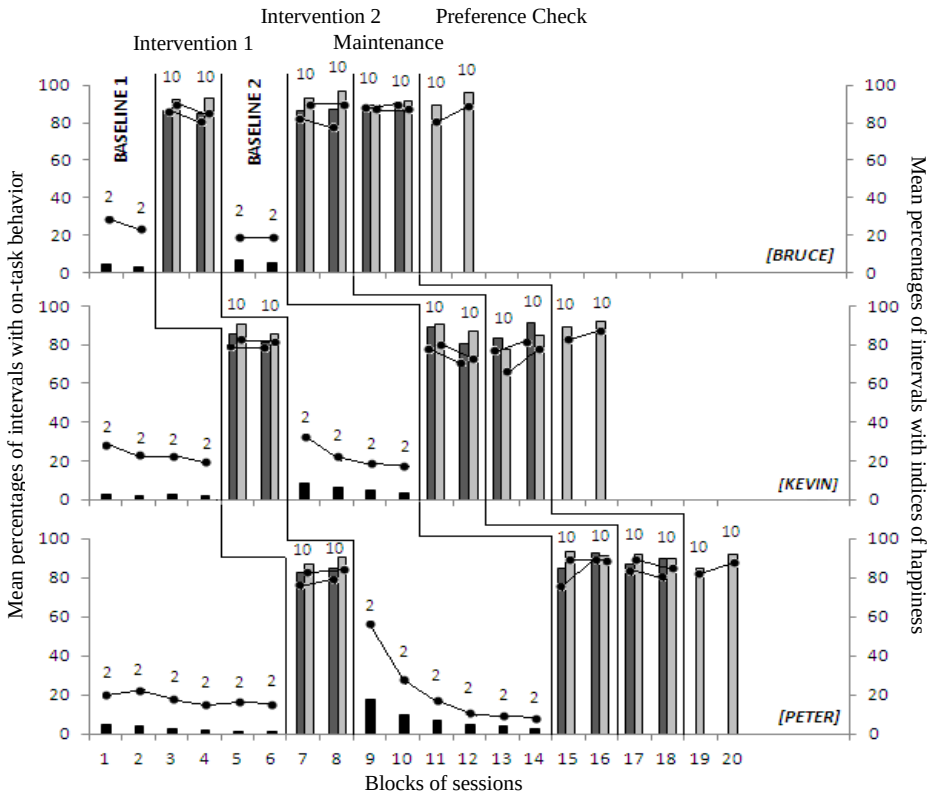
Table 1 - *Social validation questionnaire items*

1. Do you think the participant enjoys (is comfortable with) this condition?
2. Do you think the condition has rehabilitative/beneficial effects for the participant?
3. Do you think the condition is suitable for daily contexts (e.g. home and school settings)?
4. Do you think that this condition will promote the self-determination of the participant?
5. Do you support (agree with) this condition?

4. Results

Data concerning the mean percentages of intervals with on-task behavior and indices of happiness for all the experimental conditions and for all the participants are summarized over blocks of sessions and plotted in Figure 1. The percentages of intervals with off-task behaviors were not reported since they represented the inverse of the percentages of intervals with the on-task behavior (i.e., both behaviors were mutually exclusive). For practical reasons (i.e., graphical representation) blocks of sessions were reported instead of single sessions.

Figure 1 - *Mean percentages of intervals with on-task behavior and indices of happiness for all the experimental conditions and for all the participants*



Note: The three panels summarize the data for Bruce, Kevin and Peter. The black bars indicate the mean percentage of intervals with on-task behavior over block of baseline sessions. The dark gray and light grey bars refer to the mean percentage of intervals with on-task behavior during DRA and SM, over block of intervention, maintenance and preference check sessions, respectively. The black circles indicate the mean percentage of intervals with indices of happiness over blocks of baseline, intervention, maintenance and preference check sessions. The number of sessions included in each block/bar is indicated by the numeral above it.

The upper panel of figure 1 concerns Bruce's performance. He completed his first baseline with a mean percentage of on-task behavior of 5 (range 3-8). During the first alternating treatments phase, he increased his performance to 85 (range 78-91) regarding the DRA and to 93 (range 85-98) with respect to SM. He concluded the second baseline phase by decreasing his performance to 10% (range 7-12) concerning the on-task behavior. Bruce improved his performance during the second intervention phase to 88 and 96 (ranges 80-95 and 92-100) regarding DRA and SM respectively. He

consolidated his learning abilities during the maintenance phase to 90% (86 and 93 to DRA and SM) respectively (range 78-88, 89-98). During the preference checks Bruce chose always SM procedure with a mean percentage of 95 (range 90-99). His mood started with a mean percentage of 21 (range 15-27) during the first baseline. The value increased to 83 (range 68-96) and to 89 (range 78-96) during the alternating treatments phase, for DRA and SM respectively. He inverted his performance to 30% during the second baseline and improved it during the second intervention phase with a percentage mean about 90% (range 85-100). The positive mood was consolidated during the maintenance phase with 86% (range 72-96). Finally, during preference checks, Bruce showed a mean percentage of intervals with indices of happiness of about 88 (range 82-95).

Kevin completed his first baseline with a mean percentage of on-task-behavior of 4 (range 2-7). During the first alternating treatments phase, he ended his performance with a mean percentage of 80 (range 60-90) and 85 (range 70-95) for DRA and SM respectively. Kevin decreased his performance during the second baseline with a mean percentage of 8 (range 3-10), and increased it during the second intervention phase to 87 and 94 respectively for DRA and SM (range 65-96, 90-95). During the maintenance, he consolidated his score with a mean percentage of 82 and 86 respectively for DRA and SM. Furthermore, the child ended the preference checks by choosing always SM procedure and with a mean percentage of 92 (range 89-95). Regarding his mood, Kevin started with a mean percentage of intervals with indices of happiness of 22 (range 15-30), while during the first intervention phase his mean percentage increased to 74 and 82 (ranges 55-85, 74-88). The second baseline phase showed a decreasing of the positive mood to 33 (range 25-37), while during the second intervention phase, Kevin augmented his positive mood to 77 (range 73-96) and 8 (range 81-95) for DRA and SM respectively. He consolidated his mean percentage of indices of happiness to 80 (range 70-89) during the maintenance phase. Finally, he completed the preference checks with a value of about 86 (range 80-90).

Peter ended his baseline with a mean percentage of on-task behavior of 6 (range 3-7). He augmented that value to 89 and 96 (ranges 70-92 and80-100) during the first intervention phase and decreased it during the second baseline phase to 5 (range 1-8). Peter augmented his performance during the second intervention phase to 86 (range 72-96) and 91 (81-97) for DRA and SM respectively. He consolidated his values to 84 and 92 during the maintenance phase for DRA and SM respectively. Finally, the child ended

the preference checks by choosing always the SM procedure with a mean percentage of 92 (range 88-96). Concerning his mood, the participant ended his baseline with a mean percentage of 19 (range 12-25). He increased his positive mood during the first intervention phase with a mean percentage of 84 and 87 (range 70-95 and 75-100) for DRA and SM respectively. He inverted that value during the second baseline phase to 22 (range 8-59) and he completed his second intervention phase with 81 (range 72-92). Peter ended the maintenance phase with mean percentages of 82 and 90 (ranges 73-95, 88-100). Finally, the participant showed a mean percentage of intervals with indices of happiness about 96 during the preference check phase.

All the differences between the first baseline and the first intervention phases and between the second baseline and the second intervention phases were statistically significant (with $p < .01$) to Kolmogorov-Smirnov test (Siegel & Castellan, 1988). Also statistically significant ($p < .01$) were all differences between baseline and maintenance phases, while none difference was statistically significant between intervention and maintenance to the Kolmogorov-Smirnov test. Furthermore, a MANOVA repeated measure within participants revealed $F(2, 119)$ empirical scores included between 3.74 and 4.92 ($p < .05$) for assessing discrepancies between SM and DRA across the first, the second intervention, and the maintenance phases. That is, for all participants involved SM scored higher than DRA with regard to the on-task behavior.

Means and standard deviation for each item of the questionnaire are reported in Table 2. For all five items considered, none of the raters scored over 4 for the DRA phase. All the raters scored at least 4 for each item concerning the SM phase. Thus, paired *t*-test were included between 8.97 and 16.85 ($p < .001$) for the all the questionnaire items (Hastie, Tibshirani, & Friedman, 2009).

Table 2 - Mean and Standard deviations for DRA and SM to questionnaire's items

Items	*M* DRA	*SD* DRA	*M* SM	*SD* SM
Comfort	3.74	.64	4.79	.43
Rehabilitation	3.68	.55	4.82	.35
Suitability	3.54	.71	4.68	.51
Self-determination	3.32	.84	4.85	.45
Support	3.72	.92	4.58	.66

5. Discussion

Data of the current pilot study show that both intervention strategies (a) were useful by increasing on-task behavior, during academic activities in school setting, in three children with CP and developmental disabilities, and (b) had beneficial consequences on mood of all participants involved, by augmenting their indices of happiness during sessions. Moreover, all participants always chose SM instead of DRA during preference checks, by supporting its validity in promoting self-determination (i.e., conversely to DRA, participants tracked their own behavior by themselves during SM) (Stasolla, Damiani, Perilli, Di Leone, Albano, Stella, *et al*., 2014; Stasolla & De Pace, 2014; Stasolla, De Pace, Damiani, Di Leone, Albano, & Perilli, 2014; Stasolla, Perilli, Damiani, Caffò, Di Leone, Albano, *et al*., 2014; Stasolla, Perilli, Damiani, & Albano, 2016). Furthermore, social validation support both strategies, with more positive scores for SM if compared to DRA. Those findings are largely supported by previous studies (Lindsay & McPherson, 2012; Bruijn, Millard, van Gestel, Meyns, Jonkers, & Desloovere, 2013; Gofer-Levi, Silberg, Brezner, & Vakil, 2013; Park & Won, 2013) and suggest the following considerations.

First, DRA and SM were both effective by increasing intervals with on-task behavior of children with CP, thus favoring their involvement in classroom activities and their constructive engagement. Furthermore, both strategies represent two basic form of intervention in classroom aimed at the dual goal of a) positively reinforce students and b) easily manage the course by the teachers. Thus, both can be considered as educational and rehabilitative resources to be used in daily contexts (e.g. home and school settings), depending upon the economical, human, practical, personal and timing conditions (Amato-Zech *et al*., 2006; Pipkin *et al*., 2010; Stasolla, Damiani, & Caffò, 2014). For instance, one can argue that if the clinical conditions are excessively compromised, the educational and practical opportunities are still limited and the timing reduced DRA will be preferable, else SM is recommended (Reid, Trout, & Schartz, 2005; Scruggs, Mastropieri, & McDuffie, 2007; Rogevich & Perin, 2008).

Second, both strategies can be viewed as two different ways of reducing the off-task behavior on one side and proposing an alternative behavior on the other. That is, depending on context resources and on children' characteristics based on clinical observations, teachers, parents and caregivers can choose between the two options: a) to operate with the caregiver's mediation by teaching an alternative (adaptive) behavior (DRA),

or b) to promote self-determination through the acquisition of the awareness of the on-task/off-task behavior by children themselves (SM). The use of assistive technology in the latter case could better motivate students' involvement and engagement, with the reduction of caregivers' burden (Soares, Vannest, & Harrison, 2009; Stasolla & Caffò, 2013; Stasolla, Perilli, Di Leone, Damiani, Albano, Stella *et al*., 2015).

Third, since all participants had systematically chosen SM during the preference checks phase, it may be concluded that SM could promote self-determination and self-awareness, contrarily to DRA. Indeed, the two strategies pursue two different objectives: DRA has the ultimate goal to promote an alternative behavior, while SM aims at developing the self-awareness of one's own behavior. The social validation assessment may represent a formal endorsement concerning the effectiveness of both strategies. Furthermore, it may constitute a further support to the clinical validity of such procedures (Perilli Lancioni, Hoogeveen, Caffó, Singh, O'Reilly *et al*., 2013; Perilli, Lancioni, Laporta, Paparella, Caffò, Singh, *et al*., 2013). That is, those intervention opportunities may be viewed as affordable (i.e., about 500 $) and suitable in daily contexts such as school settings, considered in this study (Lancioni O'Reilly, Singh, Stasolla, Manfredi, & Oliva, 2004; Lancioni, Sigafoos, O'Reilly, & Singh, 2012; Lancioni & Singh, 2014). However, caution is undoubtedly needed since it was not clear whether the participants' preferences were really due to the adopted technique per se (i.e., SM instead of DRA) or to the use of technological supports.

Fourth, the increased intervals with indices of happiness during intervention phases for all participants show that all children involved enjoyed the sessions. Thus, both intervention strategies had positive effects on participants' mood with beneficial consequences on their quality of life (Felce & Perry, 1995). The implementation of a token economy procedure with the opportunity to collect the token and the possibility to receive a primary reinforcement at the end of each day by exchanging the collected token with a reward, can be considered as a highly motivating resource suitable for school setting (Zlomke & Zlomke, 2003; Klimas & McLaughlin, 2007; Shogren, Lang, Machalicek, Rispoli, & O'Reilly, 2011).

Fifth, the consolidation of the performance during the maintenance phase may provide strong empirical evidence concerning the learning abilities of the participants involved over time. Thus, one may argue that even if suspended for a certain amount of time (i.e., 3 months), participants' awareness concerning the use and the implementation of both strategies is

still maintained and consolidated, with beneficial effects on participants' desirability, status and social image (Lancioni, Belardinelli, Chiapparino, Angelillo, Stasolla, Singh, *et al*., 2008; Chiapparino, Stasolla, De Pace, & Lancioni, 2011; Matson & Sturmey, 2011; Matson, 2012).

6. Limitations and future research perspectives

Despite the aforementioned positive outcomes, future research should assess whether participants preferences for SM instead of DRA may emphasize an effective choice for a behavioral strategy enhancing self-determination and/or could point out participants' preference for the use of assistive technology (i.e., microswitch and laptop with adapted software). Accordingly, this critical point underlines a limitation of the present investigation. A further limitation of the study may be eventually represented by the same reinforcement strategy adopted (i.e., token economy) embedding at least a partial overlapping between the two strategies. Future research should differentiate reinforcements among strategies (e.g., by providing a primary reinforcement during DRA) in order to enabling participants to further discriminate among behavioral interventions proposed (Schlichenmeyer, Dube, & Vargas-Irwin, 2015). Additionally, caution is mandatory since this is a single-subject design involving three participants with CP.

In conclusion, new research in this area should deal with the following topics: (a) to extend the use of both rehabilitative techniques with other participants with CP and further developmental disabilities, (b) to provide a generalization phase in home or rehabilitative contexts, (c) to assess the effectiveness of both strategies through a further extension of the social validation procedure involving students and parents as raters (Lancioni, O'Reilly, Singh, Groeneweg, Bosco, Tota *et al*., 2006), and (d) to determine if the preference of participants depends on the strategy designed to promote self-determination and in an active role, or rather if it depends exclusively on the use of equipment and technology-based assistance and/or differentiating the reinforcements adopted through designing, planning and implementing specific studies on this topic (Lancioni & Singh, 2014).

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