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ORIGINAL PAPER

Effects of Task Organization on the Independent Play of Students with Autism Spectrum Disorders

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Abstract The purpose of the study was to examine the impact of task organization, a component of Structured Teaching developed by Division TEACCH, on the independent play of children with autism spectrum disorders (ASD). On-task behavior, task accuracy, task performance and teacher prompting were measured across independent play sessions in the classroom. An ABAB design was implemented to evaluate the effects of task organization on the independent play skills of two young children with ASD. Results regarding on-task behavior, task accuracy and independence were variable and are discussed. The implications of findings on the use of task organization for increasing independence in children with ASD are discussed.

Keywords Autism · Visual structure · Independence · On task behavior · Teacher prompting

Introduction

The distinct cognitive profile of students with autism spectrum disorders (ASD) and its consequences for their learning needs have been well documented in the literature (Jordan and Powell 1995; Schopler and Mesibov 1995). In line with research evidence, high functioning persons with ASD offer valuable insight into the mechanisms of the autistic mind by emphasizing that it works in an associative, not linear mode and that many, but not all, individuals with ASD are visual thinkers (Grandin 2009; Wiley 1999). Furthermore, children with ASD have stimulus overselectivity and weak central coherence, which limit their attention to environmental cues and prevent their contextual understanding of information (Happe and Frith 2006).

Another area of cognitive impairment for students with autism is executive functioning, including difficulties in "organization and sequencing, which require *dual focus,* the ability to know what has to be completed first (or next), while simultaneously understanding the relationship between steps and what the end result should look like" (Carnahan et al. 2009, p. 8). In addition, students with ASD appear to have persistent problems with other executive functions, such as flexibility, planning, inhibition, self-monitoring, goal-setting and working memory, which impede their on-task engagement and successful task completion (Ozonoff et al. 2005). The above fundamental cognitive features of autism comprise a "culture of autism", in the sense that individuals with ASD share characteristic and predictable patterns of thinking and behavior (Mesibov et al. 2005).

In spite of the major cognitive limitations of persons with ASD, independence and self-management have been put forward as essential curriculum objectives of their education, because this group of students exhibit over-reliance on caregiver prompting and feedback for completing tasks and making transitions between activities (Olley 1997). Students with ASD may show acquisition of a task under structured settings with close adult supervision (MacDuff et al. 1993) but may need adult prompting for

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engagement and independent functioning in their environments (Stahmer and Schreibman 1992). So far, different instructional techniques have proved successful in fostering self-management, ranging from pivotal response training (Koegel and Koegel 1995) to visual supports such as activity schedules (McClannahan and Krantz 1999), video modeling (Charlop-Christy and Daneshvar 2003) as well as individual work systems (Carnahan et al. 2009; Hume and Odom 2007). These strategies provide a promising instructional repertoire for clarifying the goal of tasks and organizing the steps of activities for students with ASD, which in turn enhance individual understanding, choice, responsibility, generalization of skills and independence (Hume et al. 2009).

Independent functional play represents an essential area of skills for classroom interventions for students with ASD with important implications on their social, linguistic, motor and emotional growth (Terpstra et al. 2002). Functional play does not involve any pretense and is defined as any action on one or more objects in a manner, which reflects their “proper” conventional use (e.g. putting a peg in a hole, dressing up a doll, making a construction with lego bricks). This is an area of persistent difficulty for children with ASD, since they display functional play with less variation, elaboration and integration than children with typical development or Down syndrome (Williams et al. 2001). Even though the dominating evidence supports the use of peer models (Wolfberg 2003; Wolfberg and Schuler 1993) as well as intervention in natural settings to promote generalization of skills (Rogers 2000), the use of visual supports (Johnston et al. 2003) and individual work systems (Hume and Odom 2007) has been also found to be potentially positive for enhancing independent play skills in children with ASD. Visual supports correspond nicely to the needs of students with ASD for predictability, order and consistency (Simpson and Myles 1998) and individualized schedules have been proposed as part of a positive behavior support plan for teaching appropriate behaviors (Mesibov et al. 2002).

The positive effects of visual supports on the enhancement and generalization of multiple behaviours of students with ASD have been empirically validated (Banda and Grimmett 2008). A variety of visual supports has been used, ranging from photographic activity schedules, pictures, rule reminder cards, communication boards and visual task analyses to written scripts. MacDuff et al. (1993) successfully taught four students with autism to carry out recreational and homework tasks for a full hour by following photographic schedules with graduated guidance in a group home. Also, the use of photographic schedules has been found to raise rates of engagement, maintenance and generalization of responding, as well as reduce challenging behavior. In another study by O’ Reilly et al. (2005), the modification of an activity schedule in the classroom was found to be associated with substantial decrease in self-injury and increase in classroom engagement in a child with severe autism. Dettmer et al. (2000) used a combination of visual supports (schedules and time timer) for teaching two young children with ASD to make transitions from one activity to another in community and home settings. Also, as a result of the use of visual supports, verbal and physical teacher prompts for helping the students to transition were decreased. Another intervention by Dooley et al. (2001) adds further support to the utility of a curricular modification (use of a functional picture communication board and daily schedule in increasing the smooth transition from one activity to another at school. Charlop-Christy and Kelso (2003) effectively taught three school children with ASD how to use written script/cue cards to initiate and respond to questions. Bryan and Gast (2000) report the successful use of picture activity schedules and graduated guidance for training two young students with autism to stay on-task and on-schedule on literacy tasks.

With respect to play, experimental research offers additional support to the utility of visual supports for the instruction of students with ASD. Wolfberg and Schuler (1993) used pictographic/written posters together with adult-guided participation to teach functional and symbolic play in integrated groups to three students with ASD. Visual techniques have been used to teach social skills to low-functioning preschool children with ASD and their typical peers during play activities in their schools (Gonzalez-Lopez and Kamps 1997) as well as develop their language skills across play themes in an integrated play group (Ganz and Flores 2008). Further, visual models (such as photographs of premade structures) have been proposed for teaching students with autism to play appropriately with toys in the general classroom (Goodman and Wiliams 2007). In addition, Rao and Gagie (2006) provide specific information on incorporating and assessing the use of visual cues (such as colors, photos/pictures, visual organizers) into the play and leisure activities of students with ASD.

Structured Teaching as defined by Division TEACCH (Treatment and Education of Autistic and related Communication handicapped CHildren) is an instructional approach with a strong emphasis on visual structure, which incorporates the following central components: (a) organization of the physical environment, (b) visual activity schedules (showing where/when/what the activity will be), (c) work systems (indicating what the student will do in a work area) and (d) task organization (clear information on the important materials, the goals and the steps of the task) (Mesibov et al. 2005). Task organization helps students with ASD to understand better task requirements, sequences of steps and instructions. “The organization of materials provides clear guidelines on the positional relationship between the parts and task completion" (Schopler et al. 1995, p. 258). It is essential for visual instructions to be individualized, so that they are adapted to the level and the needs of the student with ASD. For this purpose, objects, pictures, colors, numbers or words can be used and they are usually presented in a sequence from left to right or from up to down. Three aspects of visual information make tasks clear, meaningful and comprehensible: (a) visual instructions, (b) visual organization and (c) visual clarity (Mesibov et al. 2005). Visual instructions illustrate what the student is expected to do with the materials of the task. For example, a photo/picture of a Ziploc bag containing one toothbrush, one toothpaste and a comb is put in front of him as a sample product while he is handling the items. Visual organization involves the distribution and stabilization of task materials (i.e. for a packaging task, four small baskets are used to separate neatly Ziploc bags, toothbrushes, toothpaste and combs). Visual clarity helps students with ASD identify the most salient components and features of the task (i.e. in a object sorting task a picture of each object is placed at the bottom of the container so that the student knows where to put each item).

Past and recent research has shown that the use of a structured learning environment promotes on-task behavior, academic achievement and independence in children with ASD (Hume 2009; Hume and Odom 2007; Rutter and Bartak 1973). Despite the validated effects of visual strategies and the strong recommendations for their use, there is an apparent need for further research on Structured Teaching with the purpose to refine the effects of each of its aforementioned components on the independent behavior and other skills of students with ASD at various ages and developmental levels (Ganz 2007; Hume et al. 2009; Mesibov and Shea 2009). The present study aimed to contribute to the existing literature on visual supports for children with ASD and expand research on Structured Teaching by implementing task organization in the area of functional play. Students with ASD may engage in repetitive actions with toys or become obsessed with them or use them in stereotypical or atypical ways (Lewis and Boucher 1988; Williams et al. 2001). Considering the significant difficulties that students with ASD demonstrate in play, teaching independent play skills remains a challenge and an important curricular goal for their education. To our knowledge, the effects of task organization per se on the independent play skills of students with ASD have not been examined previously. The specific research questions were the following:

1. Does the use of task organization increase on-task behavior, task accuracy and task completion for students with ASD?
2. Does the use of task organization decrease teacher prompting for students with ASD?

Method

Participants

The participants of this study were two school-age boys with ASD, who had been attending the same self-contained class at a public special school for elementary students with moderate and severe disabilities ($n = 26$ students). Both were selected out of a total of seven students with ASD attending the same special school. Both participants were chosen according to the following criteria: (a) a formal diagnosis of autism/PDD based on the DSM-IV (American Psychological Association 1994), (b) good/high level of cognitive functioning, (c) teacher reports of emerging play skills, (d) teacher reports of difficulty completing play tasks independently, (e) familiarity with visual daily schedules at their class, and (f) no prior experience in the use of visual instructions for completing tasks at school, home or other therapeutic setting. Also, consideration was given to the fact that these students had been attending the school regularly (with minimal absences), permitting the smooth and consistent application of the intervention. Information about the students was collected through an interview with the class teacher and examination of school reports completed by the psychologist and the social worker of the school staff. Informed parental consent to participate in the study was obtained for each participant.

At the time of the study Vaggelis was 7 years and 6 months old and at the age of 3½ years he was first diagnosed with mild autism/PDD by a multidisciplinary team at a public Centre for Diagnosis, Differential Diagnosis and Support and by a team in a Medical-Pedagogical Centre of a public hospital. His intellectual ability was assessed to be at borderline level (IQ = 71) following his evaluation with the Weschler Intelligence Scale for Children–III (Wechsler 1991).

For the last 2 years Vaggelis had been attending the same class with another five students with severe intellectual disabilities and a 2 h private speech therapy program each week. He rarely used echolalia and his oral expression included 5–6 word sentences expressing his likes/dislikes. His understanding of one-step verbal instructions was good. Vaggelis, being calm and quiet, cooperated well with his classmates (especially older children) in group activities and followed classroom rules. He liked verbal praise and was tolerant of body contact. He showed interest and willingness to work on tasks, despite his lack of attention and difficulty in time management. His concentration and performance improved when instructions were clear and repeated, he knew what was next and was given sufficient time. He had no obsessions or stereotypical behaviors. Vaggelis was capable of recognizing and writing all the letters of the alphabet, as well as reading syllables/words with a consonant–vowel combination. As regards math skills, he was able to count and distinguish numbers from 1 to 20, as well as match numbers with their quantity value.

At the time of the study Yiannis was 7 years old and that was his first year in the special school. For the last 2 years, Yiannis had been attending a 4½ h program with speech/occupational therapy and special education in a private center. At age 4, he was given the diagnosis of autism by a Developmental Pediatric Clinic in a public hospital and a multidisciplinary team at a public Centre for Diagnosis, Differential Diagnosis and Support. In addition, he was diagnosed with speech impairment (in articulation and expression). His intellectual ability was found to be at low but average level (IQ: 82) based on his evaluation with the the Weschler Intelligence Scale for Children–III (Wechsler 1991).

His communication included (a) comprehensible oral speech, (b) articulation problems, (c) initiation of conversation with others, (d) echolalia because of tiredness and as a means for avoiding an activity, and (e) ability to follow only short verbal instructions. His social skills and difficulties were characterized by (a) preference for the company of his classmates and adults, (b) good eye-contact, (c) difficulty recognizing the feelings of others, and (d) no tantrums in response to his classmates or adults. He was generally cooperative with others and easily accepted firm boundaries for his behavior. He did not display any stereotypical behaviors or obsessions. With respect to reading, Yiannis knew all the letters of the alphabet and could read syllables of consonant–vowel combination. He was able to read, write and copy words, but had difficulty with pronoun and verb use. As regards math skills, he could identify and count numbers up to 20. Yet, he had difficulty with sorting, number sequencing, recognizing objects (but not actions) and estimation of quantities. He had moderate level of attention focus.

Both students were familiar using daily schedules in their school, but had no prior experience with visually organized tasks. Vaggelis had been using daily schedules for 1½ year prior to the study and Yannis had been using daily schedules for the last 5 months. At the time of study, both students were using pictorial (8–9 pictures) visual schedules placed on their desk and had mastered object: picture correspondence. Yannis needed teacher supervision in the use of his daily schedule but Vaggelis was independent. We need to clarify here that both students following visual schedules left their classrooms to come to the other classroom to work on the play tasks. In this room, they completed only one session and then were visually cued to return to their classroom schedule. The visual cue was on the desk for each student.

Setting and Materials

The intervention was implemented for both students within a separate, spare classroom, which was made available and re-arranged for the purposes of this study. All experimental conditions were implemented in the same classroom except the generalization sessions. This classroom had rectangular shape (4.5 × 3.5 m). The area for independent work was set in one corner of the room and included a chair, a main desk (130 × 60 cm) and another two desks (120 × 40 cm each). Materials for each task were placed in three separate containers on the left side of the main table and a green box was used for "finished" tasks on the right side of the main table. Opposite to the students' work area and at a distance of 1.5 m, a digital camera (SONY DCR-HC17E PAL) was placed for recording all sessions. The researcher would sit on a chair at the other corner of the classroom next to a set of furniture (bookshelf and two tables used for storing the tasks). During all sessions, no other children were present in the classroom.

Following teacher interviews as well as observations of free play, a list of play tasks was selected for the intervention. All tasks were grouped in three categories: (a) manipulative play, (b) independent play, and (c) games (Echenrode et al. 2003). The first category of play materials included activities, such as tangrams, shape sorter and LEGO bricks. Independent play included activities such as dressing a doll/a boy, preparing food/setting the table and an adapted sticker page (sticking cards with cars, traffic lights, policeman in the correct positions on a large picture of a city road). Games included activities, such as lotto (picture-letter/word) and domino (stabilize animal picture cards). Game cards were laminated and velcro was used for greater stability of the materials. For the generalization phase different tasks were constructed following the same grouping and visual structure as in the intervention stage. Visual instructions for each activity were made and included the following: (a) photos, drawings and picture dictionaries were printed on white paper with variable size (30 cm by 20 cm or 16 cm by 28 cm), (b) 9 cm by 9 cm cards with coloured drawings of objects, and (c) printed words with Times New Roman 14 size (see Fig. 1).

Design

This study utilized an ABAB withdrawal of treatment design across participants (Kazdin 1982). This type of experimental design is appropriate for the examination of

Fig. 1 Sample play tasks presented: **a** without visual organization and instructions and **b** with task organization and instructions

the effects of an intervention by alternating the baseline condition (A phase = no use of visual instructions) with the intervention condition (B phase = use of visual instructions) which are repeated again to complete the study. This experimental sequence allows for the replication of both baseline patterns of behavior and intervention effects (Kennedy 2005).

Procedure

Pre-Baseline Assessment of Participants

Prior to the first experimental session, the class teacher and other staff members familiar with the students were interviewed about the students' play interests, preferences, favorite toys and emergent play skills, so that teaching independent play skills would be matched with their instructional needs. Next, the researcher conducted two informal classroom observational sessions with each student separately in free play with a variety of familiar tasks (i.e., puzzles, object-to-card matching tasks) as well as toys (i.e., cars, ship, dolls, LEGO bricks, plastic vegetables/fruits and kitchenware). Following teacher interviews and the informal observations of students, it was evident that both students displayed emergent skills in independent play.

Baseline 1 (BL1)

During Baseline 1, each student accompanied by his class teacher was observed individually in a classroom within their school. Each participant was guided to sit in the independent work area and the researcher explained that he could play with the toys placed to his left side and when finished place them in the "finished" box on the right side of their desk. The class teacher had not received any instructions about altering her level of prompting during this phase and was not told that data would be collected on prompting behavior, so that any influence to her level or type of prompting behavior would be avoided. Play sessions lasted about 15′, were videotaped and data collection started when the student sat in the work area.

Intervention Condition 1 (IC1)

During Intervention Condition 1, students were engaged with the tasks with visual organization. All tasks were organized following TEACCH guidelines for visual organization, visual instructions and visual clarity (Echenrode et al. 2003; Schopler et al. 1995; TEACCH 1996). First, all tasks were visually organized to minimize extra stimulation and make it easier for the student to comprehend the meaning of the activity. All tasks were self-contained, that is all components of the task were presented to the student as one unit, placed in plastic cups or containers. Second, visual instructions were provided in various forms: materials, laminated pictures/photographs illustrating the steps for completing the activity or the product sample, picture jigs, picture dictionaries (with written labels) and words. Third, visual clarity was achieved by limiting the irrelevant or extra materials of the task, by using colors and photos of large size.

This experimental stage comprised two phases: (a) training and (b) intervention. During the training phase both participants received instructions from the researcher on the use of visual instructions. Both children were taught the following sequence of steps: (1) to work from left-to-right, (2) to attend to visual instructions to organize the materials of the task, (3) to complete the task, (4) to transfer the completed task to the "finished" box and (5) to transition independently to the next task. The researcher provided prompting about the use of visual instructions. The teacher who was in the classroom was not given instructions about her behavior towards students and neither was she informed about the purposes of the study. Data were collected on the dependent variables, as well as the number of prompts required for the completion of the above steps. Both participants needed three teaching sessions to achieve 100% accuracy in the aim of the training; this phase was followed by the intervention phase, in which the researcher did not provide any prompting to the children for task completion. At this stage, there were ten intervention sessions (15′each) for each participant.

Baseline 2 (BL2)

A return to baseline condition occurred after IC1 to establish experimental control of the use of visual instructions. Participants were given play tasks which did not include any visual instructions. At this stage, sessions (15′ each) were five for each participant.

Intervention Condition 2 (IC2)

The IC2 was a direct replication of the IC1 but without the training phase for the participants.

Generalization Phase

Generalization skills across places, materials and people were examined 3 days after the completion of the IC2 phase. Generalization was conducted in the students' classroom with the presence of their class teacher and their classmates. Tasks were different from those used in IC2 but fell under the three categories of play and were visually structured similarly to the tasks used in the intervention. Each student was observed for three sessions (lasting 15′ each) in separate days.

Visual inspection was applied to all graphed results from all sessions to examine changes in level and trend (Kazdin 1982). To supplement visual analysis, percentages of non-overlapping data (PND; Scruggs et al. 1987) were calculated for each participant for each category of data. PND is calculated by dividing the number of intervention data points higher than the highest baseline data point by the total number of intervention data points and multiplying by 100. According to Scruggs and Mastropieri (1988) PND scores over 90% indicate very effective interventions, scores between 70 and 90% indicate effective interventions, scores between 50 and 70% are questionable and scores lower than 50% indicate that interventions are not effective.

Procedural Integrity

Procedural integrity of the intervention is defined as the accurate and consistent application of an agreed upon procedure so that the outcome of the intervention is reliable and valid (Kazdin 1982). Procedural integrity was measured via direct observation of the teacher prior to the independent play sessions. To this end, a checklist with eleven questions on task organization with a Yes/No answer format was developed (i.e., "Are all visual instructions placed in the right position?", "Are all visual instructions presented on the front side?"). Procedural integrity was calculated by dividing the number of steps implemented correctly by the total number of steps completed. Two trained observers blind to the purpose of the study collected data on 30% of the intervention sessions for each participant.

Dependent Variables

The dependent variables of this study were on/off-task behavior, teacher prompting, task completion and task performance. Definitions were similar to those used by Pelios et al. (2003) and Hume and Odom (2007). *On-task behaviour* was recorded when the student was visually attending to play materials, visual instructions and manipulating appropriately materials. *Off-task behaviour* was recorded when the student was manipulating the materials in an inappropriate way (used materials in ways different from what they were designed to be used) or displayed other inappropriate behavior (i.e., hitting, mouthing objects, throwing away pieces). *Task performance* was defined as executing the correct steps/actions in each task and it was measured by the number of pieces placed correctly or the number of correct actions in each activity. For every correct action (i.e. placing the domino card in the correct position with the correct orientation), the student would get a score of 1 and for an error he would get the score of 0. *Task completion* was defined as completing tasks during sessions and was assessed by counting the number of tasks completed in each session. *Teacher prompting* was defined as any form of physical, visual, verbal or proximal cue aiming to redirect student's attention to the activity. Prompting included hand- over- hand or other manual prompts, pointing, saying student's name, giving verbal instructions or reminders, shadowing or close proximity to the student.

Observational Procedures

All sessions were videotaped for both participants—only the pre-baseline assessment sessions were not videotaped. All sessions in each condition were 15 min long in duration. Data were collected in 10 s intervals of observation of the student, followed by 10 s to record dependent variables. In total, 45 intervals were evaluated for each session and for each student. Momentary time sampling was used for recording on/off-task behaviors. Teacher prompting was recorded by partial interval recording, by placing an "X" for occurrence and an "O" for non-occurrence. Event recording was used to record task completion and task performance. In total, thirty-four sessions were recorded (thirty-one intervention sessions and three generalization sessions) for each student. At the end of each interval, the observers checked a box to indicate the occurrence or non-occurrence of each variable. One to two sessions per child were run on any given day of the study. This study started in March and was carried out until the end of the school year (mid June).

Inter-Observer Reliability

Inter-observer reliability was measured by two observers with prior experience in observing children with autism in their school placements. Their training for this study included: (a) a brief discussion of the observation and recording system and (b) training sessions using videotapes of students in independent work sessions. During their training data collectors who were "blind" to the purpose of the study had to reach 90% agreement criterion on all the dependent variables. Each observer would record behaviors following a tape-recorded cue. Inter-observer data were not collected in vivo, but data collectors simultaneously but independently observed and recorded behaviors from 30% of sessions across all conditions for each student. An agreement was scored when both observers recorded the occurrence or non-occurrence of dependent variables at the end of the interval. Interval-by-interval percentage inter-observer agreement was calculated by dividing the number of agreements by the number of agreements plus the number of disagreements and multiplying by 100 (Kazdin 1982). The mean rate of inter-observer agreement for Vaggelis was 97% (range = 90–100%) for on-task behavior, 95.4% (range = 90–100%) for off-task behaviour and 97.6% (range = 90–100%) for teacher prompting. Mean percentage agreement for Yiannis was 97% (range = 95–100%) for on-task behavior, 95% (range = 90–100%) for off-task behaviour and 94.9% (range = 90–100%) for teacher prompting. The mean rate for task accuracy and task completion was 100% for both students.

Social Validity

Social validity measures adherence to the intervention procedures and refers to the social acceptability and applied importance of intervention goals, procedure and outcomes (Kazdin 1982). A traditional method for measuring the social validity of the aims and outcomes of an intervention is subjective evaluation through the use of questionnaires (Kennedy 2005). Based on similar research (Hume and Odom 2007) a 12-item questionnaire (Observer Rating Form for Treatment Fidelity) was developed regarding the objectives, procedures and outcomes of the intervention. This questionnaire was completed before and after the intervention by four members of the school staff (class teacher, PE instructor, school nurse and the social worker) who were familiar with both students. Furthermore, the IEPs of both students were examined so that their needs for independent play would be matched with the aims of the intervention. The pre-treatment questionnaire included statements about the goals of the intervention (i.e., "My student cannot play independently") and the treatment procedures (i.e., "My student can be taught to play independently”). The post-test questionnaire included similar items as well as items on the effectiveness of the intervention (i.e., “My student learned to start and finish a play activity”). A five-point Likert type scale was used in all questions: “disagree” (point value 1), “slightly disagree (point value 2), neutral (point value 3), “slightly agree” (point value 4) and “agree” (point value 5).

Results

The use of visual instructions had an effect on all the dependent variables for both participants. The examination of behaviours across phases indicates that the two children showed an increase in their on-task behaviour and their task completion as well as a decrease in their off-task behaviour when tasks were visually structured. Visual inspection of the pattern of on-task behaviour of both students suggests that there were consistent changes in response to the different baseline and intervention phases (Figs. 2, 3). However, small changes were observed for teacher prompting across phases. Figures 2 and 3 illustrate that teacher prompting did not change as much in level—the lowest data point was observed on the last (10th) session of IC1 for Vaggelis and in the last generalization session for Yiannis.

During the initial baseline phase (BC1) Vaggelis demonstrated on-task behavior for an average of 67% of intervals (range = 20–84.4%), off-task behavior for an average of 32% of intervals (range = 15.5–80%) and teacher prompting averaged 16% of intervals (range = 6.6–24.4%). During the first intervention condition (IC1) Vaggelis’ on-task behavior increased to an average rate of 82% (range = 73.3–91.1%) and teacher prompting increased to an average rate of 17.5% of intervals (range = 2.2–35.5%), while off-task behavior decreased to 17.8% (range = 8.8–26.6%) of the intervals. During the second baseline condition (BC2), when visual instructions were withdrawn, Vaggelis’ on-task behavior dropped to 72% (range = 56–80%), off-task behavior increased to 28% of the intervals (range = 20–44%) while teacher prompting average rate decreased to 15.1% of intervals (range = 11.1–31.1%). During the second intervention (IC2) the average rate for on-task behavior increased to 88% (range = 80–93.3%) while off-task behavior decreased to the lowest percentage of 12% of intervals (range = 6.6–20%) similarly to the mean rate of teacher prompting which dropped to 8.86% (range = 4.4–11.1%). In generalization sessions, Vaggelis demonstrated an average rate of 81.4% of intervals (range = 77.7–86.6%) for on-task behaviour, an average rate of 18.5% of intervals (range = 13.3–22.2%) for off-task behaviour and he was prompted for an average rate of 19.2% of intervals (range = 15.5–22.2%).

During BC1 Vaggelis completed an average of five activities per session (range = 3–6) and the mean percentage of his task accuracy was 30.6% of sessions (range = 0–72%) (see Fig. 4). In IC1 the average number of completed activities decreased to 2.6 (range = 2–3) but his mean task accuracy rate increased to 60.7% (range = 10–100%). In BC2 the mean number of activities he completed was 2.8 (range = 2–3) and his average task accuracy rate decreased to 54.15% (range = 0–100%). During IC2 the mean number of activities he completed was 2.6 (range = 2–4) but his average task performance rate increased to 63.85% (range = 10–100%). In generalization sessions, the mean number of activities he completed was four (range = 3–5), while his average task accuracy was 68% of intervals (range = 59.9–72.48%). To supplement visual analysis, PND was calculated for Vaggelis and revealed a score of 50% for on-task behaviour and a score of 45% for task performance. These PND

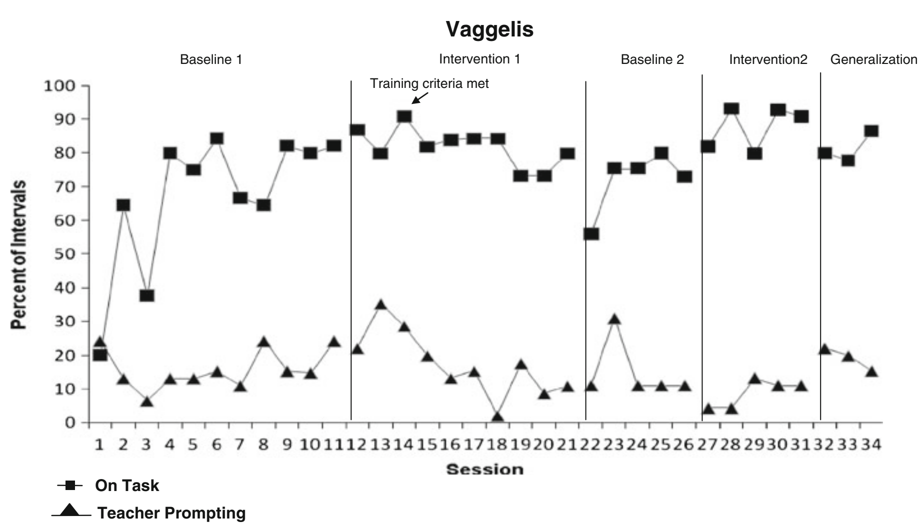

Fig. 2 Percentage of intervals of on-task and teacher prompting for Vaggelis across baseline, intervention and generalization sessions

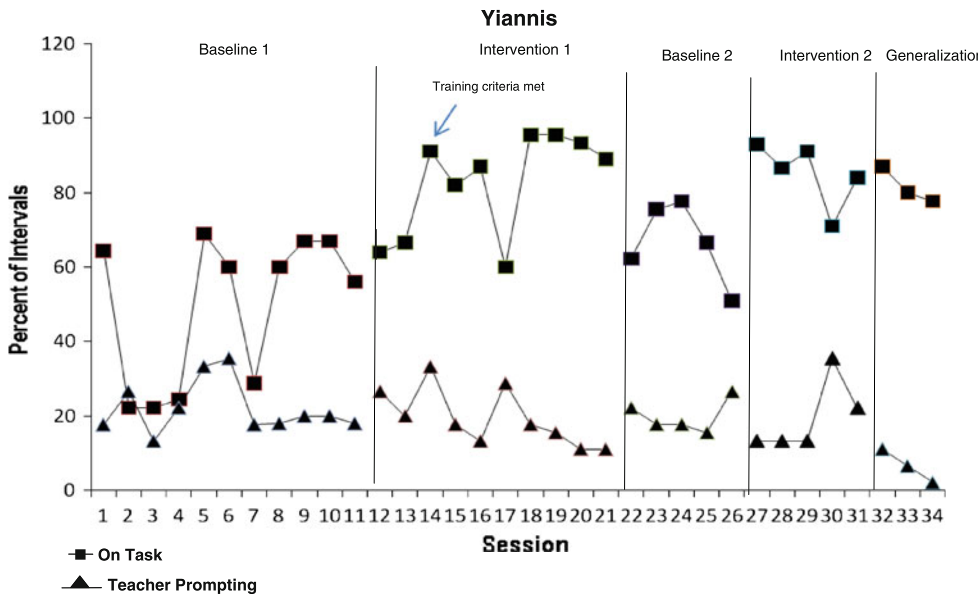

Fig. 3 Percentage of intervals of on-task and teacher prompting for Yiannis across baseline, intervention and generalization sessions

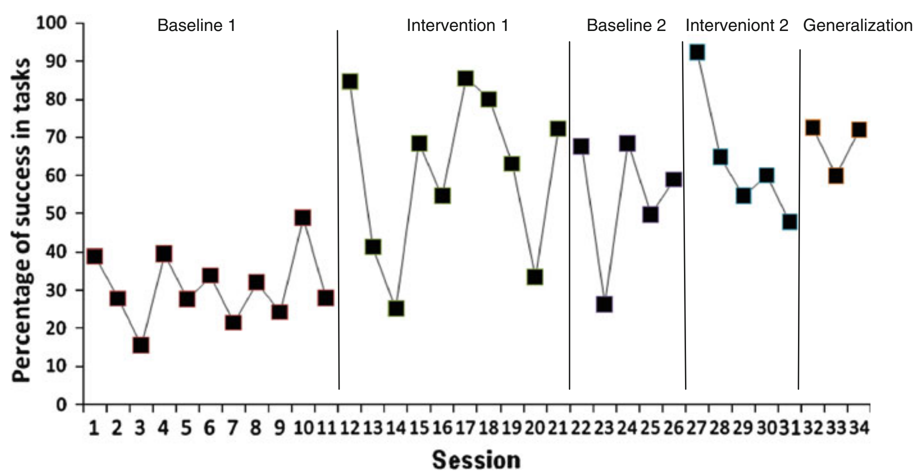

Fig. 4 Percentage of task performance for Vaggelis across all baseline, intervention and generalization sessions

scores suggest that this intervention was questionable for Vaggelis' on-task behaviour and ineffective for his task accuracy.

During the first baseline (BC1) Yiannis' mean on-task behaviour was 49% of intervals (range = 22.2–69%), off-task behavior was 51% of intervals (range = 31.1–77.7%) and the average rate of teacher prompting was 22% (range = 13.3–35.5%) (Fig. 3). During the first intervention condition (IC1), the average rate for on-task behaviour increased to 82.4% (range = 60–95.5%), the mean rate for off-task behavior decreased to 17.6% (range = 4.4–40%) and the average rate of teacher prompting decreased to 19.5% of intervals (range = 11–33.3%). In the second baseline (BC2) Yiannis' mean rate of on-task behaviour decreased to 67% of intervals (range = 51–77.7%), whereas the average rate of off-task behaviour increased to 33% of intervals (range = 22.2–49%) and the mean rate of teacher prompting increased to 20% of intervals (range = 15.5–26.6%). In the second intervention condition (IC2) the mean rate for on-task behaviour increased to 85% of intervals (range = 71–93%), the mean rate for off-task behavior decreased to 15% of intervals (range = 7–29%) and the mean rate of teacher prompting was maintained to 20% (range = 13.3–35.5%) as in BC2. During generalization sessions Yiannis displayed an average rate of 82% of intervals (range = 77.7–87%) for on-task behaviour and an average rate of 19% of intervals (range = 13–23.3%) for off-task behaviour and he was prompted for an average rate of 6.6% of intervals (range = 2.2–11.1%).

During BC1 Yiannis' mean number of completed activities was three (range = 2–4) and his average task accuracy rate was 18% (range = 0–50%) (see Fig. 5). In IC1, the mean number of activities he completed decreased to 2.4 activities (range = 1–4), but his average task accuracy rate increased markedly to 58% (range = 0–100%).

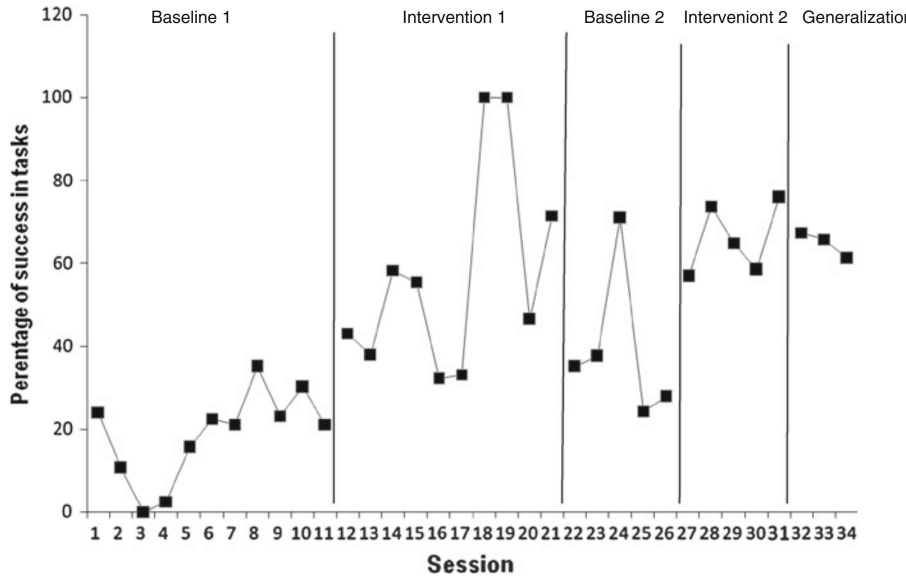

Fig. 5 Percentage of task performance for Yiannis across all baseline, intervention and generalization sessions

During BC1 the mean number of activities he completed was three (range = 2–3) and his task accuracy rate decreased to 39% (range = 0–100%). In IC2 his mean number of completed activities was 3.6 (range = 2–4) and his average task accuracy rate increased to 66% (range = 0–100%). In generalization sessions, the mean number of activities he completed was four (range = 2–5) and his average task accuracy dropped to 64.7% of intervals (range = 61.11–67.33%). To supplement visual analysis, PND was calculated for Yiannis and revealed a score of 75% for on-task behaviour, and a score of 70% for task accuracy. The PND scores suggest that this intervention was effective for Yannis.

Procedural Integrity

Following the completion of the intervention sessions, the observers filled in the questionnaire on the procedural integrity of the intervention and the rate of accuracy was found to be 100%. This means that the intervention was carried out accurately and in adherence to predetermined procedures.

Social Validity

The social validity of the research was evaluated by a questionnaire developed for this purpose and completed twice (before and after the intervention) by four members of the school staff familiar with the students. Prior to the intervention everyone agreed that the following instructional goals were important for both students: (a) “making appropriate use of play materials” (mean rating = 5), “starting and finishing one activity” (mean rating = 5), “starting and finishing more than one activities” (mean rating = 5) and “playing independently” (mean rating = 4). Besides, they all agreed that both students needed guidance for appropriate use of play materials (mean rating = 5). Staff responded that both students can be taught to play independently (mean rating for Vaggelis = 5, mean rating for Yiannis = 4.5), to use play materials appropriately (mean rating for both students = 5), to start and finish one play activity (mean rating for Vaggelis = 5, mean rating for Yiannis = 4.5) and to start and finish more than one play activity (mean rating for both students = 4).

Following the intervention, the views of the staff changed to a certain extent with respect to students’ abilities as a result of the intervention. They expressed their disagreement that both students were not able to play independently (mean rating for Vaggelis = 2, mean rating for Yiannis = 2.2). However, they remained neutral about their ability to start and finish one play activity (mean rating for Vaggelis = 3, mean rating for Yiannis = 3.25) and they agreed that students could not yet start and finish more than one play activities (mean rating for Vaggelis = 3.75, mean rating for Yiannis = 4.25).

Discussion

The findings of this study present an interesting picture, since the on-task behavior of both students with autism changed as a result of the intervention, but the PND results indicate that visual structure was effective only for one participant (Yiannis) and questionable for the other. This positive finding is consistent with research evidence on the increase of on-task behavior following a visually-based intervention (Hume and Odom 2007; McClannahan and

Krantz 1999; Pelios et al. 2003). This study with its emphasis on visually structured tasks extended the emerging line of inquiry in the effectiveness of specific components of Structured Teaching for teaching independence across different skill domains to students with ASD (Hume and Odom 2007; Hume et al. 2009; Mesibov and Shea 2009). Nevertheless, the questionable effects of the visual structure for one participant require special attention in relation to the study design. Single-subject research designs make an important contribution to the research in special education, by "analyzing the characteristics of these nonresponders, thereby advancing knowledge about the possible existence of subgroups and subject-by-treatment interactions" (Horner et al. 2005, p. 173–174).

On-task behavior was found to increase slightly in IC1 for Vaggelis, since only two out of ten data points were higher than the highest data point in BC1, but a greater increase of on-task behavior was observed in IC2, since four out of five data points were higher than data points in BC2. In generalization sessions, his on-task behavior was variable. This pattern of behavior change alongside with the PND results show that the intervention had limited positive outcomes for this participant, which might have been stable with a longer intervention. On-task behavior for Yiannis had an accelerating trend in IC1, since seven out of ten data points were above the points in BC1 and the same trend was observed in IC2, since four out of five data points were higher than points in BC2. This behavior pattern combined with the PND results lead to the safe conclusion that the applied intervention had positive effects for this participant. In generalization sessions, his mean percentage on-task behavior was similar to the level of his on-task behavior in IC1. These individual differences could be accounted by the cognitive ability of the students. It could be hypothesized that the higher cognitive estimate of Yiannis may have interfered with his higher and more stable attention to the tasks, when they were visually structured. For this purpose, it would be useful to obtain a more detailed cognitive profile of participants prior to the intervention for a better understanding of their on-task behavior. A more thorough assessment of working memory, processing speed, task duration as well as executive functioning may shed further light into the on-task behavior of students with ASD. Additional research is needed to examine the effects of task organization to individuals with ASD and different cognitive styles (visual, pattern, verbal) and the necessary adaptations for their successful learning.

An interesting finding was that although both participants completed fewer tasks in the intervention sessions, they had higher task accuracy rates in intervention sessions than in baseline sessions. However, PND results indicate that this intervention was effective only for Yiannis and questionable for Vaggelis. A possible explanation for this rise could be that when students were given visual supports they understood the purpose of the task, followed the correct sequence of steps and their performance was successful. This is in line with the literature on the beneficial effect of visual supports on the errorless performance of students with ASD (Bryan and Gast 2000; Charlop-Christy and Kelso 2003). Nevertheless, the variability of task accuracy in Vaggelis indicates a mixed picture, which could have been further explored if the intervention was longer. But given the time constraints of this study it was not possible to implement the intervention for a longer period. An alternative option would be to employ a pre-specified criterion of behavior change for shifting phases (Kazdin 1982). The lack of a training criterion for students' on-task behavior posits a limitation to this study. The application of an experimental design based on changing criteria would have been a useful methodological alternative option for measuring the stepwise increase in task accuracy and task completion and in throwing further light into Vaggelis' unstable behavior pattern.

During the intervention, teachers were not instructed to alter their prompting behavior towards the students. The lack of teacher training on delivering prompts during baseline and intervention could have an effect on the off-task behavior of participants. However, only small changes were observed on teacher prompting across conditions for both participants, showing the stability of teacher prompting. With respect to Vaggelis, teacher prompting increased in IC1 and it decreased slightly in IC2. In the generalization sessions across people, teacher prompting reached its highest mean percentage. With respect to Yiannis, teacher prompting showed a slight drop in IC1 and a slight increase in IC2, which was maintained in the generalization sessions. This finding indicates that visually structured activities alone may not bring consistently independence in students with ASD. Future experimental studies on Structured Teaching need to examine further this variable by applying systematic fading procedures, so that teacher prompting is contingent upon independent on-task behavior. A major concern is the extent to which the full benefit of scientific research is translated into best practices in actual classroom settings (Volkmar et al. 2004). Therefore, it is important to carry out similar interventions in real classrooms, so that all intervening variables can be examined for the successful replication of the intervention by teachers within the classroom routine.

A number of limitations of this study need to be addressed. First, the number of participants was small and single-subject design was applied. Given the mixed picture of the findings, it would have been useful to include all children of the same class. Although that would add further light to the effects of the intervention, it was not feasible, due to the limited number of research assistants for implementing and monitoring the intervention. Besides, the duration of each condition could have been extended, so that more repeated measurements would have been obtained and the effectiveness and the generalization of the intervention could have been evaluated to the course of time. That was not feasible though, since the study commenced in February and had to finish by the end of the school year (mid June). Another limitation is the lack of maintenance data, which was infeasible due to time constraints. That would provide further insight into the stability of the on-task behavior and the amount of teacher prompting at a later time after the intervention.

One fruitful line of future research could be the replication of this intervention in a larger number of participants with ASD (group design) and across different curriculum areas. This would provide further insight into the type and level of task organization necessary for individuals with ASD who have varying levels of ability and age range. Also it would enable generalization of the effects of this intervention across children with ASD and activities in other curriculum areas, such as social skills, academic skills, art, leisure, physical education and vocational skills. Besides, further research on the utility of visual structured tasks in different settings, such as home, community and general education classrooms is needed, so that task organization can be best applied in the settings of everyday life of individuals with ASD. Another line of research could be to explore the effects of faded close adult supervision. Most often the presence of an adult in the same room is a confounding variable for results with respect to the individual performance in the absence of a supervising adult. It would be interesting to see whether students remain on-task and show task accuracy with minimal adult supervision. Nevertheless, task organization can be easily implemented in different natural environments and is a valuable tool for increasing independence in students with ASD. Further research is needed to evaluate the specific effectiveness of task organization for a variety of individuals with ASD across curriculum areas and naturalistic settings.

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