The use of visual schedules and work systems to increase the on-task behaviour of students on the autism spectrum in mainstream classrooms

Libby Macdonald[1, 6], David Trembath[3, 6], Jill Ashburner[2, 6], Debra Costley[4, 5, 6], and Deb Keen[1, 6]

1. Autism Centre of Excellence, School of Education and Professional Studies, Griffith University
2. Autism Queensland
3. Menzies Health Institute Queensland, Griffith University
4. Autism Spectrum Australia (Aspect)
5. University of Nottingham
6. Cooperative Research Centre for Living with Autism

Address correspondence to Deb Keen, Autism Centre of Excellence, Department of Education and Professional Studies, Griffith University, Messines Ridge Road, Mt Gravatt, Brisbane, 4122, Australia. Email: d.keen@griffith.edu.au

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Abstract

Apparent differences in executive function can lead to challenges for students on the autism spectrum in mainstream settings. Difficulties with staying on-task and transitioning between tasks or task elements can interfere with students' participation in educational activities and lead to stress and anxiety. While the use of visual supports, such as visual schedules and work systems, has been shown to be effective in supporting students to stay on-task in special education and autism-specific settings, there is little research to support the use of these strategies by teachers in mainstream classrooms. This study evaluated the use of visual schedules and work systems in supporting four students on the autism spectrum to stay on-task and work independently in a mainstream setting. These strategies were implemented by teachers as inclusive practices, and evaluated using observations within the natural classroom environment to examine their feasibility in mainstream settings. All participants demonstrated improvements in on-task behaviours. Results for other, secondary, dependent variables were mixed, with some students showing reduced off-task behaviours and increased productivity. The implications for clinical practice and future research directions are discussed.

Keywords: autism spectrum disorder, visual schedules, work systems, on-task behaviour, mainstream classrooms.

The mainstream school setting can be challenging for students on the autism spectrum due to difficulties with social communication and restricted and repetitive patterns of behaviour (American Psychiatric Association, 2013). These cognitive and behavioural differences may have an impact on the way these students approach tasks requiring high levels of executive functioning such as staying on-task, transitioning between activities, and following activities with multiple steps independently (Banda & Grimmett, 2008; Milley & Machalicek, 2012). Consequently, students with autism spectrum disorder (ASD) may have difficulty engaging with school work. Issues with executive functioning may also contribute to anxiety, reduce students' ability to regulate their own behaviour, and, lead to poor educational outcomes (Ashburner, Ziviani, & Rodger, 2010; Stoner, Angell, House, & Bock, 2007). Structured teaching strategies such as visual schedules and work systems may support students on the autism spectrum to stay on-task and navigate transitions. While these strategies may suit a broad range of students, not just those with more complex needs (Bryan & Gast, 2000; Hume, Sreckovic, Snyder, & Carnahan, 2014), there is a dearth of research focussing on the use of these strategies by teachers in mainstream classrooms. Accordingly, research that examines whether these strategies are feasible and effective in mainstream contexts is needed to inform practice in this area.

Structured Teaching

Structured teaching was developed as a central component of the Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH) programme in the early 1970s (Mesibov & Shea, 2010), and is commonly used in ASD-specific education settings (Humphrey & Parkinson, 2006). It is an approach "designed for individuals of all ages and functioning levels" (Mesibov & Shea, 2011, p. 2473) comprising strategies aimed at reducing anxiety and creating an "autism-friendly" environment using

physical and visual structure. The use of visual information is central to this approach, which aligns with research suggesting students on the spectrum may have difficulty processing transient, auditory information (Quill, 1997) but that processing of static, visual information may be a relative strength (Baron-Cohen, Ashwin, Ashwin, Tavassoli, & Chakrabarti, 2009; Grandin, 1995). There is some evidence to support TEACCH as a comprehensive treatment program (e.g., D'Elia et al., 2014). However, the time, space, and resources required to implement structured teaching as a comprehensive package in mainstream settings may be prohibitive for mainstream teachers, and could be considered disproportionate to the needs of students in the class. Parts of the TEACCH approach could, however, be adapted to the mainstream environment. Evaluating separate elements of comprehensive treatment programs may help identify constituent parts (e.g., teaching strategies) that are the “active ingredients” . Effective components could possibly be used in flexible, modular ways (Boyd et al., 2014) and suit the eclectic and responsive way in which teachers often adopt new practices (Callahan, Shukla-Mehta, Magee, & Wie, 2010). Two key elements of structured teaching which may be practical for use in mainstream settings are visual schedules and work systems.

Visual Schedules

Visual schedules are used to orientate students and provide predictability within the classroom by informing students of an anticipated sequence of events using pictures, symbols, and/or written language. Making transitions predictable is thought to reduce anxiety for individuals on the autism spectrum (Sterling-Turner & Jordan, 2007), and is associated with reductions in problem behaviour (Knight, Sartini, & Spriggs, 2014). The National Autism Center (2015) lists “schedules” as “established interventions” indicating that they are useful in promoting independence and helping students to plan. Wong et al. (2015) similarly categorise “visual supports”, including schedules, as an evidence-based practice, and a review by Knight, Sartini, and Spriggs (2014) concluded that visual schedules were effective in

promoting on-task behaviour and facilitating independent transitions. Together, these reviews indicate that visual schedules are an effective way to support students on the spectrum. However, , none of the studies cited were conducted under conditions where the intervention was implemented by a mainstream class teacher as part of everyday classroom practice.

Work Systems

Work systems are a way of structuring tasks, or task elements, such that students know (a) what they are expected to do; (b) how much work is expected; (c) how to know progress is being made, or that work is complete; and (d) what to do next (Mesibov, Howley, & Naftel, 2016). There is less evidence for work systems than for visual schedules, although they share common elements (e.g., sequencing tasks, or task elements), and may have similar effects on anxiety and behaviour. Work systems were included in the review by Knight et al. (2014), however, both the National Autism Center (2015) and Wong et al. (2015) have found insufficient evidence for work systems due to the small number of studies focussing on this practice. Few studies have focussed on the use of work systems in isolation with school-aged children on the spectrum (Hume & Odom, 2007; Hume, Plavnick, & Odom, 2012; Mavropoulou, Papadopoulou, & Kakana, 2011; O'Hara & Hall, 2014). Most of these recorded increases in measures such as on-task behaviour, engagement, task accuracy, behaviour regulation, or the ability to work independently. These observable outcomes may reflect a reduction in students' levels of anxiety and improvements in their ability to self-regulate. Mavropoulou et al. (2011) noted improvements in on-task behaviour for one of two participants, and questionable results for the other. Hume and Odom (2007) recorded an increase in on-task behaviour and a reduction in prompting for three students with the introduction of work systems. Hume et al. (2012) found that the use of a work system was associated with improvements in task accuracy as well as a reduction in teacher prompting. Finally, O'Hara and Hall (2014) found that work systems increased the engagement of

students on the spectrum during play activities at recess. Nevertheless, despite preliminary data pointing to potential benefits of work systems in supporting students on the spectrum, and their suitability for use in different contexts with diverse individuals (Hume, 2015), only two studies collected data in mainstream settings (Hume et al., 2012; O'Hara & Hall, 2014). Furthermore, neither study examined implementation in class, by the classroom teacher. Questions remain about whether the positive outcomes experienced by students using work systems and visual schedules in special education or clinical settings are translatable to inclusive, mainstream settings. The aim of this study was to examine the impact of visual schedules and work systems on the on-task behaviours, productivity, and independence of students on the autism spectrum when these strategies are used as a whole-class approach in a mainstream setting.

Method

The method adopted was a multiple-baseline, single-case design across participants. This approach aligns with current evaluative processes for establishing evidence-based practices related to autism (Cook & Odom, 2013; Reichow, Volkmar, & Cicchetti, 2008). Whereas large group studies using randomised controlled trials have been considered the gold standard in providing evidence of efficacy (Dingfelder & Mandell, 2011), single subject study designs are better suited to providing data on individual behavioural change (Kasari & Smith, 2013).

The current, quantitative evaluation is based on the premise that, if visual schedules and work systems were to work within a mainstream classroom context to support executive function directly as well as helping to reduce anxiety overall, this would have a measurable effect on the observable behaviour of students on the spectrum. Accordingly, the first, and primary, hypothesis of this study was that the implementation of visual schedules and work systems, as described in a workbook for teachers, would result in measurable increases in

students' on-task behaviours. The second hypothesis was that there would also be a decrease in their off-task behaviours. The third was that students, working more independently, would require less guidance from teachers in the form of prompting, and the fourth, that the students would complete more work.

Ethics Approval

Ethics approval for the study was granted by the University of Queensland ethics committee (No. 2013001446) and relevant educational authorities. Careful consideration was given to providing information about the study in a way that was accessible to student participants and their primary caregivers, and the procedure followed in conducting this research was designed to avoid drawing attention to, or isolating, student participants within the classroom. The conspicuous use of targeted interventions and one-on-one support can result in the stigmatisation of students on the spectrum in mainstream settings (Emam & Farrell, 2009; Humphrey & Lewis, 2008). In examining the implementation of the intervention by mainstream classroom teachers, and using discrete, unobtrusive observation methods, this type of adverse outcome may be avoided.

Participants

The participants were three students in their fifth year of formal education, and one in third year, who met the following eligibility criteria: (a) verified as having an ASD diagnosis by the Department of Education and Training, which requires written documentation of diagnosis according to the DSM-IV-TR or DSM-5 from a paediatrician, psychiatrist, or neurologist; (b) attending mainstream classes in upper primary years (Years 3 to 6); (c) having the academic ability to complete work set for the class; and (d) reported, by their teachers, to have difficulty staying on task and/or transitioning between tasks. Information about the study was distributed to principals and teachers, who then identified potential participants. Parents provided information about diagnoses, and the Social Responsiveness

Scale (SRS-2) was used as a quantitative measure of traits associated with ASD (Constantino & Gruber, 2007). All four students had T-scores (total scores) over 60, which "indicate deficiencies in reciprocal social behavior that are clinically significant" (Constantino & Gruber, 2012). Teachers were asked about the students' ability to complete classwork, and the students' potential academic ability was examined using the Kaufman Brief Intelligence Test, second edition (KBIT-2; Kaufman & Kaufman, 2004). All students scored in the average, or above average, range for their chronological ages (see Table 1).

James (pseudonym) was in Year 5 and aged 10 years and 7 months at intake to the study.,His teacher described him as reluctant to participate in class activities, often wandering around the room to find preferred activities. James sometimes refused to enter the classroom and his teacher had implemented strategies to manage his behaviour, including offering free time on the computers as an incentive to complete classwork, and allowing him to spend part of the day in another, supervised setting when he determined the class to be overwhelming. Aaron, Edward, and Sam (pseudonyms) attended a different school from James, but were in separate classes. Aaron was 10 years and 4 months old and in Year 5. His teacher described him as having difficulty starting non-preferred tasks. He was sometimes noncompliant, and, when frustrated, would occasionally scream or growl at the teacher.

Edward was 11 years old and his teacher reported that his behaviour was variable. While generally on task when with his usual teacher, he sometimes displayed challenging behaviours with substitute teachers and teachers for specialist subjects. His primary caregiver reported that he had secondary diagnoses of attention deficit disorder, oppositional defiance disorder, and foetal alcohol syndrome.

Sam was a Year 3 student who was 8 years and 11 months old. Sam's teacher reported that he was sometimes reluctant to start tasks and would often complete tasks at speed, with little attention or without completing all steps. Strategies she used to manage

Sam's behaviour included offering free time playing with toys as an incentive to complete classwork.

[Insert Table 1 about here]

Setting

The study took place in two mainstream primary schools. Each class had 20-25 students. For James, Aaron, and Sam, the intervention was implemented by the classroom teacher during regular lessons. For Edward, the intervention was delivered by another teacher in languages other than English (LOTE) lessons, as this was identified as when he had particular difficulty attending to tasks. In all classes, there were frequently other adults present – volunteers, teacher aides, student teachers – who would give instructions and interact with the students. Lesson planning and the preparation of class materials was, however, undertaken by the classroom teacher in each setting.

Materials

Teachers were provided with a workbook resource closely based on work authored by Haas (2015). The workbook provided information on structured teaching as well as more specific information about visual schedules and work systems, with links to online information. It then gave guidance on creating a daily timetable (a visual schedule) for students and developing a work system, with examples of different types of work systems including a checklist and a structured literacy task using numbered task elements. Teachers were also provided with a template for a simple checklist to break down and organise a task.

Included in the workbook was a 12 point implementation checklist which included items based on core elements of visual schedules and work systems, as described in the workbook. The checklist directed teachers to ensure that visual schedules and work systems be available for use by all students, that schedules be kept up to date, and that the work systems provided adequate information about the task. The strategies, as described in the

workbook, were intended to be simple and able to be implemented with very few resources (e.g., paper and pencil) but had the scope to be implemented using computers or mobile computing devices (e.g., iPads) depending on what was available and teacher preference.

Procedures

Pre-baseline. The researcher met with each participating teacher, explained the procedures. and consulted with them about which regular classroom activities coincided with off-task behaviours in their students on the spectrum. James' teacher suggested a journal writing task. This involved a period of writing in response to a brief written stimulus shown on the board. Aaron's teacher selected a creative writing task. Edward was observed during independent work in the specialist class, which usually consisted of a worksheet, writing activity, or craft. Sam's teacher selected a creative writing task. Teachers were asked to describe behaviours that would indicate on-task and off-task behaviour for each student, and these descriptions then became the focus of coding dependent variables.

Baseline. The first author observed each student on a minimum of five occasions prior to the intervention to establish baseline rates of target behaviours. Teachers were instructed to conduct lessons as they normally would. Both student behaviours and teacher prompting of the target students were recorded from the start of the task (when the teacher indicated students should start work).

Data collection and coding. Data were collected in person by the first author. Ten-second partial interval coding was used, with behaviours being recorded if they occurred at any time during an observation interval. This partial interval recording allowed both on- and off-task behaviours to be recorded in the same interval. A 10-minute audio track, which consisted of alternating 10 seconds of music and 10 seconds of silence, was played through a digital audio device. Using earphones, the first author made observations during the silent interval and recorded them while the music played. Tasks varied in length. Observations

began when the teacher gave the instruction to commence work, and continued for the duration of short activities. Where tasks were extended over longer periods, observations were timed to sample the start, middle, and end of the task to capture student behaviour at different task stages. Unforeseen interruptions to classroom activities, where students were expected to stop work, were excluded from the observations. Following coding, the proportion of intervals in which the student demonstrated the target behaviour was calculated as a percentage of the total number of observed intervals.

Intervention. The first author started each intervention phase by providing the teacher with a hard copy of the workbook, and meeting face-to-face with the teacher for approximately 30 minutes to discuss its contents. Teachers were told about the rationales for using the strategies, and guided through the implementation checklist. Digital copies of the workbook were emailed to teachers within 48 hours. Data-collection procedures used during the baseline phase continued unchanged during the intervention period, with the exception that the same implementation checklist provided to the teachers was used to record fidelity. Teachers' implementation methods varied, but consisted of individual visual schedules, structuring tasks with task lists or numbered instructions, providing clear visual cues about how much work was provided (e.g., visual timers, pages marked with an end point), and what to do next (e.g., concrete materials for the next task, next item on schedule). The order in which the intervention was initiated across students was determined by the frequency and timing of sessions and teacher availability, and was decided in consultation with all the teachers.

Dependent Variables ***"On-task" type behaviours.*** The primary dependent variable of on-task behaviour was operationalised as follows: writing, or typing, where, if at any point during an observation interval, the student's pencil, or other writing implement, is held with the tip touching the paper, worksheet, or exercise book, or if the student presses a key on a

computer keyboard. For Edward, who was observed undertaking a wider variety of independent work, on-task included: cutting, colouring, or gluing where this was the activity in which the student was expected to be engaged, and if the student was using scissors to cut the intended material, if his pencil, other colouring implement, or glue stick, was held with the tip touching the paper, or he was pressing paper with glue to the intended surface.

"Off-task" type behaviours. Teachers were asked to identify the behaviours that occurred when each student was off task. For James, off-task type behaviours included leaving his chair, walking around the room, leaving the room, working on activities other than the teacher-directed task (e.g., drawing or going on the computers), and talking. For Aaron, off-task behaviour included refusals to work and talking. Aaron's teacher also noted that he would conceal books under his desk and read covertly instead of engaging in classwork. Reading in this way was coded as having a book open on the desk or in the lap and directing eyes towards the pages. This item was also included in Edward's off-task behaviours, as was talking, leaving his chair and throwing objects. Sam's only additional off-task behaviour was refusal to work. In addition to individual behaviours, the operational definition of off task included several generic problem behaviours that applied to all students. These were yelling, throwing objects, leaving the work area or room, lying on the ground, and being aggressive towards other students or teachers (i.e., grabbing, hitting, pushing, or shouting).

Teacher prompting. Prompting was defined as any instruction, assistance, reminder, or cue given by the teacher, teacher aide, or adult volunteer to direct the student's attention to the task, work system, or schedule, consisting of (a) verbal instructions, (b) using his name, (c) gesturing or pointing, (d) touching the student, (e) touching or tapping his chair or desk, (f) showing him a visual cue, (g) using proximity to direct his attention (i.e., moving to stand within 1 metre of his desk), or (h) using hand-over-hand guidance. Teachers were not given

any instructions regarding prompting. When prompting was recorded, a distinction was made between prompts directed specifically to the student (e.g., those using the student's name) or in response to the student engaging with the teacher (e.g., answering the student's questions), and prompts made more generally to the whole class (e.g., whole-class instruction). Only prompts directed toward, or responding to, the student were analysed.

Words written. For the students engaged in writing tasks, samples of writing were collected by either photographing or photocopying students' work and calculating the amount of writing completed during activities in baseline and intervention phases. It was not possible to make an accurate count of the number or words written for each student during every session. Some writing tasks went for more than one session and it was not always clear how many words the student added during a lesson and, in some cases, students put away undated work before it could be photographed.

Social validity. Teachers were asked to complete a survey, emailed to them at the end of the intervention phase. The survey included questions on effectiveness of strategies, ease of implementation, how motivated and independent students were in using these strategies, whether teachers would recommend the strategies to others, and usefulness of the workbook format. In addition, the first author interviewed the students to ascertain how they felt about using visual schedules and work systems, how easy they had found visual schedules and work systems to use, and how helpful they felt these strategies had been. This interview was structured using a survey with multiple choice responses, and conducted by taking the student out of class at a time convenient to the student and his teacher.

Reliability

Reliability of coding was measured with a second observer who had been trained in the data-collection methods used during a pilot study preceding this study. The second observer was provided with written instructions regarding the dependent variables and a sheet

for recording observations identical to that used by the first author. Observations were made with both observers sitting near each other at the back or side of the classroom, using a shield to prevent either one from seeing the other's recording. A second pair of earphones was used with both observers listening to the audio track simultaneously. Reliability was calculated for 27% of sessions observing James, 27% of sessions with Aaron, 27% of the observations of Edward, and 33% of sessions observing Sam. The percentage of intervals in which both observers agreed was above 87% for all measures.

Fidelity

Fidelity was measured by the first author using the same 12-point implementation checklist that was included in the workbook. The checklist included items such as, "The target student has an individual schedule" and, "The activity or lesson is broken down into a number of tasks/task steps which clearly indicate: a) what the students have to do, b) how much they have to do, c) how to know they are finished, d) what to do next."

For each session, the first author checked off items for which there was visual evidence and the number of checked items was calculated as a percentage. In Edward's case, where observations were made during a class with a different teacher, the points regarding visual schedules were checked off in consultation with the classroom teacher, while points regarding work systems were checked during the specialist subject classes.

Analysis

Data were initially analysed visually to identify changes in level, variability, trend, overlap, intercept gap, and consistency across phases (Vannest & Ninci, 2015). Additionally, the Tau-U method of analysis was used to quantify the change between baseline and intervention as it provides a way of calculating non-overlap of data while controlling for baseline trends, and is considered suitable for small data sets (Parker, Vannest, Davis, & Sauber, 2011; Vannest & Ninci, 2015). Benchmarks for effect sizes in Tau-U are such that a

change of less than .20 is considered small, .20-.60 signifies a moderate change, .60-.80 represents a large effect, and over .80 is regarded a very large change (Vannest & Ninci, 2015).

Results

James, Aaron, and Edward were each observed for six baseline sessions and baseline observations for Sam covered five sessions. James was observed for eight sessions during the intervention phase, Aaron for five, and both Edward and Sam for four. A maintenance probe was also conducted in James' classroom, something that was not possible in other classes due to the end of the school year. A summary of the statistical analysis of the results is presented in Table 2.

On-task Behaviours

As presented in Figure 1, a change in on-task behaviour from baseline to intervention was evident for all four children. James' baseline data reflected some variability in behaviour during the selected task. His teacher reported that his engagement with classroom activities was often impacted by events earlier in the day. Nevertheless, the average percentage of intervals in which James engaged in on-task behaviours increased from a mean of 20% intervals (range 5%-36%) during baseline to 53% (range 29%-79%) during intervention, representing a large, statistically significant effect (Tau-U = .6458, p = .045). However, during the maintenance probe session, James' percentage of intervals spent on task fell to 8%.

[Insert Table 2 about here]

[Insert Figure 1 about here]

Aaron started the term with a relatively high level of on-task behaviour. His teacher described this as out of character, and possibly an effect of returning from holidays with lowered anxiety. The average percentage of intervals during which Aaron was on-task was 40% (range 19%-80%) during baseline, increasing to a mean of 60% (range 47%-68%)

during intervention. This represented a large, statistically significant effect (Tau-U = .8333, *p* = .0225).

Edward's on-task behaviour demonstrated the clearest difference between baseline and intervention phases, and there was a period before the intervention where he refused to take part in the specialist lessons altogether (no data were taken during these lessons). His average percentage of intervals on task during baseline was 9% (range 0%-26%) and this rose to 65% (range 57%-78%). The effect size was very large, and statistically significant (Tau-U = 1.25, *p* = .004). The average percentage of intervals during which Sam was on task was 61% during baseline (range 37%-90%), rising to 86% (range 85%-90%). This constituted a moderate effect size, but was not statistically significant (Tau-U = .35, *p* = .3913).

Off-task Behaviours

The difference between baseline and intervention phases for off-task behaviours was not as clear as for on-task behaviours (see Figure 2). James had an average percentage of intervals with off-task behaviours of 58% during baseline and 43% during the intervention (ranges 46%-84% and 19%-63%). This represented a moderate, but not statistically significant, effect (Tau-U = .3958, *p* = .22). Aaron's off-task behaviours occurred in an average of 40% of intervals (range 14%-72%) during baseline, and 23% (range 0%-57%) during the intervention. This was calculated to be a moderate effect size, but, again, was not statistically significant (Tau-U = -.3667, *p* = .3153).

[Insert Figure 2 about here]

The mean number of intervals in which Edward engaged in off-task behaviours during baseline was 65% (range 0%-92%) and this fell to 22% (range 41%-65%) during the intervention. This was a large effect size, but not statistically significant (Tau-U = -.7917, *p* = .1098). Sam's off-task behaviours were low in baseline and did not show change in the intervention phase (Tau-U = .1). The average percentage of intervals in which Sam was off

task was 26% (range 7%-32%) in baseline and 25% (range 7.5%-39%) during the intervention. Statistically, this difference was not significant (p = .8065).

Teacher Prompting

The percentage of intervals in which teachers prompted each of the students did not show any significant change between the baseline and intervention phases (see Figure 3). James, initially received more prompting from his teacher followed by a decrease in prompts. Overall, this was not statistically significant (Tau-U = .0208, p = .9485). Aaron's teacher demonstrated only a slight change in prompting levels, but this was not statistically significant (Tau-U = -.2333, p = .5228). Edward received a moderate, but not statistically significant, increase in prompting (Tau-U = .4167, p = .2864). However, his class had a substitute teacher for the last two lessons in the intervention phase, and differences in teaching style may have had an impact on the data. For Sam, there was no discernible difference in teacher prompting before and after the intervention, and this was borne out in statistical analysis (Tau-U = 0, p = 1).

[Insert Figure 3 about here]

Words Written

James and Aaron recorded large, statistically significant increases in productivity (see Figure 4). The average number of words James wrote during an observation session before the intervention was 36 (range 0-68) and after the intervention it was 77 (range 41-148, Tau-U = .7857, p = .0184). Aaron wrote an average of 37 words (range 10-72) in baseline sessions, and 105 (range 78-121) in sessions after the intervention (Tau-U = 1.5, p = .0015). In contrast, Sam's word count went down slightly with the average falling from 98 (range 40-144) to 90 (range 86-98). While this represented a moderate change, it was not statistically significant (Tau-U = -.6667, p = .1904). Edward's class did not regularly engage in writing tasks during the specialist lessons, and so no data on words written were available.

[Insert Figure 4 about here]

Social Validity

Five teachers (including Edward's specialist subject teacher) were surveyed to ascertain their opinions of the intervention. All teachers reported feeling that visual schedules and work systems were either *very helpful* or *somewhat helpful* in their classrooms, and all teachers reported that they were *very easy* or *somewhat easy* to implement. Several teachers did, however, flag having sufficient time and/or resources as a potential difficulty. Responses were more mixed on questions regarding student motivation to use visual schedules and work systems, and their independence in using these strategies. Three of the teachers noted that they perceived that the students in the study were sometimes unmotivated and two of the teachers reported that the students were only sometimes independent. Four of the five teachers indicated that they would *strongly recommend* these strategies to other teachers and for use with other students, and the fifth teacher would be *likely to recommend* them in both cases. Four of the five teachers would be either *likely to recommend*, or *strongly recommend*, visual schedules and work systems as a whole-class approach and one teacher was neutral on the matter.

Student survey responses were mixed. James reported that he did not like using the visual schedule; however, at the end of the interview he explained that his feelings were due to the schedule changing (to accommodate end-of-year activities) without being updated. He selected a positive response (*I love it*) when asked how much he liked using a work system. James reportedly found both visual schedules and work systems easy to use and somewhat helpful. Aaron, whose teacher involved students in managing their own schedules and work systems, reported neutral feelings about using the strategies saying that he didn't like to write things down. He reported finding both visual schedules and work systems easy to use and,

while he claimed that he did not find visual schedules helpful, he found work systems of *some help*.

Edward said he barely used a schedule, but this was at odds with his teacher's reports of his behaviour. He claimed that, despite his negative feelings, he preferred having a work system in place to not having one. Sam's interview responses were, in contrast, consistently positive, indicating that he found both visual schedules and work systems *very easy* to use and *very helpful*.

Fidelity

Intervention fidelity was scored using the 12-point implementation checklist provided to teachers and calculated as a percentage (see Figure 1). James' teacher, who used only part of the intervention for the first three sessions, achieved a mean fidelity of 65% (range 50%-83%). Implementation fidelity in Aaron's class was 77% on average (range 75%-83%). Edward's teachers implemented the intervention with a mean fidelity of 69% (range 58%-83%), and, in Sam's class, mean fidelity was 79% (range 75%-83%).

Discussion

The primary hypothesis of this study, that visual schedules and work systems would increase students' on-task behaviours, was supported. A positive effect on on-task behaviour is consistent with findings of previous studies that have examined the effects of work systems (Hume & Odom, 2007; Mavropoulou et al., 2011; O'Hara & Hall, 2014). In this study, however, this effect has been observed in a mainstream classroom with the intervention implemented by classroom teachers, thus extending the findings of previous research. The findings of this study suggest that the success of these strategies in controlled environments may translate to applied settings and that offering mainstream teachers information on the use of these strategies can lead to positive outcomes for students on the spectrum.

The second hypothesis of the study, that the intervention would result in a decrease in off-task behaviours, was not supported. While it may seem intuitive that a decrease in off-task behaviours would occur as on-task behaviours increase, the operational definitions of each set of behaviours were different and the relationship between them more complicated. With the use of partial interval recording, it was possible for a student to have brief periods of on-task and off-task behaviours during the same interval. Coding for off-task behaviours also did not include time the students spent sitting at their desks without being engaged in any activity, as there was no way to tell whether they were in fact engaged in on-task thought processes. It is possible that the increase in on-task behaviours saw a corresponding reduction in time spent unsure of what to do or distracted by other thoughts, while behaviours considered off task may have served other purposes (e.g., fulfilling a need for sensory stimulation). Additionally, off-task behaviours as defined in this study did not distinguish between behaviours that might be considered 'challenging' (e.g., throwing items or walking out of class) and those that were merely 'off-task' or distracting from work tasks (e.g., talking to a neighbour). Off-task behaviour may have a variety of possible triggers unrelated to specific classroom activities and not addressed by teaching strategies in isolation. The lack of change in this measure supports the need for a more comprehensive approach to supporting students on the spectrum in mainstream classes. While off-task behaviours did not decrease, neither was there a rise in these behaviours during the intervention despite the fact that the study ran close to the end of the year when disruptions can have a large impact on student behaviour.

The third hypothesis of the study was that increases in student independence would be reflected in a reduction in the need for prompts from teachers. Other studies investigating the use of work systems with school-aged children have used teacher/adult prompting as a measure of student independence (Hume & Odom, 2007; Hume et al., 2012; Mavropoulou et

al., 2011). This study attempted to replicate this approach while capturing the natural prompting behaviour of teachers in mainstream classrooms. The relationship between student behaviour and teacher prompting is, perhaps, informative in an environment where the student has an adult's undivided attention, or where experimental conditions can be put in place to determine when prompting will occur. In a mainstream class, however, where there are potentially a large number of students requiring attention from the teacher at any time, the relationship might be more indirect. It may be for this reason that, unlike previous studies (Hume & Odom, 2007; Hume et al., 2012; Mavropoulou et al., 2011), no association was found between the introduction of visual schedules and work systems and the number of prompts students received from the teacher. Prompting was recorded to be at relatively low levels in baseline for two of the students, suggesting that, possibly, other demands on the teachers' attention in the classroom environment may have affected the result. Having a primary focus on natural prompting levels, and selecting teachers with high levels of prompting at baseline, or a specific interest in reducing prompting, would, perhaps, provide a way of assessing whether the reduction in prompting observed in other studies would translate into a reduced need for teacher prompting in the classroom.

The fourth hypothesis tested in this study was that student productivity would increase with the introduction of the intervention. For James and Aaron, the introduction of visual schedules and work systems corresponded with an increase in the amount they wrote during the writing activity. For Sam, there was no increase. His teacher, however, used the work system, in part, to direct him to check and edit his work, and there may have been a corresponding improvement in the quality of his writing that was not measured during this study. Hume et al. (2012) are alone in focussing on the effect of work systems on accuracy, and thus the quality rather than simply the quantity, of student work with their examination of

task steps completed correctly, and they identified improvements in this area as an important part of independent learning.

Although three teachers selected writing activities as the context for the intervention, it is important to reiterate that the intervention was designed to support on-task behaviour, not to develop writing skills. No attempt was made to evaluate the content or complexity of the students' work. Further research into writing interventions for students on the spectrum is warranted (Delano, 2007; Pennington & Delano, 2012), and adapted work systems may be effective in this regard. Broader educational applications of these strategies are something future research could continue to explore (Howley, 2015).

Social Validity

As described earlier, teacher feedback on the intervention was largely positive, although indicating that approaches further addressing teachers' lack of time and resources would be helpful. Student feedback, however, was mixed, and in some cases directly contradicted teacher reports. The issues experienced by the students – unreliable schedules, the perception of extra work (particularly handwriting), and the possible impact of the interviews themselves interrupting scheduled classroom activities – are things that the workbook strategies could be used to address. The students' responses suggest areas in which information for teachers regarding these strategies could better target the needs of students. Ensuring the reliable and consistent implementation of the strategies and the provision of alternatives to handwriting, which research suggests is a concern for many students on the spectrum (Saggers et al., 2015), could improve the acceptability of the intervention for students.

Limitations

There are challenges and limitations inherent in conducting research in mainstream classrooms where it is difficult to achieve high levels of control (Berliner, 2002; Brown,

1992). As Brown (1992) has noted, the move to more ecologically valid educational settings involves a "trade-off between experimental control and richness and reality" (p. 152). In this study, time constraints were problematic, affecting the number of possible baseline observations and the feasibility of conducting maintenance probes. Additionally, Sam joined the study late, and so his baseline observations did not begin until after the intervention was started with James. Contrasts with baseline and intervention between Sam, Aaron, and Edward do, however, indicate experimental control. There is considerable "noise" in the classroom environment – such as interruptions to, or abrupt changes in, planned activities, and the unpredictable behaviours of other students – which can affect not only the rigour of research, but also the on-task behaviours of students. Fidelity was also an area where this study faced limitations. Allowing teachers the freedom to make decisions about how the strategies would be implemented introduced some variability in the way visual schedules and work systems were interpreted and used. This involvement of teachers was, however, important to the study's aim of evaluating these strategies in an ecologically valid way. As Kasari and Smith (2013) emphasise, research in context is vital in developing interventions that can be implemented and sustained in real classrooms.

This study has provided preliminary evidence that visual schedules and work systems can have a positive effect on students' on-task behaviour; however, to control for variability in the classroom setting, the scope of the study was necessarily limited to just one activity. A next step could be to gather feedback from teachers on the use of these strategies in different classes across the school day. This could perhaps more adequately identify and explore other potential outcomes of using these strategies, such as reductions in anxiety and problem behaviours, and enhanced student welfare.

Conclusion

Visual schedules and work systems are simple strategies that are relatively easy to communicate to teachers and can be implemented by teachers in mainstream classes. Evidence from previous studies that these strategies can improve on-task behaviour in students on the autism spectrum appears to have been replicated here under mainstream classroom conditions. There is, however, a need for further research to explore other possible uses and effects, and to refine the delivery of information for teachers.

References:

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

Ashburner, J., Ziviani, J., & Rodger, S. (2010). Surviving in the mainstream: Capacity of children with autism spectrum disorders to perform academically and regulate their emotions and behavior at school. *Research in Autism Spectrum Disorders, 4*(1), 18-27. doi:10.1016/j.rasd.2009.07.002

Banda, D. R., & Grimmett, E. (2008). Enhancing social and transition behaviors of persons with autism through activity schedules: A review. *Education and Training in Developmental Disabilities, 43*(3), 324-333.

Baron-Cohen, S., Ashwin, E., Ashwin, C., Tavassoli, T., & Chakrabarti, B. (2009). Talent in autism: Hyper-systemizing, hyper-attention to detail and sensory hypersensitivity. *Philosophical Transactions of the Royal Society B: Biological Sciences, 364*, 1377-1383.

Berliner, D. C. (2002). Comment: Educational research: The hardest science of all. *Educational Researcher, 31*(8), 18-20. doi:10.2307/3594389

Boyd, B. A., Hume, K., McBee, M. T., Alessandri, M., Gutierrez, A., Johnson, L., . . . Odom, S. L. (2014). Comparative efficacy of LEAP, TEACCH and non-model-specific special education programs for preschoolers with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 44*(2), 366-380. doi:10.1007/s10803-013-1877-9

Brown, A. L. (1992). Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. *The Journal of the Learning Sciences, 2*(2), 141-178.

Bryan, L. C., & Gast, D. L. (2000). Teaching on-task and on-schedule behaviors to high-functioning children with autism via picture activity schedules. *Journal of Autism and Developmental Disorders, 30,* 553-567. doi:10.1023/A:1005687310346

Callahan, K., Shukla-mehta, S., Magee, S., & Wie, M. (2010). ABA versus TEACCH: The case for defining and validating comprehensive treatment models in autism. *Journal of Autism and Developmental Disorders, 40*(1), 74-88. doi:10.1007/s10803-009-0834-0

Constantino, J. N., & Gruber, C. P. (2007). *Social responsiveness scale (SRS).* Los Angeles, CA: Western Psychological Services.

Constantino, J. N., & Gruber, C. P. (2012). *The social responsiveness scale manual, second edition (SRS-2).* Los Angeles, CA: Western Psychological Services.

Cook, B. G., & Odom, S. L. (2013). Evidence-based practices and implementation science in special education. *Exceptional Children, 79*(2), 135-144.

D'Elia, L., Valeri, G., Sonnino, F., Fontana, I., Mammone, A., & Vicari, S. (2014). A longitudinal study of the TEACCH program in different settings: The potential benefits of low intensity intervention in preschool children with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 44,* 615-626. doi:10.1007/s10803-013-1911-y

Delano, M. E. (2007). Use of strategy instruction to improve the story writing skills of a student with Asperger syndrome. *Focus on Autism and Other Developmental Disabilities, 22*(4), 252-258.

Dingfelder, H. E., & Mandell, D. S. (2011). Bridging the research-to-practice gap in autism intervention: An application of diffusion of innovation theory. *Journal of Autism and Developmental Disorders, 41,* 597-609. doi:10.1007/s10803-010-1081-0

Emam, M. M., & Farrell, P. (2009). Tensions experienced by teachers and their views of support for pupils with autism spectrum disorders in mainstream schools. *European Journal of Special Needs Education, 24*(4), 407-422. doi:10.1080/08856250903223070

Grandin, T. (1995). How people with autism think. In E. Schopler & G. B. Mesibov (Eds.), *Learning and cognition in autism* (pp. 137-156). New York: Plenum Press.

Haas, K. (2015). *Helping students in mainstream primary classrooms stay on-task and transition between tasks: Visual schedules and work systems*. [A workbook for teachers]. Frenchs Forest, NSW: Autism Spectrum Australia (Aspect).

Howley, M. (2015). Outcomes of structured teaching for children on the autism spectrum: Does the research evidence neglect the bigger picture? *Journal of Research in Special Educational Needs, 15*(2), 106-119. doi:10.1111/1471-3802.12040

Hume, K. (2015). *Structured teaching strategies: A series*. Retrieved from http://www.iidc.indiana.edu/?pageId=3520

Hume, K., & Odom, S. (2007). Effects of an individual work system on the independent functioning of students with autism. *Journal of Autism and Developmental Disorders, 37*, 1166-1180. doi:10.1007/s10803-006-0260-5

Hume, K., Plavnick, J., & Odom, S. L. (2012). Promoting task accuracy and independence in students with autism across educational setting through the use of individual work systems. *Journal of Autism and Developmental Disorders, 42*, 2084-2099. doi:10.1007/s10803-012-1457-4

Hume, K., Sreckovic, M., Snyder, K., & Carnahan, C. R. (2014). Smooth transitions: Helping students with autism spectrum disorder navigate the school day. *Teaching Exceptional Children, 47*(1), 35-45. doi:10.1177/1098300709332346

Humphrey, N., & Lewis, S. (2008). "Make me normal": The views and experiences of pupils on the autistic spectrum in mainstream secondary schools. *Autism, 12*(1), 23-46. doi:10.1177/1362361307085267

Humphrey, N., & Parkinson, G. (2006). Research on interventions for children and young people on the autistic spectrum: A critical perspective. *Journal of Research in Special Educational Needs, 6*(2), 76-86. doi:10.1111/J.1471-3802.2006.00062.x

Kasari, C., & Smith, T. (2013). Interventions in schools for children with autism spectrum disorder: Methods and recommendations. *Autism, 17*(3), 254-267. doi:10.1177/1362361312470496

Kaufman, A. S., & Kaufman, N. L. (2004). *Kaufman brief intelligence test - Second edition (KBIT-2)*. Circle Pines, MN: American Guidance Service.

Knight, V., Sartini, E., & Spriggs, A. D. (2014). Evaluating visual activity schedules as evidence-based practice for individuals with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 45*(1), 157-178. doi:10.1007/s10803-014-2201-z

Mavropoulou, S., Papadopoulou, E., & Kakana, D. (2011). Effects of task organization on the independent play of students with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 41*, 913-925. doi:10.1007/s10803-010-1116-6

Mesibov, G. B., Howley, M., & Naftel, S. (2016). *Accessing the curriculum for learners with autism spectrum disorders: Using the TEACCH programme to help inclusion* (2nd ed.). Abingdon, Oxon: Routledge.

Mesibov, G. B., & Shea, V. (2010). The TEACCH program in the era of evidence-based practice. *Journal of Autism and Developmental Disorders, 40*, 570-579. doi:10.1007/s10803-009-0901-6

Mesibov, G. B., & Shea, V. (2011). Teacch. In J. S. Kreutzer, J. DeLuca, & B. Caplan (Eds.), Encyclopedia of Clinical Neuropsychology (pp. 2472-2477). New York, NY:

Springer.Mesibov, G. B., Shea, V., & Schopler, E. (2004). *The TEACCH approach to autism spectrum disorders*. New York: Springer.

Milley, A. M., & Machalicek, W. P. (2012). Decreasing students' reliance on adults: A strategic guide for teachers of students with autism spectrum disorders. *Intervention in School and Clinic, 48*(2), 67-75. doi:10.1177/1053451212449739

National Autism Center. (2015). *Findings and conclusions: National standards project, phase 2.* Randolph, Massachusetts: Author.

O'Hara, M., & Hall, L. J. (2014). Increasing engagement of students with autism at recess through structured work systems. *Education and Training in Autism and Developmental Disabilities, 49,* 568-575.

Parker, R. I., Vannest, K. J., Davis, J. L., & Sauber, S. B. (2011). Combining nonoverlap and trend for single-case research: Tau-U. *Behavior Therapy, 42*(2), 284-299.

Pennington, R. C., & Delano, M. E. (2012). Writing instruction for students with autism spectrum disorders: A review of literature. *Focus on Autism and Other Developmental Disabilities, 27*(3), 158-167.

Quill, K. A. (1997). Instructional considerations for young children with autism: The rationale for visually cued instruction. *Journal of Autism and Developmental Disorders, 27,* 697-714.

Reichow, B., Volkmar, F. R., & Cicchetti, D. V. (2008). Development of the evaluative method for evaluating and determining evidence-based practices in autism. *Journal of Autism and Developmental Disorders, 38*(7), 1311-1319. doi:10.1007/s10803-007-0517-7

Saggers, B., Klug, D., Harper-Hill, K., Ashburner, J., Costley, D., Clark, T., … Carrington, S. (2015). *Australian autism educational needs analysis – What are the needs of schools,*

parents and students on the autism spectrum? Executive summary. Brisbane: Cooperative Research Centre for Living with Autism.

Sterling-Turner, H. E., & Jordan, S. S. (2007). Interventions addressing transition difficulties for individuals with autism. *Psychology in the Schools, 44*, 681-690. doi:10.1002/pits.20257

Stoner, J. B., Angell, M. E., House, J. J., & Bock, S. J. (2007). Transitions: Perspectives from parents of young children with autism spectrum disorder (ASD). *Journal of Developmental and Physical Disabilities, 19*(1), 23-39.

Vannest, K. J., & Ninci, J. (2015). Evaluating intervention effects in single-case research designs. *Journal of Counseling & Development, 93*, 403-411. doi:10.1002/jcad.12038

Weisz, J. R. (2000). Agenda for child and adolescent psychotherapy research: On the need to put science into practice. *Archives of General Psychiatry, 57*, 837-838.

Wong, C., Odom, S. L., Hume, K. A., Cox, A. W., Fettig, A., Kucharczyk, S., . . . Schultz, T. R. (2015). *Evidence-based practices for children, youth, and young adults with autism spectrum disorder.* Chapel Hill: The University of North Carolina, Frank Porter Graham Child Development Institute, Autism Evidence-Based Practice Review Group.

Table 1. *Student Characteristics*

	Age	SRS-2 T score	KBIT-2
James	10 years, 7 months	61	Above average
Aaron	10 years, 4 months	75	Above average
Edward	11 years	69	Average
Sam	8 years, 11 months	>90	Average

Table 2. *Tau-U Calculations for Dependent Variables*

Dependent Variable	James		Aaron		Edward		Sam	
	Tau-U	*p*	Tau-U	*p*	Tau-U	*p*	Tau-U	*p*
On-task behaviours	.6458	.0454	.8333	.0225	1.25	.0040	.35	.3913
Off-task behaviours	-.3958	.22	-.3667	.3153	-.7917	.1098	.1	.8065
Teacher prompting	.0208	.9485	-.2333	-.5228	.4167	.2864	0	1
Words written	.7857	.0184	1.5	.0015			-.6667	.1904

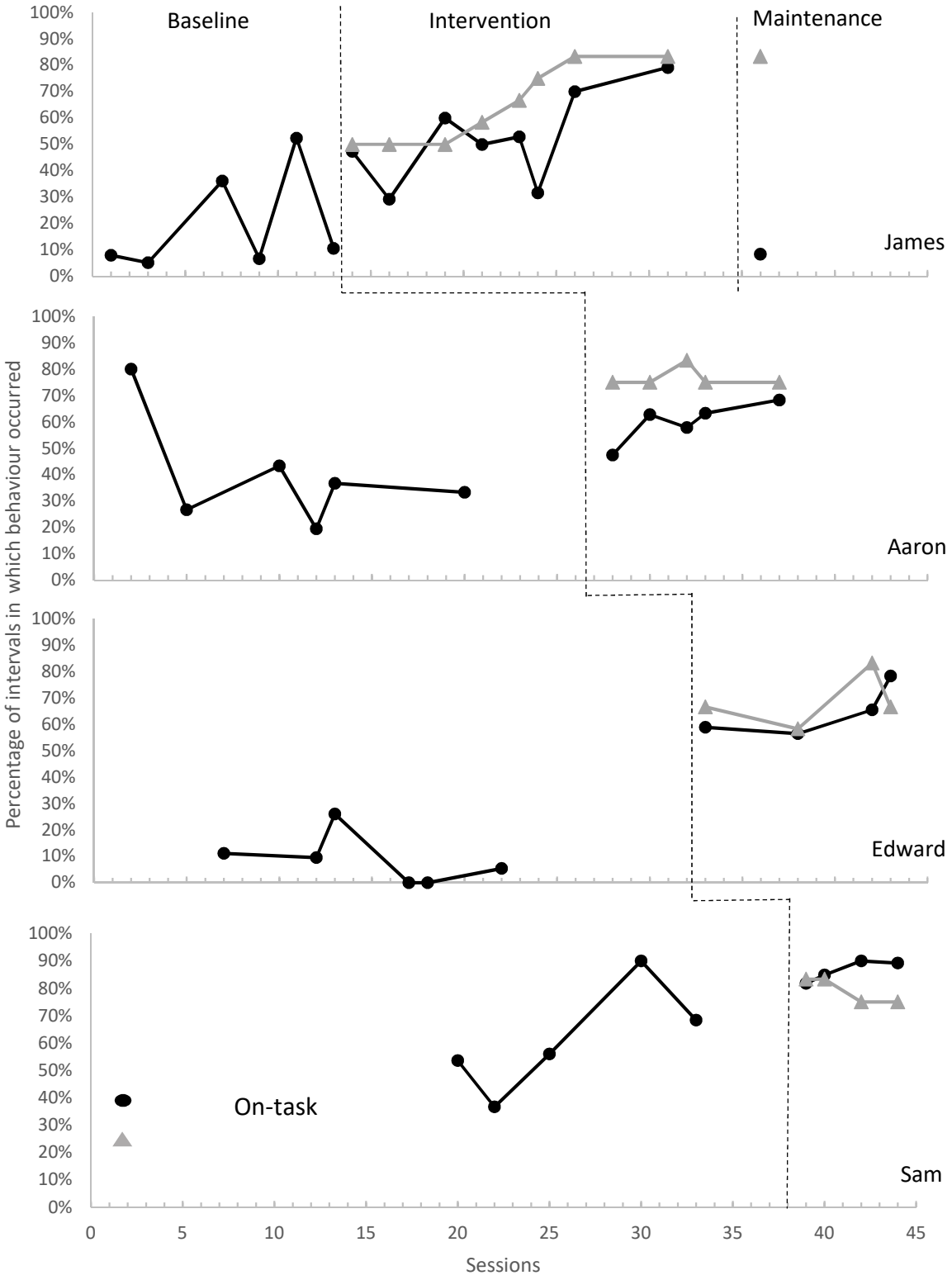

Figure 1. Percentage of intervals in which students were observed engaging in on-task behaviours.

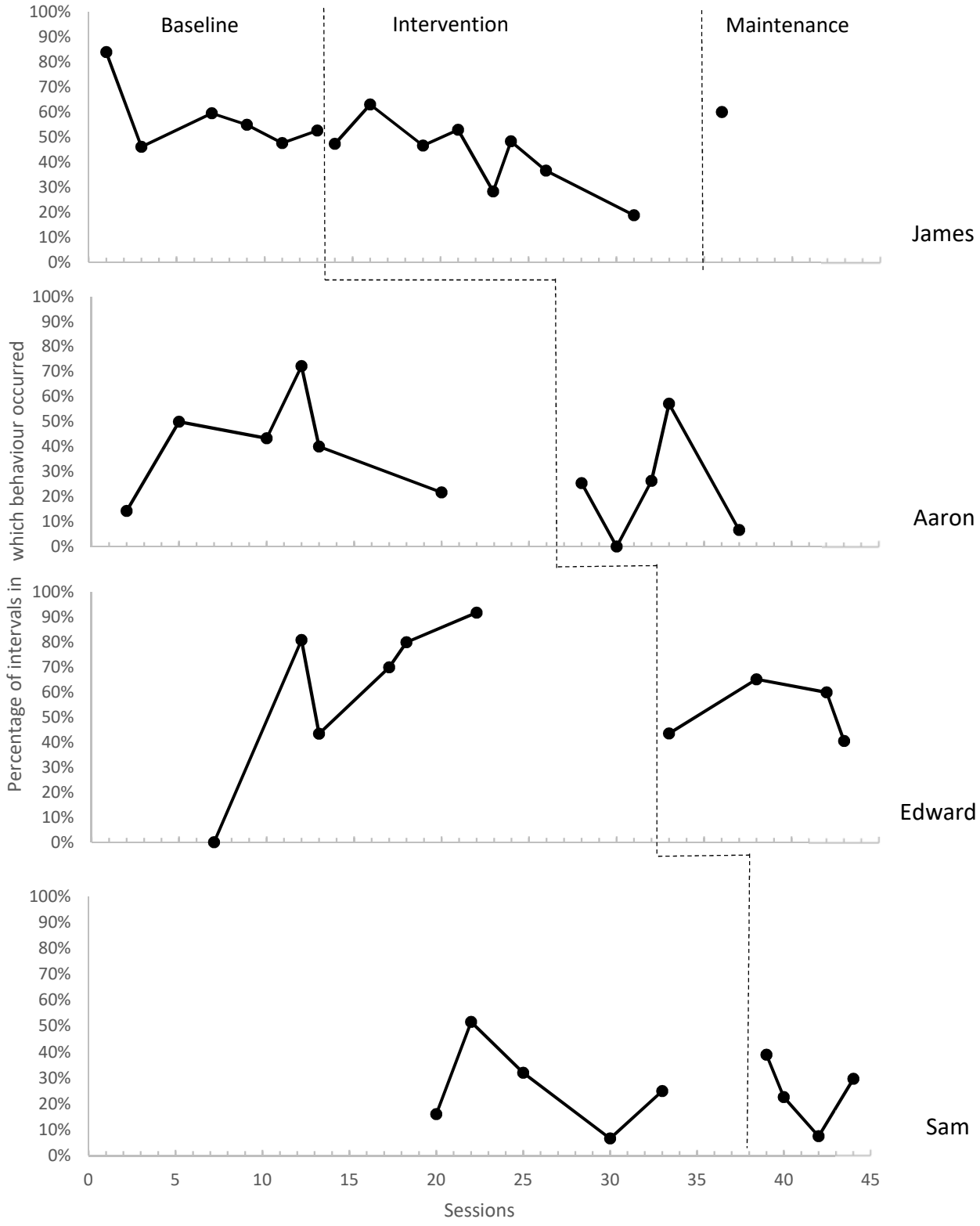

Figure 2. Percentage of intervals in which students were observed engaging in off-task behaviours.

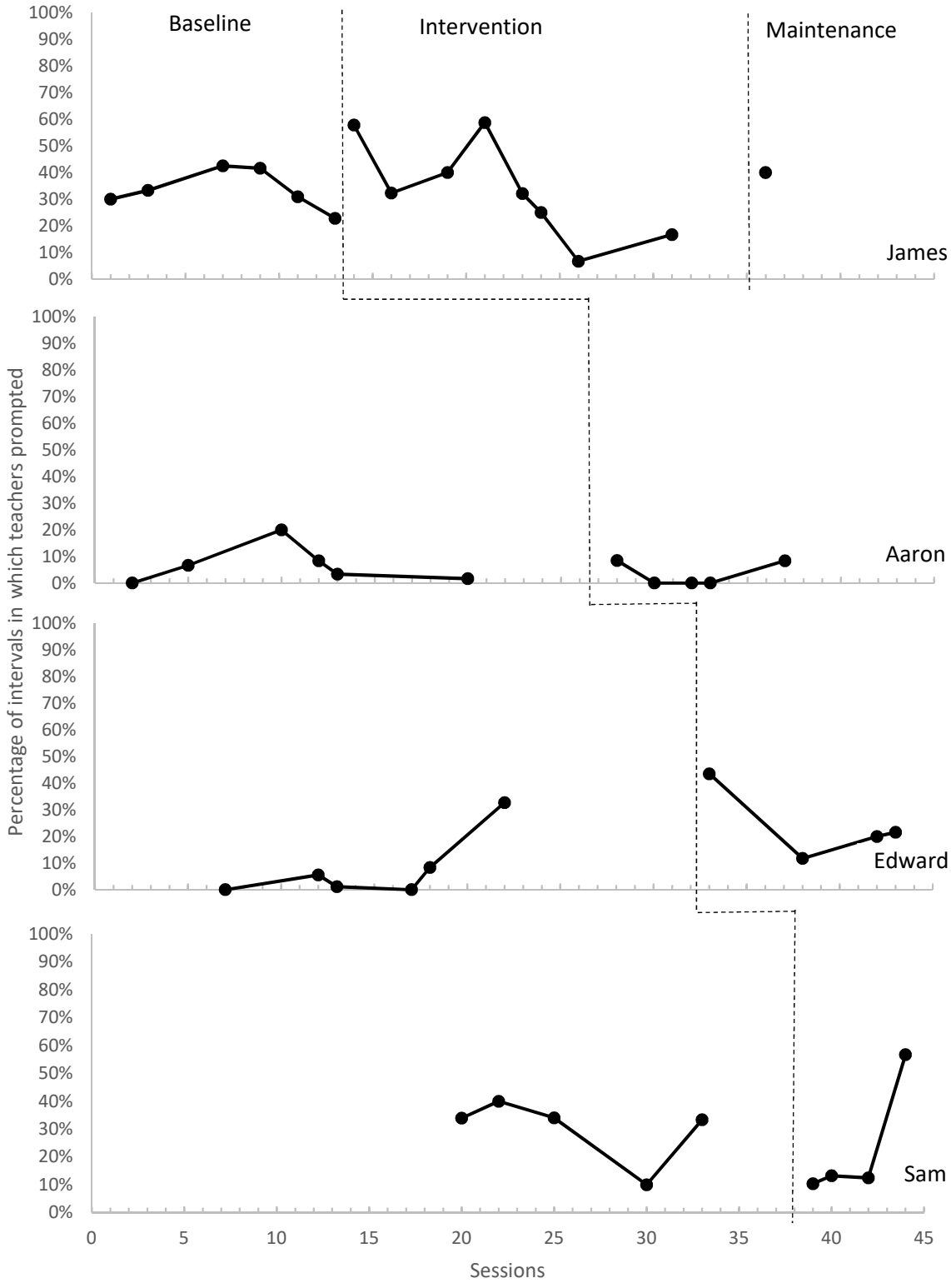

Figure 3. Percentage of intervals in which teachers prompted or responded to each student.

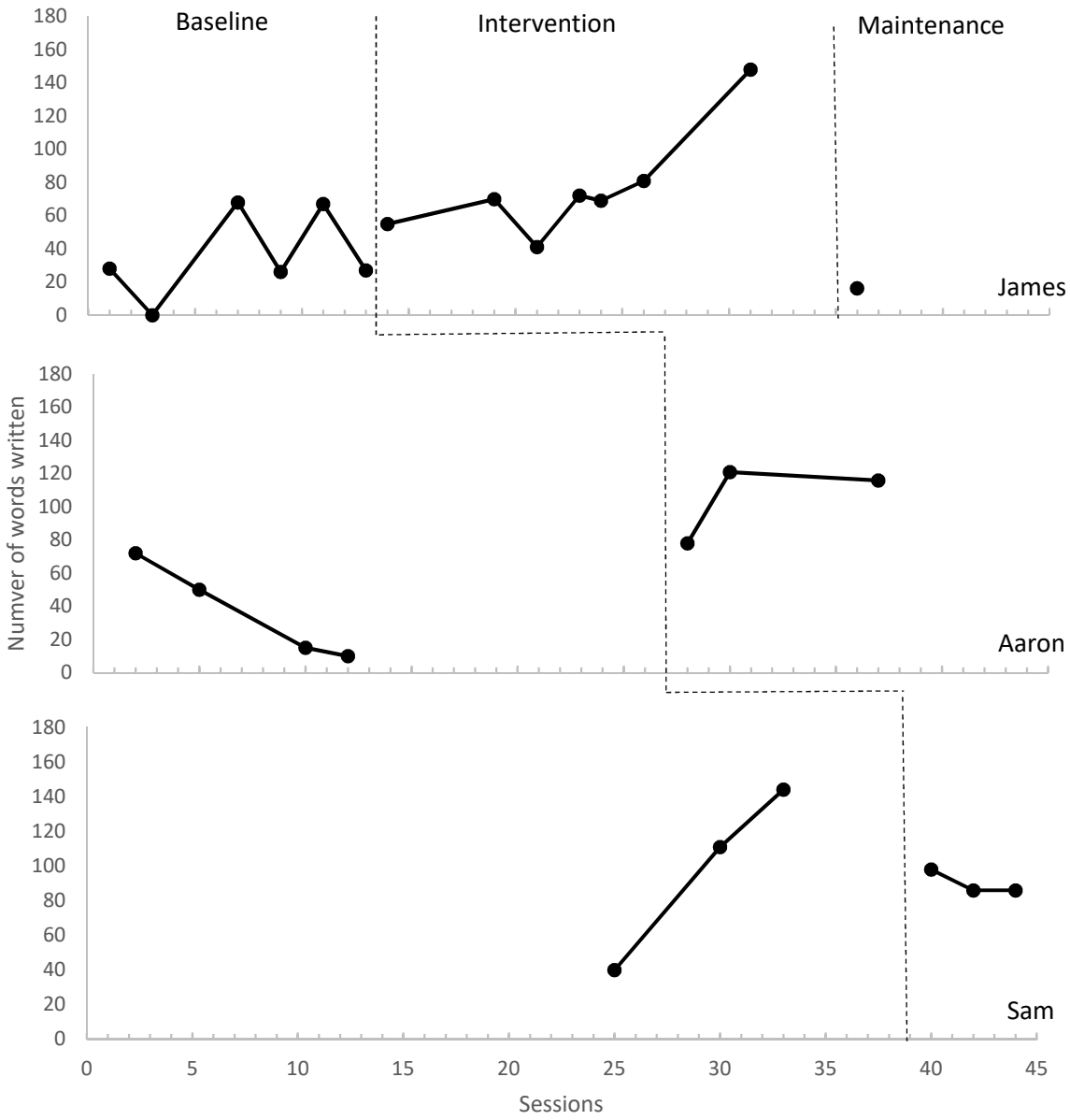

Figure 4. Number of words written by students engaged in writing tasks in each session.