Comparison of therapist implemented and iPad-assisted interventions for children with autism

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Abstract

Objective: This study compares intervention delivered by a therapist to intervention delivered using an iPad for two children with autism. Further, this study evaluates the influence of choice between the conditions.
Methods: Time on-task, challenging behaviour, session duration and correct responses were compared across conditions in an alternating treatment design. The effect of choice was evaluated in an ABAB design.
Results: The iPad was associated with shorter intervention sessions, more time on-task and less challenging behaviour for one participant. There was no difference between conditions for the second participant. Both participants selected the iPad when given the choice and, although the effect of choice was modest, choosing was associated with more time on-task and less challenging behaviour.
Conclusions: These data suggest that iPad-assisted intervention can be as effective as therapist-implemented intervention. Further, even for children for whom no differences between the interventions exist, offering a choice may be beneficial.

Introduction

Children with autism experience abnormalities in the areas of communication, social interaction, and restricted and repetitive behaviours [1]. Previous research has demonstrated that improvements in these symptoms can be achieved within carefully planned rehabilitation programmes [2, 3]. The use of computers within rehabilitation programmes for children with autism is not uncommon [4–7], and recent advances in technology have occasioned a renewed research interest in this area [8].

Previous studies have revealed that iPads may be particularly useful devices for children with autism due to the relative low cost (i.e. less than $600 USD), portability, adaptability via easily downloadable software applications (i.e. ''apps''), and potential to be less socially stigmatising than other forms of assistive technology that are not as widely used by typical developing peers [8, 9]. In particular, the use of iPads to facilitate communication appears promising, and most studies involving iPads have evaluated their utility as augmentative and alternative communication (AAC) devices [10–17]. For example, Flores et al. [11] compared an iPad

using software that enabled a modified version of picture exchange communication (PECS) to traditional laminated picture cards on the independent communication (e.g. requests for food) of five children with autism. Three out of the five participants engaged in more independent communication when using the iPad-based PECS than when using the traditional picture cards. In addition to functioning as an AAC device, iPads can also be used to deliver instruction aimed at improving academic, vocational and leisure skills of people with autism. For example, Kagohara, Sigafoos, et al. [18] used an iPad to deliver an instructional video to teach participants to check their spelling when using word processing programmes. Overall, research suggests iPads are effective tools for children with autism to the extent that they can be programmed to deliver research-based interventions [8].

Given the previously demonstrated benefits of iPad-based intervention approaches, it now appears important to assess the relative effects of iPad-based intervention compared to traditional teacher-based approaches. Neely et al. [19] compared instruction delivered via iPad to instruction delivered using traditional materials (e.g. paper and pencil) with two participants who engaged in escape-maintained challenging behaviour. For both participants, the iPad was associated with lower levels of challenging behaviour and higher levels of academic engagement than the traditional

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instructional materials. Similarly, Williams et al. [20] compared computer-based instruction to traditional book-based instruction on the development of reading skills in eight participants with autism. All eight participants spent more time on-task and were less resistant to instruction when using the computer than when receiving the same information from a book.

This current study aims to replicate and extend the findings of Neely et al. [19] and Williams et al. [20] by measuring: (a) percentage of intervals with on-task behaviour, (b) percentage of intervals with challenging behaviour, (c) time required to complete assignments, and (d) percentage of independent correct responses during a therapist-implemented intervention and an iPad-assisted intervention. Further, this study also evaluates the impact of allowing the participants to choose between the two intervention conditions.

Methods

Participants

Two male children (i.e. Michael and Aaron) receiving intervention at a university-based autism clinic participated in this study. These children were selected for participation because they frequently engaged in challenging behaviour and were often observed to be off-task during their regularly scheduled discrete trial training (DTT) sessions. Neither participant had prior experience using an iPad during therapy sessions. The skills targeted for instruction for each child were selected using The Verbal Behavior Milestones Assessment and Placement Program [21].

Michael was 4 years old and diagnosed with autism. When Michael was presented with task demands during DTT he would look away from the therapists and materials, repeat lines from movies, grab intervention materials or elope from the intervention area. The skill selected for intervention for Michael was verbally labelling actions using verb–noun combinations. For example, when Michael was shown a picture of a child colouring in a picture book and asked, ''What is he doing?'', the correct response was ''colouring picture''.

Aaron was 2 years old and diagnosed with autism. When Aaron was presented with task demands during DTT, he would look away from the therapists and materials, scream, grab materials or the therapist, or elope from the intervention area. The skill selected for intervention for Aaron was receptive identification of common objects and animals from an array of pictures. For example, when given an array of six different pictures and asked to ''Find the elephant'', the correct response was to point to or touch the picture of the elephant.

Setting and materials

All intervention sessions were conducted in a university-based autism clinic. The therapy room included a table with chairs, bookshelves containing toys, and the intervention materials appropriate for each participant's goals (e.g. pictures of target nouns or verbs). The therapist, participant and data collectors were present in the room during each session.

Materials included various picture cards created specifically for each participant based on the skills selected for intervention and an iPad with the required application loaded. Michael's intervention utilised the Photos® software, which is a pre-loaded application that is standard on an iPad. This programme displays pictures one at a time and requires a finger swipe motion to change photos. Aaron used the See.Touch.Learn® application, which is an application made by Brain Parade that is capable of displaying six pictures on the screen at once. In order to hold instructional stimuli constant across intervention conditions, the photos were downloaded to the iPad application and then printed to make a set of identical photo cards. Further, intervention was delivered in the same setting and at the same time of day in both conditions.

Dependent variables

Dependent variables included: (a) percentage of 10 s whole intervals with on-task behaviour, (b) percentage of 10 s partial intervals with challenging behaviour, (c) percentage of independent correct responses out of the total number of responses, and (d) the duration of intervention sessions in minutes and seconds. For both participants, on-task behaviour was defined as the participant sitting in a chair with their head oriented towards the intervention materials or therapist, engagement in the task, and the absence of challenging behaviour. Challenging behaviour was defined as: (a) repeating lines from movies, (b) grabbing the intervention materials, (c) screaming and (d) eloping a minimum of 0.5 m from the intervention area. A whole interval recording procedure was used for on-task behaviour, and a partial interval recording procedure was used for challenging behaviour; therefore, on-task behaviour and challenging behaviour could not be scored in the same interval. For Aaron, a correct response was defined as independently touching or pointing to the correct photo displayed on the iPad or the correct printed photo card in the therapist-only condition within 6 s of the therapist delivering the demand (e.g. ''Find the tiger''). For Michael, a correct response was defined as independently (i.e., without prompts) saying a verb–noun combination (e.g. ''brushing teeth'') within 6 s of the therapist delivering the demand (e.g. ''What's he doing?'') while showing him a photo card in the therapist-only condition or showing him the photo using the Photos® app in the iPad-assisted condition. Session duration was measured in minutes and seconds, beginning with the delivery of the first demand and ending at the completion of the last demand. The number of demands (trials) per session was held constant across all sessions.

Interobserver agreement

Interobserver agreement (IOA) data were collected during 39% of sessions for both participants by comparing the data collected by two independent data collectors. IOA was calculated on an interval-by-interval basis by dividing the total number of intervals with agreement (i.e. both data collectors scored the same presence and absence of dependent variables in the same interval) by the total number of intervals (agreements plus disagreements) per session for on-task behaviour, challenging behaviour and independent correct

responses. Independent correct responses were coded within the interval they occurred. For Michael, IOA was 90% (range, 71% to 100%) for on-task behaviour, 90% (range, 71% to 100%) for challenging behaviour, and 100% for independent correct responses. For Aaron, IOA was 86% (range, 57% to 100%) for on-task behaviour, 86% (range, 57% to 100%) for challenging behaviour, and 98% (range, 75% to 100%) for independent correct responses. IOA was not calculated for session duration due to the simplicity and accuracy of the stopwatch. However, the data collectors and therapist both confirmed the stopwatch was started and stopped accurately in every session.

Experimental design

An alternating treatment design was used to compare two conditions (i.e. therapist-only and iPad-assisted). The sequence of intervention conditions was randomly determined. However, if the same condition occurred three times in a row, the alternative condition was presented before returning to random selection; the condition implemented in session 18 was chosen by the researchers to ensure an equal total number of each condition during the alternating treatment phase. After session 18, the alternating treatment phase ceased and an ABAB design was used to evaluate the effect of allowing the participant to choose between the two conditions. Five choice sessions (A phases) and five no-choice sessions (B phases) were presented during each phase of the ABAB design. Choices were presented by the therapist placing the iPad and the stack of picture cards near each other (separated by approximately 30 cm) in front of the participant and asking, ''Which one do you want to use?''. The participant then reached for, pointed to, or verbally stated his choice. The option selected the least number of times during the preceding choice condition was then used during the no-choice conditions.

Intervention procedures

Therapist-only condition

During the therapist-only condition the therapist presented the participant with photo cards and a verbal discriminative stimulus (i.e. task demand). Specifically, Michael was presented with one picture card at a time and asked, ''What is [he/she] doing?''. If Michael answered the question correctly, verbal praise was delivered (e.g. ''That is right! Well done!''). If Michael answered the question incorrectly or did not respond within 6 s, the therapist removed the materials and performed a correction procedure. The correction procedure consisted of presenting the discriminative stimulus again and verbally prompting the correct response using a least to most prompting hierarchy. Contingent on challenging behaviour, Michael was prompted to fold his hands, sit down, and/or look at the therapist. Michael's sessions were terminated after a total of 24 trials. A trial was defined as one presentation of the discriminative stimulus plus the corresponding participant response.

Aaron was presented with an array of six photo cards and asked to find a specific object or animal depicted in the array. The same procedures used with Michael were used for Aaron's correct responses and challenging behaviour.

If Aaron responded incorrectly, the therapist removed the materials and performed a correction procedure. The correction procedure for Aaron consisted of representing the discriminative stimulus and prompting the correct response using a least to most prompting hierarchy. Aaron's sessions were finished when he completed a total of 10 trials.

iPad-assisted condition

During the iPad-assisted condition, participants were presented with the same photos, verbal discriminative stimulus, error correction and response to challenging behaviour as implemented in the therapist-only condition. The only difference between conditions was the addition of the iPad and associated software. Michael used the Photos® application available for no additional cost on the iPad, and Aaron used See.Touch.Learn® application which was purchased for use on the iPad.

Treatment integrity

In order to assess the degree to which the intervention procedures where adhered to by the therapist, a checklist of intervention components was created for each condition and was scored during 32% of sessions. Data collectors scored each of the following checklist items as ''yes'' or ''no'': (a) Did the therapist respond to challenging behaviour as planned?; (b) Were the correct demands given using the correct intervention materials for the condition?; (c) Did the therapist wait six seconds before prompting a response?; (d) Was verbal praise provided following each correct response; and (e) Were prompts delivered correctly and only when necessary? Treatment integrity was calculated by dividing the number of checklist items with a ''yes'' by the total number of items and then multiplying by 100%. Mean treatment fidelity was 98% and ranged from 80% to 100% for both participants across both conditions.

Results

First, the dependent variables were compared across the therapist-only and iPad-assisted conditions in an alternating treatments design. The first 18 sessions of Figure 1 display the data for Michael's on-task behaviour (top panel), correct responses (second panel), session duration (third panel), and challenging behaviour (bottom panel) in both conditions. The mean number of intervals on-task during the iPad-assisted condition was 72% (range, 33% to 100%) and during the therapist-only condition was 84% (range, 63% to 100%). The mean percentage of correct responses during the iPad-assisted condition was 78% (range, 50% to 100%) and during the therapist-only condition was 89% (range, 63% to 100%). The mean duration of sessions during the iPad-assisted condition was 2 min 24 s (range, 1 min 20 s to 3 min 50 s) and during the therapist-only condition was 2 min 23 s (range, 1 min 40 s to 3 min 20 s). The mean percentage of intervals with challenging behaviour during the iPad-assisted condition was 28% (range, 10% to 67%) and during the therapist-only condition was 16% (range, 0% to 38%). Despite the differences in means and ranges, visual analysis of the overlap between data paths suggests that there was no consistent difference between conditions on any dependent variables for Michael.
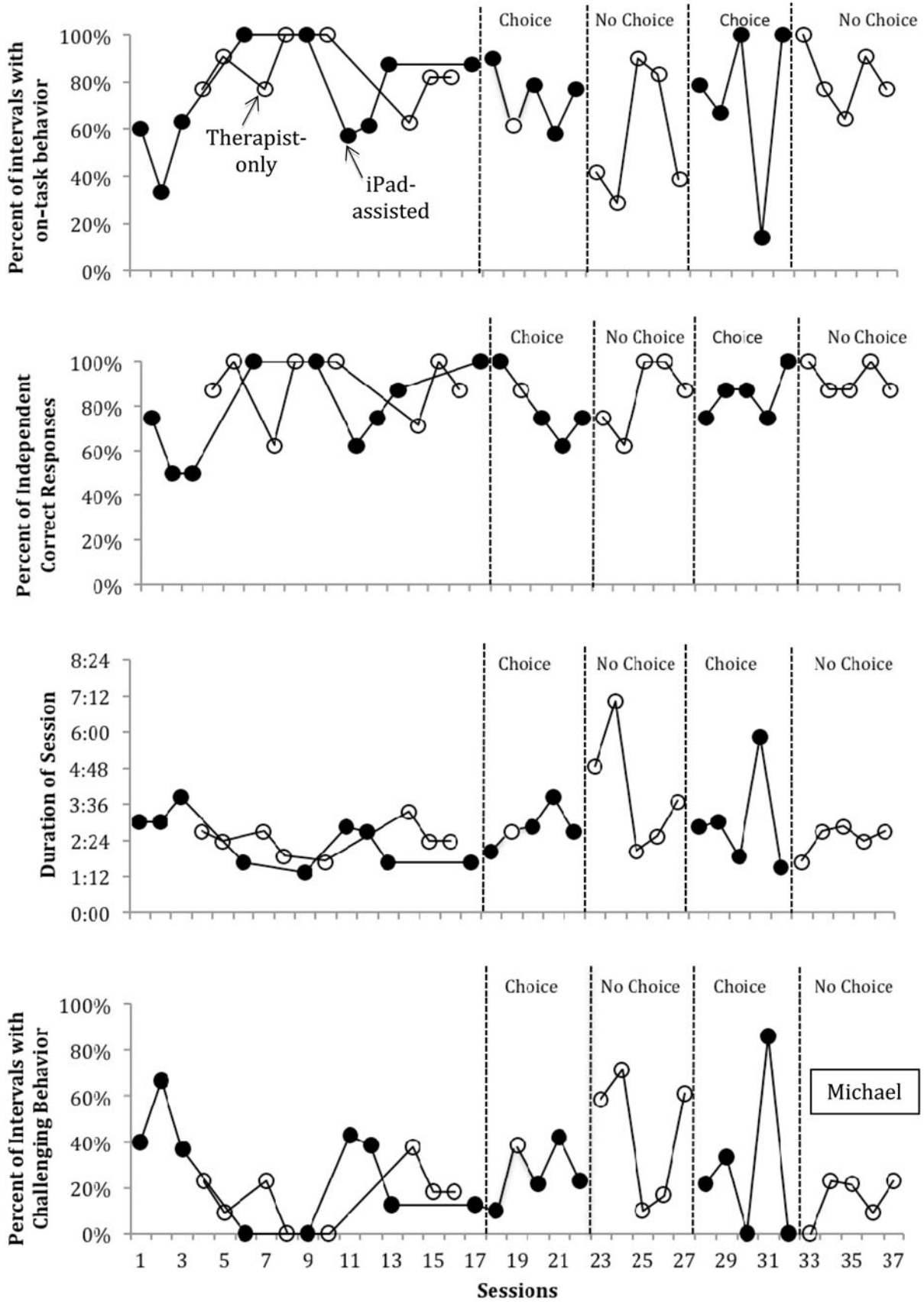
Figure 1. Displays the percentage of intervals in which Michael engaged in on-task behavior (top panel), correct responses (second panel), and challenging behavior (bottom panel). Session duration is displayed in the third panel.
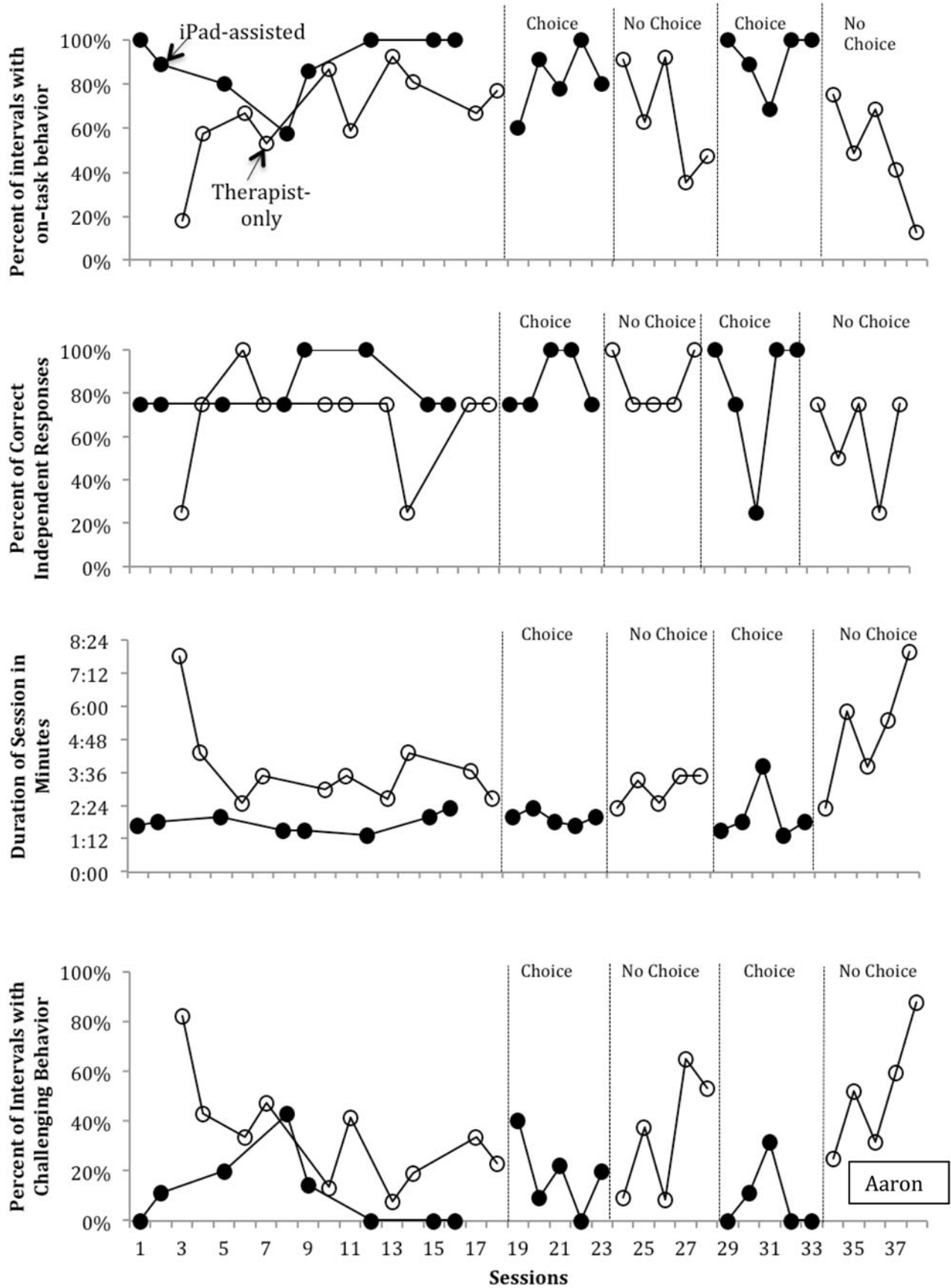
Figure 2. Displays the percent of intervals in which Aaron engaged in on-task behavior (top panel), correct responses (second panel), and challenging behavior (bottom panel). Session duration is displayed in the third panel.

The first 18 sessions of Figure 2 display Aaron's data using the same organization as figure. Aaron spent more time on-task during the iPad-assisted condition ($M = 89$, range, 57% to 100%) than in the therapist-only condition ($M = 66$, range, 18% to 92%). The lowest percentage of correct responses occurred during the therapist-only condition ($M = 68$, range 25% to 100%), but there was also considerable overlap of the two data paths. The iPad-assisted condition resulted in consistently faster completion of the session ($M = 1$ min 46 s, range 1 min 20 s to 2 min 20 s) than the therapist-only condition ($M = 3$ min 48 s, range 2 min 30 s to 7 min 50 s) with very little overlap of the data paths. Finally, less challenging behaviour occurred in the iPad-assisted condition ($M = 11$%, range 0% to 43%) than in the therapist-only condition ($M = 34$%, range 8% to 82%).

After session 18, the effect of participant choice between conditions was evaluated in an ABAB design with both participants. Data were collected for 20 total sessions with five sessions per phase. Figure 1 displays the results for Michael. When given a choice between therapist-only and iPad-assisted intervention, Michael chose iPad-assisted intervention for 90% of the opportunities. Across all of the choice sessions, Michael exhibited on-task behaviour a mean of 74% of intervals (range, 14% to 100%), engaged in challenging behaviour a mean of 28% of intervals (range, 0% to 86%), responded correctly and independently a mean of 84% of responses (range, 63% to 100%), and the mean duration of sessions was 2 min 54 s (range, 1 min 30 s to 5 min 50 s). During the sessions without an opportunity for choice, Michael exhibited on-task behaviour a mean of 69% of intervals (range, 29% to 100%), engaged in challenging behaviour a mean of 29% of intervals (range, 0% to 71%), responded correctly and independently a mean of 89% of responses (range, 63% to 100%), and the mean duration of sessions was 3 min 10 s (range, 1 min 40 s to 7 min).

Figure 2 (after session 18) displays the results for Aaron. When given a choice between therapist-only and iPad-assisted intervention, Aaron chose iPad-assisted instruction for 100% of the opportunities. Across all of the choice sessions, Aaron exhibited on-task behaviour a mean of 87% of intervals (range, 60% to 100%), engaged in challenging behaviour a mean of 13% of intervals (range, 0% to 40%), responded correctly and independently a mean of 83% of responses (range, 25% to 100%), and the mean duration of sessions was 2 min 1 s (range, 1 min 20 s to 3 min 50 s). During the sessions without choice, Aaron exhibited on-task behaviour a mean of 57% of intervals (range, 13% to 92%), engaged in challenging behaviour a mean of 43% of intervals (range, 8% to 88%), responded correctly and independently a mean of 73% of responses (range, 25% to 100%), and the mean duration of sessions was 4 min 4 s (range, 2 min 20 s to 8 min).

Discussion

This study sought to replicate and extend previous research comparing iPad-based and therapist-delivered interventions. Similar to the findings of Neely et al. [19], in which the iPad condition was associated with less challenging behaviour and more academic engagement than the traditional materials (i.e. no iPad) condition, Aaron's results (Figure 2) suggest the iPad

may have facilitated an increase in on-task behaviour, a reduction in challenging behaviour, and an overall more efficient approach to intervention (i.e. less time required to complete sessions) than the teacher-only condition. Aaron's data are tempered, however, by Michael's data (Figure 1) in which no consistent difference between conditions was identified, suggesting the iPad was as beneficial as teacher delivered instruction without any notable boon to intervention efficiency or effectiveness. Currently, it remains unclear why some children with autism may benefit less from intervention facilitated by computers than others. Child-specific characteristics such as a preference for computer or human interface, previous history using computers, or the interaction between the specific skill being taught and the suitability of the iPad for addressing that skill would seem to be variables likely to influence such comparisons that could be examined in future research.

In situations, where two approaches to intervention are equally effective and efficient and other mitigating logistical factors such as cost and access to equipment are considered negligible, it is reasonable, even potentially empowering, to allow the child to choose between the available intervention options. In this study, both participants consistently selected the iPad-assisted condition over the therapist-only condition when given the choice and, although the effect of choice was modest, making a choice was associated with more time on-task and less challenging behaviour for both participants. The positive effect of offering children with autism choices during the context of rehabilitation programmes is well documented [22]; however, this study is the first to examine a choice between traditional therapist intervention and iPad-assisted intervention. The choice phase of this study supports previous findings indicating the potential power of choice within such programmes even when the choices offered do not change the reinforcers used or the skill being taught [23].

This study is limited by the inclusion of only two participants with similar abilities and future research, in which additional participants with different abilities working on different goals (e.g. academics) appears warranted. Further, the lack of a baseline and a maintenance phase in this study prevents definitive statements regarding how much learning occurred in either condition. Additionally, it is possible that potential differences between conditions were hidden by carryover effects caused by teaching the same skill in both conditions. Specifically, participants may have experienced skill improvement in one condition that then led to improved behaviour in the other condition, because the task demands were less difficult as a result of increasing skill level. Future research in which multiple skills are targeted for intervention and are then counterbalanced across conditions and participants may be able to address this issue.

Ultimately, the findings of this study suggest that iPad-assisted intervention can be as effective as therapist-implemented intervention and, in some cases, may even result in improved performance relative to therapist-implemented interventions. Further, even for children for whom no differences between the two interventions exist, offering a choice between intervention formats may be beneficial. However, future research in which child-specific characteristics predictive of better performance with or

without the use of an iPad and in which additional skills are taught to a wider variety of participants remains warranted.

Declaration of interest

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