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How do the Activity Schedules Impact the Individuals with Autism Spectrum Disorder? A Systematic Review and Meta-Analysis

Etkinlik Çizelgeleri Otizm Spektrum Bozukluğu Olan Bireyleri Nasıl Etkiliyor? Bir Sistematik Derleme ve Meta-Analiz

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ABSTRACT: The main purpose of this study was to systematically review and meta-analyse the single-case studies on the use of activity schedules with individuals with autism spectrum disorders. The other purposes were to describe the characteristics of activity schedule studies, assess the design standards of activity schedule studies, estimate the treatment effect of activity schedules, and determine whether activity schedule is an evidence-based practice for children with autism spectrum disorders in improving appropriate behaviours. The non-overlap of all pairs was used to analyse the treatment effect measure. According to the results, seven of 32 activity schedule studies met the design standards with and without reservation. Twenty-four children with autism spectrum disorders whose ages ranged between 3 and 17 years participated in the studies. The target behaviours were on task, independent transition, appropriate peer-play, and following schedule. The photographs and texts were used in both traditional and innovative activity schedules. The overall non-overlap of all pairs score shows that the activity schedule strongly affects those participants with autism spectrum disorders. Finally, this study indicates that the activity schedules can be recommended as an evidence-based practice to improve the appropriate behaviours of children with autism spectrum disorders.

Keywords: Autism spectrum disorder, activity schedule, visual support, evidence-based practices, single-case studies.

ÖZ: Bu çalışmanın amacı, etkinlik çizelgelerinin otizm spektrum bozukluğu olan bireylerle kullanımına ilişkin tek denekli çalışmaların sistematik derlemesini ve meta-analizini yapmaktır. Ayrıca, etkinlik çizelgesi çalışmalarının özelliklerini tanımlamak, desen standartlarını değerlendirmek, etkinlik çizelgelerinin etki büyüklüğünü belirlemek ve etkinlik çizelgelerinin otizm spektrum bozukluğu olan bireyler için uygun davranışları geliştirmede kanıta-dayalı bir uygulama olup olmadığını ortaya koymak amaçlanmıştır. Müdahalenin etki büyüklüğünü analiz etmek için tüm örtüşmeyen çiftler kullanılmıştır. Bulgular, 32 çalışmadan yedisinin desen standartlarını koşulsuz ve koşullu karşıladığını göstermektedir. Çalışmalara yaşları 3 ile 17 arasında değişen, otizm spektrum bozukluğu tanısı almış 24 birey katılmıştır. Hedef davranışlar; etkinlikle ilgili olma, bağımsız geçiş, akranıyla uygun oyun oynama ve çizelgeyi izlemedir. Hem geleneksel hem de yenilikçi etkinlik çizelgelerinde fotoğraflar ve metinler kullanılmıştır. Tüm örtüşmeyen çiftlere ilişkin genel puan, etkinlik çizelgelerinin otizm spektrum bozukluğu olan katılımcılar için güçlü bir etkisi olduğunu göstermiştir. Son olarak bu çalışma, otizm spektrum bozukluğu olan bireylerin uygun davranışlarını geliştirmek için kanıta-dayalı bir uygulama olarak etkinlik çizelgelerinin önerilebileceğini göstermektedir.

Anahtar kelimeler: Otizm spektrum bozukluğu, etkinlik çizelgesi, görsel destek, kanıta-dayalı uygulamalar, tek denekli araştırmalar.

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Visual support, one of the evidence-based practices, can be used to address the developmental and educational needs of children with autism spectrum disorder (ASD; Hume et al., 2021; Wong et al., 2015). Visual support is any visual display or representation that supports children in initiating or completing skills without additional prompts (Hume et al., 2021). Visual supports include real objects, photographs, pictures, line drawings, text, scripts, maps, labels, schemas, timelines, and schedules (Meadan et al., 2011; Wong et al., 2015). One popular form of visual support is activity schedule.

Activity schedule is a sequence of visual discriminative stimuli or cues (e.g., photographs, pictures, or words) that represent assigned tasks, activities, or routines chain, for a child to complete (McClannahan & Krantz, 1999). Although the primary presentation of visual in activity schedule is a folder, binder, list, or notebook containing photographs, pictures, symbols, or text as a cue to the person to initiate and complete the activity, skill, or routine (traditional; MacDuff et al., 1993; McClannahan & Krantz, 1999), activity schedule might be enhanced with computers or cell phones using software and apps (innovative; Cihak, 2011; Stromer et al., 2006). The format of the activity schedule may be selected based on the child's age and developmental level (Downing & Peckham-Hardin, 2001). The binder or notebook includes at least three pages displaying one activity visual per page. Usually, the most preferred and familiar social interaction activities with the new activities are interspersed in the schedule. The child looks at the visual, gets the material, completes the first activity, puts the materials away, turns the next page, and continues these steps until all activities are completed (McClannahan & Krantz, 1999). The last page might include any leisure activity such as watching TV, eating a snack, doing a jigsaw, and going to the park, to reinforce the completing activity schedule (MacDuff et al., 1993).

To teach the use of activity schedule to child, graduate guidance (manual guidance, full physical prompt, prompt fading) is generally used (e.g., Akers et al., 2018). While teaching the child, the prompts are delivered from behind the child. In graduated guidance, the child is often manually prompted (e.g., holding the child's hand or placing the hand the child's shoulder) to help him complete the activities in activity schedule consecutively; however, the prompts are faded in frequency and intensity as rapidly as possible (MacDuff et al., 1993). Activity schedules can aid children with ASD increase independence by offering activity choices, providing the order of the skills, activities, or routines, and facilitating the transitions (Copeland & Hughes, 2000; McClannahan & Krantz, 1999).

Activity schedules have been used as intervention for more than three decades in improving social skills (e.g. Osos et al., 2021), play skills (e.g. Akers et al., 2018), leisure skills (e.g. Cuhadar & Diken, 2011), vocational skills (e.g. Watanabe & Sturmey, 2003), and daily living skills (e.g. Moran et al., 2022; Pierce & Schreibman, 1994), also decreasing challenging behaviours of people with ASD (e.g. Krantz et al., 1993; Lory et al., 2020). Besides the effectiveness studies, there are several reviews on activity schedules for people with ASD (Banda & Grimmett, 2008; Knight et al., 2015; Koyama & Wang, 2011; Lequia et al., 2012). In a review conducted by Banda and Grimmett (2008), 13 studies aimed at improving social and transitional skills and decreasing challenging behaviours of children with ASD and were examined. In the review, the descriptive information on participants, target behaviours, type of activity

schedule, mode of presentation, and the results were presented, while the quality assessment and the treatment effect calculation for studies were not provided. The review's overall result indicated that the activity schedules effectively enhanced social and transitional skills and reduced challenging behaviours of children with ASD.

In the second review (Koyama & Wang, 2011), 23 studies focused on the efficacy of activity schedules to promote the independent performance of individuals with ASD, and intellectual disabilities (ID) were analysed descriptively. The review described the characteristics of participants, settings, target behaviours, activities, generalisation, maintenance, and social validity; however, the studies' quality and the treatment effect were not assessed. Since the studies, which have low quality and used activity schedule in combination with other practices (e.g., video modelling) were not excluded from the review, and there were no exclusion criteria for participants and target behaviours, to deduce the efficacy of activity schedules and to generalise the results is a bit hard.

In a study carried out by Lequia et al. (2012), 18 studies implementing activity schedules to reduce the challenging behaviours of children with ASD were systematically reviewed. The authors depicted the participants, target behaviours, intervention components, and findings. Also, they reported activity schedule has medium and strong treatment effects based on the non-overlap of all pairs for participants with ASD. Although the treatment effect was determined in the study, the quality assessment was not conducted for included studies and the evidence bases of activity schedules for challenging behaviours were not reported, whereas assessing a study's quality is an important criterion to decide the overall effectiveness (treatment effect) of an intervention.

In the last review, Knight et al. (2015) reviewed 16 studies using activity schedules to improve the performance of individuals with ASD. The authors evaluated the studies' quality, calculated the treatment effect (percentage of non-overlapping data), and determined the evidence-bases of activity schedules. Though this review is the most extensive and recent, it did not exclude the studies that used multiple picture cues to present the task within a single activity without fading and did not include the transition between activities. According to McClannahan and Krantz's (1999) activity schedule definition; the picture prompting that shows each step of a skill (e.g., pour water into a bowl, stir the mixture) on one page may not be accepted as an activity schedule since visual prompts (picture or video) used in the schedule should be faded gradually. There should be only one picture left on the schedule that symbolises the activity when the participant completes the steps of the skills without any prompt. Typically, in activity schedule, when the students see the activity picture in the schedule, they should go to the relevant locations, complete the depicted responses, and return to their main schedules. Therefore, if we accept the activity schedule definition made by McClannahan and Krantz (1999), we cannot assume that this review's results can be generalised to the activity schedule.

Besides these reviews specifically focused on activity schedules, The National Autism Centre's National Standards Project [NAC] (2015) and The National Clearinghouse on Autism Evidence and Practice [NCAEP] (Hume et al., 2021; Steinbrenner et al., 2020) conducted extensive reviews aimed at determining the evidence-based practices for children and youths with ASD. In the review carried out by

NAC, schedules including activity schedules are identified as evidence-based practices for children and youth with ASD, and, also in the review made by NCAEP, visuals involving activity schedules are established as evidence-based practices for children and youth with ASD. As seen, the activity schedule was not investigated separately in these two reports; it was examined in the content of schedules and visual supports as a component. Thus, we might assume the findings of the reviews cannot be generalised to the activity schedules. Teaching the use of activity schedule requires using specific teaching techniques such as graduated guidance and fading. It has a unique training protocol during the instruction process compared to other types of visual support such as photographs and calendars. Also, an activity schedule not only teaches skills but also supports the independent living skills of individuals with ASD by listing and organising all activities for individuals. In addition, activity schedules have different shapes and formats, such as traditional and innovative. For this reason, it is thought that evaluating the overall effect and evidence-bases of the activity schedules alone would be important.

The current review aimed to broaden the scope, focus on specifically activity schedules, update the content by re-defining the activity schedule, and expand the time interval of the previous reviews (Knight et al., 2015; Lequia et al., 2012; NAC, 2015; Steinbrenner et al., 2020). The purpose of this review was to (a) describe the characteristics of activity schedule studies, (b) assess the design standards of activity schedule studies, (c) estimate the treatment effect of activity schedule, and (d) determine whether activity schedule is an evidence-based practice for children with ASD to improving appropriate behaviours.

Method

A systematic review and meta-analysis were used in the current study. A systematic review is a literature review designed to locate, appraise, and synthesise the best available evidence relating to specific research questions to provide informative and evidence-based answers (Dickson et al., 2017). Meta-analysis is a research design used to systematically review and evaluate the previous research findings, make a statistical analysis using these findings, and derive conclusions by synthesising the results (Glass et al., 1981; Viechtbauer & Cheung, 2010). We have chosen the systematic review and meta-analysis because we wanted to determine the overall effect and the evidence-bases of activity schedules for individuals with ASD. In the current study, we analysed the studies' findings that used the single-case design to examine the effects and evidence-bases of the activity schedules. In the study, we have completed the following steps respectively: (a) searching the literature electronically and ancestrally, (b) applying the inclusion and exclusion criteria, (c) applying the design standards, (d) conducting visual analysis, (e) digitising the graphical data, (f) calculating the treatment effect, (g) extracting the descriptive data, and (h) assessing the evidence-bases.

Systematic Search

We conducted a systematic and comprehensive search in two steps to recruit the studies. In the first step, we carried out the electronic database search located within the Anadolu University's library collection. Academic Search Complete, Educational

Resources Information Center (ERIC), Directory of Open Access Journals. (DOAJ), Education Index Retrospective (Wilson), JSTOR Journals, PsycArticles, PsycINFO, Social Sciences Citation Index (SSCI), and Web of Science databases were searched by using the combination of the terms "activity schedule and autism, visual schedule and autism, picture schedule and autism, photographic schedule and autism, written schedule and autism, print schedule and autism" in full text. We completed the search previously, and renewed and updated it in March 2020. The electronic search was conducted simultaneously by two authors to ensure search reliability. We compared search results and there was no difference in the number of accessed studies. The search includes the date between 1993-2019 and the date was not restricted. This database search resulted in 362 studies.

In the second step, we performed an ancestral search using footnote chasing. We examined the reference lists of included empirical studies (n=32) and reviews. We retrieved 20 different studies and accessed them from the university library collection (n=12), Google Scholar (n=7), and Google (n=1). As a result, a total of 382 studies was ascertained. After 227 studies were excluded due to duplication, 155 studies remained. All studies were downloaded, labelled, and stored in electronic media.

Applying the Inclusion and Exclusion Criteria

After completing the initial search, we evaluated all studies using the inclusion and exclusion criteria. We applied the following inclusion criteria to each study to include it in the review: (a) published in a peer-reviewed academic journal, (b) published in English, (c) included at least one participant with ASD (e.g. autism, autism spectrum disorder, autistic, Asperger, PDD-NOS, and pervasive developmental disabilities, etc.), (d) implemented the only activity schedule as a primary intervention alone, (e) used an activity schedule including at least two activities, (f) included at least one appropriate behaviour, such as on-task, engagement, transition, and play behaviours had been targeted as outcomes, (g) utilised one of the single-case designs, and (h) presented the data in line graph with individual data points. We excluded the studies if any of the following exclusion criteria: (a) published as a dissertation, conference proceeding, or letter to the editor (grey literature), (b) published in any language other than English, (c) conducted with participants with developmental and/or intellectual disabilities, (d) implemented the activity schedule combined with one of any other interventions, (e) used only one activity, skill, or behaviour in activity schedule, (f) included outcomes targeted following activity schedule or problem behaviours, (g) utilised the group experimental designs, qualitative designs, and reviews.

Applying the Design Standards

We applied the design standards proposed by What Works Clearinghouse [WWC] (2017) for single-case designs to studies that met the inclusion criteria. We categorised the studies based on the design standards as meets design standards, meets design standards with reservation and does not meet design standards. We included the studies that met design standards with and without reservation, while we excluded those that did not meet design standards. To have a study, we accepted the following criteria: (a) the intervention must be systematically manipulated, (b) each target behaviour must be measured systematically over time, (c) interobserver agreement must be reported for 20% of all sessions for each participant and each condition and reported at least 80%

agreement, (d) study must contain at least three attempts to demonstrate an experimental effect, and (e) each phase must consist of minimum of three (ideally five) data points. If a multiple baseline/probe design was used, each condition had to have at least one data point in the first three sessions and at least one data point just before the intervention phase. We excluded the studies that used the nonconcurrent multiple baseline designs to demonstrate an intervention effect.

Conducting Visual Analysis

We conducted the visual analysis for the studies that met design standards with and without reservation to determine if there was a causality relationship between the activity schedule and the target behaviours. We classified the studies as provides strong evidence, provides moderate evidence, and no evidence in visual analysis. If a study exhibits at least three demonstrations of the experimental effect, and demonstrates no non-effect, we coded as strong evidence; if a study does not provide at least three demonstrations of the experimental effect, we coded as no evidence; if a study exhibits at least three demonstrations of experimental effect and demonstrates at least one non-effect, we coded as moderate evidence (Kratochwill et al., 2013). The experimental effect means that a study documenting the consistency of level, trend, and variability within each condition, and presenting immediacy of the effect and the rate of data overlap across phases (Kazdin, 2011).

Digitising the Graphical Data

We digitised data points in each graph to obtain raw data. We used Plot Digitizer 2.6.8, data extraction software, to digitise the data points (Huwaldt & Steinhorst, 2014). We downloaded all studies as portable document file (pdf) and converted all graphs as image files (JPEG). We uploaded the graphs into the software and digitised the data following use manual. We digitised 625 data points (235 for baseline and 390 for intervention) for 27 AB phases. We exported the raw data into Microsoft Office Excel, re-graphed, and compared each original graph to each new graph.

Treatment Effect Estimation

We used the non-overlap of all pairs (NAP) to calculate the magnitude of effect. NAP is a nonparametric technique for measuring non-overlap for baseline and intervention conditions (Rakap et al., 2020; Yucesoy-Ozkan et al., 2020). NAP is the number of comparison pairs depicting no overlap divided by the total number of comparisons. NAP summarises data overlap between phase-A and phase-B data points, respectively (Parker & Vannest, 2009; Vannest et al., 2016). We preferred the NAP due to the simple calculation using a free web-based calculator, which does not include data trend, and confidence intervals are available (Vannest et al., 2016). NAP values that range 0-.65 are weak effects, .66-.92 are medium effects, and .93-1.0 are large or strong effects (Parker & Vannest, 2009).

Extracting the Descriptive Data

After calculating the treatment effect, we extracted the studies' characteristics. We developed a coding sheet to extract the data. We coded the participant's characteristics (number, gender, and age), the target behaviours, and activity schedule's characteristics (the type of schedule, mode of presentation, and training strategy) on this

coding sheet. We just included participants with ASD, and we did not code the information of the participants without ASD.

Assessing the Evidence-Bases

In this study, we used the criteria for single-case studies recommended by WWC (2017) to assess the evidence-bases of activity schedule. If there are five studies which meet design standards with and without reservations and have a functional relationship based on the visual analysis between dependent and independent variables, and at least three different researcher groups from three different geographic regions conduct these studies with a total of 20 participants, we called the activity schedule as an evidence-based practice.

Inter-Rater Reliability

Two authors conducted all phases of the current study to determine inter-rater reliability (IRR). The agreements and disagreements were determined for each phase and then calculated the IRR using the following formula: (Agreements / Agreements + Disagreements) × 100. For digitising the graphical data, a deviation of ±2 data point was considered agreement; however, a deviation of more than ±2 data point was considered disagreement. The IRR coefficient was 100% for electronic search, 91.1% for applying the inclusion and exclusion criteria, 90.4% for applying the design standards, 87.5% for conducting visual analysis, 99.6% for digitising the graphical data, 100% for calculating the treatment effect, 98% for extracting the descriptive data, and 100% for assessing the evidence-bases.

Results

Description of the Studies

In this study, the participant's characteristics, target behaviours, and activity schedule features were described. The summary of the studies is provided in Table 1. All participants had ASD diagnoses, and any participant was not excluded due to the diagnosis. A total of 24 children with ASD ranged between 3 and 17 years and participated in the studies. Nine children are pre-school age (3-6 year), 12 children are school age (7-13 years), and three children are adolescents (14-17 years). Sixteen of the children are male; two are female; however, six of the children's gender are not specified in a study. The target behaviours are on task (n=2), independent transition (n=2), appropriate peer play (n=1), and following schedule in leisure activities (n=1). The photographs are preferred as a visual in six studies, while text is chosen in a study. The activity schedule was presented in a file, binder, or notebook in three studies, embedded in a mobile device (tablet or personal assistant device) in two studies, and listed on a page in two studies. When teaching the activity schedule to children, most-to-least prompting (n=2), progressive time delay (n=2), least-to-most prompting (n=1), graduated guidance (n=1), and verbal and object prompting (n=2) were used.

Table 1

Summary of Activity Schedule Studies' Characteristics

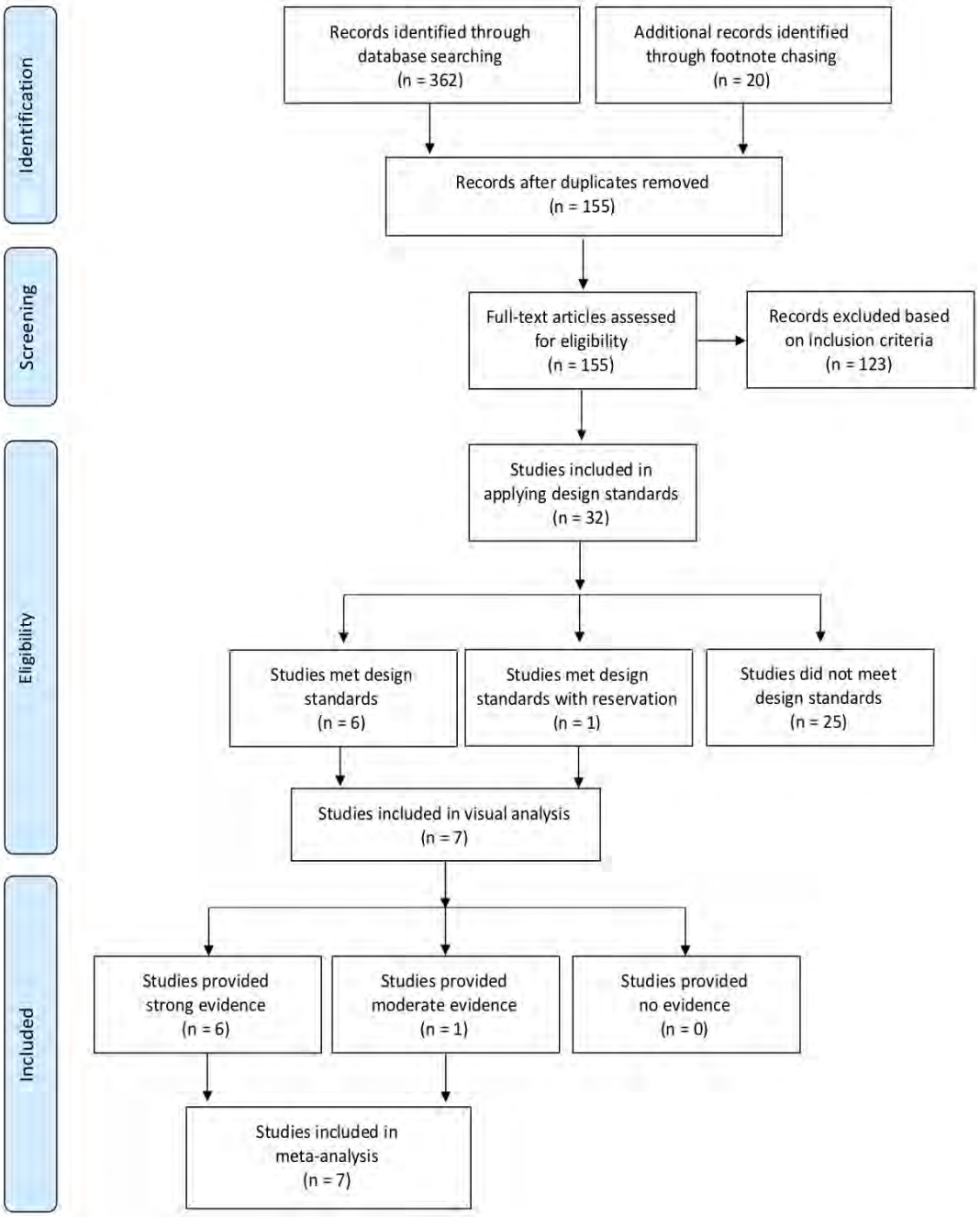
Author and Location	Participants			Target Behaviour	Activity Schedules		
	Age	Gender	Diagnosis		Type of Schedule	Mode of Presentation	Training Strategy
Newman et al., 1995 New Jersey, USA	14 y 16 y 17 y	Male Male Male	Autistic Autistic Autistic	Independent transition	Text (12 x 14 inch)	Activity and its time listed in the centre of a single page	Verbal and object prompting (tokens)
Blum-Dimaya et al., 2010 New Jersey, USA	9 y 11 y 11 y 12 y	Male Female Male Male	Autism Autism Autism Autism	On-task	Coloured photographs	File or notebook contain 27 laminated pages	Progressive time delay
Cihak, 2011 (picture) Tennessee, USA	11 y 12 y 13 y 13 y	Female Male Male Male	Autism Autism Autism Autism	Independent transition	Printed participants' photograph of engaging the activities	Displayed horizontally in the order of activity occurrence	Least-to-most prompting
Carlile et al., 2013 New Jersey and New York, USA	8 y 9 y 9 y 12 y	Male Male Male Male	Autism Autism Autism Autism	On-task (in leisure activities)	Photo icons of activities	An album embedded in mobile device (iPod Touch) contains five activities	Progressive time delay
Brodhead et al., 2014 Utah, USA	3 y 4 y 5 y 5 y 5 y 5 y	N/A N/A N/A N/A N/A N/A	Autism Autism Autism Autism Autism Autism	Appropriate peer play (hide-and-seek)	Coloured photographs	Three ring binder contain four laminated pages	Graduated guidance
Giles & Markham, 2017 (book) Pontypridd, UK	3 y 4 y 4 y	Male Male Male	Autism Autism Autism	Following schedule in leisure activities	A photograph of activity on a white background	Two ring binder contain two A-4 pages	Most-to-least prompting
Giles & Markham, 2017 (tablet) Pontypridd, UK				Following schedule in leisure activities	A photograph of activity similar to book activity schedule	An album embedded in tablet contains two pages	Most-to-least prompting

Design Standards

After we excluded 123 studies based on inclusion and exclusion criteria, we applied the design standards to 32 studies. Figure 1 presents a flowchart of the review process. Based on this process, six studies (in five articles) met design standards, one study met design standards with reservation, and 25 studies did not meet design standards. The reasons that studies failed to meet design standards were about to the following criteria: the interobserver agreement was not obtained in at least 20% of the data points within each condition (n=11), at least three demonstrations of an intervention effect each at a different point in time were not documented (n=7), the initial preintervention data collection sessions were not overlapped vertically (n=6), at least three data points were not presented within each phase (n=1).

Figure 1

The Flowchart Depicting the Review Process



Treatment Effect

In the current study, NAP was used to estimate the magnitude of the treatment effect of activity schedules on improving the appropriate behaviours of children with ASD. The number of participants, pairs compared, NAP scores, and confidence interval (95%) are presented in Table 2 for each study. The NAP scores reveal that activity schedule has a strong effect in four studies and medium effective in three studies. The NAP scores are between .89 to 1.0. Overall, the aggregated mean of the treatment effect is .95. Figure 2 depicts the forest plot of the activity schedule for NAP.

Table 2

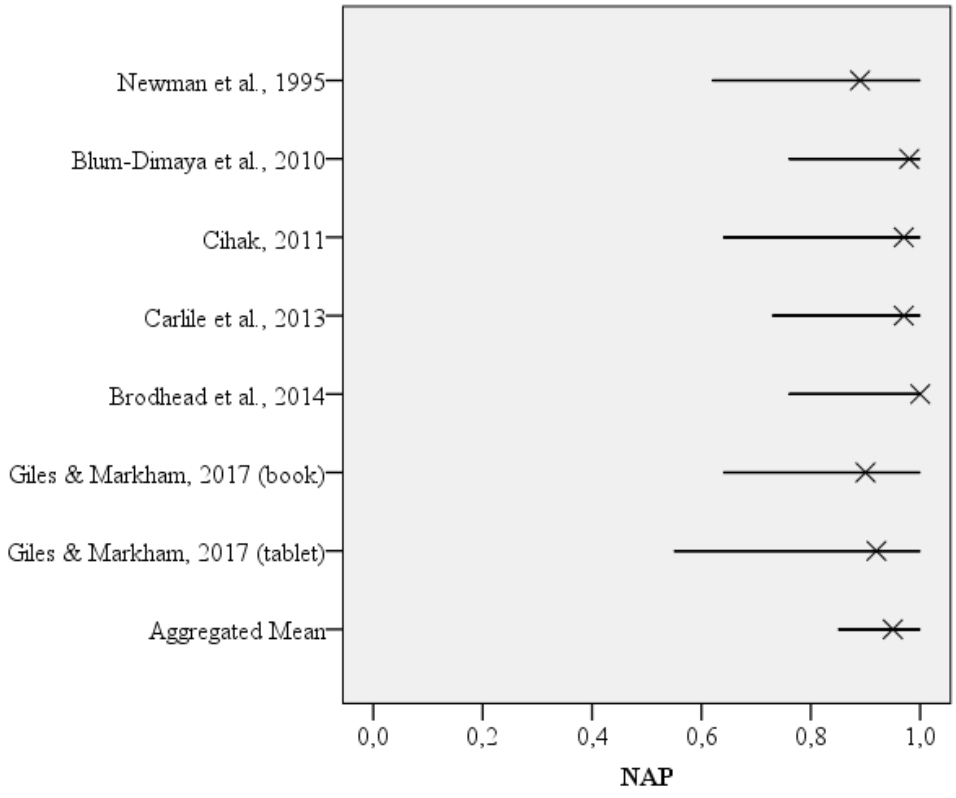
The Nonoverlap of All Pairs Scores of Studies Included in Meta-analysis

Author	*n*	Pairs	AB	NAP	95% CI	Effect
Newman et al., 1995	3	701	3	.89	.62 < > 1.0	Medium
Blum-Dimaya et al., 2010	4	986	4	.98	.76 < > 1.0	Strong
Cihak, 2011	4	170	4	.97	.64 < >1.0	Strong
Carlile et al., 2013	4	942	4	.97	.73 < > 1.0	Strong
Brodhead et al., 2014	6	396	6	1.0	.76 < > 1.0	Strong
Giles & Markham, 2017 (book)	3	230	3	.90	.64 < > 1.0	Medium
Giles & Markham, 2017 (tablet)		189	3	.92	.55 < > 1.0	Medium
Aggregated Mean	24	3614	27	.95	.85 < > 1.0	Strong

NAP: Nonoverlap of all pairs; CI: Confidence intervals

Figure 2

Forrest Plots of Activity Schedule for Nonoverlap of All Pairs



Evidence-Bases of Activity Schedule

We also investigated if the activity schedule is an evidence-based practice in this study. We evaluated the studies using the evidence-based practice criteria recommended by WWC (2017). The evaluation reveals that five different researcher groups from five different geographical locations have conducted high-quality seven studies (in six articles). These studies demonstrate that there has been a strong functional relationship between activity schedule and the appropriate behaviours. Also, the total number of participants in these studies is over 20 (n=24). Thus, it can be said that activity schedule is an evidence-based practice to improve the appropriate behaviours of children with ASD whose ages range between 3-17.

Discussion and Conclusion

This review aimed to assess the design standards of activity schedule studies, estimate the treatment effect of activity schedules, describe the characteristics of activity schedule studies, and determine whether activity schedule is an evidence-based practice for children with ASD to improve appropriate behaviours. The findings reveal that seven out of 32 activity schedule studies in the current review meet the design standards with and without reservation. The overall NAP score shows that the activity schedules have a strong effect on those participants with ASD. A total of 24 children with ASD ranged between 3 and 17 years and participated in the studies. The target behaviours are on task, independent transition, appropriate peer play, and following schedule. The photographs and text are used in both traditional and innovative activity schedules. Finally, an activity schedule can be recommended as an evidence-based practice to improve the appropriate behaviours of children with ASD.

In this review, different from the previous studies, the studies' quality was assessed (Banda & Grimmett, 2008; Koyama & Wang, 2011; Lequia et al., 2012). As a result of this assessment, only seven studies (in six articles) met the design standards with and without reservation. The number of studies that met the design standards is much less than Knight et al.'s (2015) review. There might be two possible explanations for this gap between the two reviews. The first explanation is, while design standards criteria recommended by WWC (2017) were implemented in the current review, the quality indicators suggested by Horner et al. (2005) were applied in the previous review. Since Horner et al.'s (2005) quality indicators tool is more comprehensive than WWC's (2017) tool, the number and the content of the items might make this difference. However, although the measurement of interobserver agreement (IOA) data should be collected for each variable for each participant in each condition of the study for both quality assessment tools, several studies which was not specifically reported that the IOA was measured for each condition were included in the previous review (e.g., Cuhadar & Diken, 2011). The second one is, while an activity schedule was defined as a schedule including at least two activities in the current review, in the previous review, multiple picture cues (picture prompting) to present the task within a single activity were accepted as an activity schedule (e.g., Van Laarhoven et al., 2010). Thus, the definition of the activity schedule could cause the difference. For example, in the research included in this study (Giles & Markham, 2017) explain task analyses for picture activity schedule in their study as follow: "open picture activity schedule book, point to picture of activity, get the materials of the activity in the picture, complete the

activity, clean up materials, turn the page on the picture activity schedule book, point to picture of second activity, get materials for second activity, complete second activity, clean up materials, close book." This definition was used in the current study for an activity schedule.

This study's results indicate that the activity schedules have a strong effect on children with ASD in improving appropriate behaviours. The findings of unique empirical studies (e.g., Akers et al., 2018; Cuhadar & Diken, 2011; Osos et al., 2021) and the aforementioned reviews (Knight et al., 2015; Lequia et al., 2012) are consistent with the current review and support this study. In light of the current and previous studies' results, it can be said that activity schedules are effective for children and youths with ASD both in increasing appropriate behaviours and in decreasing challenging behaviours.

Twenty-four children with ASD participated in the included studies in this study. Most of the children's age ranged from 7-13 years; two of the third were male. Generally, the use of photographs was preferred as a visual in the traditional activity schedules. Besides traditional activity schedules, an innovative activity schedule was used in two studies (e.g., Giles & Markham, 2017). The response prompting strategies (e.g., most-to-least prompting, least-to-most prompting, graduated guidance, and progressive time delay) were often used in teaching the activity schedule to children. This study's descriptive findings are similar to previous reviews and are supported by those (Banda & Grimmett, 2008; Knight et al., 2015; Koyama & Wang, 2011).

Based on the evidence-based practice criteria recommended by Kratochwill et al. (2013), the activity schedules can be recommended as an evidence-based practice to improve the appropriate behaviours of children with ASD. Because there are seven high-quality single-case studies with 24 participants which are carried out by five different research teams. Because the separate contribution of activity schedule to visuals (Steinbrenner et al., 2020) or schedules (NAC, 2015) cannot be determined in the past studies, this finding is crucial to contribute to the evidence-based practices literature. So, the activity schedules are great alternative intervention for children with ASD due to reducing the dependency on adult instructions and supporting individuals' independence (Koyama & Wang, 2011).

There are essential issues to discuss. An intervention that has used the visuals as a picture prompting and faded the visuals has been named an activity schedule in some studies. This intervention may be called visual support, not activity schedules, because, in the activity schedule, the steps of the task can be faded; in contrast, the task's visual is not withdrawn to enable the child to begin or attend the activity (Krantz & McClannahan, 2014). The activity schedule should be a reminder for children, such as an agenda, listing pictures or names of the activities the child is expected to do throughout the day or a period (McClannahan & Krantz, 1999).

In the activity schedule studies, when teaching the following schedule, already known activities or skills are used; however new activities or skills also can be embedded in the schedule (Krantz & McClannahan, 2014). The studies aiming to teach new skills or activities usually use a single-opportunity technique to measure the participant's performance in following a schedule (Dalgın-Eyiip & Ulke-Kurkcuoglu, 2021; Ulke-Kurkcuoglu et al., 2015). These studies are not included in the existing

study because it is not possible to explicitly determine the participant's performance on following a schedule. In such cases, using a multiple-opportunity technique that allows determining the participant's performance may be recommended.

Implications for Practice

Teachers are encouraged to select and use evidence-based practices in their classrooms for their students. A handful of evidence-based practices exist for children and youths with ASD (Hume et al., 2021; NAC, 2015). This review also has strong evidence for activity schedules in developing in-class appropriate behaviours, such as on-task, independent transition, and appropriate peer play. Therefore, special or general education teachers work with children and youths with ASD from preschool to high school can use activity schedules to increase the appropriate behaviours and independency and decrease the challenging behaviours and dependency of prompt/instruction of their students.

As aforementioned, when teaching the using/following a schedule, known activities or skills are often used in the schedule. However, if the student learns to use an activity schedule, the teacher should make some changes to the schedule (Krantz & McClannahan, 2014). For example, the teacher may provide selection opportunities to students for activities and reinforcements, the teacher and student may change the order of the activities, or the teacher encourages the student to prepare the schedule by himself. These adaptions also might enable self-determination (Dalgın-Eyiip et al., 2018).

Although both traditional activity schedules (e.g., book or binder) and innovative activity schedules (e.g., tablet computer, personal digital assistant) were used in the studies, the number of innovative activity schedules are less than the traditional ones. The current review reveals that both the traditional (e.g., Blum-Dimaya et al., 2010; Brodhead et al., 2014) and the innovative (e.g., Carlile et al., 2013) activity schedules have medium to strong effect, and there is no significant difference between them (Giles & Markham, 2017). Thus, teachers may select traditional activity schedules if they and their students afford low-tech devices. In contrast, teachers may prefer innovative activity schedules if they have high-tech devices, and their students are interested in technological devices. Activity schedules embedded in technological devices might increase the learning motivation of some students with ASD and enable them to learn the behaviours faster (Giles & Markham, 2017); however, it could be difficult for younger students.

Limitations

There are two main limitations of this review. The first limitation is a moderator analysis was not conducted. A moderator is a third variable that can affect the functional relationship between the dependent and the independent variables (Ro, 2012). A moderator analysis investigates how and to what extent the outcome depends on the studies' characteristics (Viechtbauer, 2007). These moderators can be participants (e.g., diagnosis, age, and severity of disability), materials (e.g., book, tablet), implementers (e.g., teacher, parent, and peer), or settings (e.g., classroom, community) in single-case research. Because the number of included studies is limited to carrying out moderator

analysis, this analysis was not realised. Once the importance of a moderator analysis in a meta-analysis is thought, the lack of this analysis could be accepted as a limitation.

The second limitation is the inclusion of comparison studies. In this review, two studies have two independent and dependent variables (Cihak, 2011; Giles & Markham, 2017). The second independent variable in Cihak's (2011) study was excluded based on inclusion criteria, while both two independent variables in Giles and Markham's study (2017) were included in the review. Since the carrier effect is a threat to internal validity (Kazdin, 2011), a possible carrier effect can be mentioned for these two studies. Thus, the comparison studies' inclusion in the review might be assumed as a limitation for the current review.

Recommendations for Future Research

Thirty-two studies were included in this review based on the inclusion criteria, and then 25 studies were removed because they did not meet design standards. The most common elimination reason was the report of IOA data. Most studies did not report explicitly whether IOA data were collected in at least 20% of sessions for each variable each participant in each condition of the study. Future studies should take into consideration the design standards and report the study in a replicable manner.

In this study, a moderator analysis could not be carried out due to the lack of studies. To examine how and to what extent the outcome depends on studies' characteristics is essential to interpret the findings and design the instructional arrangement. Therefore, a moderator analysis can be recommended for future reviews once much research that focuses on the efficacy of activity schedule is completed.

Finally, the social validity of the activity schedule's presentation mode may be investigated in further studies. The activity schedule can be presented in two ways: using a book or binder and using a cell phone or tablet. Both ways have distinctive advantages and limitations. The selection of presentation mode can be chosen based on some indicators such as the participant's age and interest, the setting's characteristics, or whether having a technological device; however, one of the vital indicators is the participant's preference. Future studies may be designed to determine the preference of the participants.

Statement of Responsibility

Derya Genc-Tosun contributed by determining the need for the study, searching databases, extracting and analyzing data, writing, editing, and reviewing the manuscript. Serife Yucesoy-Ozkan contributed by assessing the need for the study, planning the phases of the study, leading the researchers, interpreting data, writing, editing, and reviewing the manuscript. Finally, Ozlem Dalgin contributed by leading the definition of the variables, searching databases, extracting and analyzing data, and calculating intercoder reliability.

Conflicts of Interest

The authors declare no conflict of interest.

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***Studies included in this systematic review and meta-analysis.**