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Evidence-based design: Documenting a research experiment in a school environment with children with autism spectrum disorder

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Abstract

Purpose Autism spectrum disorder (ASD) is a developmental disorder affecting around 1:59 children. Among other characteristics, children with ASD can be unduly sensitive to elements in the built environment, such as noise or light. Despite this knowledge, to date there has been little evidence-based experimental research investigating how the environment affects them. The purpose of this paper is to conduct an experiment in a school environment with children with ASD and document the process as a model that other researchers could apply to similar studies.

Design/methodology/approach The study focused on whether the application of wayfinding aids (colored doors, colored shapes on the floor and signage) in a school corridor could help children with ASD navigate to a given destination, but the process could be applied to other variables at other study sites. The study documents the approval and consent process, describes setting up the experiment, assigning controlled and uncontrolled variables, selecting and recruiting participants, and running the experiment.

Findings The study concludes by reviewing the key lessons learned from the process of conducting the experiment. Study logistics were challenging to gain approval and set up and run the experiment; collaboration with school district personnel was essential to meet the aims of the study; and recruiting sufficient numbers of participants with ASD who were not familiar with the study site was challenging.

Originality/value By describing key steps in the process of conducting a research experiment with children with ASD, the study provides a model that other researchers could follow.

Keywords

Experiment, School environment, Autism spectrum disorder, Evidence-based design, Wayfinding

Disciplines

Environmental Studies | Industrial and Product Design | Interactive Arts | Interior Design | Mental and Social Health | Other Social and Behavioral Sciences | Speech and Rhetorical Studies

Comments

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1. Introduction

In recent years, led by healthcare design, designers have made efforts to create environments based on research into human behavior in the built environment with the aim of improving well-being and comfort (Center for Healthcare Design, 2008; Hamilton, 2004; Hamilton and Watkins, 2009; Martin, 2009). This evidence-based design (EBD) can be defined as "the process of basing decisions about the built environment on credible research to achieve the best possible outcome" (Center for Health Design, 2008). EBD has been a persuasive factor in justifying funding projects in the healthcare industry (Hamilton, 2004; Martin, 2009). Like healthcare, education is an area with limited resources that would benefit from an EBD approach to ensure that funds go to the design of schools that support proven educational strategies (Martin, 2009). This approach could particularly benefit children with Autism Spectrum Disorder (ASD).

ASD is a common neurodevelopmental disorder that affects a person's ability to interact socially with other people and to act in generally accepted ways of behavior (American Psychiatric Association [APA], 2013). The need to support children with ASD is pressing—current estimates are that 1:59 children have the diagnosis, an upward trend (Baio et al., 2018). Among other difficulties, children with ASD face unique sensory challenges in the environment that affects their behavior (APA, 2013; Dunn, 2008; Whitaker, 2001). Children can be hypersensitive and react to external stimuli that children without ASD may not notice, e.g., smell, noise, or the texture of an item of clothing (APA, 2013; Dunn, 2008, National Institute of Mental Health [NIMH], 2008). Conversely, children can be hyposensitive with a high tolerance level and not react to external stimuli that children without ASD normally would, e.g., they may be immune to pain when they injure themselves (Dunn, 2008; NIMH, 2008). Some children can be hypersensitive to some stimuli but hyposensitive to others (Dunn, 2008). According to the APA, the hyper- or hyposensitivity that children with ASD experience is due "to sensory input or unusual interests in sensory aspects of the environment" (2013, p. 50).

Despite this knowledge that the environment affects children with ASD, there has been little EBD research to investigate the factors that impact them. There have been studies concerning the design of schools for children with ASD, but few have been experimental. An experiment is defined as research in which participants are randomly assigned to treatment or control groups (Frankfort-Naimas and Naimas, 2008). Several researchers have adopted a design criteria/checklist approach, sending a questionnaire to caregivers and educators to establish their requirements for an environment that supports children with ASD, and evaluating the responses via a hierarchy of importance (Khare and Mullick, 2008; McAllister, 2010; Mostafa, 2008). Others have taken a case study approach (Pauli, 2004; Scott, 2009). Mostafa (2008) undertook one of the few experimental approaches investigating classroom layout and acoustics and their effect on children with ASD. However, the study has been noted to have limitations since participants were not randomly assigned to treatment and control groups (Henry, 2011a).

The design of schools that are appropriate to meet children's needs is essential to maximize their learning potential (Vaughan, 2011). Legislation in the US dictates that children with disabilities should be educated in the same school environment as children without disabilities if it meets their needs (Individuals with Disabilities Act, 2004). Many children with ASD are therefore taught in the same school environment with their peers, children without ASD (Simpson, Myles and LaCava, 2008). However, most school environments have not been

designed to suit the unique sensory challenges that many children with ASD experience. Several authors have expressed surprise that little research is available to inform designers how to create supportive environments for them (Henry, 2011a; Henry, 2011b; Khare, 2010; Martin, 2014; Shabha and Gaines, 2011; Vázquez and Torres, 2013). Research that does exist is sometimes flawed in methodology, lacking rigor, or anecdotal in origin (Henry, 2012; Martin, 2014). Moreover, knowledge can be difficult for designers to find (Scott, 2009) and is often "fragmented and inconclusive" (Shabha and Gaines, 2011, p. 228). If more rigorous research concerning designing schools for children with ASD were conducted, published, and made available to designers in an accessible format it could guide them to create supportive educational environments based on empirical evidence (Martin, 2014).

This study aimed to address the lack of EBD research by conducting an experiment in a school environment with children with ASD and documenting the process as a model that other researchers could apply to similar studies. The study focused on wayfinding, a topic that has not previously been studied in relation to children with ASD, although it can be a particular issue affecting them (Baumers and Heylighen, 2010; Gerland; 1997; Higashadi, 2013). The results of that study are not part of this paper—this paper focuses on the process of carrying out EBD research with children with ASD that could be applied to wayfinding or other experiments in a school environment. The steps taken to complete the study are outlined below.

2. Method: Setting up the experiment

This exploratory experimental study aimed to find out whether children with ASD could find their way around a school corridor more easily with the application of wayfinding aids compared to the control group finding their way around the same corridor without the addition of wayfinding aids.

2.1 Institutional approval

The first challenge, particularly with vulnerable children with disabilities, was obtaining institutional approval. The university Institutional Review Board (IRB) required School District (SD) approval before they would consider an application. In selecting a suitable SD, the number of potential subjects was considered. The SD selected reported a high incidence of students with ASD amongst their students with disabilities, (19% when the state incidence was 13%), and a doubling in the number of children diagnosed over a six year period.

An initial approach was made to the SD to discuss research possibilities before a formal application was submitted outlining study purpose and methodology, together with copies of consent forms and data collection instruments. It proved difficult to finalize these documents, over twenty of them, when the research was still at an early stage. Several months of negotiation followed requiring much revision of documents before approval was granted. To protect participants, SD approval included a requirement for the researcher to sign a confidentiality agreement; to apply to become a Student Teacher which entailed a criminal background check; and to hire and pay for a teaching assistant to monitor children in the study. Once SD approval was received, the proposal was submitted to the IRB. The IRB required some amendments necessitating further negotiation with the SD. The approval process was therefore lengthy to satisfy the requirements of both organizations.

2.2 Study location

Another challenge conducting wayfinding research with children with ASD in a school was finding a route they were not familiar with as this knowledge could confound the study. Transporting children with ASD to an unfamiliar school not only has logistical implications but also children often react adversely to unfamiliar environments which could disrupt the study. The research therefore took place during the SD Summer Program. This voluntary program ran for five consecutive weeks at select school sites and was intended to prevent children slipping behind educationally compared to if they did no studying during the summer recess. The advantages were that high numbers of potential participants with ASD were likely to attend who were unfamiliar with the layout of that particular school. In the summer prior to the experiment, the researcher observed a typical Summer Program class for children with ASD at an elementary school and concluded it would be a suitable location to run the study the following year.

School approvals

Research in a school involves more than the participants and researcher. In this study, there were additional personnel whose co-operation and assistance was needed and sought. To inform affected SD staff about the study, several presentations were made to Special Education staff and educators who would be teaching at the Summer Program. This ensured that all staff understood the aims of the research and would cooperate with it.

Approval for application of wayfinding aids was also required. The study aimed to test whether colored doors, colored shapes on the floor, and colored signage could help children with ASD navigate along the school corridors. A meeting was held with the SD Director of Buildings to discuss potential materials that could be applied as wayfinding aids. Criteria for consideration were that they had to be temporary, easy to apply, cost effective, available in a variety of colors, and would not damage existing surfaces. Matboard was selected as the best material to manufacture door and floor wayfinding aids, laminated paper for signage.

A meeting was also convened with the head teacher of the selected school to explain the study and request the cooperation of janitorial staff. This was important because the school was scheduled to be deep cleaned during the summer recess, a common occurrence, and the study would impact this process. A subsequent meeting was held with the janitor supervisor to explain the study, agree a suitable location, and seek cooperation that the wayfinding route would be clear of janitors and equipment during the experiment as any interruption could affect the results.

2.3 Uncontrolled variables (typical school corridor)

In order to keep the experiment as natural as possible, existing variables found in a typical school corridor were not controlled but data was collected to inform future studies. The main corridors measured approximately 12′-6″ wide overall with a suspended ceiling throughout of 8′-10″ height, consisting of 2′ x 2′ white acoustic tiles in a lay-in exposed grid frame. Luminaires were mounted on the ceilings, comprising fluorescent lamps covered with Perspex baffles approximately 10′ x 4′. Above the library counter was an elaborate lightwell enhanced by strip lighting which was lit during the study. Lighting levels in the corridors were generally uniform except for lower levels outside the music rooms. All corridors were internal so amount of daylight was not a factor. Doors were generally the same throughout the study site, average 34″ wide x 82″ height, finished in plastic laminate with satin anodized aluminum hardware. Classroom doors had rectangular vision panels. The predominant colors throughout the study site were beige walls and floors, blue lockers and door frames, and pink doors. Walls in the main corridors were clad in concrete tiles. Floors were a vinyl finish. Existing display materials, e.g., posters, pictures, were retained as typical distractions encountered by children when

wayfinding in a school. There were also a number of distinct artefacts retained in the Media Center, e.g., presidential portraits and two US flags.

2.4 Controlled variables

The aim of this experiment was to find out whether a combination of wayfinding aids would help children with ASD navigate more easily around the school corridor. Aids were selected that would be easy to apply to a new build school or during refurbishment of an existing school. Controlled variables included the wayfinding aids (colored doors, colored flooring, and colored signage), the wayfinding route, wayfinding scripts, and researcher interactions. These are described in more detail below.

Wayfinding route. The Summer Program took place in a designated area of the school and the remainder was cordoned off, including the area set aside for the study. A single route was identified from a designated start point to a destination point, a classroom designated as an Art Room, somewhere students might visit during a typical school day (see Figure 1). This provided a purposeful destination for the wayfinding task—participants had to collect a book from the Art Room. The destination was out of sight of the starting point. The route had opportunities to take right and left turns and to go in the wrong direction. Two sets of doors had to be opened along the route. The distance was approx. 483'. The presence of others using the wayfinding route was also a controlled variable. To enable optimum data collection, the study site was prohibited to staff and non-participant children and janitorial staff avoided it. This helped participants concentrate on the wayfinding task and ensured timing was not affected by human obstruction.

Wayfinding aids. As stated, matboard was selected to make colored door templates. Detailed dimensions were taken of the doors along the route, including location and size of vision panels, door handles, closers, left and right hand openings, etc. Matboard was available in various sizes but a manageable size was 40″ x 34″. Since the average door in the corridor was 82″ x 36″, two pieces of matboard were needed to cover each door. The matboard supplier agreed to deliver the large quantities required for the study direct to the researcher's home instead of to a retailer as usual. Matboard was cut to size using a wall mounted guillotine and final adjustments made on site. Templates were labelled so they could be easily located and applied. To fix the matboard, various products were tested. Blue decorator's tape was selected as it was easy to apply and did not damage existing door surfaces when removed. After several adherence tests, a system was developed of using multiple pieces of tape applied to the reverse of the matboard, adhering the matboard to the door, then wiping the surface of the matboard with a cloth to firmly adhere. Using this system, all templates remained in position during the study.

Matboard was also selected to create colored shapes on the floor as the low profile was not a tripping hazard when tested and the color matched the door aids providing a uniform color scheme. The existing floor had 2′ x 2′ blue contrast squares at regular intervals along the corridor length. These were covered with colored matboard as wayfinding aids so the existing floor did not cause confusion. At junctions in the corridor, larger 3′ x 3′ colored squares were inset into the floors and these were also covered with matboard squares taped together as wayfinding aids. The study also wanted to test whether different shapes on the floor had an effect so, in one area, 2′-8″ diameter circles were applied over existing squares, cut to size with a laser cutter. Matboard was loose laid since it was relatively heavy and, when tested, stayed in place well.

In addition to colored doors and floor shapes, colored signs were applied as wayfinding aids. Existing signage in the corridor consisted of proprietary plastic signs in burgundy color with white tactile raised characters in upper case. These were fixed at approx. 60″ from finished floor level, generally positioned by the opening door hand. Most signs consisted of a room name and letter/number and some had additional labels, e.g. teacher's name. The sequence of letters/numbers was confusing so signage was streamlined to make it more understandable and child friendly. This approach would also test whether clearer signage would aid participants in the treatment group. Some rooms were renamed to make them more understandable, e.g., "Inter. Music" became "Music Store" and a door labelled "No occupancy permitted by order of the Fire Marshal" was replaced with a simple "No Entry." This approach represented how, in a new school design, there would be opportunity to provide clear signage. In the control group, the sign for the classroom designated art room was covered by a color printed sign that matched existing signage so it would be perceived the same.

Signs were created in the Word program, printed on 11″ x 7″ colored paper matched to the matboard. Pictograms were included on the signs, important since children with ASD are often taught using pictures to supplement the written word. Some schools use pictograms from a recognized graphic symbol system but, since the SD in the study did not, free images were sourced from Google images. Signs were laminated to ensure robustness and applied over existing signs with concealed blue decorator's tape.

Regarding colors of wayfinding aids, the existing color palette of the corridor was beige walls/floors, blue lockers/door frames, and pink doors. Colors of wayfinding aids were selected that would contrast with the existing scheme so they would be visibly perceived (see Figure 2). Orange, yellow, red, and green were selected. Most matboard colors were available in bright chroma which stood out against existing colors but green was only available in a muted tone.

Wayfinding scripts. The study was designed that participants would be shown the way first then asked to find it themselves. This was on the basis that, in class, instructions are often repeated numerous times to children with ASD to reinforce learning. This approach also followed previous studies (Cornell et al., 1989; Helvacioğlu and Olguntűrk, 2011). To provide consistent instructions to participants, comparable wayfinding scripts were developed. In the scripts, the terms right and left were not used in case some children were unsure which was which and it caused confusion. Instead, the terms "this way" and "that way" were used, enforced by hand gestures. At the start point of the study route, all participants were told, "First, I am going to lead the way to the Art Room. I'll show you things along the way to help us find the way there. Then I'll lead us back here to the start point. Next, I will ask you to lead the way to the Art Room. Try to remember what you see along the corridor to help you find your way there when you are leading." This script was based on similar research studies (Cornell et al., 1989; Helvacioğlu and Olguntűrk, 2011). Some doors and features were not referred to, to avoid information overload.

During the first stage of the experiment, participants in both groups were pointed out select wayfinding cues on the way to the destination point and reminded of their task, a technique employed by Cornell et al. (1989). Examples of wayfinding aids pointed out to the treatment group included, "Notice there are two orange doors here"; "We are going to turn here and go through these big yellow doors into the Media Center"; and, "There's another door here and a sign Media Work Room 2 and the same picture of someone working at a desk." Participants in the control group were given similar instructions, e.g., "Notice there are two doors here"; "We are going to turn here and go through these big doors into the Media Center"; and,

"There's another door here." Colors on the floor were not referred to in the control group to avoid misleading since the same color throughout meant the floors all looked the same.
On the way back, participants in the treatment group were reminded about some of the wayfinding cues, for example, "Now, we are heading back to the start point. We are starting off in this green hallway"; "Remember these three red doors with the red signs to do with music"; and, "There is the yellow door with the yellow No Entry sign on the door that we passed earlier." Participants in the control group were given similar instructions, such as, "Now we are heading back to the start point. We are starting off in this hallway"; "Remember these three doors?"; and "There is the door with the sign on the door."

During the second stage of the test, all participants were told, "Now we have arrived back here at our Start Point. Now you are going to lead us back the same way to the Art Room." Participants were reassured that the researcher would be right behind them, that they could ask her for help if they did not know the way, and that the researcher knew the way so they would not get lost. Contingency comments were prepared in case a participant seemed unsure of the route, such as, "Do you need some help?" or "Do you remember which way to go now?" (Cornell, Heth and Rowat,1992). If a participant walked for 10 steps or more in the wrong direction, or appeared confused, or tried to enter the wrong door, they would be instructed they were going the wrong way and asked to try again. Circumstances in which to terminate participation in the study were also considered, e.g., if a child became upset or refused to take part.

The researcher, in delivering scripts, interviewing, and generally directing participants, became a human variable that needed to be controlled. To ensure that a reliable, consistent stimulus was provided to all participants, the researcher practiced delivery of scripts. The researcher wore the same plain black clothes throughout the study so her attire would not distract from colors in the corridor. This also disguised the video camera worn throughout the study on a chest strap. The researcher also wore plain black footwear so her shoes would not be a distraction as they had been to several children in the pre-study period! The researcher was also careful not to wear perfume which could disturb participants sensitive to smell. Prior to the study, the researcher had spent time in participants' classrooms so they would become familiar with her and to enable her to observe their behaviors and interactions during class activities to frame their actions during the wayfinding task. Teachers read prepared scripts to introduce the researcher who also read a story to each class so participants became familiar with her unusual accent. Participants were generally observed for a minimum of one hour on at least one occasion.

3. Method: Running the Experiment

Selection of participants

The number of potential participants was estimated at 20 based on attendance data from the previous year's Summer Program. In considering logistics, available resources, time constraints, and availability of participants, smaller sample sizes are acceptable (Frankfort-Naimas and Naimas, 2008; Sommer and Sommer, 2002), particularly since this was an exploratory study and the results were not intended to be generalized to the rest of the population (Babbie, 2010; Sommer and Sommer, 2002). Participants were screened by the SD using a screening criteria. To be eligible for the study, participants had to be identified by the SD as having a documented diagnosis of ASD. The age range of participants was selected as 8-11 years because, at that age,

children were more likely to have greater maturity and ability to follow instructions, and provide their opinion, than younger children. This was especially necessary as gaining direct feedback via a post-study interview was an important aim of the research. It was therefore also important that participants could communicate verbally in simple words or sentences: children who were non-verbal were therefore excluded. To be eligible for the study, participants also had to be able to follow simple instructions and accompany the researcher for the duration of the study. This suggests a higher intellectual/cognitive functioning level as children with a lower functioning level may not have comprehended the instructions.

Prospective participants were excluded from the study if they attended the school during the normal school year as their prior knowledge and familiarity with the study site could confound the study. Participants' level of familiarity was further identified via a pre-study questionnaire to parents/guardians asking whether their child had previously visited the school, e.g., with a sibling. Prospective participants were also ineligible to take part in the study if they had an indicator on record that they were prone to challenging behavior or physical disruption as this could impact their ability to take part in a safe manner.

Informed consent

Consents were itemized separately so that parents/guardians were clear what they were consenting to and could opt in or out of an item if they chose, including consent for the child to participate, to be videotaped, to be audiotaped, and for the SD to disclose demographic information to the researcher. A pre-study questionnaire asked for information about the child's familiarity with the study site. Parents/guardians were also offered an optional opportunity to attend an informational meeting to meet the researcher and find out more about the study. (The meeting was held but no-one attended). To avoid the potential for bias, detailed aims of the study were not provided. This guarded against what Frankfort-Nachmias and Nachmias (2008) describe as "demand characteristics" (p. 199), where people who take part in a study act in a way they think the researcher desires. The child was also asked to agree to take part in the study via a Child Assent Form. Parents/guardians were asked to review the form with their child to help them understand that they were being asked to take part in a fun study with a researcher from the university that involved walking around the school.

Demographic data

Parents/guardians were asked to consent for the SD to release demographic data to the researcher: all parents/guardians agreed. Both male and female participants were sampled, but selection was expected to reflect the gender difference in ASD, where more boys than girls are diagnosed on a ratio of 5:1 (Baio, 2012). The primary language used by participants was noted. This was relevant since participants whose primary language was not English could have more difficulty understanding the researcher and reading signage. The ethnicity of participants was also documented as there are reports of a high incidence of ASD in some populations, e.g., the Somali population (Hewitt et al., 2013). Motor functioning abilities were recorded as this could affect time taken for the participant to complete the study. Sensory impairments were also noted which could impact the study, e.g., participants with a vision impairment could take more time carrying out the wayfinding task. Participants were screened for color blindness: any with blue monochromacy color deficiency, a total lack of color vision, would be excluded since they would be unable to perceive the colored wayfinding aids. Participants with red-green or blue-yellow color deficiency would be retained as they were likely to be able to discriminate the colors.

Recruitment of participants

Shortly after student participation in the Summer Program had been confirmed, the SD used the screening criteria to identify potential participants. Recruitment packs were distributed to parents/guardians by the SD on behalf of the researcher along with key information about the Summer Program on the basis that the study information would be more likely to be read. Recruitment packs contained an informational letter, consent forms, a pre-study questionnaire, and a stamped addressed envelope to the researcher. A follow-up letter was sent to non-responders via their child attending the Summer Program. Due to slow response, a $20 gift card was offered to encourage participation, retrospectively applied to those who had already agreed. Twenty-two recruitment letters were sent out. Nine participants were recruited.

Assignment to groups

Participants were randomly assigned to the treatment or control group to avoid selecting participants who could be predisposed to one condition or the other which could bias the results (Babbie, 2010; Frankfort-Nachmias and Nachmias, 2008). Both groups took part in a wayfinding experiment along the same route in the school corridor, the control group under the existing conditions, and the treatment group using wayfinding aids applied as an intervention. Teachers and parents/guardians were primed with a note of dates to remind the child they would be taking part in a fun activity with a researcher from the University to encourage the child and diffuse anxiety. These reminders worked well in that all participants went willingly with the researcher, most excited to take part.

Time schedule

The Summer Program ran for five weeks, Monday-Friday, for three hours each morning. Week 1 was designated a settling in period and pre-testing; Week 2 the pre-study observation period; Weeks 3 and 4 the experiment was run. Two typically developing children (convenience samples) were recruited to test the control and wayfinding route in the pre-test period. Typically developing children were used because there were a limited number of participants with ASD who would be needed for the study. Also, participants with ASD were more likely to behave in unique ways so may not have provided a balanced view. From the pretest feedback, adjustments were made to the study procedures. Due to the complexity of fitting the wayfinding aids, time order for the study was: run participants in the control group, install wayfinding aids, run participants in the treatment group, remove wayfinding aids. Participants were randomly allocated a one hour time slot to take part in the study, from collection to returning to class, although, in the field, most participants finished sooner. This schedule allowed a maximum of two students per day. Each participant took part in the experiment individually and only once.

Running the study

Each morning before the study commenced, a checklist was used to confirm the route was set up correctly, e.g., corridor lights were on and display materials were in place. In addition, data was collected of the environmental conditions along the route, specifically light (amount of illumination) and sound (amount of decibels) to check whether conditions were consistent between participants, particularly since light and sound can adversely affect children with ASD. Conditions were noted consistent throughout the study.

At the appointed time, the researcher collected each participant to take part in the study. Smalltalk was made on the way to the start point to put participants at ease, e.g., “How old are

you?", "When's your birthday?", etc. At the start point the researcher commenced the script, kneeling down to smaller children to be on a child-friendly level. The control group was tested for their ability to find their way from the start point to the destination point without the application of wayfinding aids. Participants were given prompts about typical characteristics in the school corridor. The treatment group was tested for their ability to find their way from the start point to the destination point with the assistance of wayfinding aids. Participants were given prompts about wayfinding aids applied along the school corridor.

At the start point, participants were reminded to take notice of where they were going as they would have to lead the way on their own next time (Cornell, Heth and Broda, 1989; Helvacioğlu and Olguntűrk, 2011). The researcher then took the participant from the start point to the destination point, the Art Room, pointing out existing features in the school corridor control group) or wayfinding aids (treatment group). Once they had reached the destination, participants were taken back to the start point via the reverse route. On the return, they were reminded to look around them, reminded of cues they had previously passed, and that they would be finding their way to the Art Room next time. Having arrived back at the start point, the participant was immediately instructed to find his/her way back to the Art Room.

Post-study interview

Directly after the wayfinding task, a questionnaire was administered to each participant asking for his/her reactions. A spare classroom was allocated for the purpose near the start point, designated Miss [Author's name] Interview Room to help participants feel at ease. Two chairs were positioned next to one another at a desk rather than facing each other as some children with ASD prefer to avoid eye contact. The researcher explained the questionnaire and provided a separate sheet of emojis (sad and smiley faces) for participants' use. The researcher asked the questions and completed the questionnaire and the child was encouraged to point to the relevant emoji. The questionnaire took around five minutes to administer. Administering the questionnaire moments after completing the wayfinding task increased validity and gave participants the best opportunity of recalling how they felt about the activity. At the end of the process, participants were handed a personalized, laminated certificate, together with a University branded notebook and pen to thank him/her for taking part in the study. Shortly after the study concluded, parents/guardians were sent a thank-you letter enclosing a $20 gift card. Teachers and janitorial staff who had assisted with the study were also given a thank-you card and a $5 gift card (the maximum amount permitted by the SD).

Data collection

To increase reliability, data collected included: data mining by the SD, observations, questionnaires, behavioral mapping, video and audio recordings, timings, and interviews. In conducting an EBD research study, various measures were used to test the influence of wayfinding aids including:

Success of reaching the destination, measured by whether the participant reached/did not reach the destination; whether they reached it directly or indirectly; and the time taken to reach the destination;

Degree of independence, measured by degree of presence of the researcher; number of verbal prompts administered; number of physical prompts administered;

Use of wayfinding aids, measured by number of times colored doors, colored shapes on the floor, and signage were referred to by the participant while wayfinding or in the post-study interview;

Participants' opinion about the wayfinding task, measured by the post-study interview.

4. Conclusions

This paper outlines the steps taken to conduct an exploratory EBD research study designed to find out whether wayfinding aids applied along a school corridor would increase the ability of children with ASD to find their way along a set route with minimal or no verbal or physical assistance. The results of the experiment are not detailed here but will be the subject of a separate paper. Detailed here are the key lessons learned from the process of conducting the experiment.

Logistics

One of the main challenges conducting the study was logistics. The time take to gain asynchronous approval from the SD, then the IRB, then back to the SD with additional amendments, required time-consuming negotiation and revision over many months. Manufacturing and installing wayfinding aids was also a laborious task for which additional assistance was required. Researchers should be aware that an experiment of this nature can be a lengthy process and plan accordingly.

Collaboration

Conducting EBD research in a school environment with participants with ASD is not achieved by the researcher alone. It requires collaboration and the cooperation of many different parties, parents/guardians, the children themselves, SD personnel, teachers, janitorial staff, etc. The researcher also had to be prepared to compromise to the needs of the SD while maintaining the integrity of the study purpose. Also, in an experiment on site, unexpected issues can arise, e.g. a participant is off sick and has to be rescheduled. Some items can be mitigated, e.g. a check beforehand to see if a fire alarm test is scheduled. The researcher needs to be adaptable to site situations.

Number of participants

An inherent problem conducting research with children with ASD is finding sufficient participants. Despite data indicating 1:59 children has a diagnosis of ASD (Baio et al., 2018), finding large numbers of suitable participants in one school is not easy. Added to this, children at the lower end of the spectrum may be unable to take part. Also, children can be sick, or refuse to take part. Expanding the age range and keeping the selection criteria as open as possible were the most effective measures to increase participant numbers. Holding the research during the Summer Program, while increasing the number of potential participants in one place, had a drawback in that attendance was not mandatory so some potential participants were on holiday or otherwise unavailable.

Characteristics of children with ASD

The variability in the characteristics of children with ASD in the study meant that behaviors were unpredictable, from some children who were distracted and had to be continually reminded to keep on task, to those who were silent throughout. Classroom observations were useful in

framing these behaviors. Time as a measure of success lacked validity as three participants had ambulatory difficulties which were not recorded on their educational records and thus took longer to complete the study. It is unclear whether additional participants would have provided more synergy or yet more variability.

Limitations

The decision was made to use typically developing children in the pre-test for reasons outlined. Post-study we support this view since the findings indicated that children with ASD varied so much in their wayfinding behavior all foreseen circumstances could not have been identified. Also, in a normal school situation, doors would generally be open at passing times which would obscure the door color. In this situation, an additional matching strip of colored material could be applied around the door frame so that the color would be visible when the doors were open.

Future research

Future research could expand into a larger wayfinding study in a school used by children with ASD or into other environments that they visit, e.g., a hospital or store. The procedures used in this study could be applied to test other variables in schools, e.g., the effects of lighting or classroom layout. More research experiments testing environmental treatments could provide professionals with EBD findings on how to design schools suitable for children with ASD.

Summary

One of the drivers for this study was the current lack of EBD research into the design of environments suitable for children with ASD. By documenting in detail the steps taken to conduct the research, the study aimed to lay a foundation that other researchers could apply in similar experiments. It is hoped this will encourage other researchers to adapt and conduct their own similar research elsewhere.

Illustrations

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