# The Effects of Sensory Integration Strategies on The Expressive Language Skills of Students with Autism

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**ABSTRACT**

Individuals with Autism are likely to experience Sensory Processing Disorder (SPD), which characterizes one's limitation in processing the sensory information the brain receives. Due to this phenomenon, many children with Autism react adversely to different sensory inputs. As a result, they engage in self-stimulating behaviour, have difficulty regulating their emotions, and lose the opportunity to interact with others socially and develop their language skills. Therefore, this research aimed to establish the practice of sensory integration, commonly seen in occupational therapy, in the classroom to support the sensory processing dysfunction of many students. A single-subject research method was conducted in an inclusive school in Mauritius, following a multiple-treatment design. Two participants diagnosed with Autism were involved in activities inculcating specific expressive language skills. In addition, a fidget toy and a wobbly inflatable cushion were introduced at different stages, and their effects on expressive language skills were explored. Overall, the integrated sensory tools are practical and valuable as they increase students' attention to the task and their ability to express themselves by responding to verbal tasks.

Keywords: Autism Spectrum Disorder, Sensory Processing Disorder, expressive language skills, sensory integration strategies, special education program, evidence-based intervention

## 1. Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that inhibits an individual's social interactions and communication. It involves repetitive movements such as hand flapping (Reis et al., 2018). The American Psychiatric Association (2013) noted that one of the earliest signs of ASD in a child is the delay in the language development of the individual. Consequently, children with ASD often lack expressive language skills compared to their other typically developing peers; thus, they are unable to communicate effectively with the latter or anyone around them. Another common difficulty experienced by individuals with ASD is sensory processing disorders (SPDs), with a prevalence of 42% to 88% compared to other developmental peers (Benson et al., 2019; Baranek, 2002). SPD is a dysfunction in the individual's sensory processing, thus causing the latter to be limited in their functional behaviour and participation in daily life activities (Kaiser et al., 2020). The reason is that individuals with SPD often do not know how to process the sensory stimuli they receive; some will be hypersensitive. They will try to seek more of the sensory stimulus to respond, while others become hypersensitive and are easily triggered by a small amount of sensory stimulus (Neufeld et al., 2021). For instance, an increase in the smells or sounds of a room can make it challenging for individuals with SPD to participate in social settings. For individuals with ASD, they might try to cope with the sensory stimuli by using self-stimulation, such as a restless movement or fidgeting around. However, these self-stimulation behaviours often come across as socially unaccepted by many or can even be seen as challenging behaviours when the individual goes into a meltdown (Case-Smith et al., 2015).

To adaptively respond to the environment around us, individuals heavily rely on the brain's ability to receive, integrate, and respond to the ongoing flow of external sensory information. Unfortunately, those with ASD often exhibit unusual reactions towards the sensory stimuli around them due to their SPD, thus affecting their ways of coping with external factors (Tavassoli et al., 2018).

Moreover, it can be challenging to directly understand or point out the SPD of an individual because each difficulty arising from SPD varies. Different sensory modalities can be involved in SPD - the visual, auditory, smelling, taste, tactile, vestibular, proprioception and interoception abilities of an individual. While some may be affected in only one category, others may have an adverse response to several of these modalities, thus making each case unique and requiring different treatment strategies for each person (Galiana-Simal et al., 2020).

Children with ASD are commonly limited in their more excellent cognitive functioning, affecting their social skills and interactions with those around them (Miguel et al., 2017). The processing of any sensory information is vital for the higher-order cognitive functioning of an individual (Baum et al., 2015), a neurological dysfunction in such processing would affect the functioning of an individual. In addition, SPD causes individuals to experience sensorimotor difficulties, making them further unsuccessful in situational demands and meaningful participation in daily activities.

The limitations resulting from SPD can also inhibit the student's ability to focus on any verbal task or instruction given. Not only are their receptive language skills challenged, but they can also be prevented from adequately communicating their needs in return, especially when having difficulty regulating the sensory stimulus experienced, thus leading to emotional dysregulation (Laurent & Gorman, 2017). In addition, because they have these challenges to express their needs to others, they are often left out, which inhibits their communication skills even more as they cannot interact with others.

The research objectives are as follows:

As a response to the problem statement stated earlier, this study has the following twofold objectives:

1. To explore the effect of sensory equipment on the expressive language skills of children with Autism in the classroom.

2. To compare the effectiveness of integrated sensory tools in helping children with ASD to improve their expressive language skills in the classroom.

Research Questions:

In line with the research objectives, this study will aim to answer the following:

1. How does the use of sensory equipment affect the expressive language skills of students with Autism in the classroom?

2. Which sensory-integrated tool is the most effective in helping students with Autism to improve their expressive language skills in the classroom?

## 2. Literature Review

### Sensory Processing Disorders (SPDs) in children with ASD

For any individual, how the brain receives, integrates, and responds to any ongoing external sensory information is critical and will, of course, determine the individual's adaptive responses toward the environment. However, with SPD, individuals face patterns of atypical reactions to sensory input. Some may have a heightened or over-responsivity towards little exposure to sensory input such as sound or touch. On the other hand, some might be indifferent and under-responsive to sensory stimuli, thus having a reduced emotional, behavioral, or psychological response (McMahon et al., 2019). For such people, this hyporeactivity may even cause them to have an excessive desire or craving for sensory input, as they would need a greater intensity of stimulus to react to it.

Sensory processing impairment is not only experienced by many people with disabilities but also in some people without any specific disability or condition. Research has shown that 5% to 16% of children without need can experience SPD. In contrast, those with diagnoses such as ASD, intellectual disability or attention-deficit hyperactivity disorder can share some SPD with a prevalence of 40% to 88% (Kaiser et al., 2020; Benson et al., 2019). Therefore, in line with Uljarević et al. (2017), who highlighted that individuals on the spectrum have more significant sensory processing differences than their typically developing peers. Even though SPD's impact can seem more significant throughout the individual's childhood, one should realize that it is an independent and lifelong condition (Goodman-Scott et al., 2020). Many educators and researchers overlook the impact of sensory differences on a person's well-being or academic performance. However, there are numerous ways in which a sensory processing deficit can affect an individual; thus, such impairment should not be overlooked.

**Language skills and sensory regulation**

ASD is generally associated with substantial impairments in both social interaction and communication, as well as with the presence of unusual behaviors and interests. Because of the persistent limitations in touch and their lack of ability to understand social contexts, children with ASD are commonly regarded as unable to interact with others in socially acceptable ways (Jones et al., 2020; All Party Parliamentary Group on Autism, 2017).

While deficits in social communication form a general hallmark feature of ASD, the several components of communication and language proficiency may vary amongst individuals. For example, different studies have found other ways in which the receptive and expressive language skills in children with ASD vary. While some studies show that individuals have better expressive language than receptive language (Kover et al., 2013; Hudry et al., 2010; Weismer et al., 2010), other studies found the contrary or even no difference between both levels (Volden et al., 2011; Weismer et al., 2010). Nevertheless, it is essential to understand

that those language skills are still affected by their neurodevelopmental condition, ASD (Friedman & Sterling, 2019).

In addition, challenges in the child's communication and sensorial areas can compromise the relationships with their parents, teachers, or those around them (Laurent & Gorman, 2017). Because children with ASD often struggle to manage their responses to various sensory stimuli, they do not know how to effectively express their needs and communication with others, thus straining their ability to build social relationships.

Individuals with ASD often struggle to understand and communicate effectively with others since they sometimes lack motivation or interest in sharing with others. SPD may be one of the potential causes of this lack of social interest; because they have difficulties processing the external sensory stimuli around them, they tend to avoid social situations. For the individual with Autism, the sensory information involved with social interactions may be perceived as triggering. Similarly, their adverse reactions to the stimulus cause unusual social behaviors that others perceive negatively (Kojovic et al., 2019). It is interesting to note how diminished social motivation in children with Autism can affect how they develop their language skills. Since children with ASD find it difficult to interpret social behaviors and are not interested in interacting with others, they tend to avoid social situations. Therefore, this leads to fewer opportunities for the acquisition of language skills (Wojciechowski & Al-Musawi, 2016).

Children with ASD are unable to monitor, modify, and evaluate their emotional state because of their deficits in social communication and in appropriately responding to sensory inputs (Laurent & Gorman, 2017). For example, the tactile sensibility of an individual may make the latter react emotionally or even aggressively to grooming activities such as getting a haircut or trimming one's nails. Because of the emotional distress entailed in these activities, individuals become overpowered by their emotions and do not know how to regulate them to express themselves (Kojovic et al., 2019) effectively. Henceforth, the difficulties in sensory regulation when faced with situations may cause emotional distress and an additional obstacle to the effective expressive language demonstrated by an individual.

**Intervention for SPD**

Interventions for SPD are often practiced within the field of Occupational Therapy. Often, pediatric occupational therapists (OTs) provide targeted therapy right from an early age to help children with their sensory processing and integration. These therapies are deemed necessary by OTs to optimize the individual's outcomes and participation in childhood activities (Reynolds et al., 2017; Ryckman et al., 2017).

Occupational therapy, which uses the principles of Ayres Sensory Integration, is one of the services requested the most by parents of children with Autism, thus making sensory integration therapy (SIT) one of the most highly used interventions for individuals with Autism (Schoen et al., 2018; Lang et al., 2012).

SIT is an evidence-based practice that can help children learn to use all their senses together – touch, smell, taste, sight, and hearing. SIT seeks to elicit an individual's adaptive responses to different situations by engaging children in play activities and sensory-enhanced interactions. The therapists design activities which challenge a child's sensory processing using additional sensory equipment; hence the activities develop and extend the child's skills and support the latter's adaptive response to the challenge set (Case-Smith et al., 2015; Ayres, 1972).

Literature has extensively highlighted the use of SIT for children with Autism. It has vastly proven its effectiveness in occupational therapy, improving children's occupational performance and communication and language skills (Kashefimehr et al., 2017; Schaaf et al., 2014). Besides, SIT's effectiveness on children's language has significantly improved the social, emotional and behavioural performance of students, as they have been able to learn to process sensory inputs (Kashefimehr et al., 2017; Kuhaneck & Britner, 2013; Matsushima & Kato, 2013).

While SIT is vastly known, encouraged, and used in occupational therapy, outside of school, there is a shortage of knowledge and application in the field of education. Little to no research has addressed the use of sensory integration practices in education to support children with SPD (Weeks et al., 2012). Still, some of the strategies used in SIT can also be applied in the classroom to help regulate children, allowing them to focus on the verbal task.

Very often, teachers are not even aware of the sensory processing difficulties of their students. This sensory impairment is then overlooked, and teachers can wrongly perceive the reactions towards the sensory stimuli as being challenging or disruptive behaviors. Teachers should not only be taught about SPD, but they should also be trained or taught how to implement school-based therapies. With the collaboration of OTs, teachers can implement SIT in class to support students with ASD. Such implementation would involve sensory integration in direct skill teaching, capacity building, joint problem solving, communication and mutual respect between the teachers and students (Mills & Chapparo, 2017; Villeneuve, 2009).

Lin et al. (2012) described various sensory processing strategies that can be used in the classroom, such as weighted vests, seat cushions or ball chairs, to increase attention to task, in-seat behavior and decrease self-

stimulatory behavior. Ultimately, SIT should be designed based on the sensory information the individual responds to. For example, if a student is hyposensitive to sounds and seeks auditory input, the SIT designed in class would be to use music to increase engagement in class. Similarly, the contrary response, hypersensitivity, should also be considered to ensure that the activity implemented does not negatively trigger emotional distress in the student.

Using SIT in class will not only help to improve attention to a task or verbal instruction, but it will also help students to engage more in social communication as they will be able to regulate the sensory stimuli. Instead of engaging in self-stimulation, they would communicate with peers and have more opportunities to develop their expressive language, increasing their well-being (Xu et al., 2019).

## 3. Methodology

### Research Design

This study adopts a single-subject scientific, quantitative research methodology that investigates a functional relationship between a dependent variable, that is, what will be evaluated, and the independent variable, that is, what will be varied. It is a practical methodology in special education as it enables researchers to investigate low-incidence student populations, such as children with Autism while providing information on individual performance (Cakiroglu, 2012). In addition, this enables the researcher to collect data on one subject at a time. The single-subject research method generally uses the reversal design known as the ABA design. The dependent variable, represented on the y-axis, is initially observed repeatedly over time, which is represented on the x-axis at regular intervals, and a baseline is established (A). Then, in another phase, a treatment is introduced (B), and the level of responding is observed before observing the dependent variable again without the treatment (back to A) (Chiang et al., 2014). Any change in the performance will indicate the effectiveness, non-effectiveness, or indifferent effect of the treatment in question, B. Such change is noticed when the researcher plots respective graphs to visualize the data. While the ABA reversal design is a common research manipulation used to establish an experimental control, a second manipulation used in single-subject research involves the staggered introduction of the treatment (Price et al., 2015). Such a design is known as single-subject research with multiple treatments, and it will be the chosen design for this current research. This method allows the researcher to compare the effects of at least two treatments.

Following the multiple treatment design, after the researcher establishes a baseline without any treatment (A), a first treatment will be introduced (B), during which the dependent variable is measured. Then, the

following condition will introduce the second treatment (C). The participant will then be returned to the baseline (A) before reintroducing the treatments. Still, in the reverse order, C, then B, to avoid any carryover effects from the initial order. In other words, the multiple-treatment design used follows the ABCACB pattern.

Since this research evaluates the effectiveness of sensory integration practices on the expressive language of students with Autism, sensory tools will be used as treatments to support students in processing sensory information. The two sensory tools used are fidget toys; a Koosh Ball and a wobbly inflatable cushion. The independent variable will be the regular time intervals of the observations and the intervention sessions. For each phase, the time interval is one day, and the dependent variable is the child's communication ability percentage, more specifically, the expressive language skill demonstrated.

A language skills checklist, the Receptive-Expressive-Emergent Language Test-Third Edition (REEL-3) (Bzoch et al., 2003), was used to plan sensory integration activities and evaluate the student's expressive language.

**Research Setting**

The research was conducted at an inclusive school, which means that students with disabilities have the opportunity to learn alongside their classmates and follow the same curriculum as their peers. As such, the types and levels of disabilities of the students vary, but the school does cater for students with Autism. For Participant X, the activities were conducted in the classroom because of the lack of private rooms around the reception classes. Participant Y's sessions were in a separate room next to the Year 2 classrooms. It is usually the room used by the learning support teacher when the latter wants individual sessions with the students, so it allows the session to be done in a much quieter environment.

**Research Sample**

A purposive sampling method has been used for this research whereby participants are deliberately chosen due to their qualities. Hence, by purposefully selecting participants who are most likely to yield the appropriate and valuable information, the purposive sample makes use of a small sample which focuses on the depth of understanding rather than the breadth of understanding (Campbell et al., 2020; Alkassim & Tran, 2015; Palinkas et al., 2015).

The sample that will be observed throughout this study thus comprises two students diagnosed with ASD. The first participant is a five-year-old girl who has just repeated the reception level, and the second is a seven-year-old boy who has previously repeated his pre-Reception level. As part of the purposive sampling, the researcher made sure that the participants met the following criteria: the participants had to be diagnosed with Autism Spectrum Disorder or Asperger's Syndrome by a clinical psychologist. The participants also had to have a sensory processing dysfunction mentioned in their psychological report, and they should not have received any sensory integration therapy before the research. By ensuring that they met these criteria, the sampling procedure ensured that the students would benefit from the intervention practice and would therefore fulfil the research objectives. Throughout this research paper, the girl will be denoted as Participant X, and the boy will be denoted as Participant Y to conserve their anonymity.

**Research Instrument**

To collect the research data and plot the relevant graphs, the researcher had to investigate the students' expressive language skills. The specific expressive language skills were taken from the vast scale of the REEL-3 checklist (Bzoch et al., 2003) because both participants had language skills which ranged between the three to seven years old criteria. The reason for asking the respective special educator to choose an appropriate expressive language skill was because the latter knows the participant well as they each work closely with them twice a week, so they can assess where each participant is based on the REEL-3 checklist. The lessons were based on that specific expressive language skill, and the researcher created progressive observation checklists. Each observation checklist included ten criteria observed throughout each lesson, and each demonstrated behaviour based on the expressive language skill chosen was marked with a tick.

**Reliability & Validity**

The use of multiple treatment reversal designs favours the reliability of the research as it enables the researcher to repeat the measurements at two different times to check if the same results are obtained. This is in line with the test-retest reliability method, which allows researchers to observe the consistency of their measurements. For example, at condition B, where the fidget toy is introduced, the same treatment is retested later on at another phase. The researcher can then see if the results are repeatable.

Moreover, internal consistency is kept within this research as the measurement is taken until a steady result is observed. When a treatment is introduced, the observations of the expressive language skills of the participant are recorded over a period of time, such that the results obtained reach more or less a consistent

result, thus making sure that there is internal consistency in what is being measured instead of having substantial discrepancies in the results obtained for the same treatment.

According to Odom et al. (2003), to determine the effectiveness of any intervention or educational practice for children with ASD, it is most relevant to evaluate the intervention's effect. Hence, to achieve this, researchers must tightly control any extraneous variable which may affect or change the results of the observations. This is why single-subject research is known for its high internal validity.

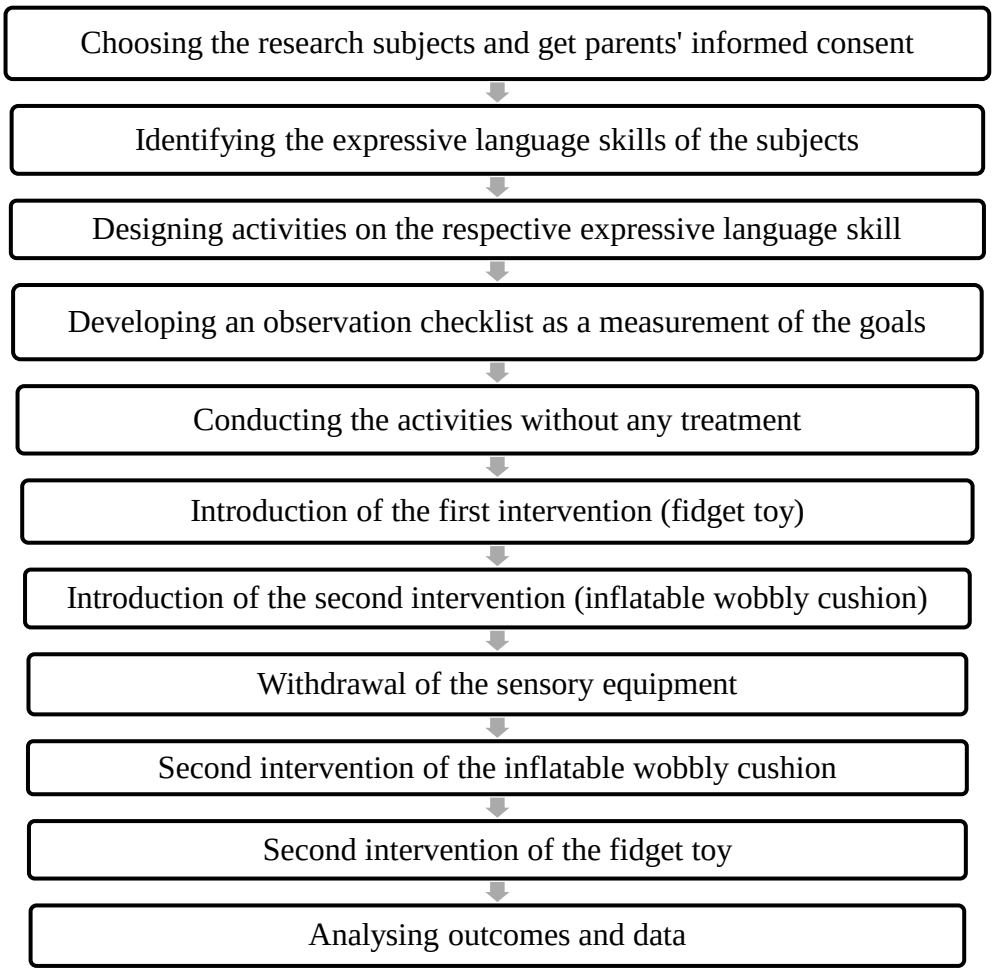
When the baseline is established, it helps the researcher to evaluate what effect, or not, will occur when the treatment is introduced. If the dependent variable changes with the treatment and then changes back when the treatment is removed, this proves that the treatment has had an effect and was responsible for the change. This is important because it helps to discard any automatic learning that might have occurred over time. Moreover, the validity of the research was further ensured through the thorough ongoing checks and validations of other teachers, particularly special educators. They were updated regularly about the progress and were able to evaluate the observational checklist and provide the necessary feedback for improvement throughout the process, therefore ensuring that the research fulfils its objectives.

**Data Collection**

The study followed a multiple-treatment reversal design where two treatments will be switched and compared to the baseline observations, thus following an ABCACB design. The study's total duration lasted about six weeks (about 22 to 23 intervention sessions per participant). Each baseline stage lasted for three days, that is, three sessions, while each treatment phase or condition lasted for four to five days, that is, four to five sessions each, as sure consistency was already observed over this period. The duration of each session varied between 15 to 25 minutes.

Figure 1 outlines the data-driven decision-making process for the sensory integration practice used in this research.

**Figure 1** *Data-driven Decision-making process for the sensory integration practice*




Adapted from "Identifying and Measuring Outcomes in Ayres Sensory Integration ® Earn" by T. May-Benson, 2018, *OT Practice, 23*(3), 24.

Based on the expressive language skill chosen, an observation checklist was designed for each student. The checklist highlighted ten different observations which could be made regarding the expressive language skills of focus. Through the activities designed and the interaction with the teacher, a tick is placed next to the criterion of the student when he/she is able to express himself or herself according to the checklist. The total number of ticks will then be made over a score of ten and converted into a percentage to be plotted on the graph.

Both participants received the same treatments, that is the two sensory tools, although they worked on different expressive language skills. While Participant X worked on the expressive language skill of "using simple present and future tenses with feminine and masculine gender markers", Participant Y worked on

the expressive language skill of "using double adjective and noun phrases", hence all the activities were targeted towards building up these concepts. Moreover, the sensory tools were each integrated at different phases for a certain period of time to really observe any change in the in-seat behaviour of the child, as well as the ability to express themselves.

**4. Analysis**

Graphs will be plotted for each condition or phase based on the results obtained from the observational checklist. The dependent variable is the percentage representing the level of expressive language skill demonstrated throughout the session, and the independent variable is the intervention sessions which are spaced over different days. For instance, if the child has demonstrated six out of the ten criteria set, in terms of the expected expressive language skill, the percentage to be plotted is 60%.

For the first question, a comparative analysis of the graphs plotted will determine if the two treatments implemented made a difference in the children's expressive language skills. A descriptive analysis will outline how each treatment affected or not the expressive language skills observed by each individual. Moreover, to evaluate if a systematic change occurred, the Conservative Dual Criterion will be used (Fisher et al., 2003). As an extension to that first question, the second question will also make use of a comparative analysis of the graphs for each individual, and a descriptive analysis will highlight which of the two treatments implemented, that is, the fidget toy and the inflatable cushion, produced the best result. The graphs for both treatments, B and C, therefore, have to be placed side by side to evaluate the tendency of each graph and choose the most effective treatment for each participant. Table 1 below provides a summary of the data analysis.

**Table 1** *Summary of the Data Analysis*

| No. | Research Questions | Instruments | Analysis |
|---|---|---|---|
| 1. | How does the use of sensory equipment affect the expressive language skills of students with Autism in the classroom? | • REEL-3 Checklist<br>• Observation Checklist<br>• Graphs Plotted | Comparative and Descriptive Analysis |
| 2. | Which sensory-integrated tool is the most effective in helping students with Autism to improve their expressive language skills in the classroom? | • REEL-3 Checklist<br>• Observation Checklist<br>Graphs Plotted | Comparative and Descriptive Analysis |

**Findings**

To distinguish between the different sessions conducted, the following labels were given.

A: Baseline phase

B: The fidget toy/Koosh ball first intervention

C: The wobbly inflatable cushion's first intervention

A: Back to the baseline (withdrawal of intervention treatment)

C': The inflatable wobbly cushion second intervention

B': The fidget toy/Koosh ball second intervention

**Participant X**

The line graph below in Figure 2.1 shows the recorded data for the six different phases of the ABCACB model;

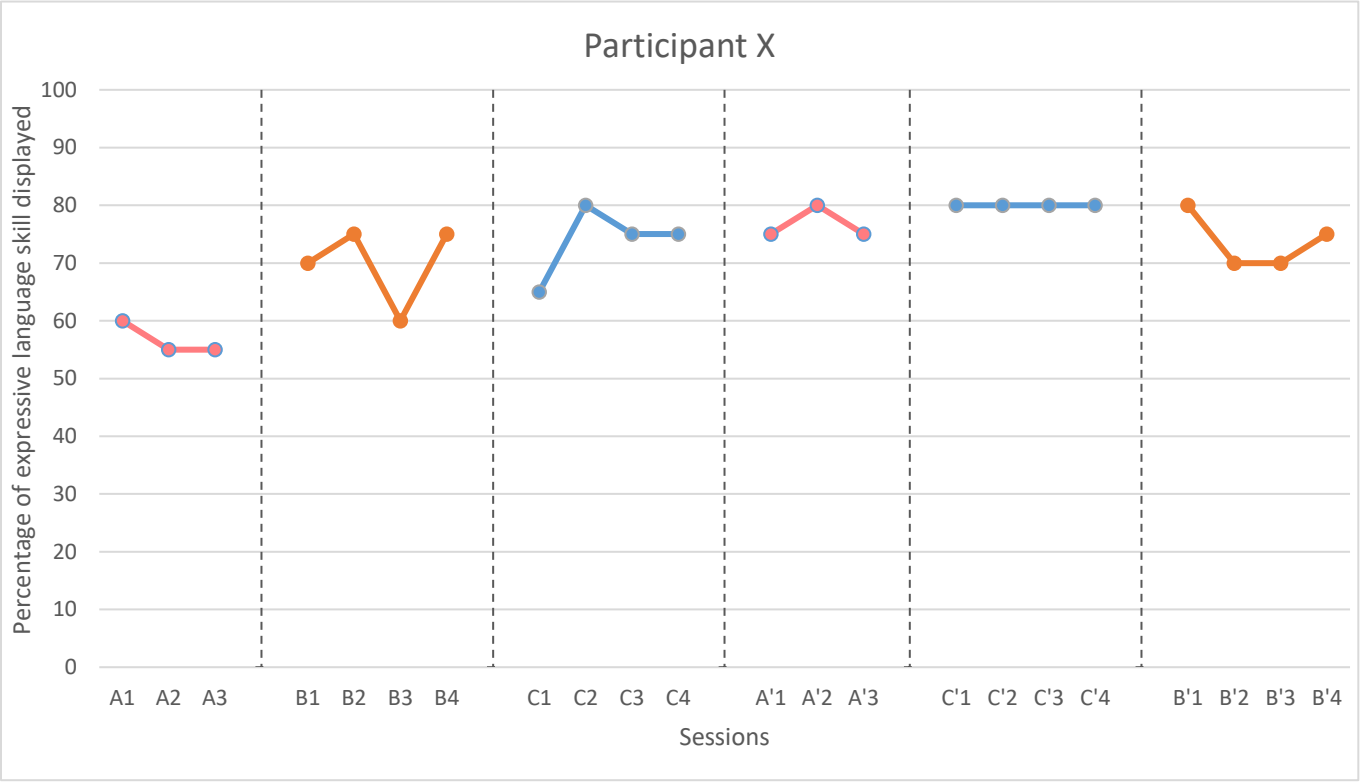



**Figure 2.1** *Line Graph of the ABCACB design of Participant X*

Similarly, Table 2.1 below describes the percentage received for each phase during the sensory integration sessions with Participant X;

**Table 2.1** *Percentage table for Participant X*

| No. | Session | Phase | Score on observation checklist | Percentage of expressive language skill (%) |
|---|---|---|---|---|
| 1 | A1 | Baseline (no treatment) | 6/10 | 60 |
| 2 | A2 | | 5.5/10 | 55 |
| 3 | A3 | | 5.5/10 | 55 |
| 4 | B1 | The intervention of a fidget toy (Koosh Ball) | 7/10 | 70 |
| 5 | B2 | | 7.5/10 | 75 |
| 6 | B3 | | 6/10 | 60 |
| 7 | B4 | | 7.5/10 | 75 |
| 8 | C1 | The intervention of a wobbly inflatable cushion | 6.5/10 | 65 |
| 9 | C2 | | 8/10 | 80 |
| 10 | C3 | | 7.5/10 | 75 |
| 11 | C4 | | 7.5/10 | 75 |
| 12 | A'1 | Back to baseline (withdrawal of treatments) | 7.5/10 | 75 |
| 13 | A'2 | | 8/10 | 80 |
| 14 | A'3 | | 7.5/10 | 75 |
| 15 | C'1 | The intervention of inflatable wobbly cushion | 8/10 | 80 |
| 16 | C'2 | | 8/10 | 80 |
| 17 | C'3 | | 8/10 | 80 |
| 18 | C'4 | | 8/10 | 80 |
| 19 | B'1 | Intervention of fidget toy (Koosh Ball) | 8/10 | 80 |
| 20 | B'2 | | 7/10 | 70 |
| 21 | B'3 | | 7/10 | 70 |
| 22 | B'4 | | 7.5/10 | 75 |

The highest score obtained for Participant X in displaying the expressive language was of 80% at different points in the study, but mainly during the use of the inflatable wobbly cushion. The lowest score throughout the research, being of 55% was found at the beginning, that is at the baseline of the study.

**Participant Y**

The total number of sessions conducted with Participant Y on the expressive language skill of "using double adjectives and noun phrases" was 23 sessions. Compared to Participant X, Participant Y required another session of the first intervention of the fidget toy treatment to ensure more consistent results.

The line graph below in Figure 2.2 shows the recorded data for the six different phases of the ABCACB model.

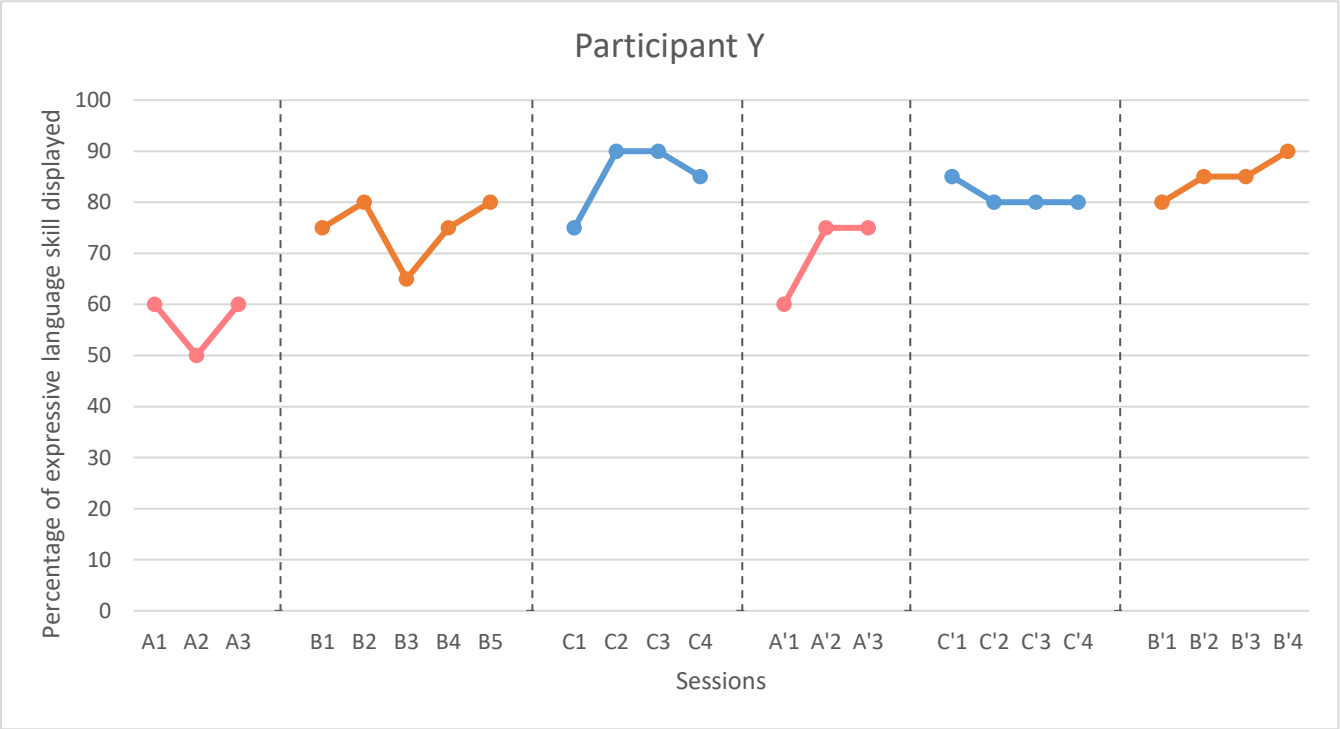



**Figure 2.2** *Line Graph of the ABCACB design of Participant Y*

Furthermore, Table 2.2 below describes the percentage received for each phase during the sensory integration sessions with Participant Y;

**Table 2.2** *Percentage table for Participant Y*

| No. | Session | Phase | Score on observation checklist | Percentage of expressive language skill (%) |
|---|---|---|---|---|
| 1 | A1 | Baseline (no treatment) | 6/10 | 60 |
| 2 | A2 | | 5/10 | 50 |
| 3 | A3 | | 6/10 | 60 |
| 4 | B1 | Intervention of fidget toy (Koosh Ball) | 7.5/10 | 75 |
| 5 | B2 | | 8/10 | 80 |
| 6 | B3 | | 6.5/10 | 65 |
| 7 | B4 | | 7.5/10 | 75 |
| 8 | B5 | | 8/10 | 80 |
| 9 | C1 | Intervention of wobbly inflatable cushion | 7.5/10 | 75 |
| 10 | C2 | | 9/10 | 90 |
| 11 | C3 | | 9/10 | 90 |
| 12 | C4 | | 8.5/10 | 85 |
| 13 | A'1 | Back to baseline (withdrawal of treatments) | 6/10 | 60 |
| 14 | A'2 | | 7.5/10 | 75 |
| 15 | A'3 | | 7.5/10 | 75 |
| 16 | C'1 | Intervention of wobbly inflatable cushion | 8.5/10 | 85 |
| 17 | C'2 | | 8/10 | 80 |
| 18 | C'3 | | 8/10 | 80 |
| 19 | C'4 | | 8/10 | 80 |
| 20 | B'1 | Intervention of fidget toy (Koosh Ball) | 8/10 | 80 |
| 21 | B'2 | | 8.5/10 | 85 |
| 22 | B'3 | | 8.5/10 | 85 |
| 23 | B'4 | | 9/10 | 90 |

As shown from the results obtained from working on the expressive language skill of "using double adjectives and noun phrases", there is definitely an increase from the beginning of the research, that is the first session, and the end at the last session. Compared to Participant X, the results are more favourable for Participant Y.

The highest score obtained for Participant Y in displaying expressive language was of 90% at different points in the study, but especially during the intervention phases whereby the sensory tools were used. On the other hand, the lowest score throughout the research, being 50%, was found at the beginning, at the study's baseline.

**Research Question 1: How does the use of sensory equipment affect the expressive language skills of students with Autism in the classroom?**

Fisher et al. (2003), came up with the Conservative Dual Criterion (CDC) to ensure the validity of systematic changes in studies such as single-subject research. CDC states that a certain number of data points need to be above two criterion lines, a level line and the trend line, to consider the effect as an increasing change.

Table 3 below shows the criteria required. The table was adapted from Fisher et al. (2003) which only shows the criteria for five data points and above. Since most of the measurements at the treatment phases of this study comprise of 4 data points, it will be assumed that four data points will also be needed above both criterion lines.

**Table 3** *Criteria for concluding that an intervention provides a systematic change.*

| No. of data points in the intervention phase | No. of points required above the two criterion lines to conclude a systemic change |
|---|---|
| 4 | 4 |
| 5 | 5 |
| 6-7 | 6 |
| 8 | 7 |
| 9-10 | 8 |
| 11-12 | 9 |
| 13 | 10 |
| 14 | 11 |
| 15-17 | 12 |
| 18-19 | 13 |
| 20-21 | 14 |

*Note.* Adapted from Fisher et al. (2003)

Henceforth, for the first sensory integrated tool, the fidget toy, Figure 3.1 and Figure 3.2 show the CDC criterion lines to evaluate any systematic change produced by the fidget toy on the expressive language of Participant X and Participant Y, respectively.

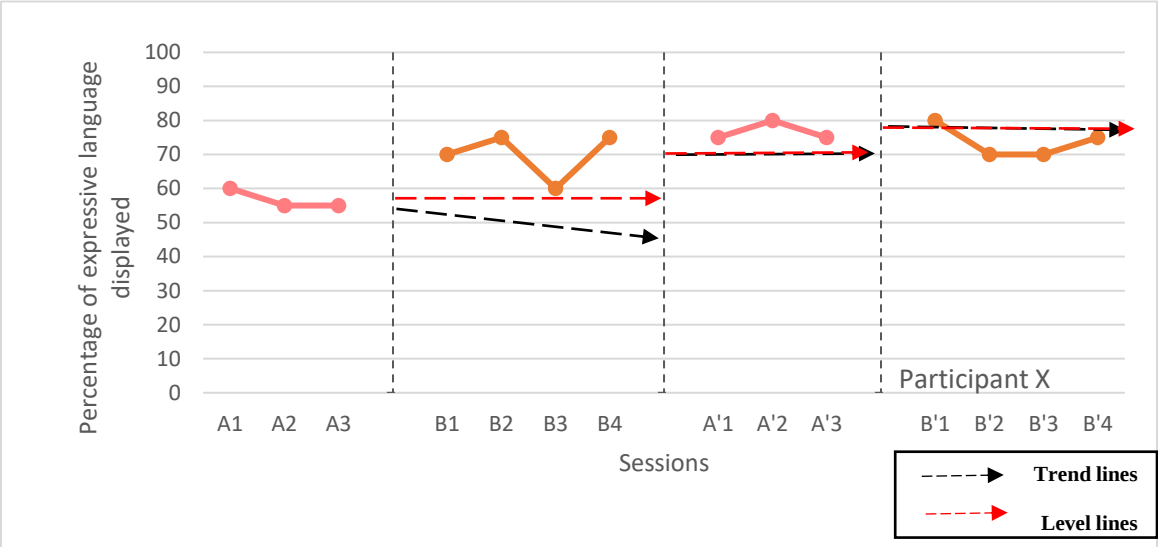



**Figure 3.1** *Graphic Display of the effect of the fidget toy as the sensory equipment, along with the CDC criterion lines, for Participant X.*

Although all four points in the B phase are above both CDC criterion lines, the second B' phase do not follow through, with 3 points being below both CDC criterion lines. Hence, the fidget toy did not provide much of a significant change on the expressive language of Participant X.

Moreover, it is clear that there is a significant increase in the second baseline (A'), showing that the fidget toy was not the leading cause of the increase in the expressive language ability of Participant X.

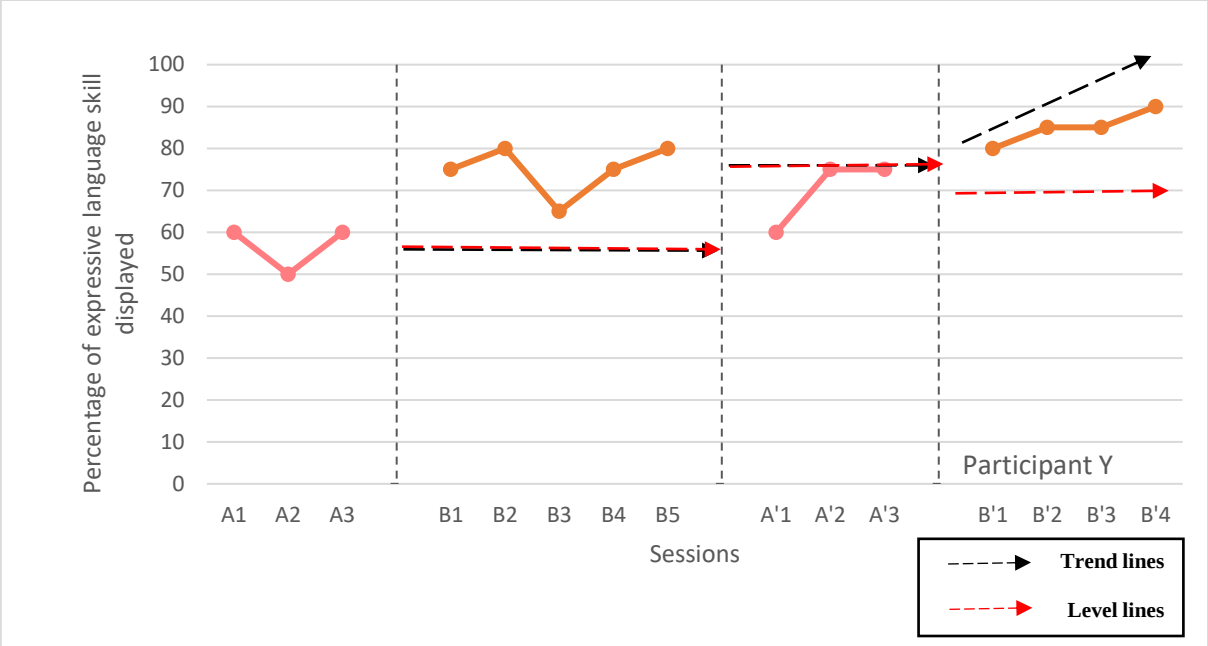



**Figure 3.2** *Graphic Display of the effect of the fidget toy as the sensory equipment, along with the CDC criterion lines, for Participant Y.*

In the first phase of the intervention (B), all five data points are above both CDC criterion lines, thus showing a significant change. However, in the second phase (B'), though all four points are over the level line, they remain below the trend line, thus the significant change at the second phase is discarded. Moreover, at the second baseline (A'), we can see with the CDC criterion lines that all three points are below both lines, hence confirming that the baseline did have a significant drop, which proves that the fidget toy was responsible for the change in the expressive language of Participant Y.

The two CDC criterion lines are repeated for the second sensory integrated tool, the wobbly inflatable cushion.

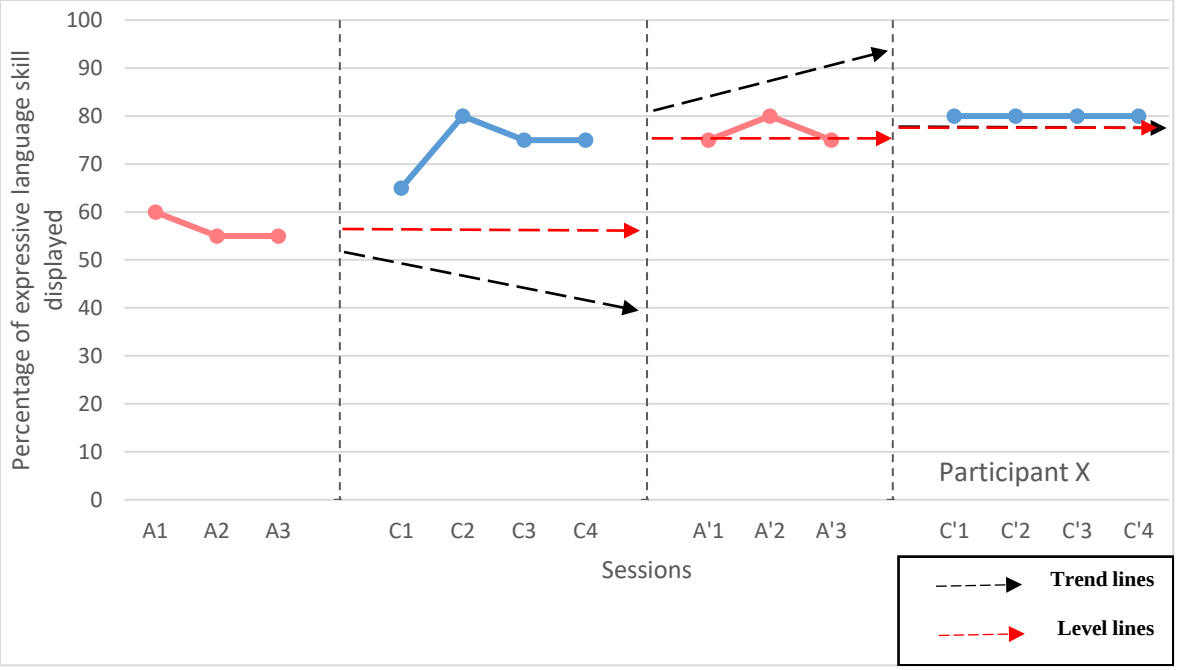



**Figure 3.3** *Graphic Display of the effect of the inflatable wobbly cushion as the sensory equipment, along with the CDC criterion lines, for Participant X*

Figure 3.3 shows that all four points for phases C and C' are above their two CDC criterion lines. Hence, it is concluded that the wobbly inflatable cushion has a significant, positive change in the expressive language of Participant X.

Although the second baseline (A') is below the trend line, the three points remain above and at the level line, hence there has not been much of a decrease in the baseline upon the withdrawal of treatment, thus showing that the intervention might not have been the single cause of change in the expressive language.

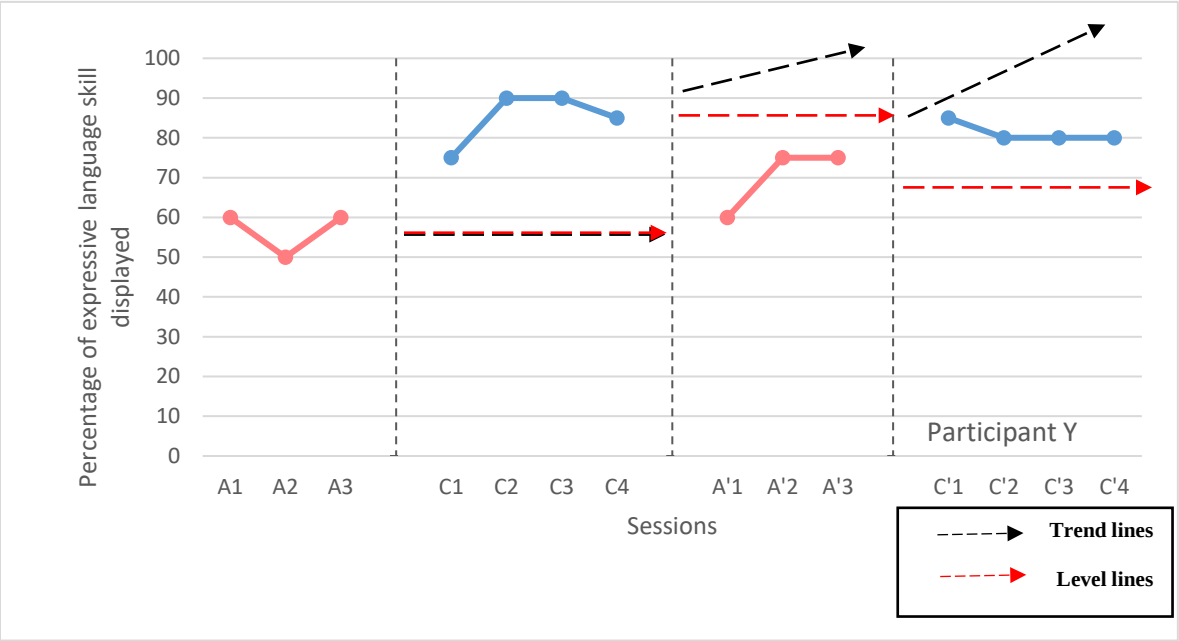



**Figure 3.4** *Graphic Display of the effect of the wobbly inflatable cushion as the sensory equipment, along with the CDC criterion lines, for Participant Y*

For Participant Y, the wobbly inflatable cushion significantly impacted his expressive language skill in the first phase (C). In addition, the significant drop in the second baseline (A') proves that the intervention made a difference in the expressive language skill of Participant Y.

Similar to Figure 3.2, the second intervention phase (C') does not present a significant change as the first (C). This is because the four points are above the level line, and they remain under the trend line. Hence, this can be discarded.

**Research Question 2: Which sensory-integrated tool is the most effective in helping students with Autism to improve their expressive language skills in the classroom?**

Figure 4.1 and Figure 4.2 show line graphs of the ABCA intervention phase data of Participant X and Participant Y. The line graphs, therefore, include the baseline data before any of the two treatments were added. For example, in orange, the intervention data for the fidget toy, Koosh Ball, is shown; in blue, the intervention data for the wobbly inflatable cushion is shown. Lastly, the line graph added the A' phase, where the integrated sensory tools were removed, and another baseline was measured.

Moreover, the line graphs also included the trend lines for each phase, hence giving a better visual representation of whether there is an increase, a decrease or no change in the data.

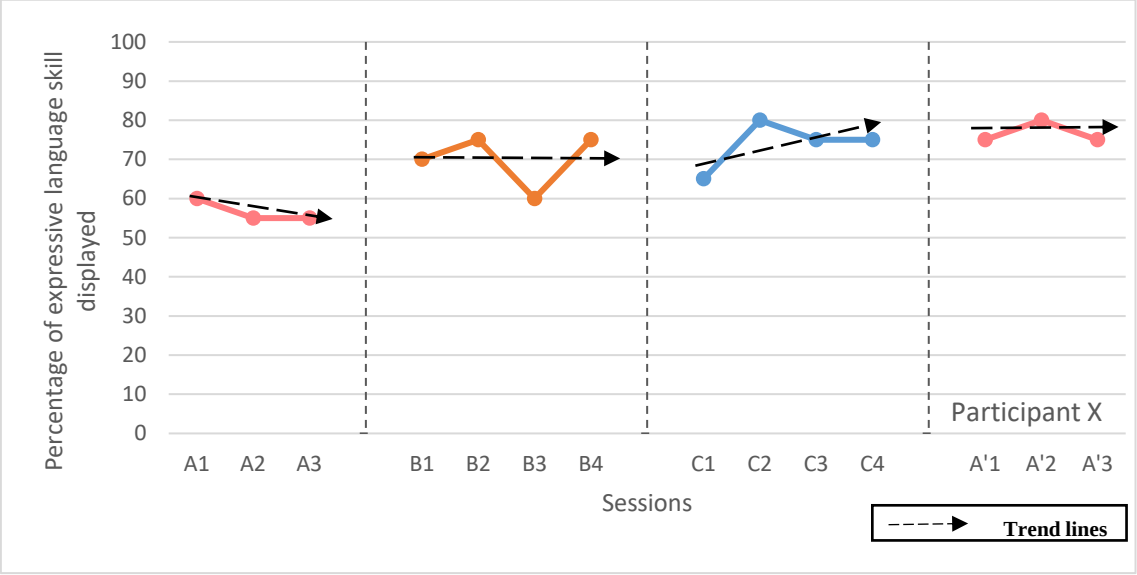



**Figure 4.1** *Graphic Display of the intervention treatments during the first intervention phase for Participant X*

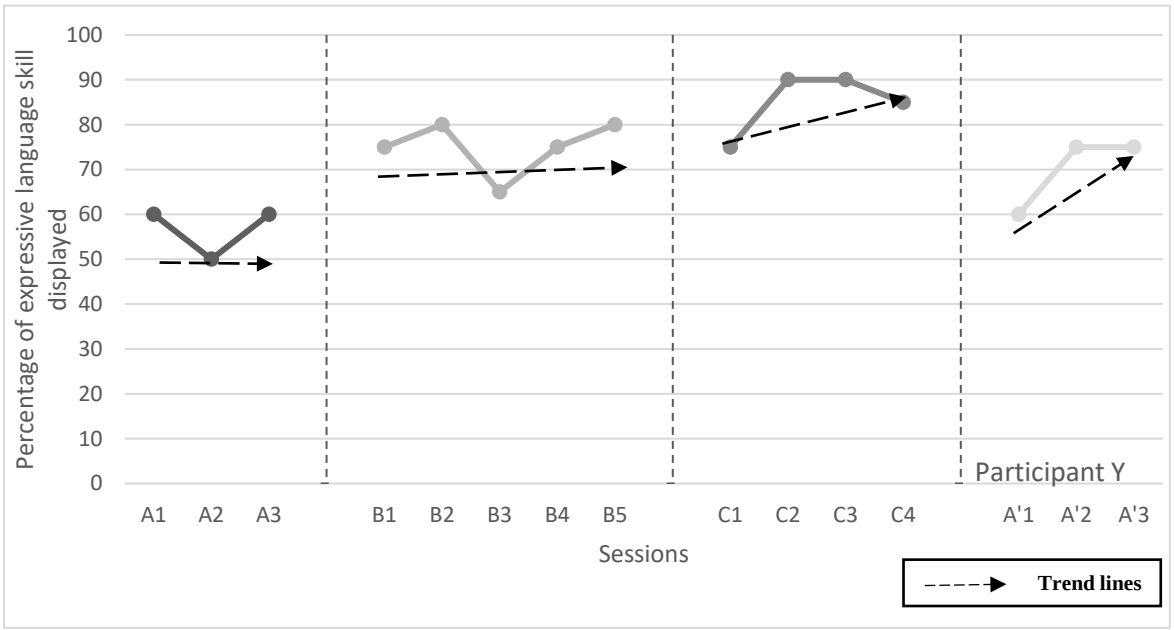



**Figure 4.2** *Graphic Display of the intervention treatments during the first intervention phase for Participant Y*

According to Figure 4.1 and Figure 4.2, the trend lines for the wobbly inflatable cushion (C) show a greater degree of increase than for the fidget toy (B). We can therefore say that the inflatable cushion toy is more promising for both Participant X and Participant Y in this ABCA design.

Below, Figure 4.3 displays the intervention data for the second phase, the A'C'B' model for Participant X.

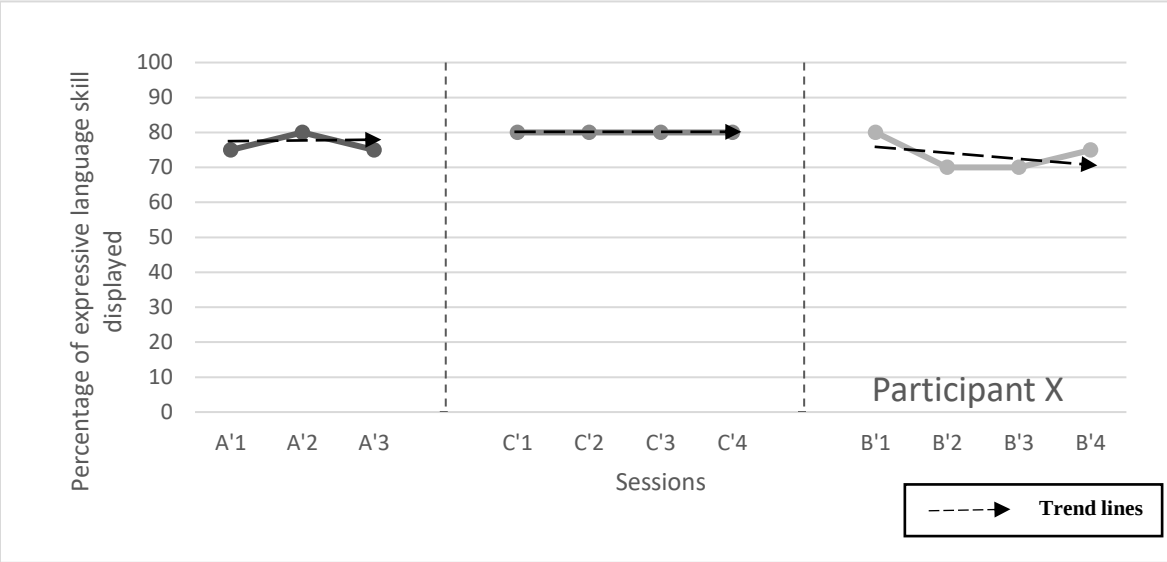



**Figure 4.3** *Graphic Display of the intervention treatments during the second intervention phase for Participant X*

Once again, for Participant X, the second intervention phase seems to show more promising results with using the wobbly inflatable cushion than with the fidget toy. The trend line of the fidget toy seems to have decreased, and thus, overall, the wobbly inflatable cushion is more effective for Participant X.

The second intervention phase, A'C'B', for Participant Y is also displayed in Figure 4.4 below.

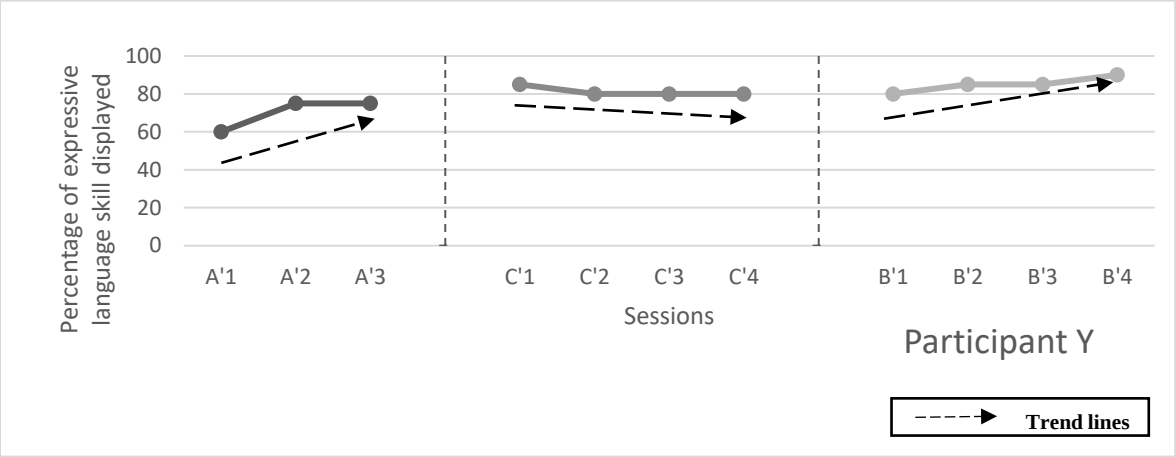



**Figure 4.4** *Graphic Display of the intervention treatments during the second intervention phase for Participant Y*

Contrary to Figure 4.2, the fidget toy seems to have a more promising increase according to the trend lines shown. In this second half of the research (A'C'B'), the use of the Koosh Ball has brought about a more positive change in the expressive language of Participant Y, than for the wobbly inflatable cushion.

## 5. Discussion

**Research Question 1: How does the use of sensory equipment affect the expressive language skills of students with Autism in the classroom?**

From a visual perspective, the graphic displays show a rather promising impact of the sensory equipment, which are both the fidget toy and the inflatable wobbly cushion, on both participants.

**Participant X:**

After six weeks of learning about simple present and future tenses with feminine and masculine markers, the researcher found out that the student can classify male and female toys and verbally distinguish if the latter is a boy or girl. However, she needs prompting to form the phrase "He is a boy" and "She is a girl". The student also does not seem to clearly understand the difference between the pronouns 'he' and 'she'. As for the simple present and future tense, Participant X already has a clear understanding of using a correct

verb in the proper tense to describe an action, but this was only when the researcher prompted her with the respective question, such as "What is the boy doing now?" "What will the boy do after?".

Aside from the graph displays and the results of the observation checklist, the researcher also took observational notes which helped to review and improve the activities as well. In fact, single-subject research does not rely only on statistical graphs but also on visual inspection (Price et al., 2015). The researcher then discussed with the class teacher and found out about the cultural difference which also caused Participant X to say the correct gender all along, but which was perceived as the opposite by the researcher.

From an analytical perspective of the graph, the results have shown an increase in the expressive language of Participant X while using both treatments. However, for both cases, the CDC criterion line show that the second baseline (A') was not decreasing as much as it should, thus the impact of the sensory equipment on the student's progress can be questioned.

In fact, as much as the sensory tool could have helped with the student's progress, there is also a possibility that the change in the learning plan helped produce better outcomes.

**Participant Y:**

As participant Y worked on the use of double adjectives and noun phrases, he first started the sessions without any knowledge of any adjective or their use, and by the end of the 23 interventions, he developed great abilities to become descriptive and made use of adjectives in his narratives.

While Participant Y starts to hyperfocus, the researcher could see that he is easily distracted and deviates from the essential, of using adjectives. Nevertheless, since the introduction of the integrated sensory tools, it was observed that he was able to better manage his hyperfocus and concentrate, thus showing a positive effect of the sensory tool. This was the intended outcome of the sensory equipment as the sensory integration activities help individuals not only to regulate their emotions associated with the sensory stimulus around them, but also the sensory information perceived, thus making it easier for them to draw their attention towards the verbal task, and respond accordingly (Laurent & Gorman, 2017).

In both Figure 3.2 and Figure 3.4, the second intervention phases of the sensory tools (B' and C') are not above the two CDC criterion lines. Therefore, it was not considered as a significant change. This observation could be possibly explained due to the nature of repetition of the sessions. Though the researcher tried to vary the learning activities and learning materials, it could be that Participant Y still experienced some boredom from not being challenged enough after so many intervention sessions.

Regardless, the increase in the expressive language skill is still promising of the effectiveness of the sensory-integrated equipment.

**Research Question 2: Which sensory integrated tool is the most effective in helping students with Autism to improve their expressive language skills in the classroom?**

When comparing the two sensory integrated tools used in this research, we can observe different results from the two participants. In other types of research, this difference in results could be viewed as a failure of reaching the research objectives, but since this study uses a single-subject method, the difference in results is actually an embracement of the uniqueness of individuals. In fact, single-subject research is known for its focus on individual participants instead of generalizing the results for a group (Richards, 2018).

**Participant X:**

When considering the two sensory integrated tools with Participant X, the trend lines from the graphic Display show that the inflatable wobbly cushion was more effective than the fidget toy, even though the significant change in the expressive language may be subject to other factors such as the learning materials used, or learning intervention used, rather than the use of the equipment itself.

Furthermore, as discussed above, the researcher's observational notes also demonstrated that the student did not show much interest in the fidget toy ~~anyway hence~~ since much more progress and change was observed from the cushion. From the visual observations made by the researcher, Participant Y also enjoyed the inflatable wobbly cushion as she was seen wiggling on it. Such cushions offer individuals a sense of deep pressure and vestibular input, giving the sensory stimulation needed for the brain to process the verbal information given by the surrounding (Seifert & Metz, 2016).

The progress in the expressive language and effectiveness of the sensory integrated activities were not as apparent with Participant X than with Participant Y. This can possibly be explained due to the level of needs of Participant X. ~~since~~ The boy is more high functioning than the girl and the latter ~~also~~ has been diagnosed with some cognitive limitations, ~~hence making~~ which makes it more difficult for her to progress as much as the other participant.

**Participant Y:**

Contrary to Participant X, Participant Y has experienced the positive effects both with the Koosh Ball and the inflatable cushion. He also demonstrated more significant interest in using the Koosh Ball, as he

acknowledged the sensory tool as a way for him to concentrate and focus on what he has to say and the task he has to complete.

Koosh Balls, or any other fidget toy, allow individuals to concentrate as they offer tactile self-soothing that does not require the brain's attention. This makes it easier for the person to pay attention to the verbal task and respond accordingly (Bura, 2019).

Both tools have demonstrated a significant increase from the baseline, but when comparing the graphs in Figure 4.2 and Figure 4.4, we can see that the Koosh Ball has more of an increase tendency to induce more feedback and interaction from the participant compared to the wobbly inflatable cushion, which bids a lesser impact to steady the state in the second intervention phase (C').

Therefore, for Participant Y, for one of the tools ~~has~~ to be proven ~~to be~~ more effective, we would say that he was more responsive with the Koosh Ball.

**6. Conclusions and Recommendations**

In light of the above exposé, SPD affects many students, especially those diagnosed with Autism, because the brain finds it difficult to process the sensory information, thus making the individuals react in ways which might not be viewed as appropriate according to society. Furthermore, since they experience that sensory information at different intensities and react adversely to them, this limits their opportunities to communicate with others and develop their expressive language skills.

As such, this research aimed to investigate the use of integrated sensory tools, following Ayres Sensory Integration Theory (1972) in developing the expressive language skills of two different participants in Mauritius. Using a single-subject research method, the researcher explored the effects of the use of a fidget toy, known as the Koosh Ball, and of a wobbly inflatable cushion.

The study was able to receive better insight on the effectiveness of the tools on each participant and to observe the uniqueness of each student since not all strategies work the same for individuals with disabilities. Nevertheless, the integrated sensory tools proved valuable in increasing the students' expressive language skills, and their use should therefore be encouraged in the field of education.

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