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Frequency and duration of manipulative actions in the act of playing with cubes in children with low vision

Frequência e duração das ações manipulativas no ato de brincar com cubos em crianças com baixa visão

Frecuencia y duración de las acciones manipulativas en el acto de jugar con cubos en niños con baja visión

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This is a cross-sectional/observational study. It aimed to analyze the frequency and duration of manipulative actions of children when exploring cubes of different sensory stimuli (light, auditory, tactile, high-contrast, transparent and black) . Seven children with low vision and seven with normal vision (8.8 years ± 1.02) were evaluated. The children were filmed during the act of playing with the cubes. For the group I, there was a significant difference in the high contrast (p = 0.031) and tactile (p = 0.017) cubes for the manipulative action of shaking the cube. For the group II, significant results occurred in the action of turning (p = 0.047) the luminous cube and in the action of removing hands (p = 0.006) in the tactile cube. There was no difference in the general average of frequency and manipulation time of the cubes. The cubes with tactile and high contrast stimuli were favorable to stimulate children with low vision from 7 to 10 years of age.
Descriptors: Vision, Low; Child development; Motor skills.

Trata-se de um estudo transversal/observacional, com o objetivo de analisar a frequência e o tempo de permanência das ações manipulativas em crianças ao explorar cubos de diferentes estímulos sensoriais (estímulo luminoso, auditivo, tátil, de alto contraste, transparente e preto). Foram avaliadas sete crianças com baixa visão e sete sem baixa visão (8,8 anos ±1,02). As crianças foram filmadas durante o ato de brincar com os cubos. No grupo I, houve diferença significativa nos cubos de alto contraste (p=0,031) e tátil (p=0,017) para a ação manipulativa de agitar o cubo. No grupo II, o resultado significativo ocorreu na ação de girar (p=0,047) o cubo luminoso e na ação de retirar as mãos (p=0,006) no cubo tátil. Não houve diferença na média geral da frequência e no tempo de manipulação dos cubos. Os cubos com estímulos tátil e de alto contraste foram favoráveis para estimular crianças com baixa visão dos 7 aos 10 anos de idade.
Descritores: Baixa visão; Desenvolvimento infantil; Destreza motora.

Se trata de un estudio transversal/observacional, con el objetivo de analizar la frecuencia y la duración de las acciones manipulativas en los niños al explorar cubos de diferentes estímulos sensoriales (estímulo luminoso, auditivo, táctil, de alto contraste, transparente y negro). Se evaluaron siete niños con baja visión y siete sin baja visión (8,8 años ± 1,02). Los niños fueron filmados mientras jugaban con los cubos. En el Grupo I, hubo una diferencia significativa en los cubos de alto contraste (p=0,031) y táctil (p=0,017) para la acción manipulativa de agitar el cubo. En el Grupo II el resultado significativo fue en la acción de girar (p=0,047) el cubo luminoso y en la acción de quitar las manos (p=0,006) del cubo táctil. No hubo diferencias en la frecuencia y el tiempo medio de manipulación de los cubos. Los cubos con estímulos táctil y de alto contraste fueron favorables para estimular a los niños con baja visión de 7 a 10 años.
Descriptores: Baja visión; Desarrollo infantil; Destreza motora.

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INTRODUCTION

Playing can be defined as a spontaneous action, commanded and controlled by the child, consisting of flexibility and pleasure, allowing new combinations of ideas and behaviors[1]. When playing, the child has the possibility of exposing their emotions, mastering impulses, growing their field of experiences and social contact[2], since it helps in the development and improvement of body movements that are named and grouped in a set called motor actions[3].

The child's functionality and independence are closely related to motor development and the manipulative skills acquired during their evolution[4]. The act of playing allows the child to improve the manipulative actions that are already part of their motor repertoire and acquire new actions, through experience-experiences and contact with different objects, expanding his range of movements[5].

Children with visual impairment may, in some cases, not have sufficient motivation to explore their surroundings, due to lack of adequate stimulation, causing delays in motor development and in the acquisition of their independence[6]. The act of playing can be used as a stimulation tool, since play is a natural action of imagination and spontaneity[7]. Another element that may or may not be inserted in the act of playing, and that contributes significantly to the stimulation and development of the visually impaired child, are toys. This object is constituted by physical or sensory characteristics variables, which contributes to stimulate the child, enabling greater exploration of the environment, improving and acquiring new skills[8].

In stimulating children with visual impairments, stimuli that work with other remaining senses, in addition to the child's visual remains[9], should be used. One of the senses that assists the child in exploring the environment is touch and physical properties of objects (such as large cubes), which allows the generation of positive results in the acquisition and improvement of motor actions[3].

Around 1.4 million children are visually impaired worldwide. Of this total, 90% are from developing countries[10]; and 20% of schoolchildren have a vision disorder with biological, social or environmental etiology[11]. In childhood, the ocular system and the pathways for conducting visual impulses are developing, and contrast-related sensitivity is being advanced. And after 2 years of age, the myelination of the optic nerve is complete[12]. During development, it is necessary to assess the perceptual-visual reactions that will result in a visomotor response to possible reactions (fixation, follow-up, exploration), in which they undergo changes and adaptations according to the chronological age of each child[10].

A study with 3-year-old children showed that the frequency of motor actions of children with low vision and normal vision, with 3-year-old children, by analyzing the manipulation of cubes with visual stimuli (light and high contrast)) and without visual stimuli (transparent and black). The authors found that the high-contrast cube stimulated children with low vision to perform more motor actions, such as bimanual reach and rotating the cube. And they identified similarities in motor actions between children with and without low vision, showing that they are able to interact with the external environment[3].

The aim of the present study was to analyze the frequency and duration of manipulative actions in children when exploring cubes of different sensory stimuli (luminous, auditory, tactile, high contrast, transparent and black stimuli).

METHOD

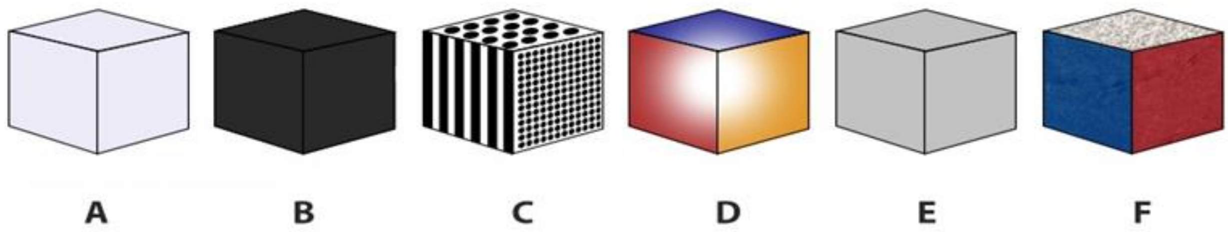
This is a cross-sectional and observational study, conducted in 2019 with children aged 7 to 10 years, in the city of Uberaba. The study was approved by the Ethics Committee of the Universidade Federal do Triângulo Mineiro (2,694,915/2018).

The inclusion criteria for the group with low vision (group I) were: both genders, aged 7 to 10 years, ophthalmological diagnosis of low vision and no other associated disability condition (intellectual, neurological, orthopedic, deafness) and history of convulsive crises), attending institutions specialized in people with visual impairment and authorization from parents or guardians to participate in the study. Due to the difficulty of obtaining a homogeneous sample, children with low vision were selected for convenience. The group without low vision (group II) was composed of children without neurological, orthopedic, sensory and cognitive changes, (especially without visual changes) of both gender, aged 7 to 10 years, with the consent of their parents or guardians. and recruited randomly at a local state school, ensuring that age and gender are matched.

This research adopted the methodology carried out in the study by Schmitt & Pereira (2014, 2016)[3], in which the motor actions of children with low vision, from 3 years to 3 years and 10 months were characterized and quantified, requiring adaptations based on in the new anthropometric profile of the children in the present study.

During the evaluation, cubes with the following specifications were used: 6 cubes (15cm x 15cm and 410g) (Figure 1): (A) acrylic cube (transparent); (B) cube without contrast (black color); (C) cube with different high-contrast stimuli in white and black; (D) cube with light stimulus inside, two of the opposite faces were coated with transparent material and the others in yellow, blue, green and red; (E) cube with auditory stimulus, with the presence of a rattle and coated with light gray paper inside it and (F) cube with tactile stimulus, presenting on each of the six faces a texture of different materials, among them: soft, wavy (small and larger), coarse and wrinkly.

Figure 1. Representation of cubes; Uberaba, 2020.



Key: A: Transparent cube; B: Black cube; C: High-contrast cube; D: Luminous cube; E: Auditory cube; F: Tactile cube
Source: Oliveira C, Silva PQN, Pelizaro BP, Pereira K, 2020[14].

Two digital cameras were used to record the manipulative actions of the children while playing with the cubes. A Samsung® camera (DVD SC-DX 103) was placed on a tripod (PowerPack - trip 21) and a GoPro® Hero 3+ Black camera was located laterally, allowing to view the entire evaluation. The standardization of height, distance and angulations was determined by means of a pilot study allowing the measures to be adjusted according to the children's anthropometric profile. In addition, two square rubber mats (1m x 1m x 3cm) and a digital stopwatch were used.

The collection was carried out in the months of April and May 2019, by a trained and guided evaluator, in rooms with harmonious conditions of lighting, temperature and noise. At each evaluation, the six cubes were randomized in sensory stimulation and face to be made available to each child, which were organized and positioned next to the evaluator to make it easier for the child during the delivery or orders.

At the beginning of the evaluation, the evaluator interacted with the child asking about their favorite games and toys, in order to reassure them and promote a pleasant evaluation. During the assessment, the child should sit cross-legged in front of the examiner so that the cubes are delivered on the mat in the child's medial region. Each cube was made available to the child for 40 seconds, with the interval between the delivery of one cube and another being

10 seconds. In the first seconds a verbal command was applied to encourage the child to explore the cube: *Let's get to know this toy?* This same procedure was carried out with all the cubes.

The footage was analyzed using the BSPlayer Profile program. At first, the speed was reduced by 70% below normal speed, to facilitate identification of manipulative actions performed by the children in each of the cubes. Then, it returned to normal speed to calculate the time the child spent manipulating the cube, and this time was calculated within the 40 seconds already established, with no accounting in milliseconds.

The motor actions counted in each cube are part of two studies[13,14]. The new actions presented in the study: Manipulative actions and the act of creating games with cubes in children with and without low vision, are in the table below (Chart 1).

Chart 1. Manipulative actions and the concepts of the actions performed by the children of both groups. Uberaba, 2020.

Manipulative actions	Concepts
Support the cube on one of its edges	Rotational movement of the cube remaining on only one of its edges
Approach the eyes to the cube	Movement approaching the eyes to the cube
Hold the cube with only one hand	Movement of supporting a cube, without it having contact with the ground, with only one hand
Touch the cube with the face	Movement of approaching the face to the cube in order to touch it

Source: Oliveira C et al.[14].

The dependent variables of the study were frequency of motor actions and length of permanence with a given cube; the independent variables: low vision and normal vision group; and the moderating variables: cubes with visual stimulus (high-contrast and bright, tactile, auditory) and without visual stimulus (transparent and black).

To perform the data analysis we used the tool Statistical Package for the Social Sciences (SPSS® 20.0), considering the significance level of 5% ($p \leq 0.05$). The data to verify frequency of manipulative actions per cube were presented in a descriptive way: median of central tendency (mean and median) and dispersion (standard deviation, measure of dispersion - minimum and maximum), absolute and relative frequency.

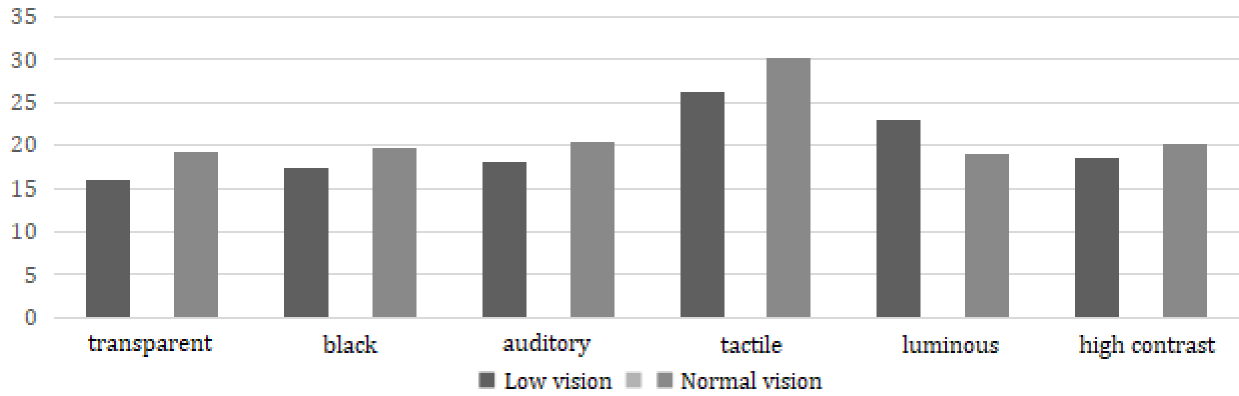
The Shapiro-Wilk normality test was applied to verify data distribution and the hypothesis of normality was not accepted for all variables, so for some variables the t test (with normality) was used and in others the Mann-Whitney test (not normal) to compare the results of the frequency of motor actions between the cubes and groups.

RESULTS

Fourteen children participated in the study, seven with clinical diagnosis of low vision and seven without low vision (8.8 years ± 1.02).

Regarding the average frequency of manipulative actions in each cube, by children, there was no significant difference between group I and group II. However, it is possible to observe that the tactile and high-contrast cube stood out in relation to the others, in group I (figure 2).

Figure 2. Frequencies of motor actions performed by children in each cube. Uberaba, 2019.



As for the frequency of each manipulative action in the cubes, there was a significant difference in group I for the manipulative action of shaking in the high-contrast cube ($p = 0.031$) and in the tactile cube ($p = 0.017$). In relation to group II, the significant result occurred in the action of turning ($p = 0.047$) the luminous cube and in the action of removing the hands ($p = 0.006$) in the tactile cube (Table 1).

When analyzing the average length of stay of each cube in seconds by the children (Figure 3), it was not possible to choose a significant difference between group I and group II.

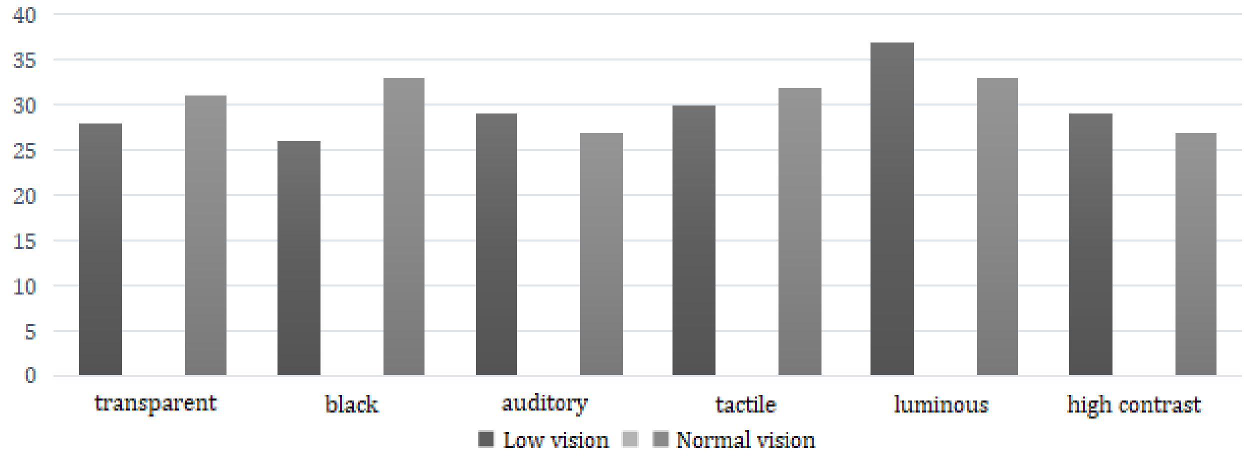
Table 1. Frequency of motor actions performed by Groups I and II in the four cubes. Uberaba, 2019.

Cubes	Groups	Freq	Put away	Shake	Bimanual Reach	Unimanual Reach	Approach	Bang with the cube	Bang the cube	Slide	Rotate	Throw	Support on one of its edges	Withdraw one hand	Approach the eyes to the cube	Hold with one hand	Touch the cube with the elbow	Touch the cube with the face
Transparent	I	Min; Max	0;1	0;2	0;3	0;1	0;4	.	0;3	0;1	2;10	0;3	1;6	0;2	0;1	0;1	.	.
		Mean	0.43	0.96	1.14	0.29	2.29	.	0.86	0.29	5.29	0.57	3.14	0.57	0.14	0.14	.	.
		p	0.827	.	0.297	.	0.684	.	0.872	0.872	0.058	0.476	0.823	0.37	1	0.476	.	.
	II	Min; Max	0;2	.	1;4	.	0;6	.	0;5	0;2	5;15	0;1	0;7	0;3	0;1	0;2	.	.
		Mean	0.57	.	1.71	.	1.86	.	1.14	0.43	8.71	0.14	2.86	1.14	0.14	0.43	.	.
		p	0.827	.	0.297	.	0.684	.	0.872	0.872	0.058	0.476	0.823	0.37	1	0.476	.	.
Black	I	Min; Max	0;1	0;3	1;2	0;1	0;3	0;1	.	0;2	0;16	.	.	0;1	.	0;4	.	.
		Mean	0.14	1.14	1.14	0.14	0.71	0.14	2.14	0.71	7.51	0.86	2	0.14	.	0.57	.	.
		p	0.53	0.08	0.476	0.53	.	.	0.831	0.943	0.601	.	0.236	0.073	.	0.656	.	.
	II	Min; Max	0;1	0;1	1.3	0;1	.	.	0;5	0;9	4;13	.	0;9	0;5	.	0;1	.	.
		Mean	0.29	0.29	1.43	0.29	.	.	1.43	1.57	9	.	3.71	1.43	.	0.29	.	.
		p	0.53	0.08	0.476	0.53	.	.	0.831	0.943	0.601	.	0.236	0.073	.	0.656	.	.
Luminous	I	Min; Max	0;1	0;1	1;2	0;2	0;7	.	0;2	0;3	4;9	.	0;10	0;2	0;4	0;2	.	.
		Mean	0.14	0.29	1.29	0.29	3	.	0.57	0.86	6.57	.	3.71	0.57	0.86	0.29	.	.
		p	1	.	0.496	.	0.054	.	0.656	0.748	0.047	.	0.445	0.393	0.943	0.593	.	.
	II	Min; Max	0;1	.	1;3	.	0;2	.	0;4	0;2	6;14	.	2;9	0;4	0;2	0;2	.	.
		Mean	0.14	.	1.57	.	0.71	.	0.57	0.43	9.57	.	5	1.14	0.57	0.43	.	.
		p	1	.	0.496	.	0.054	.	0.656	0.748	0.047*	.	0.445	0.393	0.943	0.593	.	.
Auditory	I	Min; Max	.	0;10	1;2	0;1	3;0	.	0;4	0;2	0;19	0;1	0;5	0;2	.	.	.	.
		Mean	.	3.49	0.37	0.48	1.34	.	1.43	0.57	8.57	0.14	1.43	0.71	.	.	.	.
		p	.	0.948	0.5	0.656	0.782	.	0.378	0.496	0.483	.	1	0.784	.	.	.	.
	II	Min; Max	0;1	0;7	0;3	0;2	0;2	.	0;7	0;1	5;17	.	0;4	0;4	.	.	.	.
		Mean	0.14	2.43	1.43	0.29	1	.	1	0.29	10.86	.	1.71	1.29	.	.	.	.
		p	.	0.948	0.5	0.656	0.782	.	0.378	0.496	0.483	.	1	0.784	.	.	.	.

High contrast	I	Min; Max	0;1	0;2	1;3	0;1	0;5	.	0;6	0;1	5;16	0;9	0;10	0;3	0;1	0;1	.	.
		Mean	0.29	1	1.29	0.14	1.57	.	1.71	0.43	10.29	1.57	3.86	0.43	0.14	0.29	.	.
		p	1	0.031 *	0.593	0.917	0.08	.	0.173	0.521	1	.	0.399	0.199	0.423	0.656	.	.
	II	Min; Max	0;1	0;1	1;3	0;2	0;1	.	0;2	0;4	5;15	.	0;7	0;1	0;2	0;5	.	.
		Mean	0.29	0.14	1.43	0.29	0.29	.	0.29	1.43	10.29	.	2.71	0.57	0.57	0.71	.	.
		p	1	0.031	0.593	0.917	0.08	.	0.173	0.521	1	.	0.399	0.199	0.423	0.656	.	.
Tactile	I	Min; Max	0;1	0;4	1;3	0;12	0;2	.	.	1;15	4;22	0;13	0;3	0;1	0;1	0;2	.	.
		Mean	0.14	2	1.57	2.43	0.43	.	.	6.29	8.57	3.71	0.43	0.14	0.14	0.43	.	.
		p	0.53	0.017 *	0.218	0.424	0.476	.	.	0.297	0.084	0.2	0.262	0.006 *	0.53	0.657	.	.
	II	Min; Max	0;1	0;1	1;3	0;1	0;1	.	0;21	0;7	6;26	0;1	0;7	0;3	0;1	0;3	.	0;1
		Mean	0.29	0.43	2	0.14	0.14	.	4.86	4.14	13.71	0.14	1.71	1.86	0.29	0.43	.	0.14

Key: I (Low vision group); II (Normal vision group); Freq (Frequency); Mín (Minimum); Max(Maximum). Motor action not performed. (*) Significance level (p≤0.05). Spin luminous cube (p=0.047), Shake high contrast cube (p=0.0031), Shake tactile cube (p=0.017) and withdrawn hands from tactile cube (p=0.006).

Figure 3. Average total time spent with eah cube by children with and without low vision. Uberaba, 2019.



DISCUSSION

It was found that the absence of difference between the two groups in relation to the general average of the frequency of manipulative actions in each cube, is a positive factor for children with low vision, showing, within their conditions and adaptations, they were able to perform activities such as children with normal vision[3,21].

However, when checking the frequency of each manipulative action in the cubes, there are differences in the manipulative actions in both group I and group II. The manipulative action rotate (luminous cube), stood out in group II because the child seeks new information in relation to the object in question and the lights present contribute to arouse greater interest in the object, causing greater repetitions in relation to handling.

Regarding group I, the manipulative actions highlighted (shaking cube and high-contrast cube) were similar to a study already carried out, in which it was found that the high-contrast stimulus stimulated children with low vision of 3 years of age to perform a greater number of motor actions[3]. The child is more sensitive to contrast, discriminating between neutral and similar colors[9]. The high contrast features strong colors with well-defined contours, which facilitates object recognition[3]. In this same study, no such finding was found for the tactile cube, which implies that children with low vision, between 7 and 10 years old, were more stimulated by different textures, generating more repetitions of the shaking actions.

The child uses manual exploration to obtain more information about a particular object, allowing perceptions such as shape, weight, texture and the initiative to perform manipulative actions, such as hitting, rotating, sliding, removing as many details as possible[15]. Thus, children with low vision in the present study performed more the action of rotating the cubes of high contrast and tactile than children without low vision, in order to discover the various types of stimuli presented in the shape of the cube (six sides). The high-contrast stimulus is characterized by well-defined contours and shapes that arouse children's interest in the object, resulting in a greater number of motor actions[16].

The tactile stimulus also stood out, a fact that can be justified by the age group, 7 to 10 years old, and by the different types of textures presented in the cube, stimulating new sensory interests. Another study analyzed how visually impaired children at the age of 3 learn to use the tactile sensory system, and showed that tactile exploration was more present when different textures were presented[17].

This stimulus helps to recognize sensations (unique to each individual) and to realize in the mind the awareness of what they are really touching[18]. The child with low vision, in the exploration of objects, performs an act of reorganization, using in addition to the residual vision the tactile sense, perceiving with better efficiency the object in question[13]. The tactile cube presents different textures, which arouses the child's greatest interest in the search for information, using all their sensory senses in an integrated way in the search for new discoveries and that will enrich their experiences with the environment and contribute to the improvement and acquisition of new manipulative actions.

The fact that there is no relevant result in the analysis of the average length of stay of each cube in seconds by the children corroborates the statement made in observing the general frequency of manipulative actions.

In the analysis of Table 1, Figure 2 and Figure 3, it is clear that children with low vision have an effective result when compared to children with normal vision when handling cubes with different stimuli. This perception corroborates a study[3] in which children with severe visual impairment have similar performance when compared to children with normal vision when exploring cubes and that low vision should not be considered a limiting factor for children.

The handling of objects, which can be performed by playing, contributes to the child's development, enabling new discoveries. Since the act of playing allows children, in a unique way, to use creativity and integral personality, thus discovering its potential[9].

Children with any abnormalities in the visual system should be stimulated early. For this, early diagnosis and intervention should occur as soon as possible, seeking to reduce the negative impacts generated on the child. Intervention is a multidisciplinary process, which involves doctors, therapists and the family, all with highly relevant roles in this process[19]. The visually impaired child may not be motivated to explore the environment, thus their motor development, motor actions and independence may be impaired[20].

The child is inserted in a medium full of sensations that trigger a cascade of responses, and the child with low vision needs more targeted stimuli so that they can have greater opportunities for development with productive results. Thus, the creation of toys and games or playful activities involving correct sensory stimuli will generate positive results in the development of children.

CONCLUSION

The highest frequency of manipulative actions with each cube, during the act of playing, by children with low vision from 7 to 10 years of age occurred in the high contrast and texture cubes. The time spent with each cube was similar between groups I and II, emphasizing that children with low vision have the ability to interact with objects similar to typical children.

This study had as a limitation the difficulty of performing data collection in Institutions of assistance to people with visual impairments outside the city where the study started because of the lack of financial resources.

Despite this, this research can contribute positively to the practice, especially in the stimulation and intervention of children with low vision, paying attention to the appropriate use of objects that help in the particular needs of these children, making motor development more dynamic. That can arouse the interest of researchers to carry out new research on the topic, making more and more effective resources available to the public in question.

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CONTRIBUTIONS

Caroline de Oliveira collaborated in the design and collection of data. **Karine Pereira** contributed to the design, writing and review. **Nathalia Quintino** worked in the design, data collection and analysis, writing and review. **Paula Berteli Pelizaro** collaborated in the review.

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