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# SENSORY PROCESSING IN A CHILD'S ROUTINES: AN EXPLORATORY STUDY

## PROCESSAMENTO SENSORIAL NA ROTINA DE UMA CRIANÇA: ESTUDO EXPLORATÓRIO

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**Resumo** A participação de uma criança nas atividades de vida diária revela a forma como a criança processa a informação sensorial. Este estudo pretende identificar as potenciais vulnerabilidades de uma criança no seu processamento sensorial durante as atividades de vida diária. Foi realizado um estudo correlacional transversal com 187 crianças de 8 a 24 meses, utilizando a Escala de Avaliação do Processamento Sensorial de Rotina para crianças de Lucas, Pereira e Almeida (2022). Analisou-se a influência de fatores pessoais da criança (sexo e idade) e de fatores pessoais e profissionais dos pais (idade, nível de habilitações académicas e situação profissional) nas vulnerabilidades da criança ao nível do processamento sensorial. Os rapazes e as crianças mais velhas parecem apresentar mais vulnerabilidades no processamento sensorial. As variáveis pessoais e profissionais das mães refletem a sua maior influência na avaliação das crianças, quando comparadas com as variáveis dos pais. A identificação das vulnerabilidades da criança no processamento sensorial permitirá um

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encaminhamento precoce para uma avaliação mais abrangente das questões sensoriais, potenciando oportunidades de aprendizagem nos seus momentos de rotina diária dentro dos contextos naturais.
**Palavras-chave** Disfunção do Processamento Sensorial, Atividades da Vida Diária, Família

**Abstract** A child's participation in daily living activities reveals the way the child processes sensory information. Aims. This study aims identify a child's potential vulnerabilities in sensory processing of daily living activities. A cross-sectional correlational study was conducted with 187 children aged 8 to 24 months, by using the Routine Sensory Processing Evaluation Scale for children by Lucas, Pereira, and Almeida (2022). We analysed the influence of a child's personal factors (gender and age) and of parents' personal and professional factors (age, level of academic qualifications, and professional situation) on a child's vulnerabilities in sensory processing. Boys and older children seem to exhibit more vulnerabilities in sensory processing. Mothers' personal and professional variables reflect their greater influence on the assessment of children, when compared to fathers' variables. Identifying a child's vulnerabilities in sensory processing allows an early referral to a more comprehensive assessment of sensorial issues, enhancing learning opportunities in her daily routine moments in natural contexts.
**Keywords** Sensory Processing Disfunction, Activities of Daily Life, Family

## 1. Introduction

The Sensory Integration Theory, developed by Jean Ayres, provides evidence on the ability to receive, categorize, process, and use information originating from the body and from the environment, which is received by our senses (touch, vestibular system, proprioception, vision, smell, hearing, and taste). This sensory information is processed by the brain, where it is organized and interpreted. As a result, the child forms a plan of action that allows her to have an appropriate adaptive response to the demands of the environment (Ayres, 2005).

Sensory processing can be defined as the ability of the brain to receive information from the environment, as well as from the body itself, and to respond appropriately to that information. Sensory processing occurs in four phases: 1) Registration (when the

brain receives information from the senses); 2) Modulation (when the brain regulates the intensity of the sensory stimuli); 3) Discrimination (when the brain organizes the stimuli and interprets them according to their relevance, specific characteristics, and qualities); and 4) Response (when, after all this information is integrated, the brain offers an appropriate response) (Orro et al., 2013). In view of changes in sensory processing, a child's behaviour may exhibit difficulties that, if not interpreted by the parents as a reaction to a stimulus incorrectly detected or processed, may generate misunderstandings in the child's interaction with her family (Jaegermann & Klein, 2010; Williams, Corbyn & Hart, 2023).

## 1.1. Implications of sensory processing on a child's performance and on family routines

Sensory Processing Dysfunctions impact the development of the child in all her day-to-day domains, across her activities and contexts. Since sensory processing patterns can both favour and impair participation in activities, it is natural that children choose daily activities that match their sensory preferences. The stricter and more complex daily activities are, such as those related to education, self-care and sleep, the greater the challenge for children with extreme sensory patterns may be (Bundy & Murray, 2002; Ismael, Lawson & Hartwell, 2018).

Chien et al. (2016) conducted a study investigating restrictions on the participation of children already diagnosed who exhibit signs of Sensory Processing Dysfunctions (SPD). These authors concluded that restrictions in participation are experienced by children with SPD, in particular in terms of their participation in and satisfaction with life. This result is particularly important for therapists and teachers who work with children with SPD, since it allows them to understand and to promote higher levels of child participation in Daily Living Activities.

Children with SPD exhibit more difficulty in performing Daily Living Activities, namely eating, dressing, personal care and hygiene, and show reduced quality and frequency of participation in recreational activities and in social participation (Koening & Rodney, 2010).

Bart et al. (2017) conducted a pioneering study in which they evaluated anxiety and behaviour rituals in children with and without atypical sensory reaction. The results

obtained showed that children with atypical sensory reaction exhibited significantly higher levels of anxiety. Moderate to high correlations were also found between sensory response ability and behaviour rituals. These results reinforce the idea that ritual behaviours can develop as a mechanism of response to anxiety, due to a primary difficulty in processing sensory input. Difficulties in tolerating sensory input can result in emotions such as fear, decreased feelings of control, and anxiety. It is also possible that underlying anxiety restricts the child's ability to adapt and to react appropriately to sensory stimuli (Bart et al., 2017).

A child's inability to process sensory information can have implications on the family as a whole, as well as on its daily routines (Jaegermann & Klein, 2010). Gourley et al. (2013) found that parents of children with SPD have significantly higher stress levels than parents of children without SPD.

Family is the essential component of the environment where the development of the child occurs because it influences and is influenced by the child, in a continuous and dynamic process in each moment of interaction (Crais, 2005).

The absence of biomarkers makes it difficult to evaluate and diagnose SPD. However, observation and evaluation of the child's participation in daily routine moments allows us to obtain information about her SPD and to prepare better environmental adjustments to the child's sensory needs. Adequately knowing and evaluating the child allows professionals and families to implement sensory strategies tailored to her needs, whether in the context of the family or in the context of the kindergarten (Jellett, Wood, Giallo & Seymour, 2015).

## 1.2. Objectives

The purpose of this study was to identify the difficulties in sensory processing of children aged 8 to 24 months in their daily activities and routines. The specific objectives are: a) To analyse sensory experiences during moments of the child's daily routines, according to age and gender; b) To analyse sensory experiences during moments of the child's daily routines according to the age, job, and academic qualifications of the mother and father.

This study is part of a broader research project funded by the Fundação para a Ciência e a Tecnologia, and it has been approved by the Research Ethics Committee of the University of Minho.

## 2. Methods

This was a cross-sectional correlational study because it intends to verify the occurrence of statistically significant relationships and associations between the variables selected in a data set (Lau, 2017).

### 2.1. Participants

This study sample consists of 187 children aged 8 to 24 months, without any diagnosis, living in the district of Braga (a town in the North of Portugal). Exclusion criteria were defined: premature babies or children previously diagnosed with sensory loss and with genetic syndromes.

### 2.2. Measures

The *Assessment Scale of Sensory Processing in Routines* by Lucas, Pereira, and Almeida (2022), in its preliminary version, arises as part of a doctoral project funded by the Foundation for Science and Technology. This scale allows us to identify the child's vulnerabilities in sensory processing and in daily life, and consists of a set of items distributed among seven activities underlying daily routine:

- Waking up/naptime/bedtime (16 items);
- Diaper change/sphincter control (10 items);
- Dressing/undressing (12 items);
- Breastfeeding/feeding/meals (18 items);
- Bath time/hygiene activities (13 items);
- Getting ready to go out/ to travel/to participate in activities in the community (13 items);
- Playtime (20 items).

Each item is classified according to a Likert scale, with 4 answer items: 1) Almost Never or Never; 2) Rarely or Seldom; 3) Often or Quite Often; 4) Almost Always or Always. The highest scores correspond to greater sensory vulnerabilities in the performance of the assessed routine.

## 2.3. Data Analysis

We used descriptive and inferential statistics to analyse the data, resorting to the statistical program IBM® Statistical Package for the Social Sciences (SPSS)®.

The dependent variables match the set of items that make up the seven dimensions of the *Routine Sensory Processing Evaluation Scale* by Lucas, Pereira, and Almeida (2022). The independent variables correspond to the child's personal factors (gender and age) and to the parents' personal and professional factors (age, academic qualifications, and professional occupation). To make our analysis more consistent, it was necessary to categorize some of the variables. The children's age was categorized into three levels: 1) 8 to 12 months; 2) 13 to 18 months; 3) 19 to 24 months; the parents' age, into three levels: 1) 18 to 25 years; 2) 26 to 35 years; and 3) over 36 years (inclusive); the parents' academic qualifications, into four levels: 1) basic education; 2) secondary education; 3) higher education; 4) no information provided; and the parents' professional occupation, into seven levels (based on Machado, Costa, Mauriti, Martins, Casanova, and Almeida (2003): 1) low level profession: blue-collar workers, construction workers, rural workers, and textile workers; 2) medium-low level profession: drivers, taxi drivers, hairdressers, and aestheticians; 3) medium-high level profession: teachers, nurses, bank employees and insurance staff, small and medium merchants and entrepreneurs; 4) high level profession: professions of high social status and large wages, physicians, jurists, large wholesalers and business persons; 5) unemployed (a); 6) housewives; 7) No information provided.

## 2.4. Procedures

To collect the sample, we performed a survey of all nurseries in the district of Braga and sent a request for collaboration to the boards of the selected nurseries by email. We sent a descriptive document containing the objectives, the methodology, and the data collection instrument to be used in the study. Parents were also sent an informed consent concerning their participation in the study. Of the ten nurseries identified, 9 of them agreed to collaborate in this study.

The research was approved by the Ethics Committee of the University of Minho (CEICSH Process 123/2020).

## 3. Results

### 3.1. Characteristics of Participants

Of the total sample (n= 187), 54% of the children were male (n= 101) and 46% female (n=86). The children were grouped into three age groups, in months: from 8 to 12 months, accounting for 22.5% (n=42); from 13 to 18 months, at 38.5% (n=72); and from 19 to 24 months, at 39% (n=73). The average age of the children is 17.17 months. Regarding the age of parents, we found that the average age of mothers is 34 years, and the average age of fathers is 36 years. Most parents, both father and mother, have higher education academic qualifications (level 3). The professional occupations of parents are mostly situated, for mothers, in the medium-high level and, for fathers, in the medium-low level (Table 1).

**Table 1.** *Professional levels of parents*

| Professional Level | Mother | | Father | |
|---|---|---|---|---|
| | N | % | N | % |
| **Low profession level** | 4 | 2.1% | 8 | 4,3% |
| **Low middle profession level** | 55 | 29,4% | 91 | 48,4% |
| **High medium profession level** | 84 | 44,9% | 48 | 25,7% |
| **High profession level** | 26 | 13,9% | 37 | 19,8% |
| **Unemployed** | 14 | 7,5% | 1 | 0,5% |

### 3.2. The inferential data of the study will be presented next, considering the defined hypotheses

*H1. The child's gender influences the identification of possible vulnerabilities in sensory processing in the routine moments of the child aged between 8 and 24 months.*

Analysing Table 2, the routine that presents higher average values is the *Playtime* routine, both in males and females, with values of 29.91 and 28.03, respectively. The routine with the lowest average value in children is the *diaper change routine*, with values of 14.11 for female children and values of 14.82 for male children. In most routines, data point to greater vulnerabilities in sensory processing in male children.

Table 2. *Routines assessment of children according to gender*

| | Gender | N | Mean | Standard Error |
|---|---|---|---|---|
| **Sleeping** | Female | 86 | 26.93 | 6.24 |
| | Male | 101 | 26.88 | 5.53 |
| **Diaper Changing** | Female | 86 | 14.11 | 3.23 |
| | Male | 100 | 14.82 | 3.73 |
| **Dressing/Undressing** | Female | 86 | 17.08 | 4.63 |
| | Male | 101 | 16.82 | 4.32 |
| **Feeding** | Female | 86 | 23.40 | 5.64 |
| | Male | 101 | 25.39 | 6.96 |
| **Hygiene** | Female | 86 | 19.41 | 4.35 |
| | Male | 101 | 20.37 | 5.81 |
| **Neighbourhood** | Female | 86 | 18.76 | 4.62 |
| | Male | 101 | 18.98 | 4.80 |
| **Play** | Female | 86 | 28.03 | 6.25 |
| | Male | 100 | 29.91 | 7.16 |

In a comparative analysis between genders, we observed that there are only statistically significant differences (p<.05) in the *feeding* routine (p=.032), with males exhibiting greater vulnerabilities and, consequently, with a higher average value (M=25.39), when compared to the female gender (M=23.40) in the same routine (Table 3).

Table 3. Assessment of the feeding routine according to the children's gender

| | Gender | Z | Sig | t | Df | Sig (2 ends) |
|---|---|---|---|---|---|---|
| **Feeding mean** | Equal assumed variances | 3.053 | .082 | -2.120 | 185 | .035 |
| | Equal non assumed variances | | | -2.155 | 184.571 | .032* |

*H2. The child's age influences the identification of possible vulnerabilities in sensory processing in the routine moments of the child aged between 8 and 24 months.*

From the analysis of the influence of the age group in the routine moments, we only verified the existence of statistically significant differences in the *Feeding* (p=.001) and *Hygiene* (p=.000) routine moments (Table 4).

Table 4. Results of feeding and hygiene routines according to the group ages of the children

| | Age group | N | Mean | SD | Min-Max | Sig |
|---|---|---|---|---|---|---|
| Feeding mean | 8-12 months | 42 | 21.19 | 5.22 | 11-35 | |
| | 13-18 months | 72 | 25.71 | 7.05 | 17-44 | |
| | + 19 months | 73 | 25.16 | 5.90 | 8-42 | |
| | Total | 187 | 24.48 | 6.46 | 8-44 | .001 |
| Hygiene mean | 8-12 months | 42 | 17.14 | 3.83 | 11-26 | |
| | 13-18 months | 72 | 21.26 | 5.23 | 12-36 | |
| | + 19 months | 73 | 20.22 | 5.31 | 5-35 | |
| | Total | 187 | 19.93 | 5.20 | 5-36 | .000 |

In order to deepen the meaning of the statistically significant differences in these two routine moments, *Feeding* and *Hygiene,* was performed a Scheffe contrast test (Table 5).

Table 5. Comparison of results in the feeding and hygiene routines between the age groups of children

| Dependent variable | Group Age (I) | Group Age (J) | Mean difference (I-J) | Sig. |
|---|---|---|---|---|
| Feeding Mean | 8-12 months | 13-18 months | -4.51* | .001 |
| | | + 19 months | -3.97* | .005 |
| | 13-18 months | 8-12 months | 4.51* | .001 |
| | | + 19 months | .543 | .871 |
| | + 19 months | 8-12 months | 3.97* | .005 |
| | | 13-18 months | -.543 | .871 |
| Hygiene Mean | 8-12 months | 13-18 months | -4.12* | .000 |
| | | + 19 months | -3.07* | .007 |
| | 13-18 months | 8-12 months | 4.12* | .000 |
| | | + 19 months | 1.04 | .453 |
| | + 19 months | 8-12 months | 3.07* | .007 |
| | | 13-18 months | -1.04 | .453 |

Analysing the differences between the three age groups of the children in the *Feeding* routine, when comparing age group 1 with age group 2, we found that these two age groups exhibit statistically significant differences (p=.001), with an average difference of 4.51 points. The children in group 2 exhibit greater difficulties in this routine.
The difference between age group 1 and age group 3 is statistically significant (p=.005) with an average value of 3.97 points. This result also demonstrates that older children have greater difficulties. There were no statistically significant differences between age groups 3 and 4.
In the *Hygiene* routine, there were statistically significant differences (p=.005) between age group 1 and age group 2 (average difference of 4.12 points); and between age group 1 and age group 3 (average difference of 3.07), thus showing that older children present greater difficulties in the Hygiene routine.

*H3. The age of parents influences the identification of possible vulnerabilities in sensory processing in the routine moments of the child aged between 8 and 24 months.*
*There were no statistically significant differences in the assessment of SDP, considering the age groups of the father and of the mother.*

*H4. The level of parents' academic qualifications influences the identification of possible vulnerabilities in sensory processing in the routine moments of the child aged between 8 and 24 months.*
There were no statistically significant differences in the evaluation of SDP in the different routines considering the academic qualifications of the fathers. Regarding those of mothers, there were statistically significant differences in the assessment of the following routines: *Sleep time* (p=.010) and *Diaper change* (p=0.049). In these two routine moments, the highest average is found in children whose mothers have higher academic qualifications, namely higher education, as can be seen in table 6.

**Table 6. Results of the assessments of sensory processing dysfunctions in sleep time and diaper changing routines, considering mother's academic qualifications**

| | Academic Qualifications | N | Mean | SD | Min-Max. | Sig. |
|---|---|---|---|---|---|---|
| **Sleep time Mean** | Basic Education | 19 | 26.42 | 4.06 | 14-30 | |
| | Secondary Education | 62 | 25.84 | 6.19 | 14-45 | |
| | Higher Education | 106 | **27.97** | 5.72 | 16-42 | |
| | Total | 187 | 26.90 | 5.86 | 14-45 | **.010** |
| **Diaper changing Mean** | Basic Education | 19 | 13.32 | 4.68 | 1-19 | |
| | Secondary Education | 62 | 13.95 | 2.97 | 3-22 | |
| | Higher Education | 105 | **15.03** | 3.52 | 5-30 | |
| | Total | 186 | 14.49 | 3.52 | 1-30 | **.049** |

*H5. The professional level of the father influences the identification of potential vulnerabilities in sensory processing in the routine moments of the child aged between 8 and 24 months.*

There were no statistically significant differences in the children's scores relative to the professional level of family members, the mother and father.

The results of our study seem to indicate that the characteristics of the children have a greater influence on the results of the assessment of SPD, when compared to the variables of the family (profession and academic qualifications). This result is similar to the one found in the studies by Román-Oyola and Reynolds (2013).

## 4. Discussion

The results of our study allow us to verify that the routine where children, both female and male, present greater vulnerabilities in sensory processing is the *Playtime* routine; however, there were no statistically significant differences between the two groups of children in this routine. In the comparative analysis between genders, in the *feeding* routine moment, there is statistical differentiation ($p < .05$), and male children also present greater difficulties and, consequently, higher average values (M=25.39), when compared to female children (M=23.40). These results are compatible with recent studies undertaken by Nielsen et al. (2021), which indicate that 20% of Danish children attending public education may have SPD, and that more than 20% may be at risk of

developing these difficulties. The study conducted by these researchers also verified the existence of a higher prevalence of SDP in male children. Gouze et al. (2009) analysed a sample of 796 boys and girls aged between 3 and 10 years in the USA and found a prevalence of 11.6% of SDP, with this prevalence higher in male children (with a ratio of 14.6% for males and 8.6% for females). Since deficits in sensory processing directly interfere with the ability to interact with people and objects, it seems likely that children with SDP may experience difficulties during playtime, as the results of this study demonstrate. In fact, children with Sensory Seeking may look for movements or sound inputs and, therefore, miss their teachers' directions in classroom tasks or their peers' clues to engage in social interactions, such as those required at playtime (Bundy et. al, 2007; Ismael et al., 2018).

Regarding the *Feeding* routine, we know that the variation in food properties is diverse. Smell, taste, texture, and temperature of food are sensory properties that are part of the feeding routine, whose information must be processed by the child. Along these lines, the results of our study observed concerning the *feeding* routine can be justified by the sensory demands involved in it and, thus, changes in sensory processing may be related to the level of food acceptance on the part of the child. Children with low sensory processing thresholds tend to regard as a challenge the activities that require specific sensory environments (e.g., mealtime). These children tend to avoid sensations, because they feel overloaded by sensory inputs, which makes dynamic activities involving rich sensory inputs more troublesome, such as activities inherent to mealtime (Ismael et al., 2018).

When we identified the difficulties presented in daily routines as a function of the child's age, statistically significant differences were detected in the *Feeding* (p=.001) and in the *Hygiene* (p=.000) routine moments. This differentiation indicates greater difficulties on the part of older children in these two routines. These results can be explained by the possibility of greater exposure to sensory stimuli as the child gets older. This greater diversification of sensory stimuli is related to the introduction of a variety of foods and to a higher level of demand in the hygiene routine. Crying, feeding, and sleeping problems often decrease as the child gets older and more mature. However, if babies fail to master self-regulation in these behaviours, crying, feeding, or sleep disturbances may persist or increase, and trigger other difficulties in the functioning of the family (Chien, Rodger, Copley, Branjerdporn & Taggart, 2016).

The results of our research coincide with those obtained in other studies, in which children with excessively reactive sensory patterns demonstrated greater difficulties in performing self-care tasks, which caused disturbances in family routines. Tactile sensitivity (refusal and avoidance) is strongly associated with performance deficits in daily living activities, such as dressing, and gustatory sensitivity is associated with restricted food preferences. The refusal to brush teeth or wash hair and face, as well as to comb hair, and dressing difficulties, are the routines identified by parents of children with SDP as the most difficult to deal with (Reynolds & Lane 2008).

Regarding the age of the parents of the children in the sample, in both analyses (concerning the father and the mother), there were no statistically significant differences, but we can see, by analysing the average values, that children with older mothers (26-35 years and +36 years) exhibit greater difficulties in most routines. As regards the fathers in the sample, the analysis of the averages proved to be heterogeneous, which leads us to conclude that the age of the father has no influence on the assessment of the daily routines of the children participating in this study.

As for the analysis of the influence of the academic qualifications of fathers on routine moments, the results do not show statistical significance. In the analysis of the academic qualifications of mothers, we can verify a statistically significant influence on the sleep time routine in the case of mothers with higher academic qualifications. This result may be due to the fact that these mothers have poor sleep patterns and children repeat the same patterns of their mothers. This is supported by studies such as the ones by Karraker and Young (2007) and Barclay and Gregory (2013), which reinforce the intrinsic link between sleep patterns of children and those of their caregivers.

We also verified that the professional levels of parents, both of mothers and of fathers, do not influence the identification of SDP on routines. The result is in line with the studies by Román-Oyola and Reynolds (2012), by Ryckman et al. (2017), Schmid et al. (2011), and by Silva et al. (2016), which indicate that socio-economic factors do not seem to influence sensory processing, which is mainly affected by the characteristics intrinsic to the child.

The variables that concern the mother, although less relevant than children's own variables, reflect a greater influence and relevance in the identification of SDP in the child, when compared with the father's variables, which may be explained by a

greater presence of the mother in the day-to-day life of children. Chauhan et al. (2017) reinforce this result, by concluding that the most immediate caregivers are mothers and not fathers and, consequently, mothers have a greater influence on these dysfunctions.

## 5. Conclusion

SDP are characterized by the difficulty of children to adequately process the information of the surrounding environment, as well as the one provided by their own body. The activities of daily life mediate the development of the child, and her participation in those activities depends on her skills in sensory processing. Therefore, the development of the child and the participation of the child in daily activities are interconnected and, as such, should be evaluated and be a target of intervention on the part of parents and professionals.

This investigation allows us to reinforce the importance of early identification of the child in daily life activities, to give us a greater understanding of SDP and their influence on the daily life activities of the child and, consequently, on the dynamics and functioning of her family. Parents of children with SPD exhibit significantly higher levels of parental stress, compared to parents of children without SDS. The reported stress is worrisome and reinforces the importance of an assessment and intervention in children with SPD, to promote earlier and more favourable child outcomes, greater reduction in the level of parental stress, and improvement in the relationship between parents and their children. The study also reinforces the importance of parents' participation in the assessment of their children's routines, since parents are holders of information that professionals will never be able to obtain, due to their presence and participation in most of their children's routines. The effective participation of parents and other caregivers in the identification of the child's SPD will allow a more functional, more individualized and contextualized assessment, with the fundamental presupposition of valuing natural contexts as factors of child development and of learning opportunities. Thus, we recommend that this study be expanded to all geographical areas of Portugal. The main limitations of this study include: The sample is circumscribed to one area of Portugal, which made it difficult for us to have a wider and more diverse sample, considering that the Portuguese population is distributed over five geographical areas. However, this difficulty was the result of the mandatory

confinement that forced the closure of nurseries in Portugal, due to the second outbreak of SARS-CoV-2.

We also felt limited by the scarcity of research carried out in Portugal in this area, which analyses the various moments of the child's routine and that relates them with SDP.

Regarding the selected methodology, the data were based on the perception that each parent/caregiver has about the child's sensory behaviour in her routine moments, which can lead to a fragile understanding of the data obtained, considering that these children frequent other important contexts for their development, namely the context of the nursery.

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