

علم النفس التنموي والتربوي في محور التفكير المعماري: نحو الاندماج الاجتماعي للأطفال المصابين بالتوحد

**Developmental and Educational Psychology in the focus of architectural reflection:
Towards social inclusion of autistic children**

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ملخص: يركز بحثنا على الإعاقات الحسية للأطفال المصابين بالتوحد وتصوراتهم عن البيئة المكانية. هدفنا هو أن نكون قادرين على توفير مساحات مناسبة للأشخاص ذوي الإعاقات الإدراكية أو العقلية أو الحسية لإعدادهم للاندماج التعليمي والاجتماعي. لقد لجأنا إلى التقنيات الجديدة عن طريق قياس النشاط الكهربائي للأديم لتحليل وفهم حالاتهم العاطفية، المرتبطة بنماذجهم السلوكية. تم تنفيذ هذا العمل بفضل التعاون الوثيق بين المهندسين المعماريين والمهندسين والأطباء النفسيين للأطفال. لاحظنا تفاعلات كهربية جلدية متشابهة أمام المساحات ذات الخصائص المعمارية المختلفة. نفترض أن اندماج الطفل المصاب بالتوحد في البيئات المتغيرة، حتى البيئات المضطربة، يمكن أن يكون مفيداً لعلاجهم. تتجاوز الهندسة المعمارية المقترحة الفصل الدراسي للجميع نحو مدرسة للجميع..

الكلمات المفتاحية: توحد؛ هندسة معمارية؛ علم النفس التنموي؛ علم النفس التربوي؛ إدماج.

Abstract:

Our research focuses on the sensory impairments of autistic children and their perceptions of the spatial environment. Our goal is to be able to offer adequate spaces to people with cognitive, mental or sensory disabilities to prepare them for an educational and social inclusion. We had recourse to new technologies by measuring electrodermal activity to analyse and understand their emotional states, correlated to their behavioural models. This work was carried out thanks to a very close collaboration between architects, engineers and child psychiatrists. We noted similar electrodermal reactions in front of spaces with different architectural characteristics. We presume that the integration of the autistic child in changing environments, even disturbed ones, can be beneficial for his therapy. The proposed architecture goes beyond a classroom for all towards a classroom and a school for everyone.

Keywords: autism; architecture; electrodermal activity; developmental psychology; educational psychology; inclusion.

1– Introduction

The autistic spectrum disorder induces an altered, unique and complex perception of the environment. The diversity of the atmospheres and their emotional effect is therefore essential in the conception of spaces receiving autistic children (Tola et al., 2021). But the fundamental challenge remains the control of these ambiances to ensure the comfort and promote the well-being of the occupants. For an autistic child, what is out of routine is a source of worry and discomfort. Our task, as space designers, would be to create .reassuring spaces and atmospheres (Layeb, 2020)

The research team on ambiances (ERA) of the National School of Architecture and Urbanism of Tunis (ENAU) has always perpetuated the traditions of working with multidisciplinary teams. Our work reinforces the team's cooperation with the National School of Engineering of Tunis (ENIT), and more specifically the department Information and Communication Technologies (TIC) via the Systems and Signals Processing team (U2S), actually (L3S), which has knowledge in the development of experimental protocols based on embarked sensors of physiological measurements; and the research laboratory Vulnerability to psychosis of the Faculty of Medicine of Monastir and the department of psychiatry of Fattouma Bourguiba's University Hospital Center of Monastir. This multidisciplinary partnership was formed to serve the interests of autistic children and has made it possible to exchange knowledge and initiate collaborations between these different disciplines in order to be able to act on the quality of their environment.

We are interested in the sensitive experiences of children with sensory disorders. Our goal is to offer a suitable environment and quality of life to people with cognitive, mental or sensory disabilities. This prepares them for a relational life in order to achieve educational and social inclusion.

2–Material and Methods:

In this section, we detail the experimental protocol and we precise our field of study, the description of the population, and the materials used to achieve this work.

2.1–Corpus:

We have worked on three fields of investigation, located in three different Tunisian cities: Testour, Sousse and Monastir. The results presented in this paper

concern the center for autistic children in Sousse. Inaugurated in 2010, it is one of the first psycho-educational centers dedicated exclusively to autism. It is a two-floor construction where all the spaces give onto a central roofed atrium, as we see in Figure1, except for the second floor which is under partial construction.

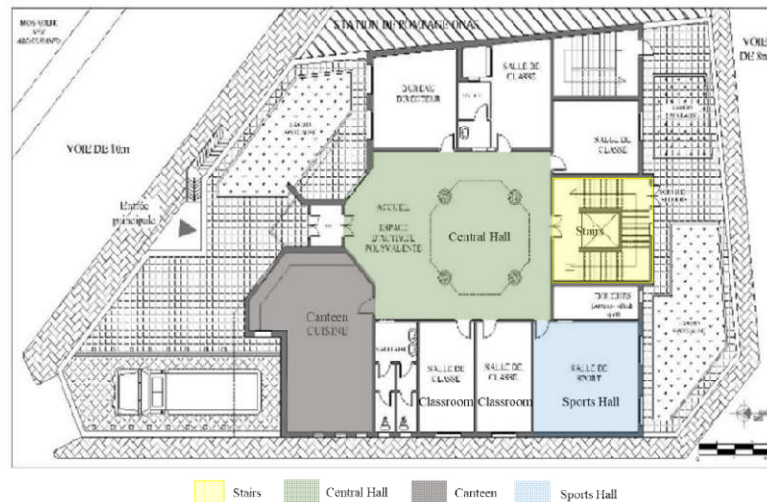


Figure (1) Ground floor plan

2.2–Population:

We were able to survey 27 children, including 4 girls and 23 boys aged from 4 to 14 years old. For each child and for ethical reasons, we have chosen to use abbreviations for their first names. The observations have taken place during different periods and seasons of the academic year. Each investigated child was followed in his daily routine during his activities in the care center, through the learning rooms, sports hall, canteen, or open-air spaces (Layeb, 2020).

2.3–Materials:

In addition to the analysis of the spatial complexity of the spaces occupied and crossed by the children, we also focused on the physical signals, through the recording of sound and light levels or through simulations (Layeb et al., 2016). Simultaneously, we have captured the feelings of the child confronted to this sensitive experience. This approach allowed us to apprehend a reality that is not usually expressible. It is based on a measurement of a physiological signal, corresponding to the Electro Dermal Activity (EDA) of the child via the conductance of his skin (Boucsein, 2012). It is conducted by an on-board biological sensor attached to the

wrist (Picard, 2009). The version used in this study, allows the data to be visualized and analysed in real time, as well as the export of the data to other formats (.csv) for further analysis, with the time variable in seconds (s) on the x-axis and the EDA in micro-siemens (μS) on the y-axis (Kristina&Picard, 2020).

Beforehand, we established a sensory profile for each child surveyed. This questionnaire is used to evaluate the impact of sensory disorders on the child's daily life (Brown et al. 2001). It is based on the theory of sensory integration, which suggests that the organization and interpretation of sensory information allows the child to plan and organize his behaviours and reactions (Dunn, 1997). This survey evaluates the behavioural reactions of the adolescent and the autistic child in response to sensory stimuli as well as their repercussions on their perception and occupation of spaces (Dunn, 2001). The results help to better understand why the child adopts certain behaviours and why he prefers certain environments or experiences according to his behavioural model: avoider, register, sensitive and seeker (Dunn, 1997). Each of these quadrants is a result of the interaction of the neurological threshold continuum and the behavioural response continuum.

Only the crossing of these data, allowed us, to reveal the various links between the physical signal, the surrounding and the perception of the autistic child.

3– Results and Discussion

The correlation of the different types of data leads to the identification of sensitive configurations generating different emotional states (panic, appeasement, ...) linked to several environmental parameters (sound, light, materials, colours, ...). In this paper, we will focus our analysis on simultaneous observations. Indeed, we were able to follow two children at the same time during the same journey: the same path and the same architectural transitions.

The experience concerns two boys: (Ap) and (Ha), in the same "patisserie class". The child (Ap) is a 9-year-old boy with a sensory profile "similar to others" called also "typical performance" and (Ha) is a 13-year-old boy as sensory register.

The correlation of their simultaneously recorded EDAs, shown in Figure 2, reveals a similarity in the general trend of the two signals. We note the increase of the EDA curve beginning at the same time and in the same space. The ascendance of the curve continues until they return to their workroom situated on the second floor.

Unfortunately, the experiment is interrupted with (Ap), we cannot predict the trend of the curve after the return to the classroom. We retain that in spite of the variability of the architectural and ambient specificities of the spaces crossed and the two different sensory profiles we note the same trend of the EDA signal.

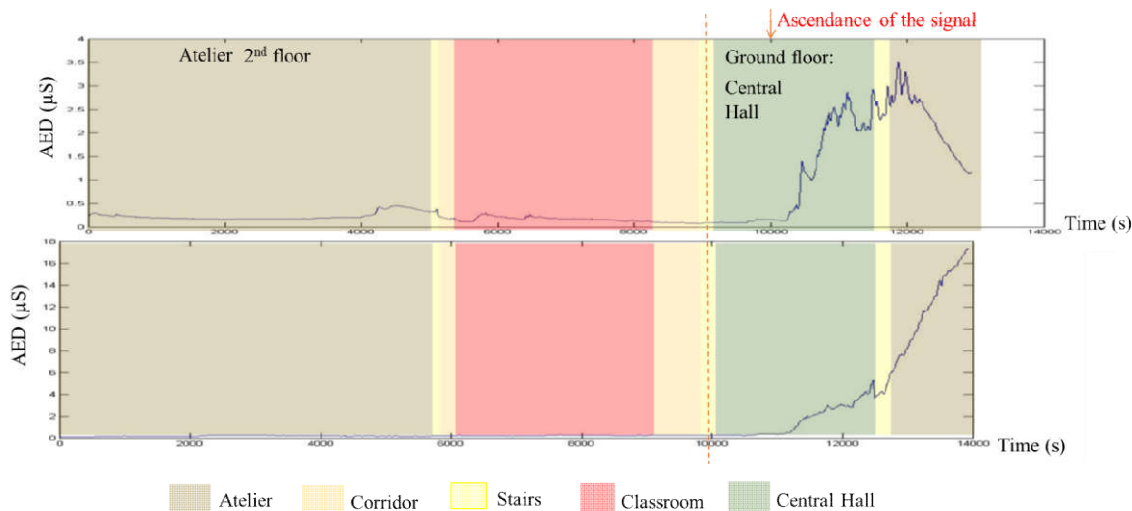


Figure (2) The variation of the ElectroDermal signal (EDA) of: on the top (Ha) and on the bottom (Ap)

The particularity of this class is how it works. The dispatching of the sessions is done in a different way from the other teachings in the center. First of all, it is the only usable space located on the 2nd floor. Then, the teaching process is done differently from the other levels. Differently from the other children, the snack is taken on the spot and the lunch hour is deferred compared to the other classes. This class schedule makes it difficult for these children to share much time with all the other children at the center. This observation led us to take a greater interest for the other children attending the same atelier.

The other three children have three different sensory profiles. (Hd) a 10-year-old boy is a sensory register, (Se) a 12-year-old boy has a typical performance "similar to others" and (Ho) a 13-year-old boy combines both quadrants: sensory seeker and sensory sensitive. We notice, in Figure 3, a great similarity in the general trend of the EDA signal with these different profiles.

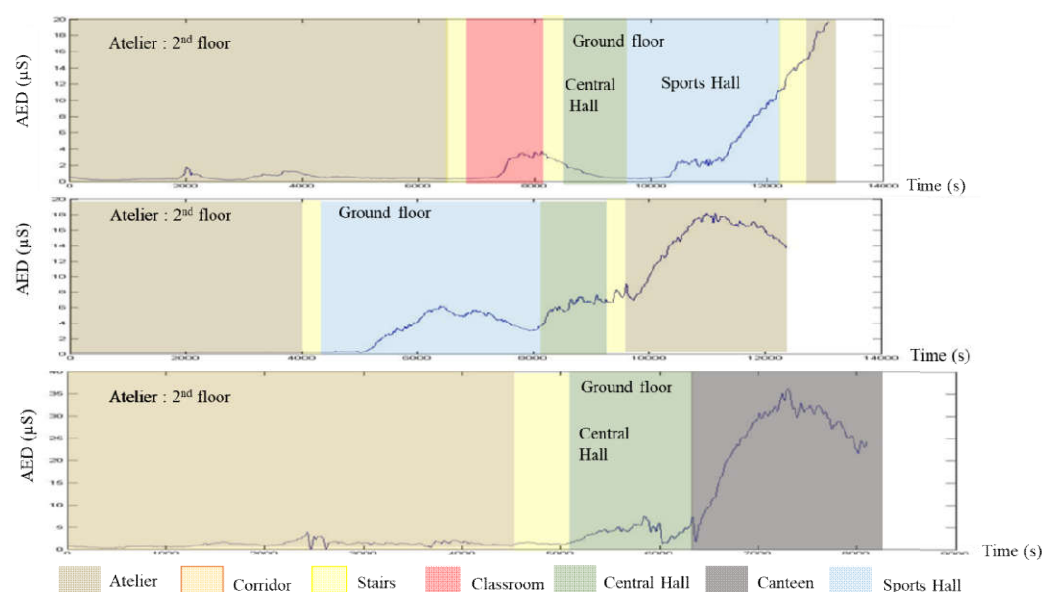


Figure (3) The variation of the ElectroDermal signal (EDA) of, from top to bottom: (Hd), (Se), (Ho)

We report very little variation during regular teaching sessions. On the other hand, we notice a signal ascendance as soon as the child is situated in the most frequented spaces, especially the central hall, except for the case of the child (Hd). This increase reflects the excitement and alertness of the children surveyed. While the stability of the curve reflects their calmness and tranquillity. The rate of variations of the physiological signal in the atelier and transition spaces is very reduced compared to the rate of variations in the common spaces of the ground floor: the sports and the polyvalent central halls.

It should be noted that physical surveys and simulations reveal that the sports hall is an indoor space, well-lighted, non-reverberant and charged with colours and textures. The polyvalent hall is double-height space, poorly lighted and highly reverberant. While the atelier is a spacious, well-lighted and reverberant space with a permanent background sound due to the noise of the various equipment.

We note similar electrodermal reactions in front of spaces with different architectural characteristics. We then suppose that the spatial specificities, on their own, are not at the only source of the emotional responses. The observation in situ, the educational staff interviews and the behavioural analysis carried out with the help of child psychiatrists (Brahem, 2017) reveals that it is an attitude due to the confrontation of the child with unusual situations (playing with "strangers", staying in the crowd, ...). Indeed, after lunch (the only activity in the ground floor) the educators

affirm that these children come back to the classroom disturbed compared to their initial state. This leads their teachers to change the type of activity because of their lack of concentration. Given the planning of the day, these children spend their time isolated from the other groups and levels.

We believe that the withdrawal of an autistic child from the others is not necessarily the best factor to reinforce his autonomy. We presume that the integration of the autistic child in changing environments, even disturbed ones, can be beneficial for his therapy (Layeb, 2020). We suppose that his confrontation with complex or even unpredictable situations can develop and even consolidate in the child with autism his capacity for adaptation and integration. Each child, according to his or her sensory behavioural model, will find a way of self-regulation to control the inputs in order to be able to manage them during similar configurations, whether at the center, at home or even in a public setting.

This hypothesis refers us to the Tunisian strategy to include children with autism in early childhood establishments or in school structures (Bouden, 2014). Despite the constraints of field application, this strategy seems promising for the social integration of these children as well as for their therapy and their emotional and social development.

3.1–From architectural reflection to an integrative approach:

It is then appropriate to wonder about the possibilities of mixing children with autism and children without disability. In Tunisia, in spite of the difficulties, there is a determination to succeed the integration of children with specific levels of autism into ordinary schools (Bouden, 2014).

The diversity of abilities and sensory needs of ASD children does not allow for a single rule for schooling children, but rather an individual approach. We believe that this approach should be divided, initially and according to the child's impairments, into two phases. First, an individual integration during learning situations, the educator is called to adapt the spatial organization according to the sensory and behavioural requirements of the child. Then, a collective integration that benefits from recreation, break and canteen times to create a social cohabitation. This approach – in addition to enriching motor skills and social interactions – confronts the ASD child with situations of sharing and being together. Once the difficulties are overcome, these two phases

can be confused. The common schooling times must then be diversified, in order to offer new shared sensory experiences in a space that is containing and reassuring for each child.

This leads us to a particular reflection on the architectural design of school spaces as well as a new vision of the role of particular populations, with a specific perception, as a support for a universal design, not only for all but for everyone (Thomas, 2011). Our approach is then based on people with mental disabilities in order to avoid architectural disability (Layeb et al., 2016). It is a question of starting from the user to create an architecture for the user. This development leads us to another paradigm which is the inclusive approach in architectural design.

3.2–From an integrative to an inclusive approach:

Inclusive design is based on collaboration between the designer and the user. It aims to involve the user in the project, in an upstream, to integrate his particularities and needs in the project (Thomas, 2011). The designer thinks about his entire conceptual process with potential users. The difference thus becomes an asset to be valued; it is then a question of transforming the experience of disability into an expertise of the accessibility of the project (Layeb et al., 2016). The difficulty in this approach is to be able to access information, given the communication difficulties with autism.

In the literature review, a totally adapted architecture can present a risk of overprotecting users and consequently disadvantaging their personal development (Heylighen&Bianchin, 2012) (Heylighen&Nijs, 2015). Nevertheless, the architectural space, if it does not take into account the specificities of its users, can present an obstacle, which aggravates the difficulties and uncomfortable situations (McAllister&Maguire, 2012) (McAllister&Hadjri, 2013). The architect must therefore find the right balance between the architectural response and the requirements of all types of users. Faced with the problem of communication with certain users, information can be transposed through pictography (image, illustration, drawings, ...) (Decker, 2014). Otherwise, the advisory opinion can be given to the health care team or to the parents, as a major contributor in the educational process of these children (Tufvesson&Tufvesson, 2009). This procedure once again returns to the educator's

role in adapting the learning environment of the child with autism, in condition that the spatial organization allows the transformable and the evolution. This inclusive approach could then be applied on the design of all scholar spaces.

3.3–From pedagogical approach to architectural disposal:

This leads us to an educational approach that includes the comprehension of the spatial and environmental needs of the learning spaces of people with ASD (Thomas, 2011). Indeed, the specialized project, as TEACCH or ABA for example, goes beyond educational content to a spatial and temporal organization of the various activities of ADS people. Montessori pedagogy also offers an alternative educational method to the traditional approaches. Created for "neurotypical" children, it seems to us that it could also be adapted to children with autism, given to the similarities with the TEACCH program. Both approaches support the role of the educator, therapist or parent to investigate, analyse and understand the particularities of each profile in order to propose the appropriated space.

The role of the architect is then to be able to manage the contribution of future users through a flexible and modular space ready to receive the different adaptations of the user (Layeb, 2020). This spatial quality can be transposed in specialized infrastructures as well as in ordinary environments. We propose to provide to the teaching team all the controlled facilities, such as removable devices, which allow them to adjust the space according to the sensory specificities of the child as well as the type of activity.

4– Conclusion

Through the first results of this research, we concluded that the isolation of these children in specific structures and programs did not necessarily favour their integration and their capacity to confront spatial and societal changes. We concluded, so that there is not a unique architecture for autistic children. Therefore, as architects we are called to propose spatial dispositions and devices that could offer possibilities of control and modification, by the educator, parents or the health care staff. The proposed architecture goes beyond a classroom for all towards a classroom and a school for everyone.

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