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Social Cognition in Neuropsychiatric Disorders in Pediatric Age

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Abstract: *Objective: The purpose of our study was to assess social cognition in ad-olescents and children with epilepsy or Specific Learning Disorder (SLD) compared to typical individuals. It was verified whether the age of onset, duration and drug therapy of epileptics can influence this ability and if there is a correlation between Social Cognition, intelligence and executive functions.*
Methods: This is an observational cross-sectional study that included a total of 125 subjects between 7 and 16 years (62 with focal epilepsy and 63 with SLD). The control group included 32 healthy subjects. Study sub-jects were evaluated with neuropsychological tools to evaluate executive functions (EpiTrack Junior), Social Cognition (NEPSY-II), and intelli-gence; a nonverbal cognitive test (Raven's Matrices) was used in subjects with Epilepsy, while WISC-IV was administered to SLDs.
Results: the groups of subjects scored significantly lower than the con-trols in Social Cognition. The results showed a positive correlation be-tween affect recognition scores and executive function in both groups. In patients with epilepsy the deficit in Affect Recognition appeared to be linked with early age of onset of epilepsy, long term of disease and lack of non-verbal intelligence; a high frequency of seizures, on the other hand, was related to poor performance in the Theory of Mind (ToM). In the SLD group there was no correlation between social cognition and in-tellectual level.
Conclusions: The results of our study suggest that individuals with focal epilepsy or SLD have deficits in the recognition of facial emotions and ToM compared to their peers.
In epilepsy group, the Social Cognition deficit seems to be linked to characteristics of epilepsy, particularly the deficits in the recognition of facial emotions seems linked to problems in nonverbal intelligence and in executive function.
In the SLD group, however, the ability to recognize emotions was correlated only with executive functions.

Keywords: *social-cognition; epilepsy; specific learning disorder; executive functions.*

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Introduction

A very important skill for a good adaptation and a good quality of life is social cognition, which allows us to define social stimuli giving them an appropriate interpretation and response. Social cognition is made up of more basic skills like the ability of affect recognition and the theory of mind (ToM) (Frith & Frith, 2007).

The ability of affect recognition through facial expressions begins to develop early and becomes more precise and meticulous with age; some studies point up that happiness is the first emotion recognized, followed by emotions like disgust and fear (Burlea et al., 2010). The subcortical structure that seems to play an important role in the recognition of emotions is the amygdala with other structures such as the insular cortex, the basal ganglia and the orbitofrontal cortex (Nelson et al., 2003).

ToM allows to attribute to oneself and to people thoughts, beliefs, states of mind and emotions. As with the recognition of emotions, the theory of mind also develops very early, around 3-4 years, and improves with age; the neural structures involved in this ability appear to be the medial prefrontal cortex, temporo-parietal and mesolimbic cortex (Xiao et al., 2019). Since social cognition is a skill that develops during the course of life, some studies have tried to investigate how it evolves in children with developmental disorders, such as in Specific Learning Disorder (SLD) subjects or with childhood-onset diseases such as epilepsy (Dimitrovsky et al., 1998; Ives-Deliperi & Jokeit, 2019). Several studies have shown that subjects diagnosed with SLD were not as good at recognizing emotions than subjects with typical development (Bloom & Heath, 2010).

Studies on epileptic patients have shown that these subjects had difficulties both in recognizing emotions and in theory of mind tasks, this pointing out that there might be a correlation between the brain structures affected by the epileptic focus and the impoverishment of social cognition skills, underlining however that there is no real difference between focal and generalized epilepsy (Fusar-Poli et al., 2009; Meletti et al., 2009; Stewart et al., 2018; Stewart et al., 2019).

Another set of skills, called Executive Functions, appear to be related to Social Cognition, although this association is not yet clear (Wade et al., 2018; Zhang et al., 2018). The term Executive Functions means the set of skills including working memory, inhibitory control, cognitive flexibility, problem solving and planning. This set of skills, as well as the ability to recognize emotions (Theory of mind), develop during childhood and improve

in adolescence to adulthood, and their correct functioning allows a good quality of life (Diamond, 2013; Lupu et al., 2015).

In this study, social cognition in subjects with SLD and epilepsy was evaluated and the results were compared with a control group; it was evaluated if other factors, such as age of onset of epilepsy, duration and drug therapy, could influence this ability; lastly, the presence of a correlation between social cognition, executive functions and intelligence was investigated.

Methodology

Participants

The clinical sample in this study consisted of 125 children and adolescents aged 7 to 16 years old, from the Child Neuropsychiatry Unit of the University Hospital of Salerno. The first group includes 62 subjects with focal epilepsy; the second one includes 63 individuals with SLD. The control group includes 32 heathy subjects and is homogeneous for age and sex. The diagnosis of epilepsy or SLD was kept out in all control group subjects. All subjects signed informed consent after adequate description about the purpose of the study and about procedures involved.

Assessment

Study subjects were evaluated with standardized instruments to evaluate the executive functions (EpiTrack Junior), the Social Cognition (NEPSY-II) and the intelligence: a nonverbal cognitive test (Raven's Matrices) was used in subjects with Epilepsy, while WISC-IV was administered to SLDs.

Nepsy II - Social Cognition domain

The Developmental NEuroPSYchological Assessment 2nd edition battery (Nepsy-II) include 2 tests to evaluate Social Cognition: the identification of emotions through facial expressions (AR) and the ability to decode and interpret the intentions of others and their points of view and understand how these affect behavior (TM).

Epitrack Junior

EpiTrack Junior includes activities aimed at attention, executive functions and working memory. This test is made up of 6 subtests: interference, inverted digit span, linking numbers, linking numbers and points, labyrinth and verbal fluency. Children must be at least 6 years old to be able to read numbers '1' and '2' aloud and count from 1 to 20 to take this test.

Raven's Matrices

Progressive Raven Standard Matrices (SPM) were administered to participants with epilepsy to assess non-verbal cognitive abilities: this test consists of five series of 12 elements each and is characterized by an increasing order of difficulty of the items.

WISC-IV.

The WISC-IV (Wechsler, 2003) is a clinical and diagnostic tool for the assessment of cognitive abilities for children aged 6 to 16. This test provides a total IQ score and indices, which are the Verbal Comprehension Index (VCI), Perceptual Reasoning Index (PRI), Working Memory Index (WMI) and Processing Speed Index (PSI).

Results

In our study, for the data that had a normal distribution the Student t test was used for those that did not have a parametric distribution, the Mann Withney U test was used to compare the means.

Student's t-test showed that the mean affect recognition score was more clinically lower in the epileptics than in the control group ($p < 0.05$) (Figure 1). Analyzing individual emotions, using the Mann-Withney U test, it emerged that the epilepsy group showed a lower performance in recognizing emotions like sadness, happiness, fear and anger than the control group ($p < 0.05$) (Figure 2).

Poor performance in emotion recognition seemed to be related to some epilepsy-related variables: early age of onset of epilepsy, long term of disease, poor executive functions, and poor non-verbal intellectual profile.

Regarding the ToM, the average score was clinically inferior in the epileptics than in the control group ($p < 0.05$) (Figure 3) and deficiencies in this ability appeared to be linked to a high seizure frequency.

As for the SLD group, the non parametric Mann-Withney U test for unpaired samples was used and it was found that the mean emotion recognition score was significantly lower than the control group ($p < 0.005$) (Figure 1).

In particular, regarding to individual emotions, the SLDs do worse than the control group in the ability to recognize neutrality, sadness, happiness, fear and anger ($p < 0.005$) (Figure 2). Scores in AR were positively related to scores of executive function, while with the level of IQ no correlation was detected .

Also in the subtest about Nepsy-II Theory of Mind, the SLD group obtained a lower total score than subjects in the control group: specifically, the mean total scores on the subtest TM were at the lower than normal limits for the group of subjects with DLS (less than 1 standard deviation) while the mean control score was normal (Figure 3).

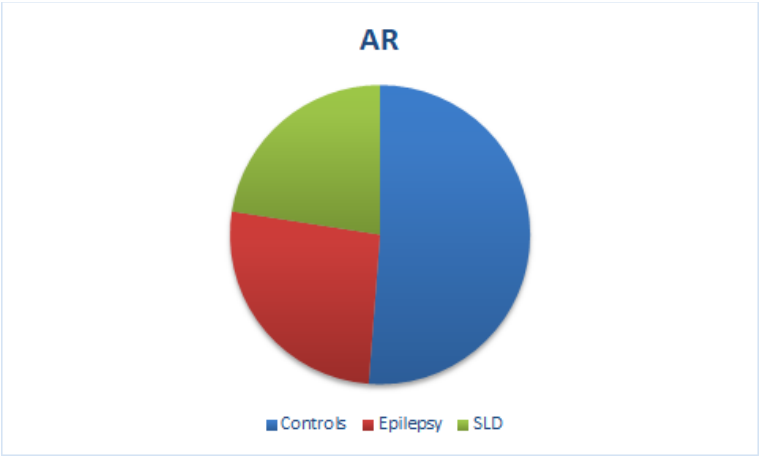

Figure 1: Affect recognition score in SLD, epilepsy and control group
Source: authors'own contribution

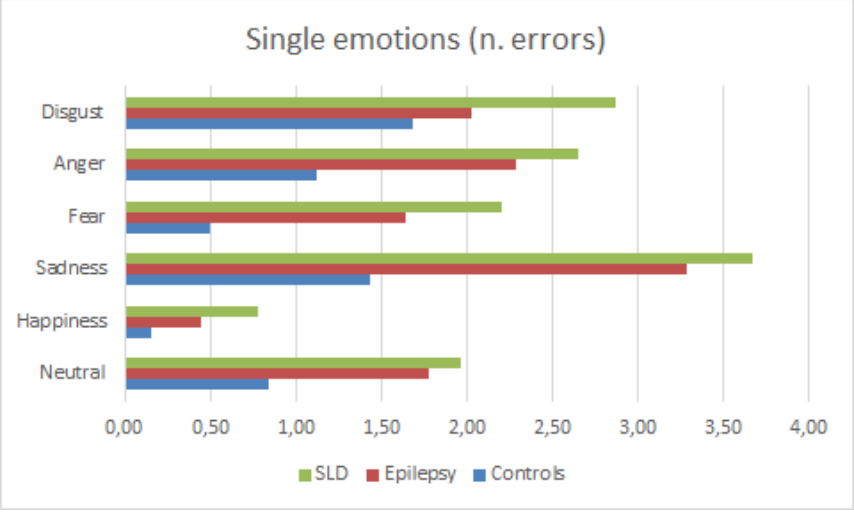

Figure 2: number of errors in SLD, epilepsy and control group
Source: authors'own contribution

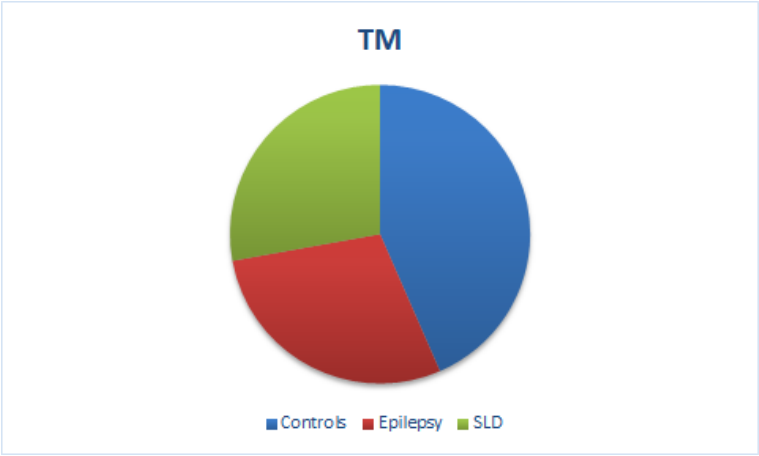

Figure 3: Theory of mind score in SLD, epilepsy and control group
Source: authors'own contribution

Discussions

In accordance with the previous studies (Stewart et al., 2019, p. 106-146; Bloom & Heath, 2010, p. 180-192) the results of our study highlights that subjects with focal epilepsy and those with SLD had difficulties in the recognition of facial emotion and in ToM confronted with their peers. Specifically, both groups exhibited greater problematic in recognizing happiness, sadness, anger and fear, but the SLD group also had a lower performance in recognizing neutral facial expressions.

Previous research has highlighted a correlation between executive functions and ToM (Wade et al., 2018): our study confirms this positive correlation between social cognition - both ToM and Affect Recognition - and executive functions, which emerged in both the epileptic group and the SLD group.

Furthermore, it should be added that the Social Cognition deficit present in subjects with epilepsy seems to be associated with specific characteristics of the disorder: in particular, difficulties in emotion recognition appeared to be linked to early age, long duration of disease, onset of epilepsy, poor nonverbal intelligence and poor executive functions. In fact, in these patients a lower non-verbal intelligence score corresponded to a worse performance in recognizing facial expressions (Luca et al., 2019). On the other hand, in SLDs subjects a correlation between intellectual level and social cognition skills did not emerge.

Deficiencies in ToM appeared to be linked to a high seizure frequency in epileptics subjects.

Conclusions

In conclusion, from the results obtained it can be affirmed that two aspects that are fundamental in social cognition, as they promote and favor social relations, are ToM and AR. The latter ability also appears to be correlated with executive functions. Therefore, all these skills should be evaluated in developmental age to provide specific interventions and ensure an optimal quality of life for children and adolescents.

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