Empathizing, Systemizing, Intuitive Physics and Folk Psychology in Boys with Asperger Syndrome

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Abstract

The present study focused on empathizing, systemizing, intuitive physics and folk psychology in children with Asperger syndrome. 50 boys from Slovakia in the range from 6 to 18 years participated in the research follow-up. The inclusion criteria were the diagnosis of Asperger syndrome according to ICD-10 and normal intellect (WISC-III). The tests measuring EQ, SQ, intuitive physics and folk psychology were used. Control group consisted of 60 boys from primary schools and grammar schools aged from 6 to 18 years of age. The results pointed to poor performance in empathizing and high performance in systemizing in children with Asperger syndrome in comparison with the control group. The scores on intuitive physics test and folk psychology test confirmed our findings.

INTRODUCTION

Asperger Syndrome (AS) is a neurodevelopmental disorder first described by Hans Asperger more than 50 years ago (1944). Characteristic behavioral features are evident. Asperger identified them in the group of young males and they included difficulties in social development and communication, social deficits, lack of empathy, narrow interests, one-sided conversations and motoric clumsiness. The current diagnostic criteria (DSM-IV, 1994) describe AS by social interaction impairments, circumscribed interests and repetitive stereotyped behavior. Apart from clear similarity, the key difference between AS and autism is absence of language delay or cognitive impairments in AS.

During the past two decades autism spectrum disorders has reached growing attention and the researchers have focused on studying the pathogenesis of its phenotypic characteristics (Kelemenová & Ostatníková 2009; Kelemenová 2009). Some theorists have focused on cognitive deficits (Ozonoff *et al* 1991; Russell *et al* 1996), others have conceptualized autism as an inability to bind parts into a unit – weak central coherence (Frith 1989; Happe 1997) or have explored autism within the concept of the Theory of mind (Baron-Cohen *et al* 1985; Happe & Frith 1996; Leslie & Frith 1988).

Theory of mind aims on empathizing and systemizing skills (Baron-Cohen 2009). Findings of a sex differences in empathizing (females perform better) have led theorists to investigate the possibility that autistic spectrum disorders may constitute an extreme version of cognitive difference which extends across entire population. Empathizing is defined as the drive to identify emotions and thoughts in others and to respond to their mental states with an appropriate emotion. Empathizing allows one to predict another's behavior at an accurate level to improve social interaction. Systemizing is defined as the drive to analyze and build systems e.g. technical, natural, taxonomic, numeric, motor, and social. Systemizing allows the subject to predict and control such systems (Wheelwright *et al* 2006).

The empathizing-systemizing model proposes two psychological dimensions closely allied with concepts of folk psychology and folk physics (Baron-Cohen 1997). Intuitive physics comprises higher-level understanding of physical causality. This refers to skills relating to mechanics and understanding how things work. Folk psychology comprises higher-level social intelligence. This includes being able to judge how an agent is expressing a basic emotions. In short, it includes the skills that are involved in normal reciprocal social relationships and in communication – understanding social causality (Baron-Cohen *et al* 2001). These concepts are related to the extreme male brain theory of autism (Baron-Cohen 1999).

Extreme male brain theory (EMB) was unofficially described by Hans Asperger (1944), who considered autistic personality as an extreme variant of male intelligence. This theory is nowadays empirically tested. Studies exploring systemizing and empathizing in autistic individuals (Baron-Cohen *et al* 2002, 2003, 2005) revealed that people with AS scored higher on the SQ and lower on the EQ. The evidence of EMB theory includes the findings from Reading the mind from eyes test that revealed that neurotypical females score higher than males, but people with AS score even lower than neurotypical males (Baron-Cohen 1997). EMB theory posits two dimensions: empathizing (E) and systemizing (S). Male brain type is defined as S>E and female brain type as E>S. Individuals from autistic spectrum disorder (ASD) are considered as extremely systemized S>>E (Baron-Cohen 2009).

Empathizing – Systemizing theory is connected with sex differences in testosterone levels. It is hypothesized that men having more testosterone are more systemized and women reversely. Different results have been reported (Knickmeyer *et al* 2006; Wakabayashi *et al* 2007; Barbeau *et al* 2009; Krajmer *et al* 2009; Schmidtova *et al* 2010) as far as the relationship between testosterone levels and empathizing/systemizing scores are concerned.

Bellow average empathy is a way to explain the social communication difficulties, whilst average or even above average systemizing is a way of explaining the narrow interests, repetitive behavior and resistance to change/need for sameness (Baron-Cohen 2008).

In our study we compared boys with AS and normal boys (two subgroups: under and over 10 years of age). Criterion for the division was the variability of testosterone in different age groups.. We suppose the higher SQ and intuitive physics scores in boys with AS in contrast to neurotypical boys and lower EQ and folk psychology scores in boys with AS in contrast to neurotypical boys.

PARTICIPANTS AND METHOD

Participants included 50 boys with Asperger syndrome and 60 neurotypical individuals with no history of autism. Asperger participants were recruited by their local psychologists and psychiatrists. All subjects met ICD-10 criteria for Asperger syndrome, their IQ according to WISC-III ranged from 93 to 128. The boys were divided to two groups according to age: prepubertal boys under the age of 10 (AS boys mean age 8.32; SD=1.52, control boys mean age 8,48; SD=1.47) and pubertal boys over 10 years of age (AS boys mean age 13.71; SD=2.56 control boys mean age 14.75; SD=1.73).

The reason why the prepubertal and pubertal participants were studied separately was related to testosterone levels which were related to psychological parameters in another study. Testosterone levels undergo biorhythmical fluctuations with quite high individual variability. Within the fluctuations of testosterone levels during childhood the effect of testosterone on cognition could be divided to prepubertal and post pubertal childhood periods.

During the prepubertal period, which extends throughout the first 10 years of age, the gonadotropin levels are low. It is due to the coincidence of the two mechanisms. The first one being very high sensitive hypothalamo-pituitary-gonadal negative feedback that is effective from mid gestation (Grumbach *et al* 1974) and is active in early childhood up to the 4th year of age. Between the 4th and the 11th year of age the steroid independent mechanism via the central inhibition of pulse generator in mediobasal hypothalamus prevails. Negative feedback system is secondary during this period. With the onset of puberty the central inhibitory mechanism consequently ceases. Hypothalamic releasing hormone generator becomes less sensitive to the increased gonadal steroid concentrations (Griffin & Wilson 1992). Following puberty onset the negative feedback mechanism reaches setup point characteristic for the adults and is again the dominating mechanism limiting gonadotropin secretion. Puberty is very dynamic period of physical growth, sexual and mental maturation and the changing testosterone levels affect not only physical appearance but also cognitive and behavioral characteristics. It is due to relatively stable testosterone concentrations in prepubertal age and due to dynamic changes with high variability in pubertal age the subjects were divided into two groups: prepubertal till the age of 10 and pubertal from 10 to 18 years of age (Ostatníková *et al* 2000, 2002a, 2002b, 2007; Kelemenová & Ostatníková 2008).

Each participant completed four psychological tests measuring empathizing, systemizing, intuitive physics and folk psychology (Reading the mind from eyes test). Six participants were excluded during testing for methodological reasons. All tests were developed in Autism Research Centre at the University of Cambridge and were used with kind permission of Professor Baron-Cohen (Baron-Cohen 1997; Baron-Cohen *et al* 2001, 2003). They meet the standard psychometric criteria. The primary instruments for this study were the adapted Slovak translation versions of the adult EQ and SQ questionnaires. (Ostatníková 2007; Jánošíková 2008). Both tests assessing empathy by EQ (empathizing quotient) and assessing systemizing by SQ (systemizing quotient) consist of 60 items. The participants indicated how strongly they agree with each statement by ticking one of several options: 'definitely agree', 'slightly agree', 'slightly disagree', or 'definitely disagree'. Maximum score was 80 and minimum was 0 points. Folk physics was assessed by Intuitive physics test with 20 problems from everyday real world experience on the physical-causal world with four given solution. The subject had to choose one of the possible solutions. Folk psychology was assessed by Reading the mind from eyes test that contains photographs of the eye region of the face. The subject was asked to pick one out of 4 given descriptions that fit the feeling expressed in the eyes on the picture.

At least one of the parents of all participants gave informed consent to participate in the study.

RESULTS

The raw scores on EQ test, SQ test, folk psychology test and intuitive physics test (Tab. 1) were compared using t-test for unrelated samples in the statistical software SPSS.

In prepubertal group, boys with AS had lower raw EQ score than control boys [$t(47)= -2.79$; $p=0.007$]. Similarly, in pubertal group boys with Asperger syndrome scored lower than control boys [$t(86)= -2.54$; $p=0.013$] in empathizing.

In pubertal group no significant differences in systemizing between boys with Asperger syndrome and control boys were found [$t(47)= 0.39$; $p=0.302$]. In contrast, in pubertal group boys with Asperger syndrome scored significantly higher in systemizing than control boys [$t(86)= -2.95$; $p=0.004$].

In the folk psychology test, in group under 10 years there were no differences between the groups [$t(41)= -0.96$; $p=0.343$]. The older children with Asperger syndrome had lower raw scores than their peers from the control group [$t(59)= -1.99$; $p=0.050$].

In the test on intuitive physics, in group under 10 years boys with Asperger syndrome were superior to the control group [$t(41)= 4.92$; $p<0.001$]. Similarly, older children with Asperger syndrome scored higher than their control peers [$t(59)= 4.44$; $p<0.001$]. In the Reading the mind in the eyes test, the autistic group performed significantly less accurately than controls (Fig. 1).

DISCUSSION

The Empathizing Quotient (EQ) and Systemizing Quotient (SQ) aim to evaluate the extent to which individuals empathize and systemize. Connection between EMB theory and empathizing/systemizing is reported. Boys with AS scored lower on the EQ than control group what may reflect their social roughness and disability of decoding the mental states of others. On the SQ only boys with AS over 10 years scored higher. Non-significant differences in the group of boys under 10 years of age predict the fact that systemizing as a pattern becomes evident at pubertal children and adults.

Higher scores on intuitive physics test in boys with AS revealed their interest in correctness and regularity of various systems. On the other hand, unrecognized emotions in the eyes may indicate the problems in social functioning. Absence of any difference in Reading the mind from eyes test in prepubertal boys points to the fact that it might be difficult for young children to recognize the emotions from the eyes generally.

Test on intuitive physics can be helpful in occupational decision making process and predestinates children with AS for natural and technical sciences. Above-average systemizing in people with AS points to narrow interests, repetitive behavior, change resistance and necessity of uniformity. They prefer sameness, then the world is more predictable and comprehensible for them. There are typical examples of systemizing in people with AS: need of unvaried food, making collections and catalogues, studying maps and traffic orders, compulsive playing of the same games, memorizing the animal species, watching the same film again and again (Baron-Cohen 2008).

Future research will focus on relating the levels of testosterone to the scores on studied psychological tests.

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