The metaphor and sarcasm scenario test: a new instrument to help differentiate high functioning pervasive developmental disorder from attention deficit/hyperactivity disorder

Taeko Adachi\textsuperscript{a,b}, Tatsuya Koeda\textsuperscript{c,*}, Shinichi Hirabayashi\textsuperscript{d}, Yukinori Maeoka\textsuperscript{e}, Madoka Shiota\textsuperscript{f}, Edward Charles Wright\textsuperscript{g}, Ayako Wada\textsuperscript{a}

\textsuperscript{a}Division of Neurobiology, Department of Biomedical Sciences, Tottori University Graduate School of Medicine, Tottori, Japan
\textsuperscript{b}Department of Speech Pathology, Matsue Co-medical College, Matsue, Japan
\textsuperscript{c}Department of Humanity Education, Faculty of Education and Regional Sciences, Tottori University, Koyama-cho Minami 4-101, Tottori 680-8551, Japan
\textsuperscript{d}Department of Neurology, Nagano Children’s Hospital, Nagano, Japan
\textsuperscript{e}Department of Occupational Therapy, Hiroshima Prefectural College of Health Sciences, Hiroshima, Japan
\textsuperscript{f}Department of Pediatrics, Tottori Prefectural Kake Rehabilitation Center for Disabled Children, Tottori, Japan
\textsuperscript{g}Department of Curriculum and Instruction, Faculty of Education and Regional Sciences, Tottori University, Tottori, Japan

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Abstract

It is sometimes difficult to discriminate high functioning pervasive developmental disorders (HFPDD) from attention deficit/hyperactivity disorders (AD/HD) in young children because of the behavioral similarities between the two. For adequate diagnosis, understanding fundamental differences in their social cognitive abilities might become significant. In order to detect the differences in social cognitive abilities between AD/HD and HFPDD, a new test, the Metaphor and Sarcasm Scenario Test (MSST) was developed. One hundred and ninety-nine normal school children (the control group), 29 AD/HD children and 54 HFPDD children were involved. The results showed that the inability to understand a sarcastic situation was specific to children with HFPDD, both children with AD/HD and HFPDD could not equally understand metaphor. The correlation between the comprehension of sarcasm and success in the theory of mind task was remarkably high but not for comprehension of metaphor. In conclusion, the MSST has the potential to discriminate HFPDD from AD/HD in young children.

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Keywords: High functioning pervasive developmental disorder; Attention deficit hyperactivity disorder; Social cognition; Metaphor; Sarcasm

1. Introduction

Recently, the number of Japanese school children who have difficulty in adapting to school life has been increasing. Some of them have developmental disorders, such as attention deficit/hyperactivity disorder (AD/HD), learning disabilities (LD), high functioning autism, Asperger’s syndrome (AS), etc. [1]. AD/HD can be grouped into attention deficit and disruptive behavior disorders, while autism and AS are on the spectrum of pervasive developmental disorders. These two groups have a completely different diagnostic axis; however, there are often behavioral similarities, e.g. hyperactivity, impulsive behavior and single focused attention [2,3].

As children with AS become older, their social and educational problems seem to be exacerbated because appropriate diagnosis tends to occur at around the age of 11. Before the age of 11, some children with AS are misdiagnosed as having emotional disorders, AD/HD or other developmental disorders [4,5]. Some children with high functioning autism also externalize their behavior as AD/HD children do, e.g. running around the classroom, especially if the stereotypical symptom of repetitive behavior is diminished. Thus, it is sometimes difficult for clinicians to determine an appropriate diagnosis.

It is well known that some children with HFPDD fail the theory of mind (ToM) task [6]; therefore, it is often said
they have ‘mind blindness’. Indeed, HFPDD children are frequently faced with socially problematic situations in the school and at home. This is partly due to their inability to understand false beliefs. However, other reasons should also be considered, e.g. difficulties of understanding metaphoric and sarcastic or ironic situations [7–9]. Objective evaluation of these difficulties in the clinical setting might be useful in determining the diagnosis, HFPDD or AD/HD. The purpose of this study was to investigate whether metaphoric and sarcastic scenarios can be used to distinguish AD/HD from HFPDD.

2. Methods

2.1. Subjects

One hundred children with AD/HD or HFPDD were chosen for this study. They had already visited child neurology outpatient clinics in Tottori, Nagano and Hiroshima Prefectures from September 2001 to March 2002 and had been diagnosed with AD/HD and HFPDD by the criteria of DSM-IV. The conditions for participation were a score of more than 70 for the full intelligence quotient (IQ) and for verbal IQ on the Wechsler Intelligence Scale for Children-Revised (WISC-R) or the Wechsler Intelligence Scale for Children–Third Edition (WISC-III). After screening, 83 children aged 7–14 years old (72 boys and 11 girls), were selected. In the AD/HD group, there were 29 children (26 boys and three girls) aged 7–14 years old. In the HFPDD group, there were 54 children (46 boys and eight girls) aged 7–14. Prior to the study, informed consent was obtained from their parents.

One hundred and ninety-nine children (96 boys and 103 girls), aged 8–12 years old, without mental retardation, who were students at ordinary schools also participated in this study as the control group after the informed consent of their parents had been obtained.

The profiles of control, AD/HD and HFPDD groups are presented in Table 1. There was no difference in mean age, gender and IQs between AD/HD and HFPDD groups. However, the gender balance was significantly different between the control and patient groups ($\chi^2$ (d.f. = 2) = 36.22, $P < 0.001$).

Table 1

<table>
<thead>
<tr>
<th>Groups</th>
<th>Age (years)</th>
<th>Gender (M/F)</th>
<th>FIQ</th>
<th>VIQ</th>
<th>PIQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controls</td>
<td>10.0 (1.4)</td>
<td>96/103</td>
<td>ND</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>AD/HDs</td>
<td>9.6 (1.8)</td>
<td>26/3</td>
<td>96.7 (15.7)</td>
<td>98.0 (14.9)</td>
<td>95.8 (16.7)</td>
</tr>
<tr>
<td>HFPDDs</td>
<td>9.8 (2.1)</td>
<td>48/8</td>
<td>96.1 (13.1)</td>
<td>98.0 (13.7)</td>
<td>94.8 (15.6)</td>
</tr>
</tbody>
</table>

Mean (1 S.D.); M, male; F, female; ND, not done. There was significant difference in gender balance between controls and patient groups (Chi square test, $P < 0.001$).

2.2. Metaphoric and Sarcastic Scenario Test (MSST)

This test consists of five metaphoric and sarcastic scenarios (MSST; see Appendix A). In the MSST, the metaphorical scenarios are odd numbered and the sarcastic scenarios even. The words and sentences in MSST were selected from standard textbooks of Japanese language (Mitsumura Press) for first, second and third classes in elementary school. The expressive sentence dictionary (Saera Press) was employed as the reference for the construction of scenarios.

The test employed a multiple-choice style, i.e. one was correct with four incorrect answers. The number of correct answers in the metaphoric and the sarcastic scenarios represent the metaphorical score and sarcastic score, respectively. One of the incorrect answers in each sarcastic scenario was a ‘landmine answer’. The landmine answer involves misunderstanding the speaker’s sarcasm to mean admiration. For example, the landmine answer to the second question in the MSST (see Appendix A) is ‘(a)’. The number of times the landmine answer was avoided became ‘the landmine avoidance score.’ Subjects were given one point for correct answers to metaphoric, sarcastic questions and landmine avoidance.

In the task, children were asked to read each question silently. Due to this condition, children with developmental dyslexia were excluded from the study.

2.3. The ’Box of Marbles’ task (Theory of Mind task)

In order to investigate whether the participants understood false beliefs, all children were given a Theory of Mind (ToM) task. The original task is called the ‘Box of Smarties’ task [10]. But instead of using smarties, we used a box of ‘marble chocolates’, which is a popular chocolate among Japanese children, hence the ‘Box of Marbles’ task. The procedure is the same as for the ‘Box of Smarties’ task [10]. The procedure is as follows. Three pieces of clips are in a box of marbles instead of chocolates. The examiner showed a child the box and asked what is in this box. After the child answered, the examiner opens the box and shows the clips to the child. In front of the child, the clips are put into the box again. The examiner asks ‘If other child came here now and I asked the child what was in this box. How do you think what does the child answer?’

A pilot study was conducted with 10 children without intellectual and behavioral problems aged 7–9, and none of them failed. Thus, we decided that the task was suitable for Japanese children.

2.4. Statistics

First, we compared individual scores of metaphoric, sarcastic and landmine avoidance scores among three groups by using the Kruskal–Wallis test. As the post hoc test, multiple comparisons were also done [11]. The comparison
between each group was done by using the Mann–Whitney U-test. Wilcoxon test was employed for the comparison of metaphoric and sarcastic score in each group. Second, the correlations between each score on the MSST and individual ages and each IQ score were analyzed by using Spearman’s correlation. Last, according to the results from the ‘Box of Marbles’ task, a comparison for each score on the MSST was carried out using a Mann–Whitney test. For the statistical analysis, SPSS® for Windows, Base Statistics Release 11.5 was used.

3. Results

3.1. MSST scores

The results of the MSST are presented in Table 2. Group effects were highly significant in the Kruskal–Wallis test (total score; χ² (d.f. = 2) = 52.85, metaphor score; χ² (d.f. = 2) = 53.34, sarcastic score; χ² (d.f. = 2) = 29.33, landmine avoidance score; χ² (d.f. = 2) = 45.54, all P < 0.001). The results of post hoc tests, and total and metaphorical scores in the control group were significantly higher than in AD/HD group and all scores in the HFPDD group (P < 0.001). The sarcastic and landmine avoidance scores in the HFPDD group were significantly lower than those of the AD/HD groups (P < 0.01).

A comparison between metaphorical and sarcastic scores within groups showed significant differences in the control and HFPDD groups (Wilcoxon test, P < 0.001, P < 0.01, respectively, Fig. 1). With regard to the gender difference, there were no significant differences in all groups.

3.2. ToM task

Twenty-two children (84.6%) with AD/HD successfully performed the ToM task, while 36 children (69.2%) with HFPDD passed the task. There was no significant difference in the percentages of children who passed the task between the two groups.

3.3. Correlation analysis

The correlation between each score on the MSST and age, FIQ, VIQ and PIQ is summarized in Table 3. The metaphorical score correlated significantly with all factors except for age in AD/HD group and PIQ in the HFPDD group. The only factor that correlated with the sarcastic score was age in the control group. There was no significant relation in landmine avoidance score.

3.4. Success vs. failure in the ToM task

In Table 4 the comparative results according to the ‘Box of Marbles’ task are presented. AD/HD children who failed the ToM task had significantly lower FIQ (t(d.f. = 12.8) = 3.2, P < 0.01), while HFPDD children who had failed the task had significantly higher FIQ (t(d.f. = 50) = 2.9, P < 0.01) and PIQ (t(d.f. = 50) = 2.0, P < 0.05) and showed a tendency to have been high on the VIQ (t(d.f. = 19.7) = 2.0), P < 0.1). These children also showed significantly lower scores on total and sarcasm (Mann–Whitney test, P < 0.05, P < 0.01, respectively).

Table 2

<table>
<thead>
<tr>
<th>Groups</th>
<th>MSST scores</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Controls (n = 199)</td>
<td>7.4 (2.5)*</td>
<td>4.1 (1.2)*</td>
<td>3.3 (1.7)*</td>
<td>4.2 (1.2)*</td>
</tr>
<tr>
<td>AD/HDs (n = 29)</td>
<td>5.5 (2.7)</td>
<td>2.5 (1.7)</td>
<td>3.0 (1.6)#</td>
<td>3.7 (1.6)#</td>
</tr>
<tr>
<td>HFPDDs (n = 54)</td>
<td>4.3 (2.8)</td>
<td>2.5 (1.6)</td>
<td>1.8 (1.8)</td>
<td>2.5 (1.7)</td>
</tr>
</tbody>
</table>

Mean (1 S.D.); [], best possible score. *P < 0.001, between control and HFPDD groups; +P < 0.001, between control and AD/HD groups; #P < 0.01, between AD/HD and HFPDD groups.

Fig. 1. Comparison of metaphorical and sarcastic scores in three groups. metaphorical score; sarcastic score. *P < 0.01, **P < 0.001 (Wilcoxon test).
4. Discussion

In our study, we found a remarkably different pattern of responses between the AD/HD and HFPDD groups. In children with AD/HD, metaphoric and sarcastic comprehension was lower than in the control group. In children with HFPDD, metaphoric and sarcastic comprehension was also lower than those of the control children. Importantly, for the HFPDD children comprehension of sarcastic scenarios was remarkably lower than comprehension of metaphoric scenarios. This implies that a worse comprehension of sarcasm in comparison to metaphor is specific to children with HFPDD. It is well known that children with HFPDD have a rich vocabulary, a formal way of talking and a tendency for literal interpretation. It has also been shown that their comprehension of metaphoric stories, sarcasm and jokes is impaired [12–14]. Research has investigated the nature of this impairment [15,16], but none of the findings so far have referred to the difference between metaphoric and sarcastic comprehension. In our study, we would like to show that HFPDD children cannot understand sarcasm, while the inability to comprehend metaphor is common to both children with AD/HD and HFPDD. This distinction could well prove crucial to correct diagnosis of these disorders.

Correlation analysis showed that while the comprehension of metaphoric scenarios was dependent on IQ and age in both patient groups and the control group, the comprehension of sarcastic scenarios in the patient groups was independent of IQ and age. This suggests that other factors must be associated with the comprehension of sarcasm in the patients. The results from the comparison with successful vs. failed children on the ToM task gave us some ideas as to what these factors might be. In the AD/HD group, it was considered that a lower IQ might be related to failure on the ToM task. In regard to children with HFPDD, however, those who failed the task showed significantly higher IQ and lower sarcastic scores than the HFPDD children who passed the ToM task. It was evident that IQ was not responsible for lower sarcastic scores in this group, and also that the comprehension of sarcasm was closely related to success on the ToM task. One idea is that the comprehension of sarcasm and the ToM task might be similar in that they both require empathic ability. Dyck et al. have shown that empathic ability is independent of intelligence and that it is useful to discriminate between children on the autistic spectrum and children who are not on the spectrum [17]. Poor empathic ability has often been suggested as one of the fundamental deficits in those with autism.

Although a large number of researchers have deployed the ToM task, relatively little is known about interpreting the difference between metaphoric and sarcastic situations [12,18,19]. Several reports have shown how HFPDDs have had difficulty understanding metaphors, because they demand the ability to ‘read between the lines’. [20–22].

| Groups | MSST scores | | | |
|---|---|---|---|
| | Metaphoric | Sarcastic | Landmine avoidance |
| Controls | | | |
| Age | 0.576*** | 0.269*** | 0.095 |
| AD/HDs | | | |
| Age | 0.326 | 0.142 | 0.049 |
| FIQ | 0.419* | −0.040 | −0.086 |
| VIQ | 0.406* | 0.077 | −0.051 |
| PIQ | 0.406* | −0.050 | −0.042 |
| HFPDDs | | | |
| Age | 0.481*** | 0.220 | −0.047 |
| FIQ | 0.422** | −0.052 | 0.067 |
| VIQ | 0.527*** | 0.084 | 0.018 |
| PIQ | 0.188 | −0.179 | 0.019 |

*P < 0.05, **P < 0.01, ***P < 0.001.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Success (n = 22)</th>
<th>Failure (n = 4)</th>
<th>Success (n = 36)</th>
<th>Failure (n = 16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD/HDs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>9.7 (1.9)</td>
<td>9.3 (1.3)</td>
<td>10.1 (2.1)</td>
<td>9.1 (2.0)</td>
</tr>
<tr>
<td>FIQ</td>
<td>99.0 (16.7)</td>
<td>83.4 (6.2)**</td>
<td>92.9 (10.8)</td>
<td>103.4 (15.0)**</td>
</tr>
<tr>
<td>VIQ</td>
<td>99.6 (15.9)</td>
<td>87.8 (8.8)</td>
<td>95.3 (10.3)</td>
<td>104.8 (17.4)</td>
</tr>
<tr>
<td>PIQ</td>
<td>98.3 (17.2)</td>
<td>82.5 (10.1)</td>
<td>91.8 (16.7)</td>
<td>101.0 (11.1)*</td>
</tr>
<tr>
<td>MSST scores</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5.4 (3.0)</td>
<td>5.3 (2.1)</td>
<td>4.8 (3.0)</td>
<td>3.1 (2.0)*</td>
</tr>
<tr>
<td>Metaphoric</td>
<td>2.5 (1.9)</td>
<td>2.0 (1.4)</td>
<td>2.5 (1.6)</td>
<td>2.5 (1.8)</td>
</tr>
<tr>
<td>Sarcastic</td>
<td>2.9 (1.6)</td>
<td>3.3 (1.7)</td>
<td>2.3 (1.9)</td>
<td>0.6 (0.7)***</td>
</tr>
<tr>
<td>Landmine avoidance</td>
<td>3.5 (1.7)</td>
<td>4.5 (0.6)</td>
<td>2.8 (1.7)</td>
<td>1.9 (1.8)</td>
</tr>
</tbody>
</table>

Mean (1 S.D.), *P < 0.05, **P < 0.01, ***P < 0.001.
The failure to comprehend sarcastic scenarios resembles this difficulty in comprehending metaphor since both are caused by an incapacity to interpret the thoughts of the speaker, hence show a lack of empathic ability. In addition, sarcastic statements are inconsistent with reality, therefore children with HFPDD are likely to be confused. Thirty-six of children with HFPDD who succeeded in the ToM task did not avoid the landmine answers. The successful comprehension of sarcasm and the ToM task both involve empathic ability yet understanding sarcasm requires greater empathic sensitivity because its meaning contradicts the literal meaning of an utterance and can only be understood through the tone of the speaker. A comparative study regarding ToM and task involving sarcastic scenarios should be conducted to clarify the fundamental deficit in autistic children.

Our comparative study on controls, AD/HDs and HFPDDs suggests that comprehension of sarcasm is closely related to success on the ToM task, but not to the comprehension of metaphoric statements. This finding might correspond to the differences of empathic ability between AD/HDs and HFPDDs. Bishop and Baird have developed a novel communication checklist as a practical guide to distinguishing AD/HD children from those in the autistic spectrum or with other developmental disorders [23]. The MSST can also be useful in clarifying the deficits in social cognition experienced by HFPDD children. The MSST also partly shows how to care for AD/HD and HFPDD children at school and at home since each scenario is a good example of how the way they misunderstand things can be socially problematic.

While metaphor and sarcasm are, of course, contingent upon language and culture, the primary deficits of autism are likely to apply across cultures. We would like to emphasize that it is the misunderstanding of sarcasm, not metaphor, that relates to the lack of empathic ability, which is a fundamental deficit of autism. To clearly distinguish children with HFPDD from children with suspected AD/HD is sometimes difficult because of their behavioral similarities. We need strategies for evaluating these young children. As a novel strategy, a test composed of metaphoric and sarcastic scenarios, specific to each language and culture, may well be the tool for making this distinction.

In this study, the MSST was yet to be standardized. In order to be able to be generalized, the MSST needs to be standardized and expanded. More controls and a greater number of test subjects are necessary if we are to better comprehend the specific patient groups and their responses to this test.

Appendix A

Table A1

<table>
<thead>
<tr>
<th>MSST (Metaphor and Sarcasm Scenario Test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Circle the most correct response to each of the following sentences.

(1) My neighbor’s daughter leaves the house looking beautiful because of her make-up. When my younger brother saw her, he said to me, “she can really bakersu (transform) herself with make-up, can’t she?”

   (a) she became an obake (ghost).
   (b) she was transformed into a tanuki (raccoon dog).*
   *In Japanese mythology raccoon dogs are famous for their ability to transform themselves into different shapes.
   (c) he began to hate her.*
   *This answer depends upon the distinction between kirai (to hate) and kirei (beautiful).
   (d) she becomes a completely different person when she puts on her make-up.
   (e) Don’t know.

(2) When Jiro’s mother came home, his clothes were strewn all over his room. When she saw this, she said to him, “How do you always keep your room so tidy?”

   Jiro’s mother thinks he...
   (a) is a tidy boy.
   (b) is a messy boy.
   (c) is a boy.
   (d) has taken a bath.
   (e) Don’t know.

(3) When Taro plays soccer, no one at his school migi ni deru (comes close to him).*

   *In Japanese migi means right. The phrase migi ni deru mono ga inai means no one comes close to him, i.e. he is the best by miles.

   Taro...
   (a) is the best soccer player in the school.
   (b) is the worst soccer player in the school.
   (c) is sitting to the right of all the students.
   (d) Taro thought he was going to play soccer.
   (e) Don’t know.

(4) Today my family all went to a restaurant for dinner. Taro and Jiro were mucking about while we were eating. The old lady sitting next to us said, “your children are very quiet.”

   The lady thinks Taro and Jiro are...
   (a) badly behaved.
   (b) quiet.
   (c) cute.
   (d) children.
   (e) Don’t know.

(5) A policeman said, “I’ll let him oyogu (swim) for the time being”.*

   *This phrase means the policeman is going to release the suspect, in the hope that he will implicate himself in his crime.

   The policeman...
   (a) is going to take the criminal to the sea and let him swim.
   (b) regards the criminal as his friend.
   (c) is going to release him.
   (d) is asking the criminal to go to the swimming pool.
   (e) Don’t know.

(6) Saburo’s room is so full bits and pieces of paper that there’s nowhere to sit down. When Hanako entered his room, she said to him, “your room is always so tidy.”

(continued on next page)
Table 5 (continued)

Hanako thinks that Saburo’s room is...
(a) bright.
(b) small.
(c) messy.
(d) tidy.
(e) Don’t know.

(7) Goro always wins the relay. When Taro saw Goro gobonuki* (catch up with people and overtake them until he was in the lead), he cried, “Goro is like a cheetah”.

*Gobonuki refers to uprooting _gobo_ (a long thin Japanese root vegetable) in a single action. In this case it refers to Goro outstripping the opposition.

Taro says that Goro is...
(a) a cheetah.
(b) a handsome boy.
(c) running very fast.
(d) uprooting gobo.
(e) Don’t know.

(8) The old man’s garden is completely unkempt and overgrown. When an old lady went into the garden, she remarked, “oh, what a beautiful garden it is!”

The old lady thinks the old man’s garden is...
(a) tidy.
(b) lovely.
(c) messy.
(d) spacious.
(e) Don’t know.

(9) The old lady said to me, “Your rosy cheeks remind me so much of apples, I want to eat them”.

I thought that...
(a) the old lady loved apples.
(b) the old lady wanted to eat apples.
(c) the old lady wanted to eat my cheeks.
(d) the old lady thought I was cute.
(e) Don’t know.

(10) When Kiyoko saw my old shoes with the holes in them, she said, “they’re very nice shoes, aren’t they?”

Kiyoko thinks my shoes are...
(a) new.
(b) excellent.
(c) shabby.
(d) cool-looking, i.e. well-ventilated.
(e) Don’t know.

References


