Mental state terms and the role of working memory in high functioning autistic children’s narrative production

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Aims

- To investigate:
  
  a. possible dissociations in the use of internal state language denoting *thoughts* and *feelings* in the narrative performance of children with High Functioning Autism (HFA) and typical development (TD)

  b. rates of use of *cognitive* and *affective* mental state terms in HFA and TD children’s narrations across a range of ages to shed light on the development of their expression of the feelings and thoughts of other characters

  c. the link between the ability to use mental state terms in relation to syntactic complexity and working memory
Individuals with HFA belong to the autism spectrum with no learning disability (Frith, 2004)

Basic language functioning (phonology, syntax) is age-appropriate while higher level linguistic abilities (e.g. use of language in context, pragmatic inferencing, intentionality) are inappropriate (Joliffe & Baron-Cohen, 2000)

Verbal and non-verbal IQ ≥85
Autism

ASD is one single neurodevelopmental disorder characterized by:

- social interaction, social communication
- restricted repetitive behaviors, interests, and activities

(American Psychiatric Association, 2013)
Cognitive approaches to autism

a. **Mind-blindness**: deficit in Theory of Mind (**ToM**) - the ability to interpret the ‘other’ as distinct from ‘self’

   (Baron-Cohen, 1995)

b. **Weak Central Coherence** - inability to **integrate** relevant pieces of information: no ‘big picture’ --- *excellent attention to detail* both in terms of processing and memory

   - WCC mostly explains cognitive benefits in autism (rote memory, jigsaw-puzzles)

   (Frith, 1989/2003)

c. **Deficit in Executive Functions (EF)**: limited or no cognitive flexibility, inability to abandon decisions or misguided interpretations of actions

   - Controversial results with respect to **verbal WM capacity** in HFA

     (e.g. Schuh & Eigsti, 2012; Dawson et., 2002)

   - Verbal WM abilities found to account for significant variance in language skills and symptom severity in HFA; also, closely linked to deficits in HFA children’s syntactic abilities

     (Schuh & Eigsti, 2012; Tyson et al., 2014; Eigsti, 2009)

   - Deficits in HFA reported for phonological or spatial WM, but not verbal WM

     (Whitehouse et al., 2008; Williams et al., 2005, 2006)
Theory-of-Mind

- The ability to attribute thoughts (e.g. beliefs and desires) in order to explain and predict behaviour
- ‘mentalizing’ ability
- Mind-blindness predicts:
  - Impairment in aspects of social/communicative behaviour (e.g. perspective-taking and problem-solving, cooperation, empathy, emotional understanding)
ToM and HFA

- Mentalizing abilities of HFA are good: they pass first- and second-order ToM belief tasks (but not more complex ones, e.g. inferring bluff) (cf. Bowler, 1992; Baron-Cohen et al., 1996; Baron-Cohen, 2001)

- Language (syntax and vocabulary tasks) strongly correlated with performance on false-belief tasks (Fisher, Happé, & Dunn, 2005; Ozonoff & McMahon Griffith, 2000; De Villiers, & de Villiers, 2000)

- Syntax: the ability to use and understand complement clauses claimed to be the strongest predictor of ToM abilities in HFA (Tager-Flusberg, 2001, Tager-Flusberg & Joseph, 2005; Lind & Bowler, 2009)

- However, understanding of emotions as well as social behaviour (e.g. co-operation) seems difficult for these individuals (Peristeri, Tsimpli, & Williams, 2014)
Contradictory findings in studies of autism and verbal marking of affect

HFA: Speech language therapy showed no qualitative change in the use of verbs and nouns expressing mental states, including affective terms (Rodrigues, Tamanaha, & Perissinoto, 2010)

no quantitative difference btw TD children and children with HFA in spontaneous interaction analysis of verbal marking of affect but were less likely to initiate affect-marking sequences or talk about the affective responses of others (Müller & Schuler, 2006)

School-aged children with HFA used less cognitive mental state language during storytelling compared to TD controls, but no difference was observed in their use of emotional mental state language (Rumpf et al., 2012)
HFA: Affective ToM

- Autobiographical memory narratives by children with HFA included fewer emotional mental state terms than TD children.
- HFA children’s storybook narrations: their ability to identify emotions strongly correlated with length and diversity of syntax in their narrations.

(Brown, Morris, Nida, & Baker-Ward, 2012)
Questions

- What is the relationship between age and mental state terms in stories told by 7-12 year-old children with HFA and typical development matched on age, IQ and vocabulary?
- Will developmental patterns be different for cognitive and affective mental state terms for each group?
- Do working memory and syntactic complexity measures play a role in enhancing HFA children’s ability to produce cognitive and affective mental state terms?
I. The study - Participants (I)

- 20 Greek-speaking children diagnosed with HFA
  - Younger HFA group (3 girls, age range: 7;2-9;5, Mean: 8;3 yrs., SD: 0.8)
  - Older HFA group (1 girl, age range: 10;8-12;6, Mean: 11;7 yrs., SD: 0.5)

- **Diagnostic criteria:**
  - Autism Diagnostic Interview-Revised (ADI-R; Lord, Rutter, & Le Couteur, 1994)
  - clinical assessment of the child’s social-adaptive functioning by a child psychiatrist
Particpants (ctd.)

- 20 typically-developing (TD) Greek-speaking children
- Younger TD group age-matched with younger HFA group (3 girls, age range: 7;2-9;6, **Mean: 8;4 yrs., SD: 0.8**)
- Older TD group age-matched with older HFA group (1 girl, age range: 10;9-12;9, **Mean: 11;7 yrs., SD: 0.6**)
II. The study – Methodology

Screening tasks

- Memory for Digit Span assessment (Greek version of WISC-III (Wechsler, 1992); adapted in Greek by Georgas, Paraskevopoulos, Besevegis, & Giannitsas, 1997): measures child's ability to manipulate verbal information while in temporary storage (Maximum score: 14)

- Greek Expressive Vocabulary task (Vogindroukas, Protopapas, & Sideridis, 2009; adaptation from Renfrew Word Finding test, 1995). Each child was asked to name 50 pictures depicting every-day objects (Maximum score: 50)

- Standardized for 4-8 year-old monolingual Greek-speaking children and normed for 3-10 year old children
<table>
<thead>
<tr>
<th>Groups</th>
<th>WISC (general IQ index)</th>
<th>Digit Backward (max. score: 14)</th>
<th>Expressive Vocabulary (max. score: 50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Younger group with HFA</td>
<td>104.7</td>
<td>4.8 (2.6)</td>
<td>42.8 (4.4) MEVA: 9;10</td>
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<td></td>
<td>(min. 80-max. 125) (14.8)</td>
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<tr>
<td></td>
<td>Mean verbal IQ: 100.8 (14.1)</td>
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<td>Mean performance IQ: 119.5 (12.9)</td>
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<td></td>
<td></td>
<td>sign.</td>
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<tr>
<td>age-matched younger Controls</td>
<td>108.1</td>
<td>3.3 (1.1)</td>
<td>39.0 (5.2) MEVA: 10;1</td>
</tr>
<tr>
<td></td>
<td>(min. 98-max. 125) (7.9)</td>
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<tr>
<td></td>
<td>Mean verbal IQ: 100.4 (10.3)</td>
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<tr>
<td></td>
<td>Mean performance IQ: 106.8 (9.5)</td>
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<tr>
<td>Older group with HFA</td>
<td>102.0</td>
<td>6.6 (3.0)</td>
<td>43.7 (4.3) MEVA: 10;1</td>
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<td>(min. 88-max. 122) (14.5)</td>
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<tr>
<td></td>
<td>Mean verbal IQ: 102.6 (12.1)</td>
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<td>Mean performance IQ: 109.0 (13.9)</td>
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II. The study – Methodology

Narratives

- the Edmonton Narrative Norms Instrument (ENNI, Schneider, Dubé & Hayward, 2005)

- Wordless storybooks: ‘Harry the dirty dog’ (Zion, 1956), ‘Peter’s chair’ (Keats, 1967)

- Telling: 2 stories (all pictures were presented initially and then two-by-two on the computer screen; the experimenter was watching)

- Retelling: 2 stories (the child listens to stories through headphones; the experimenter was not watching the screen; the child had to retell the story looking at the pictures again)

- Present study: half of children in each group assigned the ENNI stories and the other half the stories Harry the dirty dog’ & ‘Peter’s chair’ - focus on retelling data – data transformed into z-scores

-- Retelling mode follows COST Action IS0804 instructions
II. The study – Methodology
Narratives (ctd.)

Children’s retellings were analyzed using the following measures:


- Frequency of main and subordinate clauses

- Syntactic Complexity Index (Hunt, 1970): shows the number of subordinated sentences for every c-unit

- Content words (nouns, verbs, adjectives)

- Lexical diversity (number of different words as a measure of lexical richness in a narrative)

- Narrative length measured through c-units
Edmonton Narrative Norms Instrument – An example
“Harry the dirty dog” picture-story
III. Results
Frequency (raw data) of **Cognitive** vs. **Affective** term use in children’s retelling

- **within-group comparisons**
  - cognitive>affective terms for both HFA groups ($p<.015$)

- **between-group comparisons**
  - old HFA > young HFA in **cognitive** term use ($p=.050$)
  - old TD > young TD in **cognitive** term use ($p=.041$)
  - old HFA used sign. less **affective** terms than the rest of groups ($p=.000$)
  - young TD used sign. less **affective** terms than old TD children ($p=.05$)
Main vs. Subordinate clause use, and Syntactic Complexity Index per group in retelling

- **Syntactic Complexity Index**
  - measure of linguistic complexity based on measuring the frequency of subordination for every T-unit (Hunt, 1970)

- **within-group comparisons**
  - subordinates > main for older TD children \( p = .02 \)

- **between-group comparisons**
  - old TD > both HFA groups in Syntactic Complexity Index \( p < .04 \)
Content words, lexical diversity and length per group in retelling

- **Narrative length**
  - old HFA > young HFA (p=.000)
  - old TD > young TD (p=.02)

- **Content words**
  - old HFA > young HFA (p=.000)

- **Lexical diversity**
  - old HFA > young HFA (p=.001)
  - young TD > young HFA marg. sign. (p=.06)
Correlations btw. use of cognitive-affective mental state terms and syntactic complexity index

- **TD children**
  - sign. positive correlation btw. frequency of use of *cognitive* mental state terms and Syntactic Complexity Index ($r=+.666$, $p=.001$)

- **HFA children**
  - sign. positive correlation btw. frequency of use of *cognitive* mental state terms and Syntactic Complexity Index ($r=+.489$, $p=.048$)
Correlations btw. use of cognitive-affective mental state terms, narrative length and working memory

- **TD children**
  - **sign. positive correlation** btw. frequency of use of **cognitive** mental state terms and WM ($r=+.511$, $p=.03$)
  - **sign. positive correlation** btw. narrative length and WM ($r=+.464$, $p=.04$)

- **HFA children**
  - **sign. positive correlation** btw. frequency of use of **cognitive** mental state terms and WM ($r=+.491$, $p=.000$)
Correlations btw. Syntactic Complexity Index and working memory

• **TD children**
  ✔ sign. positive correlation btw. Syntactic Complexity Index and WM ($r=+.783$, $p=.000$)

**HFA children**

✔ no sign. correlation found
Summary and Discussion:

- Increase in the use of cognitive terms observed for both TD children and children with HFA.
- Decrease in the use of affective terms observed only for older children with HFA (vs. TD controls); such difference between older HFA group and typical age-matched groups indicates problems in the verbalization of terms that refer to the emotional states of others.
- (Peristeri, Tsimpli, & Williams, 2014): Disorder in emotion perception (in the Ostracism condition) was more marked in HFA adults than children with HFA.
- Contrast between older children with HFA and older control children also observed for Syntactic Complexity Index; syntactic complexity of information structure in retelling data weaker relative to age-matched TD children; weak syntax more marked in old vs. young group with HFA.
- Similar levels of performance between HFA and TD children in narrative length and content words; old children with HFA converge towards expected lexical diversity levels.
Summary and Discussion: ToM tasks

- TD children: Syntactic skills related to WM capacities. Furthermore, both factors were found to positively influence the use of cognitive terms and narrative length in TD children.

- Children with HFA: also tapped on syntactic abilities and working memory to verbalize the cognitive states of others; no interdependence shown btw. WM and syntactic abilities.

- Older children with HFA showed higher verbal WM capacity with respect to age-matched TD controls; such cognitive advantage, though, did not seem to affect narrative length or syntactic complexity in children with HFA.

- Asperger child better than highly-gifted child only in WM tasks involving digits (Peristeri, Tsimpli, Bablekou, & Chrysochoou, 2013); backward digit task might involve visuo-spatial processes.

- Verbalization of emotions appeared to be unaffected by language abilities in either group.
Conclusions

- Affective mental state terms developmentally differ from cognitive terms in children with HFA.
- WM advantage in children with HFA does not interact with quantitative (length) and qualitative (syntactic complexity) properties of narrative production.
Thank you!

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