Irony processing in Adolescents: an ERP study

Irene Symeonidou¹, Iroise Dumontheil², Wing-Yee Chow¹ and Richard Breheny¹

¹Division of Psychology and Language Sciences, University College London

²Department of Psychological Sciences, Birkbeck, University of London

Introduction

Irony comprehension requires complex inferences about a speaker's mind^{1,2}. It involves understanding the speaker's intention to share an emotional attitude (e.g. ridicule). Behavioural data suggest that while children (ages 6-10) begin to show some appreciation of the communicative intent in an ironic remark², full appreciation of speaker attitude might be developing into adolescence³. This is in line with recent findings suggesting that online use of Theory of Mind (ToM) shows a prolonged development through late childhood and adolescence^{4,5}. fMRI evidence shows that adolescents activate the ToM network differently from adults during an irony task⁶.

Stimuli

- 120 stories in English (each with 7 sentences)
 - 60 ironic and literal stories** plus fillers (30 decoy and 30 other)
 - The 6th sentence was the target sentence which was identical across the ironic and literal conditions.

Sample story with two experimental conditions: (a) Ironic (b) Literal
Janet and Leanne sing in the same opera.
The evening of the first performance, they meet at the theatre.
The show starts right on time.
a) <i>During the performance, they forget their words and sing out of key.</i>
b) <i>The performance is excellent and the singers are applauded for a long time.</i>
After the show, Janet tells Leanne:
"Our performance was <u>superb</u> tonight."
While they are removing their make-up, the two girls continue to talk about the show.
Question: Are Janet and Leanne theatrical technicians?

- Decoy fillers: negative context that did not lead to an ironic remark
- Other fillers: positive context with a positive remark

Aim of the study

- We aim to investigate:
- How adolescents' (11-18 y. o.) brains process irony in real time compared to adults (24-34 y.o.).**
 - The extent to which adolescents' and adults' processing of irony is modulated by individual differences in empathy.**

A recent ToM model^{8, 9} proposes that ToM is comprised of cognitive ToM (inferring others beliefs) and affective ToM (inferring others affective states). Studies show that adolescents do not perform as well as adults in affective ToM tasks in comparison to cognitive ToM tasks¹⁰.

Method

Participants: 24 Adults (24-34yrs), 26 Adolescents (14-18.5yrs)

Task: story comprehension; adapted form Spotorno et al. (2013)

ERP data analysis:

- 12 electrodes: left-anterior (F3, C3); midline-anterior (Fz, Cz); right-anterior (F4, C4); left-posterior (P3, O1); midline-posterior (Pz, Oz); right-posterior (P4, O2)
- P600 time window: 500ms to 800ms after target word onset
- Mixed repeated measures ANOVA:
 - Story type (Ironic, Literal) x Laterality (Left, Midline, Right) x Anteriority (Anterior-central, Parietal-central) x Age group (Adolescent, Adult)

Questionnaires: irony comprehension; empathy (Interpersonal Reactivity index, IRI¹¹)

Additional analysis: correlation (Pearson's r) between participants' empathic concern score on the IRI with the size of their P600 effect

Results

- A significant main effect of Story type [$F(1,44) = 7.89, p = .007$]: ERPs at the target word were more positive in the ironic condition than the literal condition for both age groups, replicating previous results.^{7, 12, 13}
- The positivity was right-lateralised in adults but broadly distributed in adolescents.
- In adults, a significant positive correlation was found between empathy and the size of the P600 effect, suggesting that irony elicited a larger P600 effect in adults with a higher empathy score [$r(23) = 0.51, p=0.013$].
- No correlation was found in adolescents [$r(23) = -0.22, p=0.32$].

Discussion

- Irony elicited an increased positivity (a P600 effect) in both age groups.
- However, differences between adolescents and adults' data suggest that they do not process irony in the same way:
 - The topographic distribution of the P600 effect
 - This suggests that adolescents and adults engage different brain areas to process irony, and
 - it might also be due to structural changes that are occurring in the brain during adolescence.¹⁴
 - The presence of correlation between the size of the P600 effect and empathy score in adults but not in adolescents.
 - This might be due to ongoing development in the ability to integrate affective and cognitive ToM during adolescence.

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