

Better theory-of-mind skills in children hearing voices mitigate the risk of secondary delusion formation

Bartels-Velthuis AA, Blijd-Hoogewys EMA, van Os J. Better theory-of-mind skills in children hearing voices mitigate the risk of secondary delusion formation.

Objective: To examine the social cognitive vulnerabilities mediating delusion formation in children presenting with hallucinatory experiences.

Method: A sample of 259 12- and 13-year-old children, from a baseline case-control sample of children with and without auditory hallucinations (AH), were re-assessed after 5 years for presence of AH. Presence of delusions and theory of mind (ToM) were also assessed, to examine the hypothesized moderating role of ToM in delusion formation in children hearing voices.

Results: In children with AH at age 7–8 and/or 12–13 years, the risk of delusion formation was significantly higher (P interaction = 0.027) in those with lower ToM skills (OR = 4.3, 95% CI 1.9–9.9, P = 0.000), compared to those with higher ToM skills (OR 1.6, 95% CI 0.7–3.7, P = 0.26), independently from secondary school level.

Conclusion: The results suggest that better mentalizing abilities confer protection against delusion formation in children experiencing perceptual anomalies, not reducible to general cognitive ability.

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Significant outcomes

- Abnormal perceptions in children are associated with delusional ideation.
- Better theory-of-mind skills in children with auditory hallucinations may confer protection against delusion formation and clinical psychosis outcomes.

Limitations

- The theory of mind (ToM) task was administered to 77% of the sample, with the possibility of differential non-response.
- Psychometric properties of the ToM task used have not yet been examined extensively.
- Measures of delusional ideation and general intelligence were crude.

Introduction

The ability to correctly interpret another person's intentions or emotions, referred to as mentalizing ability or 'theory of mind' (ToM) (1, 2), is altered in children with psychotic symptoms (3) and associated with delusional ideation in individuals at risk (4). It has been observed that the experience of auditory hallucinations (AH) is associated with (secondary) delusional ideation (5), which is

thought to increase the risk of need for care and patient status (6, 7). However, little is known about the cognitive vulnerabilities mediating delusion formation in children experiencing perceptual anomalies. ToM may be associated with (verbal) intelligence (8–10), although a study in 8- to 11-year-old children showed that ToM may be a distinct cognitive ability not related to general intelligence (11). A direct link between mentalizing ability and delusions is suggested by their presen-

tation as alterations in social inference (4). For example, paranoid delusions involve erroneous attribution of harmful intentions to behaviour observed in others (12, 13). Mentalizing ability is also associated with reasoning biases observed in psychotic disorder, particularly a data gathering bias, referred to as 'jumping to conclusions', underlying severity of delusional ideation (14).

Aims of the study

The purpose of this study was to test the hypothesis that in children with auditory hallucinations (AH), development of delusional ideation would be moderated by level of theory-of-mind (ToM) skills. To this end, a cohort of children with AH was followed and delusional ideation examined as a function of ToM, taking into account the level of general cognitive ability.

Material and methods

Procedure

From the original case-control sample of the first wave ($n = 694$) (15), parents of 605 children (87%) who gave informed consent for the follow-up study were sent a notification letter by mail. Non-responders were sent one or two reminders, and in case of persistent non-response, parents were contacted by telephone as far as their numbers could be traced.

Seven (female) interviewers (six orthopedagogy students of the University of Groningen and one psychology graduate) conducted the interviews at the children's home, separately from their parents. During training, the interviewers first were introduced to the topic of (auditory) hallucinations and delusions. Subsequently, they observed, with consent, several therapeutic sessions of adult patients at the Voices Outpatient Department of the University Medical Center Groningen (VOPD), were informed in detail about the structure and results of the baseline study and received training in the administration of follow-up instruments and in conducting interviews with children. Finally, they practiced patient interviews at the VOPD, under supervision of a psychiatrist and a psychologist specialized in the field. In addition, booster sessions were arranged to discuss interview and scoring procedures and to prevent interviewer 'drift'. The interviewers used a detailed protocol on how to approach the families and conduct the interviews. To prevent bias, interviewers were unaware of children's AH status at baseline.

Children were screened about the experience of hearing voices in the past 5 years. All children were successively interviewed about experiences of delusional ideation. The ToM task, constructed to be entertaining for the child, was administered at the end of the interview. Parents were primed on how to contact the research team in case they or their children had questions or worries resulting from the interview. Written informed consent was obtained from both parents and children.

Subjects

Theory of mind was assessed in 259 children (of a total of 337 available at follow-up). Mean age was 13.1 years (SD 0.5), and 46.7% were boys. Socio-economic status was evenly represented (31% low, 38% middle, 31% high). The 78 children in whom ToM was not assessed more often were above the age of 13 years (73%, vs. 54% in the group with ToM assessment; $\chi^2 = 9.3$, $P = 0.002$) and more often reported (definite) delusions (40%, vs. 27% in the group with ToM assessment; $\chi^2 = 4.3$, $P = 0.04$). No other large or significant differences existed in demographic or outcome variables.

Materials

A new ToM task, the 'ToM Storybook Frank' (16), was developed for children aged 10–14 years, analogous to the ToM Storybooks for younger children (17). The test contains ToM tasks of different levels of difficulty, including first-order false belief, deception (2), second-order false belief, deception paradigm (18), white lie, irony, double bluff (19) and 'faux-pas' (20). Answers were summed (maximum total score = 47, higher score indicates better ability). Internal consistency (Cronbach's alpha), measured in the children who had never heard voices and without (likely) delusions ($n = 87$), was 0.72. Mean duration of administering the Storybook was 16 min (range: 10–25).

Presence of AH at follow-up and delusional experiences ('mind reading', 'paranoid ideas' and 'receiving media messages') (21), validated by Kelleher et al. (22), were assessed. AH could be rated as: 0 (no) or 1 (yes) and were assessed at baseline over the past year and at follow-up over the five intervening years. Delusions could be rated as: 0 (no), 1 (yes, likely) or 2 (yes, definitely) and were assessed over the lifetime. A variable was constructed indicating presence of at least one (definite) delusion (hereafter: delusions).

As a global measure of intelligence, secondary school level was assessed: 1 (lower/vocational) and 2 (higher/preacademic).

Statistical analyses

Children who had reported AH either at age 7–8 (in the past year) or at age 12–13 years (in the past 5 years) and children who experienced at least one definite delusion (lifetime) were identified. The variable ‘group’ denoted the following categories: AH only, delusions only, both AH and delusions and no symptoms.

Standard multinomial logistic regression (MLR) analyses, yielding odds ratios (OR) and 95% confidence intervals (CI), were used to compare the four groups (AH only, delusions only, AH and delusions and referent group without symptoms), with the referent group as reference category. Logistic regression analyses were used to examine moderation by ToM skills (centred around the mean) of the association between AH and delusions, with delusions as the dependent variable and AH, ToM score and the interaction between AH and ToM score as covariates. Odds ratio’s (OR) indexing associations between AH and delusions were calculated for low and high ToM groups. The interaction between AH and secondary school level as a proxy for general cognitive ability was entered into the model, to examine to what degree the results for ToM were reducible to general cognitive ability. Significance tests were two-tailed with alpha set at 0.05. Analyses were carried out using SPSS 16.0 for Windows and STATA 11.

Results

In the sample ($n = 259$), 12% of the children with AH ($n = 30$) continued hearing voices at follow-up, 4% ($n = 10$) reported AH at follow-up but not at baseline, 36% ($n = 94$) no longer heard voices at follow-up and 48% ($n = 125$) did not report AH at either assessment.

Auditory hallucinations at age 7/8 and/or age 12/13 years were reported by 52% ($n = 134$), at least one definite delusion by 28% ($n = 71$) and 55% of the children ($n = 135$) attended secondary school at a higher level.

Table 1 presents the descriptive statistics of the outcome variables stratified by group. The mean ToM score in the sample was 27.2 (SD 4.9, range 14–38) and did not differ significantly as a function of group ($F = 2.1$, $df = 3$, $P = 0.11$). The four subgroups similarly did not differ regarding dichotomized ToM score or secondary school level as a proxy for general cognitive ability.

Children with AH reported more delusions (37%) than those without AH (18%; $\chi^2 = 11.7$, $P = 0.001$). Children with AH did not differ from the children without AH on dichotomous ToM score ($\chi^2 = 0.4$, $P = 0.84$) or secondary school level as a proxy for general cognitive ability ($\chi^2 = 0.1$, $P = 0.75$).

A significant negative interaction was observed between ToM score and AH in the model of delusions ($\chi^2 = 4.9$, $P = 0.027$), indicating higher likelihood of secondary delusional ideation in AH positive children, given lower ToM skills.

Children attending higher level secondary education scored higher on the ToM task (28.6; SD = 4.7) than children attending secondary schools at a lower level (25.6; SD = 4.6) ($t = 5.1$, $P = 0.000$). No differences were found between secondary school level and presence of delusions ($\chi^2 = 2.6$, $P = 0.11$) or presence of AH ($\chi^2 = 0.1$, $P = 0.75$).

For the group with ToM values below the mean, AH and delusions were positively associated (OR = 4.3, 95% CI 1.9–9.9, $P = 0.000$), more than twice the effect size for the group with ToM values above the mean value (OR = 1.6, 95% CI 0.7–3.7, $P = 0.26$). Entering the interaction

Table 1. Outcome variables by group, with tests for differences ($n = 259$)

	AH only ($n = 85$)				DEL only ($n = 22$)				AH + DEL ($n = 49$)				No symptoms* ($n = 103$)	
	%	Mean (SD)	OR (CI)	<i>P</i> value	%	Mean (SD)	OR (CI)	<i>P</i> value	%	Mean (SD)	OR (CI)	<i>P</i> value	%	Mean (SD)
ToM sum†		28.1 (4.6)				28.0 (5.5)				26.6 (4.6)				26.6 (5.0)
ToM‡														
Dichotomously defined (> mean)	55		1.4 (0.8–2.5)	0.24	55		1.4 (0.6–3.5)	0.50	39		0.7 (0.4–1.5)	0.36	47	
School level‡														
Dichotomously defined (higher)	64		1.6 (0.9–3.0)	0.11	59		1.3 (0.5–3.3)	0.57	40		0.6 (0.3–1.2)	0.16	53	

AH, auditory hallucinations; DEL, delusions; SD, standard deviation; OR, odds ratio; CI, confidence interval; ToM, theory of mind.

*The reference category.

†No significant differences between the groups ($F = 2.1$, $df = 3$, $P = 0.11$).

‡Entered separately into the regression model.

between AH and secondary school level into the regression model revealed that the positive association between AH and delusions in children with ToM scores below the mean was not reducible to general cognitive ability (AH: OR = 6.6, 95% CI 2.4–18.2, $P = 0.000$).

Discussion

Many of the theories that have relevance for the observation of co-occurrence of delusions and hallucinations (23–30), which was confirmed in the current paper, contain elements that, at least in part, are compatible with arguably the oldest and best established theory, that delusions may be secondary to abnormal perceptual processes (31–33) or, as described more recently, aberrant attribution of salience (34). This theory has clinical validity and some empirical support (5, 6, 35, 36). In addition, there is evidence that secondary delusional ideation is particularly likely in the presence of affective dysregulation (37), a factor that previous work suggests is essential in the formation of psychotic symptoms (38–43).

The current analysis suggests that cognitive abilities associated with mentalizing ability in addition may play a mitigating role in the early phases of psychotic symptom formation and may shed light on the association between lower ToM abilities on the one hand and psychotic illness (1, 2, 44, 45) and symptoms (3) on the other.

This study has some limitations. First, the ToM task was administered to 77% of the sample at follow-up. However, under the assumption that those not assessed may have lower ToM skills, results may be considered conservative rather than anticonservative. Second, younger children (< 13 years) were more willing to be assessed. This may not be a major problem, as 14 years appeared to be the age limit for the ToM task, given that some of the older children found the task somewhat ‘childish’. Finally, the psychometric properties of the ToM task Frank have not yet been examined extensively. Nevertheless, the internal consistency of the task was found to be fair. Also, the ToM task Frank is strongly based on the ToM Storybooks, which have good psychometric qualities (17).

Delusions were assessed over the lifetime, so it is not clear whether delusions were developed after the experience of AH, but it is most likely that this is the case in the children who already heard voices at age 7–8 years.

Only a proxy global measure for general cognitive ability was available in the form of level of secondary education. However, ToM sum

scores were positively associated with higher secondary school level, which is consistent with most other studies in this field. Therefore, the observation that the moderating effect by ToM of the association between AH and delusions was not reducible to general cognitive ability may be valid.

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Declaration of interest

Jim van Os is an unrestricted research grant holder or has received financial compensation as an independent symposium speaker from Eli Lilly, BMS, Lundbeck, Organon, Janssen-Cilag, GSK, AstraZeneca, Pfizer and Servier. Agna Bartels-Velthuis and Els Blijd-Hoogewys have nothing to declare.

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