



# Peer-reported bullying, rejection and hallucinatory experiences in childhood

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## Abstract

**Objective:** Psychotic experiences, such as hallucinations, occur commonly in children and have been related to bullying victimization. However, whether bullying perpetration, peer rejection, or peer acceptance are related to hallucinatory experiences has remained under-examined. We used a novel peer nomination method to examine whether (i) bullying perpetration and (ii) social positions within peer networks were associated with future hallucinatory experiences.

**Methods:** This prospective study was embedded in the population-based Generation R Study. Bullying perpetration, peer rejection, and peer acceptance were assessed using peer nominations at age 7 years ( $N = 925$ ). Using a social network analysis, we estimated social positions within peer rejection and acceptance networks. Bullying victimization was assessed using self-reports. Self-reported hallucinatory experiences were assessed at age 10 years. Analyses were adjusted for sociodemographic covariates.

**Results:** Higher levels of bullying perpetration were prospectively associated with an increased burden of hallucinatory experiences (OR = 1.22, 95% CI 1.05–1.43,  $p = 0.011$ ). Bullies had a 50% higher, and bully-victims had a 89% higher odds, of endorsing hallucinatory experiences three years later than children who were not involved in bullying (OR<sub>bully</sub> = 1.50, 95% CI 1.01–2.24,  $p = 0.045$ ; OR<sub>bully-victim</sub> = 1.89, 95% CI 1.15–3.10,  $p = 0.012$ ). Unfavorable positions within peer rejection networks, but not peer acceptance networks, were associated with an increased risk for hallucinatory experiences (OR<sub>peer rejection</sub> = 1.24, 95% CI 1.07–1.44,  $p_{\text{FDR-corrected}} = 0.024$ ).

**Conclusion:** Using peer reports, we observed that bullies and socially rejected children have a higher likelihood to report hallucinatory experiences in pre-adolescence. Children who are both a bully *and* a victim of bullying (ie, bully-victims) may be particularly vulnerable for psychotic experiences.

## KEYWORDS

hallucinations, psychotic disorders, child and adolescent psychiatry, epidemiology, trauma

## 1 | INTRODUCTION

Psychotic experiences, such as hallucinatory and delusional experiences, are common in the general population.<sup>2</sup> They are estimated to have a prevalence of approximately 5–7% in adults and 17% in children.<sup>3,4</sup> Psychotic experiences are thought to exist on the lower end of a psychosis continuum, which proposes that the psychosis phenotype is expressed along a spectrum of increasing severity, persistence, and impairment.<sup>5</sup> Youth who report psychotic experiences often suffer from other mental health problems and are more likely to function poorly.<sup>6–9</sup> While psychotic experiences are associated with increased risk for later psychotic disorders, most individuals who report psychotic experiences do not go on to develop a psychotic disorder.<sup>10–12</sup> Rather, psychotic experiences seem to represent a trans-diagnostic marker of psychopathology, which is reflected by a range of negative health outcomes associated with psychotic experiences, including mood disorders, mental healthcare use, and suicidal behavior.<sup>8,13–15</sup> This highlights the clinical and public health importance of identifying modifiable risk factors for psychotic experiences, that is, those risk factors that may be subject to prevention or intervention.

Bullying is a common and serious problem in school-aged children.<sup>16</sup> While bullying victimization has repeatedly been associated with increased risk for psychotic experiences and psychotic disorders,<sup>17–20</sup> the relationship between bullying perpetration and psychotic experiences has remained under-examined.<sup>21–23</sup> Similar to their victims, bullies are at risk for various adverse outcomes later in life, such as depression, criminal offending, and substance abuse.<sup>24,25</sup> Since the negative outcomes of bullying perpetration are not as well recognized as those of bullying victimization, bullies may be an under-recognized group of children that may not receive the care that they need. Furthermore, prior studies have shown that children who are involved in both bullying perpetration *and* bullying victimization (ie, bully-victims) are the most vulnerable group of children, displaying highest levels of aggression and being at greatest risk for future mental health problems.<sup>24,26</sup>

Next to bullying, peer rejection can have detrimental consequences for children's mental health.<sup>27</sup> Peer-rejected children are deprived of social support and positive peer relationships, which are of fundamental importance for well-being and development.<sup>28</sup> It is well documented that peer rejection is associated with increased risk for internalizing problems, externalizing problems, and academic difficulties.<sup>28,29</sup> Furthermore, social exclusion—a closely related construct—is considered to be an etiological factor in the development of psychotic disorders<sup>30,31</sup> and has been suggested to explain the robust relationship between childhood adversity and psychosis.<sup>32</sup> In addition, it has been argued that high levels of social isolation may trigger hallucinations

### Significant outcomes

- Children who were perceived as bullies by their peers were more likely to report hallucinatory experiences in pre-adolescence.
- Children who were both a bully *and* a victim of bullying were at particularly high risk for hallucinatory experiences.
- Children who were socially rejected (ie, disliked) by their peers had an increased risk of reporting hallucinatory experiences three years later.

### Limitations

- A self-report questionnaire was used to assess hallucinatory experiences, which may have led to an overestimation of the prevalence of hallucinatory experiences.
- Although this is a prospective study, the temporal direction of the associations cannot be determined because of the lack of a baseline measure of hallucinatory experiences.

### Useful definitions

- Bullying = Aggressive and goal-directed behaviour that harms another person within the context of power imbalance.<sup>1</sup>
- Bully-victim = Someone who is a bully as well as a victim of bullying.
- Peer rejection = Being disliked by peers. This does not necessarily involve aggressive behaviour towards the child, unlike bullying. Note that peer rejection and peer acceptance do not cancel each other out (e.g., a child who is liked by 5 peers and disliked by 5 peers is different than a child who is liked and disliked by none).
- Peer acceptance = Being liked by peers. Note that peer acceptance and peer rejection do not cancel each other out (e.g., a child who is liked by 5 peers and disliked by 5 peers is different than a child who is liked and disliked by none).
- Peer-nomination method = Technique to assess peer status by combining multiple peer judgements.

and delusions in response to the absence of social input.<sup>33</sup> Considering these findings, peer rejection may be an important risk factor for psychotic experiences. Conversely, peer acceptance has previously been linked to lower levels of psychopathology and higher levels of psychosocial and academic adjustment<sup>34</sup> and may therefore potentially protect children from developing psychotic experiences.

The present study employed a novel peer nomination method to assess bullying perpetration, peer rejection, and peer acceptance in elementary school classes. A peer nomination method combines judgements of multiple peers who are present in the social environment of a child, together providing a highly valid and reliable assessment.<sup>35</sup> Peer nominations are particularly suitable to assess bullying perpetration, because parents are likely to underestimate children's involvement in perpetration,<sup>36</sup> and self-reports are susceptible to social desirability since bullying is considered to be an anti-social behavior.<sup>37</sup> Furthermore, data from peer nomination assessments are highly suitable to be examined using a social network analysis. A social network analysis is based on graph theory and reveals patterns of connections between individuals, offering rich insight into social ties and social positions of individuals within a group (eg, a school class).<sup>38</sup>

## 1.1 | Aims of the study

We aimed to test the hypotheses that (i) peer-reported bullying perpetration and (ii) unfavorable social positions within peer rejection and acceptance networks would prospectively be associated with hallucinatory experiences in pre-adolescence. We additionally hypothesized that all bullying involvement roles, that is, bullies, victims, and bully-victims, would be associated with a higher likelihood to develop hallucinatory experiences. Finally, in order to involve multiple rater perspectives, we examined whether we would observe similar findings using teacher- and mother-reported assessments on bullying behavior.

## 2 | MATERIAL AND METHODS

### 2.1 | Design and study population

This study was part of the Generation R Study, a large population-based prospective cohort.<sup>39</sup> From 2002 to 2006, 61% of all pregnant women living in Rotterdam, the Netherlands, were included in the study ( $N = 9778$ ). Compared to baseline, mothers of children who still remained in active follow-up at the most recent assessment wave were more highly educated and more often of Dutch nationality.<sup>39</sup> All study procedures were approved by the Medical Ethics Committee of the Erasmus Medical Centre Rotterdam. Written informed consent was obtained from all participants of the Generation R study.

The peer nomination assessment was conducted in a subsample of the Generation R Study participants and their classmates.<sup>40</sup> Schools invited for participation were randomly selected from all schools in Rotterdam that had at least one participant of the Generation R Study in grades

1–2. We obtained passive informed consent from all parents and children. Parents were informed about the study and could withdraw their child's participation by informing the teacher or researcher before the assessment. Children gave oral consent before the start of the assessment. Out of the 4017 children who participated in the PEERS measure, 1447 children were part of the Generation R cohort (assessment waves of 6–10 years). In the present study, analyses were performed in  $n = 925$  children for whom hallucinatory experiences data were available (see Figure S1 for a flowchart). Additional analyses were conducted in children for whom teacher ( $n = 2728$ ) or mother ( $n = 3276$ ) reports of bullying were available.

### 2.2 | Measures

#### 2.2.1 | Peer nomination assessment—age 7 years

The PEERS measure is a computerized peer nomination assessment designed for children in the early grades of elementary school.<sup>40</sup> Four common forms of bullying were assessed: physical, verbal, material (eg, damaging or taking classmate's belongings), and relational bullying. For each bullying type, a child was presented with an explanation and illustration and was asked whether he or she has been bullied in this particular way by any of the classmates. If affirmative, a follow-up question instructed the child to nominate the classmates (ie, by clicking on their photo) by whom they were victimized. The number of outgoing nominations was used to calculate the bullying victimization scores, and the number of incoming nominations was used to calculate the bullying perpetration scores. Thus, bullying victimization was self-reported and bullying perpetration was peer-reported. Since the average school class consisted of 21 children, children's bullying perpetration scores were based on the ratings of about 20 peers. The victimization and perpetration scores were averaged across the different types of bullying and weighted by the number of classmates. Furthermore, we dichotomized the continuous bullying perpetration and victimization scores using the top 25th percentile as cutoff, which has been applied in previous studies.<sup>41,42</sup> Children were categorized into one of four groups: (i) uninvolved, (ii) bullies, (iii) victims, and (iv) bully-victims.

In addition, children had to imagine going on an exciting school trip and nominate a maximum of 6 classmates whom they wanted to invite (peer acceptance) and whom they would not want to invite (peer rejection) to join the trip. Using a social network analysis (Statnet package in R), we constructed two networks for each school class based on children's incoming nominations for peer rejection and acceptance ( $n = 897$ ).<sup>43</sup> We calculated two centrality measures—degree

centrality and closeness centrality—and one reciprocity measure (Figure 1). Degree centrality is a local measure based on the number of a child's direct connections (ie, nominations) divided by the maximum possible number of direct connections. Closeness centrality is a more global measure, calculated as the reciprocal of the mean distance of the shortest path of a child to all other children in the network. Therefore, it accounts for both direct and indirect connections and provides an indication of how central a child is positioned within the network. In the peer rejection network, high centrality scores suggest an unfavorable social position, indicating that a child is actively disliked by others in the network. In the peer acceptance network, high centrality scores indicate that a child is highly liked or popular, whereas low centrality scores reflect a more peripheral position. The degree of reciprocity (ie, the proportion of mutually returned nominations) reflects how balanced a child's peer relationships are in a given network and provide an indication of mutual antipathies or “enemies” (peer rejection network) and “friendships” (peer acceptance network).

### 2.2.2 | Teacher and mother-reported bullying—age 7–8 years

Teachers and mothers filled out a questionnaire on physical, verbal, and relational bullying perpetration and victimization.<sup>44</sup> Teachers additionally rated the occurrence of material bullying. Items were rated on a four-point scale ranging from “less than once a month” to “more than twice a week” by teachers and on a five-point scale ranging from “never” to “several times per week” by mothers. Overall bullying victimization and perpetration scores were calculated by summing the items of each scale.

### 2.2.3 | Hallucinatory experiences—age 10 years

Hallucinatory experiences were assessed using two items on auditory and visual hallucinations from the Youth Self-Report

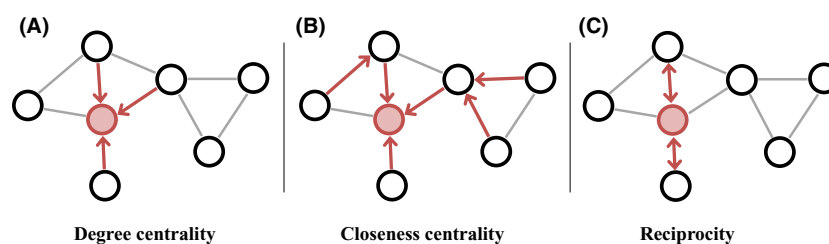
questionnaire.<sup>45</sup> Each item referred to the preceding 6 months and was rated on a three-point scale: “not at all” (0), “a bit” (1), or “clearly” (2). We classified the sum score into the following categories: no (0 points), mild (a score of 1 point on at least one of the items), and moderate-to-severe (a score of 2 points on at least one of the items) hallucinatory experiences, in line with our previous work.<sup>6,7</sup>

### 2.2.4 | Covariates

Children's ethnicity was determined using the classification procedure of Statistics Netherlands.<sup>46</sup> Ethnicity was defined as Dutch when both parents were born in the Netherlands and Non-Dutch when at least one parent was born outside of the Netherlands. Non-Dutch children were further classified into Other Western and Non-Western. Maternal educational level consisted of three categories: low (primary school or lower), middle (lower and intermediate vocational training), or high (higher vocational education and university). In addition, we assessed whether the hallucinations questionnaire was completed alone or with help from others (eg, a parent), since we previously observed a higher prevalence of hallucinatory experiences in questionnaires that were filled in alone versus with help from others (unpublished data).

### 2.2.5 | Statistical analyses

First, the association of continuous peer-reported bullying perpetration and self-reported bullying victimization scores with hallucinatory experiences was examined using ordinal logistic regression analyses. The association between categorical bullying involvement roles and hallucinatory experiences was also examined with these regression models. Additionally, we conducted similar analyses to assess the associations of continuous mother and teacher-reported bullying scores with hallucinatory experiences. In a sensitivity analysis, we repeated these analyses in the subsample of children for whom peer reports were available.



**FIGURE 1** Social network characteristics examined in the present study. Degree centrality (a) is based on the number of *direct* connections of a child within the network. Closeness centrality (b) is based on the number of *direct* and *indirect* connections. Reciprocity (c) refers to the degree of *mutual* connections. [Colour figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

Second, we performed ordinal logistic regression analyses to assess the associations of degree centrality, closeness centrality, and reciprocity scores within peer rejection and acceptance networks with future hallucinatory experiences. We applied the Benjamini and Hochberg false discovery rate (FDR) correction accounting for 6 predictors in separate analyses.<sup>47</sup>

All analyses were adjusted for age, sex, ethnicity, maternal education, and whether the hallucinatory experiences questionnaire was completed alone or with help from others. In analyses using the peer nomination scores, we additionally adjusted for classroom size (bullying variables) or total network size (peer network variables). Peer nomination scores were square root transformed and normalized to enhance interpretation. We also examined possible interactions between sex and bullying/social network scores in relation to hallucinatory experiences. Missing data on covariates were handled

using multiple imputations in MICE 2.46.<sup>48</sup> All statistical analyses were performed using R version 3.6.0.<sup>49</sup>

### 3 | RESULTS

#### 3.1 | Study population characteristics

Table 1 shows the characteristics of the study population ( $n = 925$ ); 24.0% of children reported mild hallucinatory experiences, and 6.3% of children reported moderate-to-severe hallucinatory experiences. There were no sex differences in the prevalence of hallucinatory experiences. The characteristics of the teacher and mother report samples are presented in Table S1.

#### 3.2 | Peer-reported bullying

Table 2 shows the prospective associations between bullying and hallucinatory experiences based on the peer nomination assessment. In analyses adjusted for sociodemographic covariates, higher peer-reported bullying perpetration scores (OR = 1.22, 95% CI 1.05–1.43,  $p = 0.011$ ) and self-reported bullying victimization scores (OR = 1.16, 95% CI 1.01–1.34,  $p = 0.036$ ) were associated with an increased risk for future hallucinatory experiences. Furthermore, we observed that bullies (OR = 1.50, 95% CI 1.01–2.24,  $p = 0.045$ ) and bully-victims (OR = 1.89, 95% CI 1.15–3.10,  $p = 0.012$ ), but not victims (OR = 1.26, 95% CI 0.84–1.88,  $p = 0.26$ ), were at higher risk for hallucinatory experiences than children who were not involved in bullying. We observed no interactions between sex and bullying perpetration/victimization scores in relation to hallucinatory experiences.

#### 3.3 | Teacher- and mother-reported bullying

Table S2 shows the associations of mother-reported and teacher-reported bullying perpetration and bullying victimization scores with future hallucinatory experiences, adjusted for sociodemographic covariates. Compared to our findings of peer-reported bullying perpetration, we observed that the associations between bullying perpetration scores and hallucinatory experiences were somewhat less strong for both teacher (OR = 1.08, 95% CI 0.97–1.14,  $p = 0.15$ ) and mother-reported bullying perpetration (OR = 1.11, 95% CI 1.03–1.19,  $p = 0.005$ ). Consistent with self-reported bullying victimization scores, mother-reported bullying victimization scores (OR = 1.18, 95% CI 1.10–1.27,  $p < 0.001$ ) and teacher-reported bullying victimization scores (OR = 1.13, 95% CI 1.02–1.25,  $p = 0.023$ ) were associated with a higher risk for hallucinatory experiences. These associations were

**TABLE 1** Characteristics of the study population

	Study population ( $n = 925$ )	
	$n$	
<b>Child characteristics</b>		
Sex, % girls	925	52.8%
Ethnicity, %	914 <sup>a</sup>	
Dutch	635	69.5%
Other Western	96	10.5%
Non-Western	183	20.0%
Auditory hallucinations, %	925	
No	689	74.5%
A bit	189	20.4%
Clearly	47	5.1%
Visual hallucinations, %	925	
No	783	84.7%
A bit	114	12.3%
Clearly	28	3.0%
Age (years) at hallucinations assessment, mean (SD)	925	9.9 (0.4)
Hallucinations assessment, % filled out alone	925	47.6%
Age (years) at bullying assessment, mean (SD)	925	7.5 (0.8)
<b>Maternal characteristics</b>		
Educational level, %	872 <sup>a</sup>	
Low	27	3.1%
Medium	308	35.3%
High	537	61.6%

<sup>a</sup>Missing data are imputed using multiple imputation.



**TABLE 2** The association of bullying perpetration and victimization at age 7 years and hallucinatory experiences at age 10 years ( $n = 925$ )

Peer nomination assessment at age 7 years	Hallucinatory experiences at age 10 years (3 levels)		
	OR	95% CI	<i>p</i> -value
Continuous scores			
Peer-reported bullying perpetration score	1.22	(1.05–1.43)	0.011
Self-reported bullying victimization score	1.16	(1.01–1.34)	0.036
Bullying involvement groups			
Uninvolved ( $n = 550$ )	<i>ref</i>		
Bully ( $n = 148$ )	1.50	(1.01–2.24)	0.045
Victim ( $n = 144$ )	1.26	(0.84–1.88)	0.26
Bully-victim ( $n = 83$ )	1.89	(1.15–3.10)	0.012

Analyses are adjusted for sex, age, ethnicity, maternal education, class size, and whether hallucinations assessment was filled in alone or with help from others. Missing data on covariates are imputed using multiple imputation. Continuous bullying and victimization scores are standardized (mean = 0; SD = 1).

similar in the subsample of children who participated in the peer nomination assessment (Table S2).

### 3.4 | Peer rejection and peer acceptance

Table 3 shows the associations of social positions within peer rejection and acceptance networks with hallucinatory experiences, adjusted for sociodemographic covariates. Within the peer rejection network, a more central (ie, unfavorable) social position was associated with a higher risk for hallucinatory experiences (degree centrality: OR = 1.24, 95% CI 1.07–1.44,  $p = 0.004$ ; closeness centrality: OR = 1.18, 95% CI 1.00–1.39,  $p = 0.044$ ). After correction for multiple testing, the association between degree centrality scores and hallucinatory experiences remained ( $p_{\text{FDR-corrected}} = 0.024$ ). Children with more mutual antipathies (ie, reciprocity) were not at increased risk for hallucinatory experiences.

Within the peer acceptance network, a more central (ie, favorable) social position was associated with lower risk for hallucinatory experiences (degree centrality: OR = 0.85, 95% CI 0.74–0.99,  $p = 0.035$ ), but this association did not remain after correction for multiple testing. There was no statistically significant association of the level of popularity (closeness centrality: OR = 0.88, 95% CI 0.75–1.04,  $p = 0.12$ ) or the number of “friendships” (reciprocity: OR = 0.88, 95% CI 0.77–1.01,  $p = 0.071$ ) with hallucinatory experiences. We did not observe interactions between sex and social network scores in relation to hallucinatory experiences.

**TABLE 3** The association of social network characteristics at age 7 years with hallucinatory experiences at age 10 years ( $n = 897$ )

Social network characteristics at age 7 years	Hallucinatory experiences at age 10 years (3 levels)		
	OR	95% CI	<i>p</i> -value
Peer rejection			
Degree centrality	1.24	(1.07–1.44)	0.004
Closeness centrality	1.18	(1.00–1.39)	0.044
Reciprocity	1.06	(0.92–1.22)	0.45
Peer acceptance			
Degree centrality	0.85	(0.74–0.99)	0.035
Closeness centrality	0.88	(0.75–1.04)	0.12
Reciprocity	0.88	(0.77–1.01)	0.071

Analyses are adjusted for sex, age, ethnicity, maternal education, network size, and whether hallucinations assessment was filled in alone or with help from others. Missing data on covariates are imputed using multiple imputation. All social network characteristic scores are continuous and standardized (mean = 0, SD = 1).

## 4 | DISCUSSION

Using an innovative peer nomination method, this study showed that peer-reported bullying perpetration in childhood was associated with increased risk for hallucinatory experiences in pre-adolescence. Examining bullying involvement roles suggested that bullies and bully-victims were at higher risk for hallucinatory experiences than children who were not involved in bullying. Furthermore, unfavorable social positions within peer rejection networks were associated with increased risk for hallucinatory experiences, while favorable social positions within peer acceptance networks showed little to no protective effects on the development of hallucinatory experiences. These associations were independent of age, sex, ethnicity, and maternal education.

Our findings are consistent with the few previous studies that examined the association between bullying perpetration and psychotic experiences.<sup>21–23</sup> In contrast to prior studies, we used a novel peer nomination method, providing a highly valid and reliable measurement<sup>35</sup>—with each child being rated by an average of 20 classmates. In addition to self-report or parent report of bullying perpetration, it is of considerable value to examine the extent to which children are perceived as a bully by their peers. Besides the potential problem of shared method bias in studies that use self-report, children have been shown to greatly underreport their involvement in bullying perpetration.<sup>37</sup> Moreover, research has shown that parents are often unaware of their child bullying other children.<sup>36</sup> Teachers may be a better source of information since they can directly observe bullying behavior, although they may fail

to witness more subtle, covert or indirect acts of bullying. Importantly, in order to combine different rater perspectives, we additionally assessed bullying using mother and teacher ratings at similar ages as the peer nomination assessment. Although smaller in magnitude, the associations of mother- and teacher-reported bullying perpetration with hallucinatory experiences were largely consistent with those of peer reports, providing further support for the association between bullying perpetration and psychotic experiences. These weaker observed associations may be partly accounted for by the underreporting of bullying perpetration by parents and teachers.

Of all bullying involvement roles, we found that bully-victims were at highest risk for hallucinatory experiences, which is in concordance with two prior studies in adolescents.<sup>21,22</sup> This finding is not surprising given that bully-victims display higher levels of aggressive and disruptive behavior,<sup>35</sup> are more anxious and depressed<sup>25</sup> and have lower psychosocial functioning than “pure” victims or bullies.<sup>16</sup> Moreover, bully-victims are at particularly high risk for negative long-term outcomes, including psychiatric disorders, substance abuse, criminal offending, and suicide.<sup>24,26</sup> Importantly, we observed that “pure” bullies also had a higher likelihood to develop hallucinatory experiences, demonstrating another risk enrichment pathway related to bullying perpetration but unrelated to bullying victimization. Contrary to our expectations, we did not find convincing evidence that “pure” victims had a higher risk for hallucinatory experiences than uninvolved children. While prior studies have shown that “pure” victims are at increased risk for a range of adverse mental health outcomes,<sup>16,26</sup> there are inconsistent findings regarding the risk for psychotic experiences.<sup>21,22</sup> However, we observed relatively high prevalence rates of self-reported bullying victimization (range 15–35%), which may have resulted in reduced statistical power to detect an association.

The nature of the association between bullying perpetration and psychotic experiences is not yet fully understood. Engaging in the act of bullying perpetration may be stressful,<sup>50</sup> thereby increasing the risk of developing psychotic experiences. In addition, children who bully may be more likely to be socially excluded, rejected, or victimized themselves, which in turn may lead to the development of psychotic experiences.<sup>19,41,51</sup> Alternatively, a pre-existing vulnerability may predispose children to engage in bullying perpetration and develop psychotic experiences. These risks may be genetic, environmental, neurodevelopmental, or, more likely, a combination of these. Earlier work from our research group showed that aggression problems as early as age 3 years predicted pre-adolescent psychotic experiences.<sup>6</sup> In a similar vein, another population-based cohort study observed prospective associations between childhood oppositional/conduct disorders and psychotic experiences in adolescence.<sup>52</sup> Aggressive

behavior in childhood may therefore be one of the precursors or developmental markers of an underlying vulnerability for severe mental illness, which manifests itself into phenotypes such as bullying perpetration and psychotic experiences. In addition, there may be other common risk factors, such as attention-deficit/hyperactivity disorder (ADHD)<sup>42,53</sup> and exposure to domestic violence, physical abuse, or parental neglect,<sup>18,54,55</sup> which might explain the prospective link between bullying perpetration and psychotic experiences.

With respect to peer rejection, we observed that children who were more disliked by their classmates were at increased risk for hallucinatory experiences. This extends previous findings of a lower peer status<sup>51</sup> and a higher level of social isolation<sup>56</sup> in relation to increased risk for psychotic experiences. The association between peer rejection and hallucinatory experiences may potentially be explained by the social defeat hypothesis.<sup>30</sup> This hypothesis suggests that social defeat—as defined by “the negative experience of being excluded from the majority group”—increases the risk for schizophrenia by sensitization of the mesolimbic dopamine system. While the social defeat hypothesis refers to the clinical end of the psychosis spectrum, similar mechanisms may be at play at a subclinical level. Being rejected by peers may also lead to loneliness or social isolation, which, as suggested by the social deafferentation hypothesis,<sup>33</sup> may induce hallucinations and delusions in response to social deprivation. In addition, peer rejection is associated with increased risk of anxiety, depression, and a low self-esteem,<sup>28,29,57</sup> which in turn may lead to the development of psychotic experiences. Alternatively, based on the finding that some individuals with psychotic disorders show social maladjustment in childhood,<sup>58,59</sup> children who show odd or socially incompetent behavior because of a pre-existing psychiatric vulnerability may be more vulnerable to be rejected by their peers. Furthermore, peer rejection has consistently been linked to higher levels of aggression,<sup>28</sup> which may predispose children to being rejected by their peers and contribute to adverse outcomes including psychotic experiences. However, even if peer rejection is a consequence of aggressive or socially incompetent behavior, the additional impact of being rejected by peers may potentially exacerbate the risk for psychotic experiences.

Contrary to our hypothesis, we observed that favorable social positions within peer acceptance networks showed no, or only a limited, protective relationship with the development of hallucinatory experiences. Children who were liked more by their peers had a slightly reduced likelihood of developing hallucinatory experiences, but this was not statistically significant after adjustment for multiple testing. More popular children and children with more reciprocal friendships did not have a lower risk for hallucinatory experiences. Our findings are in contrast to Crush et al.<sup>60</sup> who reported that a higher level of self-reported perceived social support was associated with a reduced likelihood of psychotic experiences.

Although these conflicting findings may potentially be explained by the different assessment methods (ie, self-report versus peer report), the limited research to date calls for careful conclusions and replicative studies.

The present study is strengthened by the peer nomination assessment in a large sample of elementary school children and the multi-informant approach including children, mothers, and teachers. A limitation of this study is that the temporal direction of the associations cannot be determined because of the lack of baseline measures of hallucinatory experiences. However, it is very difficult to assess hallucinations in children aged 7 years or younger.<sup>61</sup> Another limitation is that we may have underestimated or failed to detect some effects owing to the young age of our study population, since psychotic experiences are more prevalent and more likely to be transient in younger children.<sup>4</sup> Moreover, the use of self-reports may have led to an overestimation of the prevalence of hallucinatory experiences.<sup>3</sup> However, self-reported auditory and visual hallucinations (as used in the present study) are highly predictive of any clinician-confirmed psychotic symptoms.<sup>62,63</sup> Finally, the peer nomination method used in the present study was restricted to school classes—bullying and peer relationships outside the school class were not taken into account.<sup>64</sup>

In summary, we observed that children who bully others and children who are rejected by their peers are at higher risk to report hallucinatory experiences in pre-adolescence. While a wealth of studies investigated the risk pathway from bullying victimization to psychotic experiences, the findings of this study suggest that bullying perpetration is another important risk pathway. Considering the myriad of adverse outcomes related to bullying perpetration, bullies—and particularly bully-victims—are a vulnerable group in need of extra attention within our school systems and mental health institutions.

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## DECLARATION OF INTEREST

All authors declare no conflicts of interest relevant to this work.

## PEER REVIEW

The peer review history for this article is available at <https://publons.com/publon/10.1111/acps.13282>.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study can be obtained upon request. Requests should be directed to the management team of the Generation R Study ([secretariaat.gnr@erasmusmc.nl](mailto:secretariaat.gnr@erasmusmc.nl)), which has a protocol of approving data requests. Because of restrictions based on privacy regulations and informed consent of participants, data cannot be made freely available in a public repository.

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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