

## Regular Article

# Predicting psychosis-spectrum diagnoses in adulthood from social behaviors and neighborhood contexts in childhood

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### Abstract

Research showing that risk for schizophrenia, bipolar disorder with psychosis, and other psychosis-spectrum diagnoses in adulthood is multidetermined has underscored the necessity of studying the additive and interactive factors in childhood that precede and predict future disorders. In this study, risk for the development of psychosis-spectrum disorders was examined in a 2-generation, 30-year prospective longitudinal study of 3,905 urban families against a sociocultural backdrop of changing economic and social conditions. Peer nominations of aggression, withdrawal, and likeability and national census information on neighborhood-level socioeconomic disadvantage in childhood, as well as changes in neighborhood socioeconomic conditions over the lifespan, were examined as predictors of diagnoses of schizophrenia, bipolar disorder, and other psychosis-spectrum disorders in adulthood relative to developing only nonpsychotic disorders or no psychiatric disorders. Individuals who were both highly aggressive and highly withdrawn were at greater risk for other psychosis-spectrum diagnoses when they experienced greater neighborhood disadvantage in childhood or worsening neighborhood conditions over maturation. Males who were highly aggressive but low on withdrawal were at greater risk for schizophrenia diagnoses. Childhood neighborhood disadvantage predicted both schizophrenia and bipolar diagnoses, regardless of childhood social behavior. Results provided strong support for multiple-domain models of psychopathology, and suggest that universal preventive interventions and social policies aimed at improving neighborhood conditions may be particularly important for decreasing the prevalence of psychosis-spectrum diagnoses in the future.

**Keywords:** schizophrenia, psychoses, poverty, social behavior, longitudinal

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The severity of the global health effect of mental illness cannot be overstated. Psychiatric diagnoses are highly prevalent and contribute to personal distress, disability, and disadvantage, as well as broader societal tolls of high health care costs and lost productivity and opportunity (Kessler et al., 2009; Whiteford et al., 2013; World Health Organization, 2011). Among the most debilitating and costly of mental illnesses are those in the psychosis-spectrum, including schizophrenia and bipolar disorder with psychosis (Goeree et al., 2005; Knapp, Mangalore, & Simon, 2004; Stain et al., 2012). There is urgent need for more and better scientific investigation of the etiological factors in childhood that contribute to the development of schizophrenia, bipolar disorder, and other psychosis-spectrum diagnoses in adulthood to better inform the design of targeted and effective preventive interventions to decrease suffering and reduce health care costs (van Os, Linscott, Myin-Germeys, Delespaul, & Krabbendam, 2009).

Although many investigators across the health and social sciences continue to test single-factor models of mental health, recent years have borne witness to a rapid increase in the amount of theoretical and empirical attention being given to the complex and multideterminant nature of the etiology and development of psychiatric problems (Cicchetti & Toth, 2009). The bioecological model of development (Bronfenbrenner & Ceci, 1994) has long emphasized that the contexts that affect health are constructed through the dynamic and bidirectional interactions of both organismic and environmental variations. This has become one of the organizing principles of the developmental psychopathology macroparadigm (Cicchetti, 2008). The diathesis-stress (Hankin & Abela, 2005) and differential susceptibility models (Ellis et al., 2011) have been proposed to predict how particular combinations of early environmental experiences and nascent individual traits or endowments contribute to the development of mental health over the lifespan. To date, however, there have been few applications of such frameworks to studies and datasets that afford a truly lifespan perspective or that have examined the development of psychosis-spectrum disorders. We approached these issues with a focus on the potential etiological factors of disadvantaged socioeconomic contexts and problematic social behaviors in childhood.

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There is considerable evidence for prospective links between childhood experiences of familial poverty (Kwok, 2014) and socioeconomically disadvantaged neighborhood conditions (O'Donoghue, Roche, & Lane, 2016) and adult psychosis-spectrum disorders. Examining problematic social behavior in childhood as potential risk markers of severe adult psychopathology began with early retrospective studies of adults with schizophrenia (Phillips, 1953), prospective studies of children with a schizophrenic parent (Mednick & Schulsinger, 1968), and clinic-referred children (Robins, 1966). These studies suggested that interpersonal difficulties, aggression, and withdrawal were characteristic of children who later developed schizophrenia. The risk criteria used for sample selection in such studies, however, constrained the generalizability of the findings, and many individuals with schizophrenia or other psychosis-spectrum diagnoses do not have a biological parent who carries a similar diagnosis (Heston, 1966). Despite these constraints, the implication of identifying behavioral markers of children's maladaptive social development as candidate precursors of schizophrenia and other psychosis-spectrum disorders continues to have considerable appeal given the potential for improved early identification and preventive interventions for these debilitating illnesses (Tarbox & Pogue-Geile, 2008).

Prospective prediction of specific future diagnoses is challenging, though, for a variety of reasons. Most psychosis-spectrum disorders have low prevalence rates, such that large samples are needed to identify significant predictors. For those who receive psychosis-spectrum diagnoses, there often are multiple sequential or concurrent distinct diagnoses (Loeber *et al.*, 2009). This can result from changes over time in presenting symptoms that lead to revised diagnoses or misdiagnoses because of disorders having overlapping symptoms (Altamura *et al.*, 2015; Zimmerman, 2008). Indeed, changes in psychiatric diagnoses across visits with health professionals have led to the argument that an essential criterion for establishing the validity of a diagnosis is documentation of its long-term consistency (Robins & Guze, 1970; Ruggero, Carlson, Kotov, & Bromet, 2010). In accord with the principal of multifinality, it is also the case that multiple childhood risk factors contribute to a plurality of adult mental health problems. Even so, identifying specific combinations of childhood characteristics and life contexts that distinguish trajectories of risk for developing different psychosis-spectrum diagnoses rather than nonpsychotic disorders could be very informative for targeted prevention efforts (Sariaslan *et al.*, 2016; Tarbox & Pogue-Geile, 2008).

In this paper, we report on the findings from a 30-year prospective longitudinal study of the predictors of schizophrenia, bipolar disorder with psychosis, and other psychosis-spectrum diagnoses in a large cohort recruited from lower income urban contexts. This investigation was focused on the additive and interactive contributions of known risk factors for mental illness: disadvantaged socioeconomic conditions and poor social functioning in childhood, in addition to familial (intergenerational) risk. The study was conducted over a generational period of marked societal change, which affected families to varying degrees, allowing us to also examine how changes in socioecological disadvantage over the lifespan shaped the likelihood that problematic social behavior in childhood would have a bearing on the risk of psychosis-spectrum disorder in adulthood.

### Socioecological disadvantage and the development of psychosis-spectrum disorders

Although historically there is mixed evidence for the association between being raised in lower income or impoverished families

and manifesting schizophrenia and other psychosis-spectrum diagnoses in adulthood, recent studies and prospective longitudinal studies have tended to find greater support for this link (Kwok, 2014; Werner, Malaspina, & Rabinowitz, 2007). There are many potential mechanisms linking early economic hardship to later psychosis-spectrum diagnoses, such as nutritional deprivation, toxin exposure, parental stress, unavailable social infrastructure such as high-quality schools, and chaotic and dangerous neighborhoods (Page, Conger, Guyer, Hastings, & Thompson, 2016). Several of these factors are attributable less to a given family's limited resources than to the nature of the less affluent and advantaged neighborhoods in which they can afford to live (Bradley & Corwyn, 2002), such as children's witnessing of gang violence. There has been increasing attention in recent years to examining the contributions of neighborhood-level social conditions to children's development of mental health and illness (Hudson, 2012). The multiple stresses of living in disadvantaged neighborhoods can exact neurobiological (e.g., allostatic load; McEwen & Stellar, 1993; Ramsay *et al.*, 2015) and psychological tolls (e.g., stereotype threat [Heberle & Carter, 2015]; poverty blindness [Ventres & Gusoff, 2014]) that undermine future mental health and well-being. Longitudinal and intervention studies have shown that the risks for mental health problems (Leventhal & Dupéré, 2011), including psychosis-spectrum diagnoses (O'Donoghue *et al.*, 2016), increase in accordance with the duration of children's and adolescents' exposure to neighborhood impoverishment.

The impetus for studies examining the predictive association between childhood experiences of neighborhood socioeconomic disadvantage and adult psychosis-spectrum diagnoses can be traced back to social causation theory, the view that early adversity brings on psychiatric disorders (Hollingshead & Redlich, 1958). Conversely, the reverse process of social drift, or declining socioeconomic status and contexts in connection with the emergence of chronic severe mental illness, has also been posited as the reason for individuals with psychosis-spectrum disorders being at higher risk for living in impoverished conditions (Wender, Rosenthal, Kety, Schulsinger, & Welner, 1973). Whether that drift is due to the social consequences of psychoses or underlying genetic susceptibilities has been debated (Sariaslan *et al.*, 2016). It is plausible that an iterative process is at play, accounting for ongoing intergenerational cycles of socioeconomic disadvantage and psychosis-spectrum diagnoses due, at least in part, to poor childhood conditions. Intervention studies have shown a causal link between living in socioecologically disadvantaged neighborhoods and many aspects of adults' mental health problems (Graif, Arcaya, & Diez Roux, 2016; Ludwig *et al.*, 2012), and there is marked stability of poverty both within and across generations (Sharkey, 2013; Wagmiller & Adelman, 2009). These factors may conflate prospective effects of childhood exposure to neighborhood disadvantage on adult psychoses with acute effects of adults' concurrent neighborhood disadvantage on their psychotic symptoms and diagnoses. In this study's focus on socioecological disadvantage, therefore, we considered attributes of participants' neighborhoods in both childhood and adulthood that provided macroscopic frames of adversity as contexts for day-to-day experiences. Environmental adversity can be scaled quantitatively by the attributes of disadvantage in the neighborhood in which the individual resides, such as the rate of unemployment, the prevalence of poverty, the proportion of single-parent families, and proportion of heads of household who have not completed high school (Dunn, Milliren, Evans, Subramanian, & Richmond, 2015; Ramsay *et al.*, 2015).

### Childhood social behaviors as predictors of adult psychosis-spectrum disorders

Considerable research has demonstrated that childhood levels of aggression (or antisocial behavior or externalizing problems), withdrawal (or social wariness or internalizing problems), and overall social functioning predict psychosis-spectrum diagnoses in adulthood. Tarbox and Pogue-Geile (2008) reviewed nine birth-cohort prospective longitudinal studies relating childhood social behaviors with incidence of schizophrenia and other diagnoses in adulthood. In those studies that measured child behaviors from ages 7 to 12 years, which corresponds with the ages of the participants in this study when social behaviors were assessed, adult diagnoses of schizophrenia were predicted from children's poor social response to an examiner, aggression or externalizing behavior, and, to a lesser extent, social withdrawal or internalizing behavior. In addition, Tarbox and Pogue-Geile (2008) determined that there was evidence for predictive specificity of aggressive/externalizing behaviors to schizophrenia versus nonpsychotic disorders, particularly for males, but not for distinguishing schizophrenia from other psychosis-spectrum disorders, including bipolar disorder with psychosis. Conversely, there was less evidence for specificity of withdrawal/internalizing behaviors, which predicted similarly to schizophrenia, mania, depression, anxiety, and general neuroses. Despite these findings, Tarbox and Pogue-Geile (2008) echoed earlier developmental scientists (Mednick & Schulsinger, 1968; Moskowitz & Schwartzman, 1989) in suggesting that more research is needed to determine whether children with a behavioral profile of combined aggression and withdrawal are at particular risk for schizophrenia.

#### *Is problematic behavior a social or genetic vulnerability?*

Parents' psychosis-spectrum diagnoses predict increased risk for psychosis-spectrum diagnoses in their offspring (Rasic, Hajek, Alda, & Uber, 2014), but cross-generational consistency in diagnoses is modest (Dean, Stevens, Mortenson, Murray, Walsh, & Pederson, 2010). Good mental health is observed in the offspring of many parents with schizophrenia, bipolar disorder, and other psychosis-spectrum diagnoses; conversely, psychotic problems emerge in many offspring of parents who themselves appear to have good mental health. Still, it is plausible that childhood social-emotional characteristics of high aggression or withdrawal, or low likeability, could be prodromes (Cornblatt et al., 2003), or pre-morbid displays of genetically based susceptibilities for psychoses, in children of parents with psychoses or other mental health problems. An apparent predictive link between problematic childhood behaviors and later psychosis-spectrum diagnoses in adulthood, therefore, could be attributable to a shared genetic risk for manifesting these behaviors as symptoms at different points in maturation. Although genetic data were not available in the current study, parents' lifetime histories of psychosis-spectrum and nonpsychotic disorders were obtained from their cumulative health records. If childhood social characteristics predict adult psychosis-spectrum diagnoses over and above the risk conferred by parents' diagnoses, it would argue against a purely hereditary genetic explanation. Indicators of poor social functioning could be subclinical precursors of later emerging syndromes that do not stem from inherited genetic risk, or they could be social skills deficits that leave children vulnerable to having adverse reactions to developmental challenges.

### Interactive models of multiple risk factors

Developmental psychopathology has moved beyond purely additive perspectives on the multiple risk factors contributing to the development of mental health disorders (Cicchetti, 2008; Cicchetti & Curtis, 2007). It is important to consider the development of individual children in their life contexts because individual differences between children who experience disadvantage may shape their responses and adjustment to adverse life conditions. More versus less aggressive, withdrawn, or socially skilled children may react to neighborhood-level adversity differently, either in terms of their likelihood of developing psychiatric disorders versus mental wellness, or the particular disorders to which they would be most prone, such as psychosis-spectrum disorders versus nonpsychotic disorders. This has been the primary focus of multiple-domain models of developmental psychopathology (Cicchetti & Curtis, 2007) that have garnered considerable attention recently, including the differential susceptibility (Ellis et al., 2011) and diathesis-stress (Hankin & Abela, 2005) models. It is worth noting, however, that such efforts have been applied primarily to the development of problems and disorders of the internalizing and externalizing spectrums, and more rarely to schizophrenia, bipolar disorder with psychosis, or other psychosis-spectrum disorders. In this investigation, we were agnostic with respect to which model would hold sway, but expected to find that children's characteristics of social behavior would moderate the links between socioecological disadvantage and incidence of psychosis-spectrum diagnoses in adulthood.

#### **Leveraging the advantages of the Concordia Longitudinal Risk Project**

The Concordia Longitudinal Risk Project (Ledingham, 1981; Schwartzman, Ledingham, & Serbin, 1985; Stack et al., 2017), initiated in the inner-city neighborhoods of Montréal, Québec, in 1976, provides a valuable opportunity to examine how life-span changes in socioecological disadvantage contribute to the development of psychiatric disorders for children with varying social characteristics. There were major social changes in Québec in the latter half of the 20th century, including compulsory schooling to age 16, universal health care, income-protected family leave, and other changes (Dickenson & Young, 2008). Thus, the society and life experiences of the parent generation (G1) in the Concordia Project, who were primarily born between the 1930s and 1950s, were very different from those of their offspring, the focal targets of this study (G2), who were born between 1965 and 1971. Because of these broad societal changes, we expected that there would be increased socioecological diversity for the Concordia Project's participants from 1976 to 2006, with many G2 adult participants living in less socioecologically disadvantaged contexts than they experienced while being raised in their parents' homes. These trajectories of improvement were not equally the case for all, however. Some families lived in more advantaged neighborhoods than others in 1976, and the fortunes of some families improved less than that of others over the subsequent 30 years (Véronneau, Serbin, Stack, Ledingham, & Schwartzman, 2015). In the present study, we were able to examine the extent to which adult psychiatric diagnoses were associated with childhood experiences of neighborhood socioecological disadvantage, as well as stability of or change in neighborhood disadvantage from childhood to

adulthood in a large sample of individuals for whom social behavior was assessed in middle childhood to preadolescence.

## Goals and hypotheses

This prospective, intergenerational, longitudinal study focused on the contributions of children's social-emotional characteristics to their risk for future psychiatric diagnoses in a climate of socioecological change. We contrasted individuals who developed psychosis-spectrum disorders versus individuals who did not develop any psychiatric disorders in adulthood, as well as versus individuals who developed only nonpsychotic disorders, to determine the specificity of predictive associations. We expected that greater socioecological disadvantage in childhood would predict greater likelihood of all psychosis-spectrum diagnoses in adulthood (Hypothesis 1), and that less improvement, or worsening, of socioecological disadvantage from childhood into adulthood would be associated with risk for psychosis-spectrum diagnoses (Hypothesis 2). We also predicted that childhood characteristics of being more aggressive, more withdrawn, and less likeable would increase the risk of psychosis-spectrum disorders in adulthood (Hypothesis 3), and would moderate the predictive associations between childhood socioecological disadvantage and adult diagnoses, with stronger links being evident for more aggressive, more withdrawn, and less likeable children (Hypothesis 4). In particular, neighborhood disadvantage in childhood was expected to predict adult psychosis-spectrum diagnoses most strongly for children who were both highly aggressive and highly withdrawn. Finally, we explored whether there were gender differences in these predictive associations.

## Method

### Participants

The sample consisted of 10,911 members of the Concordia Project research population whose administrative medical health records were on file through 2006. They constituted 95% of the original community-based, French-speaking school children who were residing in low to low-middle income areas of Montréal in 1976 and their parents. Those without records were no longer residents of Québec, were deceased, or were missing a birthdate in the records used for analysis (see the following section). The sample comprised 6,874 parents (G1), followed into their 60s to 70s, and their 3,905 children (G2), followed into their late 30s to early 40s. Participant demographics and neighborhood sociodemographic characteristics are presented in Table 1. Educational levels and socioeconomic status for both generations were significantly below Québec and Canadian averages (Véronneau *et al.*, 2015).

The procedures of this study were reviewed for their adherence to ethical principles and approved by the Human Research Ethics Committee of Concordia University and by the Québec Commission d'accès à l'information (no. 07 08 71). The Commission specifically approved the procedures adopted to protect the anonymity of the dataset. The Commission, rather than the participants, provided consent for the health records to be used in this study. All health records were coded and deidentified before analysis. Consent for children's participation in the original (1976) phase of the study, when childhood behavioral measures were obtained, was obtained by school administrators and parent/school committees. Children provided assent when they volunteered for participation.

## Measures

### Psychiatric status

Residents of Québec are entitled to receive cost-insured health services. Psychiatric status, diagnosis, and prevalence rates were determined on the basis of information contained in individual numerically coded health records that were provided by Québec's health ministry. The records date to 1981, the year when automated, computerized data entry and storage systems were instituted, and cover 1981–2006. Psychiatric data were therefore available for the adult to senior years of G1 and the adolescent to adult years of G2. The records contain the following information: (a) date of contact with a physician; (b) site of contact (office, community health center, hospital emergency, outpatient clinic; inpatient unit); (c) provider category (i.e., medical specialty of physician); (d) category of service rendered (e.g., assessment, surgery, prescriptive medication); (e) prescribed medication(s); and (f) diagnosis(es) as defined by the Manual of the International Statistical Classification of Diseases Injuries and Causes of Death, Ninth Revision (ICD-9; World Health Organization, 1975). Hospitalization records provided by the Ministère de la Santé et des Services Sociaux du Québec contain information pertaining to diagnosis at admission, treatment received, length and frequency of hospitalization, and condition at discharge. Records that did not contain information on diagnostic status (neither identifying a diagnosis nor explicitly stating the absence of a diagnosis) were excluded from analyses.

Records were reviewed using an algorithmic procedure we developed to assign five mutually exclusive categories of adult psychiatric status to members of the G1 and G2 cohorts. The five categories of adult psychiatric status were defined on the basis of consistency of diagnosis across contact occasions and concordance of diagnoses, psychiatric services, medications, and psychiatric hospitalizations. Given the likelihood of occasional and inconsistent diagnoses of psychotic disorders in psychiatric populations (Robins & Guze, 1970; Ruggero *et al.*, 2010), strict criteria of repeated diagnoses over time were required for categorization of schizophrenia and bipolar disorder; although conservative, this minimized the likelihood of false positives. Categories were mutually exclusive and based on the final primary diagnosis within the most recent 10-year period. The psychiatric status of each G1 and G2 participant included in the analyses was identified within the following categories.

**Category 1.** Schizophrenia diagnosis. A primary diagnosis of schizophrenia disorder on  $\geq 3$  or more occasions within a 10-year block period of psychiatric contact occasions. This category took precedence over all antedating and subsequent psychiatric diagnoses except bipolar disorder, if the latter was the final diagnosis.

**Category 2.** Bipolar diagnosis. A primary diagnosis of bipolar disorder on  $\geq 3$  occasions within a 10-year block period of psychiatric contact occasions. This category took precedence over all other antedating and subsequent psychiatric diagnoses except schizophrenia, if the latter was the final diagnosis. ICD-9 classified bipolar disorders as being within the broader category of psychosis-spectrum mental illnesses; it did not include bipolar disorder without psychotic features (which was added in ICD-10; category F.31.1). In the current sample, confirmatory evidence of the presence of psychosis in the Régie de l'assurance maladie du Québec and Ministère de la Santé et des Services

**Table 1.** Description of sample

	G1 participants		G2 participants	
	Male	Female	Male	Female
<i>N</i>	3,183	3,691	1,955	1,950
Mean age in 1976–1978 ( <i>SD</i> )	40.0 (7.1)	37.5 (6.8)	10.3 (2.6)	10.1 (2.6)
Mean age in 2006 ( <i>SD</i> )	69.0 (7.1)	66.5 (6.8)	39.2 (2.6)	39.1 (2.6)
Father presence in G2 childhood, %	—	—	85.5	84.6
G2 education level, range 1–4 ( <i>SD</i> ) <sup>a</sup>	—	—	2.10 (0.96)	2.29 (0.96)
Neighborhood sociodemographic characteristics 1976				
% Low-income families (<\$10,000; <i>SD</i> )	15.87 (0.06)		—	
% Single-parent families ( <i>SD</i> )	22.31 (0.05)		—	
% Education < Grade 10 ( <i>SD</i> )	30.61 (0.05)		—	
% Unemployed ( <i>SD</i> )	13.33 (3.05)		—	
Neighborhood sociodemographic characteristics, 2006				
% Low-income families (<\$20,000; <i>SD</i> )	—		17.82 (0.09)	
% Single-parent families ( <i>SD</i> )	—		18.98 (0.06)	
% Education < Grade 10 ( <i>SD</i> )	—		22.97 (0.07)	
Unemployed ( <i>SD</i> )	—		6.97 (2.67)	

Note. G1 = parent; G2 = offspring; *SD* = standard deviation. <sup>a</sup>G2 education scored as: 1, high school noncompletion; 2, high school completion; 3, junior college attendance; 4, university attendance.

Sociaux du Québec records was present for all cases in the bipolar category, including earlier diagnoses of schizophrenia, endorsement of “psychotic features were noted as present” by the attending health professional, and prescription of neuroleptic and atypical antipsychotic medications.

**Category 3.** Other psychosis-spectrum diagnosis. A primary diagnosis within the psychosis-spectrum range (e.g., psychotic depression) rendered on at least one or more contact occasions. Individuals with inconsistent diagnoses of schizophrenia or bipolar disorder (e.g., an initial diagnosis that was not sustained over the subsequent 10 years; Ruggero et al., 2010) were included in this category, because they evidenced psychosis but likely did not reach criteria for valid diagnoses of schizophrenia or bipolar disorder. Individuals who had received a psychosis-spectrum diagnosis associated with cardiovascular or neurological disease were excluded.

**Category 4.** Nonpsychotic diagnosis. A primary diagnosis of a nonpsychotic disorder at least once and on all contact occasions (e.g., anxiety-spectrum, depression, drug dependence, personality disorder). This category served as a reference group for multivariate logistic regression analyses of psychosis-spectrum diagnoses (see the following section).

**Category 5.** No diagnosis. No history of psychiatric problems. No psychiatric diagnosis recorded and no psychiatric services rendered. This category also served as a reference group for multivariate logistic regression analyses of psychosis-spectrum diagnoses (see the following section).

Inter-rater reliability of diagnostic category assignment was determined using 4 independent raters and 20 cases selected at random from each of the 5 psychiatric categories for a total of

100 cases under review; all 4 raters examined all 100 cases. Agreement between each pair of raters was examined (i.e., comparing the 6 possible pairs afforded by the 4 individual raters). Rater agreement averaged 92.5% (range: 91%–96%) across cases. There was consensus (100%) on categories 5 (no psychiatric history) and 4 (nonpsychotic diagnosis). Agreement between rater pairs averaged 95% for schizophrenia (range: 90%–100%); 86.3% for bipolar disorder (range: 80%–90%); and 85% (range: 80%–90%) for other psychosis-spectrum disorders.

#### *Neighborhood socioeconomic disadvantage*

To parallel comparable analyses of neighborhood-level socioeconomic data in Canada (Roos, Magoon, Gupta, Chateau, & Veugelers, 2004), census tract data from 1986 and 2006 (Statistics Canada, 1986, 2007) provided the following sociodemographic information based on Canadian Postal Service sortation codes: within the neighborhood of the G1 family residence in 1976 and the G2 residence in 2006, percentages of (a) families headed by a single parent; (b) households with total income < \$10,000 (CDN) in 1976 and \$20,000 (CDN) in 2006; (c) adults who had < Grade 10 education; and (d) adults who were unemployed. Because 1976 census information was not available for data linkage, we used values derived from the 1986 census for the neighborhoods of the local schools the children had attended in 1976. The G2 family residence neighborhoods in 2006 were identified based on medical records of family home postal code at the time of contact with health services closest to the date of the census.

Principal component factor analyses (Marcoulides & Hershberger, 1997; Widaman, 2007) of the neighborhood descriptors generated a 1976 score of disadvantage for each G1 family household and a 2006 score for each G2 family household: the higher the score, the greater the level of disadvantage.

Single-factor solutions were supported for both times. The factor loadings ranged from 0.87 to 0.98 for 1976, and from 0.64 to 0.92 for 2006; and the 1976 and 2006 percentages of variance covered were 88.3 and 65.9, respectively. The correlation between 1976 G1 and 2006 G2 factor scores was  $r = .22$  ( $p < .0001$ ). The 1976 factor score was labeled G1 neighborhood disadvantage and characterized the neighborhood context experienced by G2 in childhood. Standardized residual values indexed change in level of disadvantage between 1976 and 2006 using G1's disadvantage status in 1976 as the reference point. The resulting residualized change score was labeled  $\Delta$  worsening neighborhood, with more positive residual scores indicating increases (or smaller decreases) in sociodemographic disadvantage for G2 participants maturing into adulthood.

### *G2 social-emotional characteristics in childhood*

A total of 4,100 classmates of G2 children provided peer reports of their aggression, social withdrawal, and likeability using the Pupil Evaluation Inventory (PEI; Pekarik, Prinz, Liebert, Weintraub, & Neale, 1976 [French translation]). Raters were enrolled in Grades 1, 4, and 7 in 150 classrooms at 23 schools. First graders completed a 16-item version of the PEI, whereas those in Grades 4 and 7 completed the full 34-item version. The PEI required each classmate to nominate up to four boys and four girls who best fit descriptions of behaviors pertaining to aggression, social withdrawal, and likeability. For each of these three factors, incoming nominations were summed, corrected for skew (via square root transformations), and were  $z$ -scored (within sex and within classroom). The full range of the  $z$ -score distribution on each factor was represented. Internal consistencies were acceptable for aggression ( $\alpha = 0.94$ – $0.98$ ), withdrawal ( $\alpha = 0.73$ – $0.94$ ), and likeability ( $\alpha = 0.89$ – $0.91$ ). The psychometric strength of the French PEI was affirmed in a series of studies (Ledingham, Younger, Schwartzman, & Bergeron, 1982; Moskowitz, Schwartzman, & Ledingham, 1985; Serbin, Lyons, Marchessault, Schwartzman, & Ledingham, 1987).

### *Father presence*

Parental linkages (i.e., G1 to G2) in the Ministère de la Santé et des Services Sociaux du Québec files allowed us to determine whether a G1 father was identified for each G2 offspring. Father presence was coded as 0 = absent and 1 = present and used as a control variable in all regression analyses because the health records of the G1 fathers of some of the G2 participants were not available for these cases (Table 1).

### *Education*

Based on deidentified education data provided by the Ministère de la Santé et des Services Sociaux du Québec, G2 participants were grouped into four categories in order of ascending educational attainment: (a) high school noncompletion; (b) high school completion; (c) junior college attendance (with or without completion of degree); and (d) university attendance/completion (including all programs).

### *Plan of analyses*

To properly structure the data for later analysis, participants' childhood peer sociometric ratings, childhood and adult neighborhood socioeconomic disadvantage, and provincial health records were matched using deidentified but individual-specific coding. Next, two multinomial logistic regression analyses were used to test the

hypotheses. In the first multinomial logistic regression, the no psychiatric diagnosis category (5) was contrasted with each of the 3 psychoses categories (e.g., schizophrenia [1], bipolar [2], and other psychosis-spectrum [3]), whereas in the second multinomial logistic regression, the nonpsychotic diagnosis category (4) was contrasted with each of the 3 psychoses categories. Each analysis included six steps to account for control variables and examine the predictive main effects; the two- and three-way interactions involve neighborhood disadvantage, change in disadvantage, and childhood behavioral characteristics. Only effects that were significant ( $p < .05$ ) across both multinomial logistic regression models, and therefore distinguished cases with psychosis-spectrum disorders both from cases with no psychiatric diagnoses and from cases with only nonpsychotic psychiatric diagnoses, were interpreted. This analytic approach both decreased the likelihood of Type 1 errors, relative to separate logistic regressions, because effects had to replicate across two models, and increased the ability to draw inferences about the specificity of associations between predictors and psychosis-spectrum diagnoses.

Both multinomial logistic regression models used the same structure. Predictor variables for step 1 included G2 gender, G2 age, number of parents with any psychotic diagnoses (none, one parent, both parents), number of G1 parents with nonpsychotic psychiatric diagnoses (none, one parent, both parents), G1 father presence, and G2 education. (Frequency of G1 bipolar and schizophrenia diagnoses were too low to include as separate control variables.) In step 2, G1 neighborhood disadvantage and G2  $\Delta$  worsening neighborhood were entered. In step 3, the childhood characteristics of aggression, withdrawal, and likeability were entered. Step 4 included two-way interactions between the three childhood characteristics (e.g., aggression  $\times$  withdrawal). Step 5 introduced the six two-way interactions between G1 neighborhood disadvantage and the childhood characteristics (e.g., G1 neighborhood disadvantage  $\times$  withdrawal) and between G2  $\Delta$  worsening neighborhood and the childhood characteristics. Last, step 6 entered six three-way interactions in which the two-way interactions in step 4 were crossed with either G1 neighborhood disadvantage or G2  $\Delta$  worsening neighborhood (e.g.,  $\Delta$  worsening neighborhood  $\times$  aggression  $\times$  withdrawal).<sup>1,2</sup> Interactions that were significant in both multinomial models were probed by examining the association between the predictor variable and the diagnosis variable at low ( $-1$  standard deviation [ $SD$ ]) versus high ( $+1$   $SD$ ) levels of the moderator variable(s), with childhood social-emotional characteristic variables treated as the moderators of neighborhood disadvantage variables. Figures are presented for the interaction effects from the multinomial model including no diagnoses as the referent group; all effects were extremely similar across the two models, and figures from the model including nonpsychotic diagnoses as the referent group are available from the first author upon request.

Supplemental analyses examined G2 gender as a moderator variable, again using two multinomial logistic regression models to contrast the psychosis-spectrum diagnosis categories (1–3)

<sup>1</sup>In preliminary analyses, the two-way interaction of G1 neighborhood disadvantage  $\times$   $\Delta$  worsening neighborhood, the three-way interaction of aggression  $\times$  withdrawal  $\times$  likeability, and the three three-way interactions between the childhood behavioral characteristics and the two-way interaction of neighborhood variables (e.g., G1 neighborhood disadvantage  $\times$   $\Delta$  worsening neighborhood  $\times$  aggression) were also examined. These were not significantly associated with any G2 diagnoses and were therefore excluded from the final models presented.

<sup>2</sup>For clarity of presentation, only the significant interaction effects for steps 5 and 6 are presented in Tables 3–5. Copies of the full logistic regression models including all interaction effects are available from the first author on request.

versus the no-diagnosis category (5) and versus the nonpsychotic diagnosis category (4). Steps 1–4 were identical to the steps described previously. Step 5 included the two two-way interactions between G2 gender and the two neighborhood variables (e.g., gender  $\times$  G1 neighborhood disadvantage). Step 6 included the three two-way interactions between G2 gender and the three childhood characteristic variables (e.g., gender  $\times$  aggression). Finally, step 7 included the three three-way interactions between G2 gender and the two-way interactions of childhood characteristic variables (e.g., gender  $\times$  aggression  $\times$  withdrawal). When interactions between gender and the other variables were significant, separate analyses by gender were carried out to examine the nature of the interaction.<sup>3</sup>

## Results

### Descriptive statistics

Sample characteristics are summarized in Table 1. The prevalence of G2 diagnoses are presented in Table 2. Across all categories of psychoses, positive diagnoses were present for 6.35% ( $N = 248$ ) of the 3,905 G2 participants, including 1.25% with schizophrenia, 2.28% with bipolar, and 2.82% with other psychosis-spectrum disorders; 55.93% ( $N = 2,184$ ) had nonpsychotic disorders only. Considering G1 diagnoses, there were 51.6% ( $N = 3,549$ ) with nonpsychotic diagnoses only and 5.8% ( $N = 402$ ) with any psychosis-spectrum diagnoses.

### Logistic regression models

The multinomial logistic regression models predicting G2 individuals' schizophrenia, bipolar, and other psychosis-spectrum diagnoses are presented in Tables 3–5. The models contrasting psychosis diagnoses versus no diagnoses are presented on the left side of the tables; the models contrasting psychosis diagnoses versus nonpsychotic diagnoses are presented on the right side. Specific predictor statistics are presented for the final model, including all predictors; for clarity of presentation, only interaction effects that were significant in at least one of the multinomial models are included in the tables. Both models including predictors were significantly better fits than intercept-only models, both  $\chi^2 > 110$ , degrees of freedom = 78,  $p < .01$ , accounting for 7.9%–16.4% (Nagelkerke pseudo  $R^2$ ) of the variance in schizophrenia, bipolar, and other psychosis-spectrum diagnoses. After having accounted for any associations between the control variables and G2 diagnoses, the significant effects for neighborhood disadvantage and childhood characteristics were examined in relation to the hypotheses, with main effect and lower order interaction effects interpreted in the context of the highest order significant interaction effects.

### Control variables

Across the two multinomial models, the only consistently significant control variable was that G1 psychotic diagnoses predicted higher likelihood of G2 schizophrenia diagnoses. No other control variable consistently distinguished cases with psychosis-spectrum diagnoses both from cases with only nonpsychotic diagnoses and from cases without any diagnoses.

### Hypotheses 1 and 2: Neighborhood disadvantage and adult diagnoses

G2 individuals who had lived in more socioeconomically disadvantaged neighborhoods in their childhoods were more likely to have received consistent diagnoses of schizophrenia and bipolar disorder by adulthood. In addition, G2 participants who experienced worsening, or less improvement, of neighborhood conditions from childhood to adulthood were more likely to receive schizophrenia diagnoses. These effects were not moderated by two- or three-way interaction effects. Finally, diagnoses of other psychosis-spectrum disorders were associated with worsening neighborhood conditions from childhood to adulthood, but this was moderated by childhood social behaviors (see the following section).

### Hypothesis 3: Childhood characteristics and adult diagnoses

The only significant unique association between G2 social behaviors in childhood and diagnoses in adulthood was that more withdrawn children were less likely to receive bipolar diagnoses. This effect was moderated by G2 gender (see the following section).

### Hypothesis 4: Interactions between childhood characteristics and neighborhood disadvantage

In both multinomial models predicting G2 schizophrenia diagnoses, childhood likeability significantly moderated the association between G2  $\Delta$  worsening neighborhood and G2 schizophrenia diagnoses in adulthood; the effect for the model with no diagnoses as referent group is depicted in Figure 1. The positive association between increasing neighborhood disadvantage and probability of schizophrenia diagnoses was significant for higher likeability in childhood: for the no-diagnosis referent model,  $B = 1.047$ ,  $SE = .313$ ,  $p = .001$ ,  $\text{Exp}(B) = 2.849$ , confidence interval (CI) [1.542, 5.263]; for the nonpsychotic diagnosis referent model,  $B = .826$ ,  $SE = .269$ ,  $p = .002$ ,  $\text{Exp}(B) = 2.285$ , CI [1.349, 3.870], but nonsignificant for lower childhood likeability (both  $p > .600$ ). Consistent with the weak tendency (no-diagnosis referent model:  $p = .073$ ; nonpsychotic diagnosis referent model:  $p = .115$ ) for likeability to be inversely associated with schizophrenia, however, this crossover effect revealed that it was only under the most severely worsening neighborhood conditions ( $\geq 1$  SD) that G2 individuals who had been high in likeability were more likely to receive schizophrenia diagnoses than those who had been low in likeability. When G2 individuals experienced little neighborhood change or greater improvement of neighborhood conditions as they matured, more likeable children were less likely to develop schizophrenia compared with less likeable children. This interaction is consistent with the differential-susceptibility model.

There were no consistently significant interaction effects in the two models predicting G2 bipolar diagnoses.

In the models predicting G2 other psychosis-spectrum diagnoses, a significant two-way interaction involving childhood withdrawal and G2  $\Delta$  worsening neighborhood was subsumed within one of two significant three-way interactions. G2 aggression and withdrawal jointly moderated the associations of both G1 neighborhood disadvantage in childhood (Figure 2) and G2  $\Delta$  worsening neighborhood (Figure 3) with G2 other psychosis-spectrum diagnoses. For both interactions, it was only when both aggression and withdrawal were high that greater childhood neighborhood disadvantage predicted greater probability of other psychosis-spectrum diagnosis (for the no-diagnosis referent model:  $B = .837$ ,  $SE = .291$ ,  $p = .004$ ,  $\text{Exp}(B) = 2.309$ , CI [1.304, 4.087]; for the nonpsychotic diagnosis referent model:  $B$

<sup>3</sup>Significant moderating effects of gender are described in the text. Copies of the full regression models including all gender interaction terms are available from the first author on request.

**Table 2.** Prevalence of psychiatric disorder categories for G2 participants: Number (percent, based on full G2 sample;  $N = 3,905$ )

Diagnostic category	Male	Female
1. Schizophrenia diagnosis, $N$ (%)	32 (1.6)	17 (0.9)
2. Bipolar diagnosis, $N$ (%)	36 (1.8)	53 (2.7)
3. Other psychosis-spectrum diagnosis, $N$ (%)	42 (2.1)	68 (3.4)
4. Nonpsychotic diagnosis, $N$ (%)	930 (47.6)	1,254 (64.3%)
5. No diagnosis, $N$ (%)	915 (46.8)	558 (28.6)

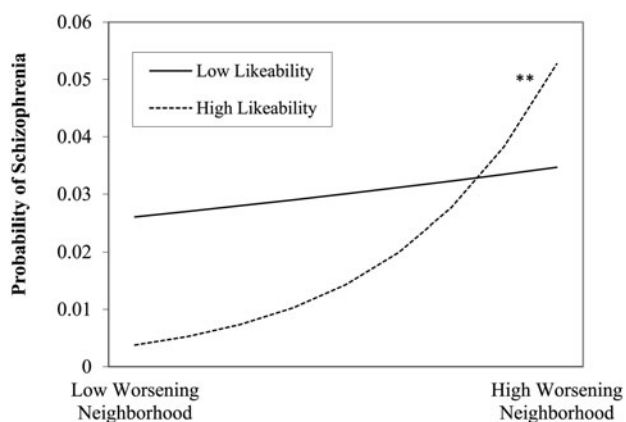
$= .811$ ,  $SE = .296$ ,  $p = .006$ ,  $\text{Exp}(B) = 2.250$ ,  $CI [1.259, 4.020]$ ), and that worsening neighborhood disadvantage into adulthood predicted greater probability of other psychosis-spectrum diagnosis (for no-diagnosis referent model:  $B = 1.024$ ,  $SE = .284$ ,  $p < .001$ ,  $\text{Exp}(B) = 2.784$ ,  $CI [1.596, 4.856]$ ); for nonpsychotic diagnosis referent model:  $B = .782$ ,  $SE = .240$ ,  $p = .001$ ,  $\text{Exp}(B) = 2.185$ ,  $CI [1.367, 3.495]$ ). The predictive associations of both childhood neighborhood disadvantage and worsening neighborhood disadvantage with likelihood of developing other psychosis-spectrum diagnoses were nonsignificant for low aggression and low withdrawal, high aggression and low withdrawal, and low aggression and high withdrawal (all  $p > .150$ ). Examining the figures, the risks entailed by more disadvantaged neighborhoods in childhood and worsening neighborhoods into adulthood were in keeping with the diathesis-stress model.

### Examining gender as a moderating variable

Two additional multinomial logistic regression models were run to examine G2 gender as a moderator of neighborhood disadvantage and childhood characteristics predicting the likelihood of adult diagnoses. Consistent across both models, gender was not a significant moderator of any effects for the prediction of other psychosis-spectrum diagnoses, but was involved in one significant interaction effect for each of the schizophrenia and bipolar disorder models.

In the models predicting G2 schizophrenia diagnoses, there was a significant three-way interaction of G2 gender  $\times$  G2 withdrawal  $\times$  G2 aggression (for no-diagnosis referent model: final  $B = .476$ ,  $SE = .158$ ,  $p = .003$ ,  $\text{Exp}(B) = 1.610$ ,  $CI [1.181, 2.194]$ ); for nonpsychotic diagnosis referent model: final  $B = .451$ ,  $SE = .148$ ,  $p = .002$ ,  $\text{Exp}(B) = 1.569$ ,  $CI [1.175, 2.096]$ ). Higher childhood aggression significantly predicted greater risk for schizophrenia diagnoses only in G2 males with low childhood withdrawal (for no-diagnosis referent model: final  $B = .963$ ,  $SE = .315$ ,  $p = .002$ ,  $\text{Exp}(B) = 2.620$ ,  $CI [1.415, 4.853]$ ); for nonpsychotic-diagnosis referent model: final  $B = .637$ ,  $SE = .286$ ,  $p = .026$ ,  $\text{Exp}(B) = 1.890$ ,  $CI [1.080, 3.308]$ ). Childhood aggression did not predict schizophrenia for males with higher withdrawal, females with higher withdrawal, or females with lower withdrawal (all  $p > .100$ ).

In the model predicting G2 bipolar diagnoses, G2 gender significantly moderated the effect of G2 withdrawal (for no-diagnosis referent model: final  $B = -.392$ ,  $SE = .135$ ,  $p = .004$ ,  $\text{Exp}(B) = 0.675$ ,  $CI [0.518, 0.880]$ ); for nonpsychotic-diagnosis referent model: final  $B = -.393$ ,  $SE = .137$ ,  $p = .004$ ,  $\text{Exp}(B) = 0.675$ ,  $CI [0.515, 0.883]$ ). Greater childhood withdrawal predicted decreased likelihood of being diagnosed with bipolar disorder

**Figure 1.** Likeability moderated the association between  $\Delta$  worsening neighborhood and schizophrenia. Note.  $**p < .01$ .

for G2 women (for no-diagnosis referent model: final  $B = -.597$ ,  $SE = .192$ ,  $p = .002$ ,  $\text{Exp}(B) = 0.550$ ,  $CI [0.378, 0.802]$ ); for nonpsychotic diagnosis referent model: final  $B = -.640$ ,  $SE = .196$ ,  $p = .001$ ,  $\text{Exp}(B) = 0.527$ ,  $CI [0.359, 0.774]$ ) but not for G2 men (both  $p > .200$ ).

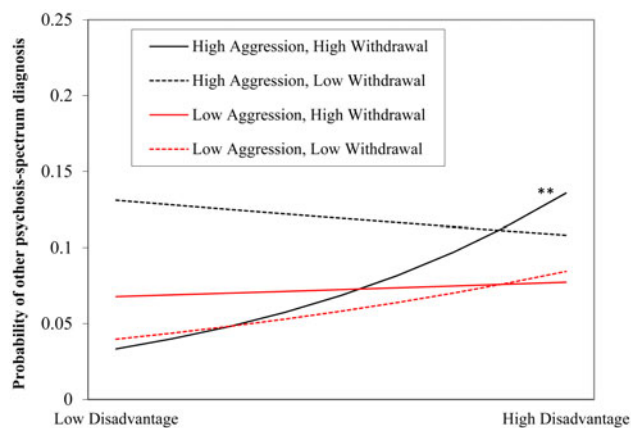
### Discussion

This 30-year prospective, longitudinal investigation revealed that social behaviors with peers in childhood, neighborhood-level socioecological conditions in childhood, and changing socioecological contexts over maturation, contributed to the probability of being diagnosed with psychosis-spectrum disorders in adulthood. At 6.25% of the sample, the prevalence of all psychoses diagnoses not attributable to physical ailments was higher than most other estimates of psychoses by mid-adulthood (Perälä et al., 2007), which may be attributable to the targeted recruitment of an urban, predominantly lower income sample (van Os et al., 2001, 2009). Even within this sociodemographically at-risk sample, however, variability in neighborhood conditions was associated with the likelihood of developing psychoses in adulthood. Independent of future disadvantaged socioecological conditions associated with receiving any psychotic diagnoses, having been raised in more disadvantaged neighborhoods in childhood increased the likelihood of being consistently diagnosed with schizophrenia and bipolar disorders over the ensuing 30 years. The salience of children's social behaviors with peers for potentiating these environmental risks for psychosis-spectrum disorders was evident. In line with multiple-domain models of psychopathology (Cicchetti & Curtis, 2007; Ellis et al., 2011), neighborhood disadvantage was more strongly predictive of schizophrenia, bipolar disorder with psychosis, and other psychosis-spectrum disorders for children with particular social behavior tendencies.

### Neighborhood socioeconomic disadvantage

Within this urban, generally low-income sample, children in the 1970s who were raised in the most socioeconomically disadvantaged neighborhoods were at the greatest risk of being consistently diagnosed with either schizophrenia or bipolar disorder with psychosis by the time they were in middle adulthood. These effects were robust in models that accounted for parent psychiatric diagnoses, educational attainment, childhood social characteristics,



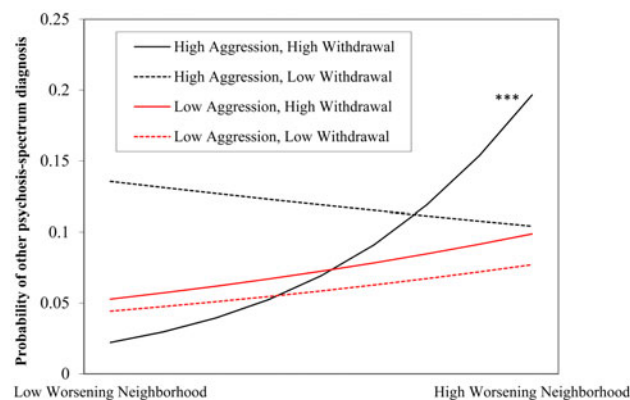


**Figure 2.** Aggression and withdrawal jointly moderated the association between neighborhood disadvantage in childhood and other psychosis-spectrum diagnoses. Note. \*\* $p < .01$ .

and change in neighborhood disadvantage over the lifespan, thereby providing support for theoretical models positing that exposure to socioeconomic deprivation in childhood, in and of itself, may play a causal role in the development of psychotic diagnoses in adulthood (Bradley & Corwyn 2002; O'Donoghue et al., 2016). Numerous life stressors are associated with living in more impoverished neighborhoods, including exposure to more environmental toxins, more crime, lower quality schools, fewer community resources, and increased parental distress (Martin-Storey et al., 2013; Masarik & Conger, 2017; Page et al., 2016). There are therefore likely to be numerous social and biological mechanisms by which childhood neighborhood disadvantage conveys increased risk for psychosis-spectrum disorders.

Hertzman (1999) proposed that stressful childhood experiences affect the maturation and functioning of neural and metabolic systems, a process of "biological embedding" of the environment, thereby undermining future health and well-being. Evidence for such models has been increasing steadily, such as the recent report by Brody et al. (2014) that adolescents who experienced increasing neighborhood poverty from age 11 to 18 years manifested greater allostatic load (McEwen & Stellar, 1993) at age 19 years, as reflected in blood pressure, cortisol levels, and catecholamine levels. Such effects of neighborhood-level poverty on biological indices can be buffered by intervention, including individual- and family-focused psychosocial interventions administered in childhood (Campbell et al., 2014) and adolescence (Miller, Brody, Yu, & Chen, 2014), suggesting that the effects of neighborhood disadvantage on children's quality of family relationships and social-cognitive processes may be key mechanisms linking poverty to health, in accord with social causation models (Hollingshead & Redlich, 1958; Page et al., 2016).

Being diagnosed with schizophrenia also was associated with concurrently living in more disadvantaged neighborhoods, as shown by the relatively negative trajectory of neighborhood conditions from childhood to adulthood. As with chronic physical health ailments, severe mental health problems such as schizophrenia can interfere with the ability to obtain and maintain gainful employment (Luciano & Meara, 2014), such that affected adults can only afford to live in less costly, and hence less advantaged, neighborhoods. Perhaps more striking is that this was the case in a province and country in which universal health care and social welfare were available throughout the adult lifespan



**Figure 3.** Aggression and withdrawal jointly moderated the association between  $\Delta$  worsening neighborhood and other psychosis-spectrum diagnoses. Note. \*\*\* $p < .001$ .

of the participants, and that the link between declining neighborhood conditions and schizophrenia diagnoses was independent of, and additive to, the association of childhood neighborhood disadvantage with future diagnoses. Both of these points suggest that, in addition to social causation from childhood experiences of neighborhood adversity, downward social drift is a pervasive and pernicious phenomenon for adults with schizophrenia (Lawrence & Kisely, 2010; Wender et al., 1973).

#### *Childhood social behaviors: Divergent paths for males and females*

Counter to our expectations, social behaviors with peers in childhood were not robust independent predictors of future diagnoses of psychosis; however, boys' and girls' displays of aggression and withdrawal were differentially predictive of their future diagnoses of schizophrenia and bipolar disorders. It was only among less withdrawn boys that greater aggression predicted more diagnoses of schizophrenia and only among girls that greater withdrawal predicted fewer diagnoses of bipolar disorder. The former association replicates and extends the classic findings from Watt (1978) and Done et al. (1994) that boys who went on to develop schizophrenia in adulthood were more aggressive, disruptive, and disagreeable than their peers, and to a lesser extent were less introverted, timid, and isolated, according to teachers. In their review of multiple prospective longitudinal studies, Tarbox and Pogue-Geile (2008) also concluded that the association between childhood aggression and adult schizophrenia is stronger in males than in females. Highly aggressive behavior in childhood is a reflection of being impulsive and undercontrolled (Liu, 2006), stemming from poor physiological, cognitive, and emotional self-regulation (Eisenberg, Spinrad, & Eggum, 2010; Kahle, Utendale, Widaman, & Hastings, 2018). The current study's novel observation that schizophrenia in males was specifically predicated on the combination of high aggression and low withdrawal could reflect processes of poor neurocognitive regulation manifesting as disinhibition, which has been posited as a core developmental deficit of schizophrenia (O'Donnell, 2011). In addition, these aggressive and frequently socially engaged boys likely would have evidenced a disruptive and aversive behavioral style, likely to elicit conflict, anger, rejection, and punishment from peers and adults (Patterson, 2002). Such social experiences

**Table 3.** Logistic regression models for schizophrenia diagnoses

Predictors	Versus no diagnoses group			Versus nonpsychotic diagnoses group		
	B (SE)	Exp(B)	95% CI	B (SE)	Exp(B)	95% CI
G2 Gender	−0.04 (0.17)	0.97	[0.70, 1.34]	−0.43 (0.16) <sup>c</sup>	0.65	[0.47, 0.89]
G1 Father presence	−0.07 (0.26)	0.93	[0.56, 1.53]	0.01 (0.24)	1.01	[0.63, 1.61]
G1 Nonpsychotic diagnosis	0.35 (0.25)	1.42	[0.88, 2.31]	0.17 (0.24)	1.19	[0.74, 1.91]
G1 Psychosis diagnosis	<b>1.24 (0.36)<sup>d</sup></b>	<b>3.45</b>	<b>[1.72, 6.92]</b>	<b>1.17 (0.34)<sup>d</sup></b>	<b>3.21</b>	<b>[1.65, 6.26]</b>
G2 Age in 2006	0.12 (0.07) <sup>a</sup>	1.13	[0.99, 1.29]	0.08 (0.07)	1.08	[0.94, 1.23]
G2 Education completed	−0.11 (0.18)	0.90	[0.63, 1.29]	−0.01 (0.17)	0.99	[0.71, 1.40]
G1 Neighborhood disadvantage	<b>0.54 (0.22)<sup>b</sup></b>	<b>1.71</b>	<b>[1.11, 2.65]</b>	<b>0.50 (0.22)<sup>b</sup></b>	<b>1.65</b>	<b>[1.06, 2.56]</b>
G2 Δ Worsening neighborhood	<b>0.57 (0.19)<sup>c</sup></b>	<b>1.77</b>	<b>[1.21, 2.57]</b>	<b>0.45 (0.18)<sup>b</sup></b>	<b>1.56</b>	<b>[1.10, 2.21]</b>
G2 Aggression	0.07 (0.21)	1.08	[0.72, 1.62]	−0.15 (0.21)	0.86	[0.57, 1.29]
G2 Withdrawal	−0.18 (0.22)	0.84	[0.55, 1.28]	−0.23 (0.21)	0.80	[0.53, 1.20]
G2 Likeability	−0.39 (0.22) <sup>a</sup>	0.68	[0.44, 1.04]	−0.32 (0.20)	0.73	[0.49, 1.08]
G2 Δ Worsening Neighborhood × G2 Likeability	<b>0.50 (0.20)<sup>b</sup></b>	<b>1.64</b>	<b>[1.10, 2.45]</b>	<b>0.40* (0.17)</b>	<b>1.49</b>	<b>[1.06, 2.09]</b>

Note. Interaction effects that were nonsignificant in both models are not depicted; copies of the full models are available on request. Effects that were significant in both multinomial models are presented in **bold font**. CI = confidence interval; G1 = parent; G2 = offspring; SE = standard error; <sup>a</sup> $p < .10$ ; <sup>b</sup> $p < .05$ ; <sup>c</sup> $p < .01$ ; <sup>d</sup> $p < .001$ .

may have further undermined aggressive, outgoing boys' well-being and exacerbated the likelihood of maladjustment (Stack, Serbin, Mantis, & Kingdon, 2015). Akin to the argument that some children diagnosed with attention deficit-hyperactivity disorder may be exhibiting premorbid or pediatric bipolar disorder (Galanter & Leibenluft, 2008), it may be worthwhile to screen for psychotic symptoms in school-age boys exhibiting profiles of highly aggressive and less withdrawn behavior with peers.

Unlike Done et al. (1994) or Watt (1978), we did not find that having childhood characteristics related to being highly withdrawn predicted schizophrenia in females. Schizophrenia is moderately more prevalent in men (McGrath, Saha, Chant, & Welham, 2008), although that may be particularly true in early to mid-adulthood (Perälä et al., 2007); thus, it is possible that stronger associations between childhood social behaviors and adult diagnoses in women would have been evident had the sample been followed beyond the start of the middle-age period. Alternatively, as concluded by Tarbox and Pogue-Geile (2008), it may be the case that withdrawal or internalizing problems in childhood are not specific predictors of schizophrenia or psychosis-spectrum disorders in adulthood, relative to other diagnoses.

An intriguing, and to our knowledge unique to this study, finding was that being highly socially withdrawn in childhood emerged as a protective factor against bipolar disorder with psychosis in women only. All participants in this study were raised in lower income urban neighborhoods, and the more disadvantaged these childhood neighborhoods were, the greater the likelihood that youths would develop bipolar disorders. Given gender-typed socialization practices, school-age boys were likely allowed greater freedoms to explore these local environs than were girls (Stone, Faulkner, Mitra & Buliung, 2014); more withdrawn girls were probably even more likely to avoid these urban contexts and minimize interactions with risky and delinquent peers (Dishion, Ha, & Véronneau, 2012). Inhibited, shy, and withdrawn tendencies are considered to be stereotypically

feminine and more acceptable for girls to display than for boys (Doey, Coplan, & Kingsbury, 2013; Zahn-Waxler, Klimes-Dougan, Slattery, 2000); thus, more withdrawn girls may have been less exposed to the environmental risk of their neighborhoods while also having their timidity accepted by parents and peers. Given the novelty of the finding, however, replication in independent samples is warranted to properly evaluate this potentially gender- and context-specific effect.

#### Multivariate predictors of psychiatric diagnoses

Interest in how the individual characteristics of children may make them more or less likely to develop psychopathology in the context of adverse experiences has existed for more than two decades (Rutter, 1990), and empirical attention to such multivariate effects has surged in recent years (van Ijzendoorn & Bakermans-Kranenburg, 2015). There were three such effects. Perhaps most striking were two that appeared to support the diathesis-stress model for other psychosis-spectrum disorders: the elevated risk of psychosis-spectrum diagnoses other than consistently confirmed schizophrenia or bipolar disorder was associated with disadvantaged childhood neighborhoods and worsening neighborhood disadvantage in adulthood only for individuals who had been both highly aggressive and highly withdrawn in childhood. This is exactly the multifaceted profile of social behavioral deficits that has long been posited to characterize children at risk for developing schizophrenia (Mednick & Schulsinger, 1968; Robins, 1966; Tarbox & Pogue-Geile, 2008) and could suggest that it is not schizophrenia per se but other diagnoses such as psychotic depression and schizoaffective disorder that may arise from childhood tendencies to be both aggressive and withdrawn. Counted within the category of "other psychosis-spectrum disorders" were those individuals who had received diagnoses of schizophrenia once or twice, but not three or more times consistently within a decade. Schizophrenia has complex and diverse presentations that may have multiple etiologies (Abel, Drake, &

**Table 4.** Logistic regression models for bipolar diagnoses

Predictors	Versus no diagnoses group			Versus nonpsychotic diagnoses group		
	B (SE)	Exp (B)	95% CI	B (SE)	Exp (B)	95% CI
G2 Gender	0.53 (0.12) <sup>d</sup>	1.70	[1.35, 2.15]	0.11 (0.12)	1.12	[0.89, 1.41]
G1 Father presence	-0.17 (0.17)	0.84	[0.60, 1.18]	-0.03 (0.16)	0.97	[0.71, 1.33]
G1 Nonpsychotic diagnosis	0.40 (0.17) <sup>b</sup>	1.49	[1.06, 2.10]	0.08 (0.17)	1.08	[0.78, 1.50]
G1 Psychosis diagnosis	0.29 (0.33)	1.33	[0.70, 2.56]	0.19 (0.32)	1.20	[0.65, 2.24]
G2 Age in 2006	0.06 (0.05)	1.06	[0.97, 1.17]	0.01 (0.05)	1.00	[0.92, 1.10]
G2 Education completed	-0.15 (0.13)	0.86	[0.66, 1.12]	0.02 (0.13)	1.02	[0.79, 1.30]
G1 Neighborhood disadvantage	<b>0.48 (0.16)<sup>c</sup></b>	<b>1.61</b>	<b>[1.17, 2.21]</b>	<b>0.38 (0.16)<sup>b</sup></b>	<b>1.46</b>	<b>[1.07, 2.00]</b>
G2 Δ Worsening neighborhood	0.30 (0.13) <sup>b</sup>	1.35	[1.05, 1.74]	0.20 (0.12) <sup>a</sup>	1.23	[0.97, 1.55]
G2 Aggression	0.12 (0.14)	1.13	[0.87, 1.47]	-0.02 (0.13)	0.98	[0.76, 1.27]
G2 Withdrawal	<b>-0.33 (0.14)<sup>b</sup></b>	<b>0.72</b>	<b>[0.55, 0.95]</b>	<b>-0.34 (0.14)<sup>b</sup></b>	<b>0.72</b>	<b>[0.54, 0.94]</b>
G2 Likeability	-0.16 (0.15)	0.85	[0.63, 1.14]	-0.11 (0.14)	0.90	[0.69, 1.18]
G1 Neighborhood Disadvantage × G1 Withdrawal × G1 Likeability	0.39 (0.17) <sup>b</sup>	1.47	[1.06, 2.04]	0.24 (0.13) <sup>a</sup>	1.26	[0.98, 1.64]

Note. Interaction effects that were nonsignificant in both models are not depicted; copies of the full models are available on request. Effects that were significant in both multinomial models are presented in **bold font**. CI = confidence interval; G1 = parent; G2 = offspring; SE = standard error; <sup>a</sup> $p < .10$ ; <sup>b</sup> $p < .05$ ; <sup>c</sup> $p < .01$ ; <sup>d</sup> $p < .001$ .

Goldstein, 2010); thus, it may be the case that the aggressive-withdrawn profile characterizes children who, in the context of environmental adversity, are at risk either for developing milder or remitting symptoms of schizophrenia or for developing later emerging schizophrenia that becomes consistently diagnosed after mid-adulthood (Perälä et al., 2007). Even so, these multivariate effects again provided evidence for both social causation and social drift being active and important processes affecting the life courses of individuals at risk for psychosis-spectrum disorders.

In accord with the differential susceptibility model (Ellis et al., 2011) was the surprising observation that individuals who had been highly likeable as children ranged from having the lowest likelihood of developing schizophrenia when they experienced relatively improving neighborhood conditions over maturation, to having the highest likelihood when they experienced markedly worsening neighborhood socioeconomic changes. This was unexpected because much of the research on differential susceptibility has indicated that openness to influence for better and for worse is observed in children with characteristics that have been traditionally seen as vulnerabilities, such as a difficult temperament (Belsky & Pluess, 2009), which is associated with being disliked by peers (Rubin, Bukowski, & Parker, 2006). Why would the social advantage of being liked by peers function similarly? Perhaps more likeable individuals are also more open, engaged with, and receptive to the influences of those peers and neighbors who perceive them as likeable. Moving from relatively more advantaged to more disadvantaged neighborhoods as they matured over adolescence and into adulthood, they may have had increasing contact with people with criminal or deviant tendencies. Or, lacking earlier socializing experiences with how to cope with disadvantaged neighborhoods, they may have been more vulnerable to the stressors of their declining circumstances. These are speculations, but our finding that more likeable children might also be “orchids” is provocative and merits further investigation.

### Limitations

The primary strengths of the study, specifically its unique prospective assessment of a community-based sample of individuals tied to a particular region, culture, and period of historic change, and its concern with a largely lower income to working class population that spans two generations, may be seen by some persons as a limitation. Although there may be reason to be concerned with any study conducted in a particular place and time, the present findings might generalize to subsequent prospective longitudinal research that examines the transgenerational ramifications of socioecological change in immigrant families and in families living in rapidly developing countries. Second, the use of public health records as a single-source measure of psychiatric status may be seen as a potential constraint on the generalizability of the findings. Diagnostic heterogeneity resulting from symptom overlap among diagnoses, comorbid presentation of disorders, differing applications of diagnostic criteria across health professionals, and other factors can limit the ability to make confident inferences about the specificity of associations between risk factors and distinct psychosis-spectrum disorders. Our conservative criteria for assigning diagnoses of schizophrenia and bipolar disorder on the basis of multiple consistent records over time has been validated in prior independent studies (Ruggero et al., 2010), however, and Perälä et al. (2007) reported that assignment of psychoses diagnoses via health records has good sensitivity, specificity, and agreement with Diagnostic and Statistical Manual of Mental Disorders–based diagnostic assessments by psychiatrists and clinical psychologists. Further, this limitation may be offset by the application of an unchanging set of diagnostic criteria based on the ICD-9 that anchored Québec’s health records across generation cohorts, and the study’s focus on patterns of psychiatric risk factors over the lifespan rather than on “true” prevalence rates of disorders at a given point. Third, a further consideration specific to the ICD-9 is the system’s lack of explicit distinction between bipolar diagnoses with and without

**Table 5.** Logistic regression models for other psychosis-spectrum disorder diagnoses (excluding schizophrenia and bipolar disorder)

Predictors	Versus no diagnoses group			Versus nonpsychotic diagnoses group		
	B (SE)	Exp(B)	95% CI	B (SE)	Exp(B)	95% CI
G2 Gender	0.57 (0.11) <sup>d</sup>	1.76	[1.43, 2.17]	0.12 (0.10)	1.13	[0.92, 1.38]
G1 Father presence	-0.35 (0.15) <sup>b</sup>	0.71	[0.53, 0.95]	-0.22 (0.13)	0.81	[0.62, 1.05]
G1 Nonpsychotic diagnosis	0.43 (0.16) <sup>c</sup>	1.53	[1.12, 2.10]	0.14 (0.15)	1.15	[0.85, 1.54]
G1 Psychosis diagnosis	0.40 (0.31)	1.50	[0.81, 2.75]	0.20 (0.30)	1.22	[0.68, 2.18]
G2 Age in 2006	0.04 (0.04)	1.04	[0.95, 1.13]	-0.01 (0.04)	0.99	[0.91, 1.07]
G2 Education completed	-0.21 (0.12) <sup>a</sup>	0.81	[0.64, 1.02]	-0.08 (0.11)	0.92	[0.74, 1.15]
G1 Neighborhood disadvantage	0.29 (0.14) <sup>b</sup>	1.34	[1.01, 1.78]	0.25 (0.14) <sup>a</sup>	1.29	[0.98, 1.70]
G2 Δ Worsening neighborhood	<b>0.35 (0.12)<sup>c</sup></b>	<b>1.43</b>	<b>[1.13, 1.79]</b>	<b>0.28 (0.11)<sup>c</sup></b>	<b>1.33</b>	<b>[1.07, 1.64]</b>
G2 Aggression	0.19 (0.12)	1.21	[0.95, 1.53]	-0.03 (0.12)	0.97	[0.78, 1.22]
G2 Withdrawal	-0.11 (0.12)	0.89	[0.71, 1.13]	-0.17 (0.12)	0.84	[0.67, 1.06]
G2 Likeability	-0.01 (0.12)	0.99	[0.78, 1.26]	-0.02 (0.12)	0.98	[0.78, 1.23]
G2 Aggression × G1 Withdrawal	-0.23 (0.13) <sup>a</sup>	0.79	[0.62, 1.01]	-0.31 (0.12) <sup>c</sup>	0.73	[0.58, 0.93]
G2 Δ Worsening Neighborhood × G1 Withdrawal	<b>0.31 (0.12)<sup>c</sup></b>	<b>1.36</b>	<b>[1.08, 1.72]</b>	<b>0.25 (0.11)<sup>b</sup></b>	<b>1.28</b>	<b>[1.05, 1.58]</b>
G1 Neighborhood Disadvantage × G1 Aggression × G1 Withdrawal	<b>0.34 (0.14)<sup>b</sup></b>	<b>1.41</b>	<b>[1.07, 1.85]</b>	<b>0.31 (0.14)<sup>b</sup></b>	<b>1.36</b>	<b>[1.04, 1.78]</b>
G1 Neighborhood Disadvantage × G1 Aggression × G1 Likeability	0.35 (0.19) <sup>a</sup>	1.42	[0.98, 2.06]	0.35 (0.17) <sup>b</sup>	1.42	[1.02, 1.97]
G2 Δ Worsening Neighborhood × G1 Aggression × G1 Withdrawal	<b>0.29 (0.12)<sup>b</sup></b>	<b>1.34</b>	<b>[1.06, 1.70]</b>	<b>0.23 (0.11)<sup>b</sup></b>	<b>1.26</b>	<b>[1.01, 1.56]</b>
G2 Δ Worsening Neighborhood × G1 Aggression × G1 Likeability	0.28 (0.15) <sup>a</sup>	1.32	[0.97, 1.78]	0.27 (0.13) <sup>b</sup>	1.31	[1.02, 1.68]

Note: Interaction effects that were non-significant in both models are not depicted; copies of the full models are available on request. Effects that were significant in both multinomial models are presented in **bold font**. CI = confidence interval; G1 = parent; G2 = offspring; SE = standard error; <sup>a</sup> $p < .10$ ; <sup>b</sup> $p < .05$ ; <sup>c</sup> $p < .01$ ; <sup>d</sup> $p < .001$ .

psychosis. Although both the ICD-9 criteria for assigning a bipolar diagnosis and our use of confirmatory evidence from medical records make it unlikely that individuals with bipolar disorder without psychosis were included in the bipolar category, it is possible that diagnostic heterogeneity within this category may have obscured the detection of more specific associations with childhood social behaviors. Fourth, the study is essentially a prospective epidemiological overview of correlations of markers and agents of processes generic to the development of psychiatric disorder. The variables constitute broad groupings of behavior, disorder, and circumstance that in practical terms may best serve as guideposts for future small-sample process-centered research. Fifth, it is not possible to clearly distinguish the temporality of the associations between diagnoses in adulthood and changes in neighborhood disadvantage from childhood to adulthood; the onset of psychoses disorders may have led to declining economic circumstances, or experiencing chronically worsening neighborhood conditions may have undermined mental health and exacerbated psychoses. Sixth, there are factors of major relevance to mental health that cannot be evaluated in the study, such as parental socialization. Seventh, despite the size of the research population, there were statistical power constraints on the findings pertaining to low-incidence disorders, reflecting the actual prevalence of psychiatric disorders within a community-based sample.

## Conclusion

In accord with bioecological and multilevel models of developmental psychopathology, this prospective, lifespan longitudinal, two-generation study provided clear evidence for the independent

and interactive contributions of children's social characteristics and environmental contexts to their risk for manifesting schizophrenia, bipolar disorder with psychosis, and other psychosis-spectrum disorders in adulthood. Beyond the risk entailed by parental diagnoses, being raised in neighborhoods characterized as socioeconomically disadvantaged was a potentiating factor for the future emergence of all psychosis-spectrum disorders, particularly for children who had been seen as highly aggressive and withdrawn by their peers. The disinhibited profile of being highly aggressive but not withdrawn conveyed risk for schizophrenia in males. In turn, those who developed psychiatric disorders were more likely to reside in such disadvantaged neighborhoods as adults. Children's tendencies to be aggressive and intrusive toward peers may have been prodromes indicative of premorbid, subclinical symptoms of incipient psychotic illness, and also may have elicited aversive, rejecting, and isolating responses from social partners that conferred added risk. The breadth of factors predicting risk for psychosis-spectrum diagnoses also point toward the potential for multiple points of intervention and prevention. Economic and social policy interventions such as preventive interventions to address the needs of all families living in socioeconomically disadvantaged neighborhoods, and more targeted cognitive-behavioral therapies with school-age children manifesting atypical social characteristics, may prove effective for reducing the future prevalence of these seriously debilitating and costly psychiatric diagnoses.

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