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Childhood cat bites and disorganized symptoms of schizotypy in adulthood

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CHILDHOOD CAT BITES AND DISORGANIZED SYMPTOMS OF SCHIZOTYPY IN ADULTHOOD

by

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ABSTRACT

During recent years of schizophrenia research, many etiologies have been emphasized, some of them implicating infectious and autoimmune diseases. Many different infectious agents have been examined, but the root seems to stem from the secondary autoimmune deregulation, which can be caused by different infectious agents. Among the effects that autoimmune deregulation has on the body, one prominent effect is on the brain, resulting in either severe or mild encephalitis. The mild encephalitis that has been implicated as one of the causes of schizophrenia-spectrum disorders has been associated with different pathogens, many of which can be transmitted by the household cat. Thus in the present research we have used the schizotypy personality construct model as an analog for schizophrenia spectrum disorders, and the relationship between current schizotypy and childhood household cat interactions were examined. An online questionnaire was completed by 356 undergraduate students and assessed the current schizotypy using the Schizotypal Personality Questionnaire Brief Revised (SPQ-BR), as well as questions about cat ownership and cat bites (puncturing skin) prior to age 13. While no significant relationship was found between childhood cat ownership and current schizotypy, individuals endorsing a cat bite prior to age 13 (N = 66) reported a significantly higher level of current overall schizotypy, which was largely driven by the Disorganized factor of the SPQ-BR.. This relationship should be explored further by examining the antibodies and sera of individuals with the schizophrenia spectrum disorder.

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INTRODUCTION

Schizophrenia is one of the most debilitating mental diseases, and yet its origins are a controversial topic. It has been an accepted belief that there is no single cause for this illness; moreover, it is unclear whether schizophrenia is a single disease or an umbrella term for several diseases with similar symptoms (Torrey, 2006). There are several different theories regarding causal factors for schizophrenia, which include genetic, neurochemical, developmental, infectious, immune, nutritional, endocrine, and stress contributions (Torrey, 2006). While each of these theories contributes to the understanding of schizophrenia, recent research has reexamined the role of infectious diseases.

Many different kinds of infections have been implicated in the development of schizophrenia, which include the parasite *Toxoplasma gondii,* (Brown, 2008; Yolken, Dickerson, & Torrey, 2009), as well as bacterial and viral infections (Bo Mortensen et al., 2007; Brown et al., 2005; Yolken et al., 2009), human endogenous retrovirus-W (Karlsson et al., 2001), and autoimmune diseases (Eaton et al., 2006; Jones, Mowry, Pender, & Greer, 2005; Strous & Shoenfeld, 2006). In all of these studies, the diseases were acquired in one of two ways: during prenatal development (i.e., the mother acquired the disease and it spread to the fetus), or from childhood exposure, with most studies finding a relationship with the later development of schizophrenia if the exposure occurred prior to 13 years of age (Brown, 2008; Dalman et al., 2008).

However, the mechanism by which an infection can influence brain development and cause psychiatric symptoms remains unclear. One unifying theory proposes that the genetic and environmental factors cause abnormalities in the immune system, which in turn becomes the risk

factor for schizophrenia (Kinney et al., 2010). Consistent with this theory, several studies have reported a range of immunological abnormalities in patients with schizophrenia (McAllister et al., 1995; Müller, 2004; Patterson, 2011; Song, Lv, Li, Hao, & Zhao, 2009). It is possible that a higher rate of infectious exposure may deregulate the immunological balance which then causes a neurotransmitter imbalance in individuals with schizophrenia (Benros, Mortensen, & Eaton, 2012; Eaton et al., 2006). This theory is supported by the observation that anti-inflammatory drugs may relieve some of the symptoms of schizophrenia (Mansur et al., 2012; Sommer, de Witte, Begemann, & Kahn, 2012; Webster, Lamberton, Donnelly, & Torrey, 2006).

A different theory suggests that mild encephalitis (ME), in which low level of neuroinflammation (LLNI) causally underlies some psychiatric disorders, including schizophrenia (Bechter, 2012). This theory is supported by findings of ME in the prodromal phase of encephalitis, in which classical CNS inflammation symptoms are not yet developed, but subthreshold psychiatric symptoms are observed (Bechter, 2012). LLNI is assumed to be influenced by pre-existing genetic factors, such as immune and inflammatory response–related genes (Bechter, 2012)

Considering the vast array of diseases and conditions that can cause encephalitis, in the present study we have focused on exposure to specific pathogens transmitted by the household cat. More than 400,000 cat bites occur every year in the United States and somewhere between 28-80% (depending on the particular study) result in acute infection (Kravetz & Federman, 2002). There are several pathogens that can be transmitted from household cats which can cause encephalitis. Among these are: *Toxoplasma gondii*, *Bartonella henselae* (cat-scratch disease), *Coxiella burnetii* (infection associated with Q fever), Rabies, *Leptospira spp*, *Pasteurella*

multicida (Bornard, Orban, Oregioni, Grimaud, & Ichai, 2005; Green, Ramsey, & Nolan, 2002; Tjen, Wyllie, & Pinto, 2007), and bacteria such as *Streptoccoccus* and *Neisseria* (Granerod et al., 2010). It appears that only one existing published study has examined the relationship between cat-transmitted infections and schizophrenia and found correlation between cat ownership prior to age 10 and schizophrenia diagnosis in adult life (Torrey & Yolken, 1995).

Despite all the progress made in the field of schizophrenia research, the obstacles seem to be the heterogeneity of this condition, comorbidity, and confounding effects of psychotropic medications (Torrey, 2006). Another pathway to investigate the pathophysiology of schizophrenia is through studies with nonpsychiatric participants with schizophrenia spectrum disorders, namely schizotypal personality traits, or schizotypy. The concept of schizotypy refers to the psychological construct of latent schizophrenia liability on the level of personality organization (Lahti et al., 2009). Schizotypy, as well as schizophrenia, has been associated with multitude of environmental etiologies (Raine, 2006). There is also evidence of common genetic and cognitive abnormalities found in schizophrenia and schizotypy samples (Fanous et al., 2007), implicating similar neurodevelopmental as well as genetic linkage in these conditions. In addition, similar to schizophrenia, research suggests a relationship between schizotypy and infectious diseases (Machon et al., 2002; Mittal, Saczawa, Walker, Willhite, & Walder, 2008; Venables, 1996).

While the studies about infectious origin of mental health have focused on either prenatal stages or childhood (Brown, 2008; Dalman et al., 2008), a couple of studies have identified the presence of the common cat residing in the home, particularly before age 10, as one of the risk factors for schizophrenia-spectrum disorders (Torrey & Yolken, 1995; Torrey, Rawlings, &

Yolken, 2000). As there are a multitude of infections that could be transmitted through cat bites and then result in neuroinflammation, in the present study we wanted to broaden the research area and investigate whether there are relationships between a history of household cat interaction or being bitten by a cat (both prior to age 13) and current schizotypy in a sample of young adults.

We hypothesized that the magnitude of current overall schizotypy would be higher in a sample of undergraduate students reporting a history of: 1) having a cat reside in the household during childhood, or 2) being bitten (puncturing the skin) by a cat during childhood.

METHODS

Participants

Participants were undergraduate students enrolled in psychology courses at the University of Central Florida recruited through Sona Systems, a web-based research participation management software. Three hundred and fifty-four participants completed the online survey and were retained following exclusion criteria (described below). These 354 participants were at least 18 years of age (M = 21.4; SD = 5.3; Range = 18-53), and 70% were female (n = 248), 68.6% Caucasian (n = 241), 8.5% African American/Black (n = 30), 5.4% Mixed (n = 19), 4.8% Asian (n = 17), 12% other race (n = 42), and 0.8% unknown (n = 3). Two participants (0.6%) reported a diagnosis of schizophrenia or schizoaffective disorder, 12 (3.4%) reported having been prescribed an antipsychotic/neuroleptic medication, 27 (7.7 %) reported at least one biological relative who has been diagnosed with schizophrenia or schizoaffective disorder, and 46 (13%) reported at least one biological relative who has been prescribed an antipsychotic/neuroleptic medication. All participants received academic credit toward a psychology course for participation in the study.

Measures

The Schizotypal Personality Questionnaire-Brief Revised (SPQ-BR; Cohen, Matthews, Najolia, & Brown, 2010) is a 34-item self-report measure of personality characteristics consistent with DSM-IV criteria for schizotypal personality disorder (SPD). This version includes a subset of items from the original SPQ (Raine, 1991) and employs a Likert-style format. It consists of seven subscales which load onto three factor scores: cognitive-perceptual, interpersonal, and

disorganized. The SPQ-BR has high convergent validity and internal reliability ($\alpha = 0.95$; Cohen, et al., 2010).

The Abbreviated Marlowe-Crowne Social Desirability Scale (MC; Reynolds, 1982) is a 13-item self-report questionnaire based on the original 33-item version (Crowne & Marlowe, 1960) that examines whether participants are responding in a socially desirable manner. The 13-item form was found to have acceptable internal consistency ($r = .76$) as well as strong reliability with the longer Marlowe-Crowne Standard Form ($r = .93$; Reynolds, 1982). An 8-item scale modeled after the Infrequency Scale of Personality Research (IS; Jackson, 1984) was used to estimate attention paid to the content of questions. This scale measures the frequency with which participants choose highly unlikely responses

Contact with cats were assessed via two questions regarding cat ownership and puncturing cat bite wounds prior to age 13: “To the best of your knowledge, prior to age 13, was there a cat in the household?” and “To the best of your knowledge, prior to age 13, were you ever bitten by any cat to the point of skin being broken?” After each question, the participant reported the age of the cat ownership and bite occurrence, which were broken down into three age categories: 0-12 months, 1-3 years and 4-12 years.

Procedure

The entire study was conducted online. Informed consent was obtained prior to any survey questions. First, demographic data as well as information regarding schizophrenia-spectrum disorders and antipsychotic medication use in the participant and his or her family was obtained. Next, questions regarding cat ownership and penetrating cat wounds. The following sections consisted of the SPQ-BR and the MC. Questions from the IS were scattered throughout

each section. At the end of the survey, participants were debriefed as to the reasons for the study and current research in the area.

Participants were excluded from data analysis based on the following: (1) survey completion time of 5 minutes or less (i.e., $< 10^{th}$ percentile in completion time for entire sample); (2) incomplete survey; (3) an IS score of 2 or more; and (4) a MC score of more than two standard deviations above the mean.

RESULTS

The SPQ-BR total scores from the final sample (N = 354) ranged from 0 to 87 (M = 36.11; SD = 15.37). The Interpersonal factor score ranged from 0 to 27 (M = 10.84; SD = 5.23); Cognitive Perceptual score ranged from 0 to 34 (M = 11.77; SD = 6.91); and Disorganized factor score ranged from 0 to 30 (M = 13.51; SD = 6.39). One hundred forty-seven participants (41.54%) endorsed having cats in the household prior to age 13 and 66 (18.64%) endorsed having been bitten by a cat to the point that it punctured the skin prior to age 13.

Independent sample *t*-tests revealed no significant difference in SPQ-BR total scores between participants who had a cat present in the household and those who did not, $t(352) = 0.07$, $p = .95$, $d = 0.01$. However, there was a significant difference in total SPQ-BR scores between those who have been bitten by a cat, and those who have not (prior to age 13); $t(352) = 2.22$, $p = .03$, $d = 0.30$ in that those who had been bitten by a cat (n = 66, M = 39.85; SD = 15.76) had higher scores on the SPQ-BR total then those who did not (n = 288, M = *35.25;* SD = 15.05). There was no interaction between the cat bite group and sex on SPQ-BR total scores, $F(1,350) = 0.04$, $p = .84$, $\eta^2 = .03$.

Further analysis revealed that of the three SPQ-BR factors, only scores on the Disorganized factor was significantly different between the cat bite groups, $t(352) = 3.08$, $p = 0.002$, $d = 0.42$. Participants who endorsed cat bites had higher scores on this factor (M = 15.67, SD = 6.56) than those who had never been bitten (M = 13.01, SD = 6.26). Neither of the other factor scores differed between the cat bite groups (both *p*'s > .31).

Regarding the age of the bites, it was found that out of 66 participants, one participant was bitten between 0-12 months of age, five between 1 and 3 years and fifty-four participants

were bitten between 4 and 12 years. As there were not more than five participants in two of the three categories, we were unable to run inferential statistics on this variable.

DISCUSSION

For a century, the etiology of schizophrenia has been a burning question for both clinicians and investigators. One hundred years later, with the human genome sequenced and other unforeseen advances in molecular biology, there still remains much to be researched in this area. Barriers in this field of research may include the heterogeneity of the condition and presumptuous clustering of similar symptoms into one disease. More recent research has approached this issue in novel and multifaceted ways. While this study was correlational, it might lead the way to a different understanding of schizophrenia with new etiologies and mechanisms.

Although not in all cases, infectious diseases do play a significant role in schizophrenia. Immune activation and autoimmune processes help formulate a sound hypothesis for the course of schizophrenia-spectrum disorders (Kinney, et al., 2010). Since some of the diseases involved in neuroinflammation are associated with cats, the current study has attempted to investigate into the relationship between cats and schizotypy, a psychological construct used as an analog for schizophrenia.

Our first hypothesis about cat ownership in childhood and higher schizotypy scores was not supported, in contrast to two studies that did find significant correlation between cat ownership and schizophrenia in survey type analysis (Torrey & Yolken, 1995; Torrey et al., 2000). The difference could be due to a recent finding that only ownership of three or more kittens was a risk factor for schizophrenia (Jones et al., 2009), as well as mixed results regarding cat ownership and transmission of parasite *Toxoplasma gondii* (Bobić, Jevremović, Marinković, Sibalić, & Djurković-Djaković, 1998; Cook et al., 2000; Kolbekova, Kourbatova, Novotna,

Kodym, & Flegr, 2007). In addition, the previous studies examined the diagnosis of schizophrenia rather than schizotypy in a nonpsychiatric sample.

The finding regarding cat bites and schizotypy was consistent with our second hypothesis that predicted that those with this childhood history would report a higher level of overall schizotypy in adulthood. Further analysis revealed that only the Disorganized factor score was significantly higher in those with a childhood cat bite history. Figure 1 in APPENDIX A illustrates the distribution of scores across the SPQ-BR Disorganized factor between the cat bite groups. As can be seen, no outliers were observed, with seemingly homogeneous density of distribution. This was an interesting result and merits further exploration.

Due to the correlational design of the study, we cannot determine the causal direction of the relationship between childhood cat bites and adult schizotypy. However, the findings suggest that one or more cat bites during childhood may serve as a risk factor for the later development of schizotypy. Given the multitude of infectious agents that could be transmitted through cat bite (Center for Disease Control and Prevention, 2010), and the effects it can have on developing childhood immune system, prodormant encephalitis can be the underlying precursor for schizophrenia-spectrum disorders (SSD), namely schizotypy in this case (Bechter, 2012). As we only found that Disorganized symptoms of schizotypy to differ between the cat bite groups (when examining the three factor scores), it is possible that these particular symptoms are the most associated with infectious etiology (i.e., inflammation-induced). However, this preliminary finding needs further replication and exploration in future work.

There are also other explanations for this finding. One possibility is that children who were already predisposed to schizotypy traits were more likely to play with cats and thus get

bitten, although we are not aware of any evidence in the literature suggesting that children with schizotypy traits are more likely to interact with or be bitten by cats, or any other animal.

The biggest limitation of the study was that all data was collected from self-report measures. While a psychometric approach is a valid and reliable means of assessing schizotypy, it is not the optimal method for obtaining the information about cat interaction during early childhood. However, as our question regarding cat bites clarified that the bite needed to have punctured the skin; it is likely that participants could accurately recall whether or not such a significant bite had occurred, particularly for those endorsing the question. Also, although we did gather information on age ranges of cat bites, we did not ask about the frequency of the bites.

This appears to be the first study of childhood cat exposure in relation to adult schizotypy in a nonpsychiatric sample, and further research is necessary to elucidate the current findings. Since the immune response is the most obvious link to systemic inflammation after a cat bite, future studies in this area should assess serum antibodies in relation to schizotypy and the history of cat bites. Also, since cat bites are not the only source of infection, other routes of infectious transmission should be evaluated.

APPENDIX A: Figure 1

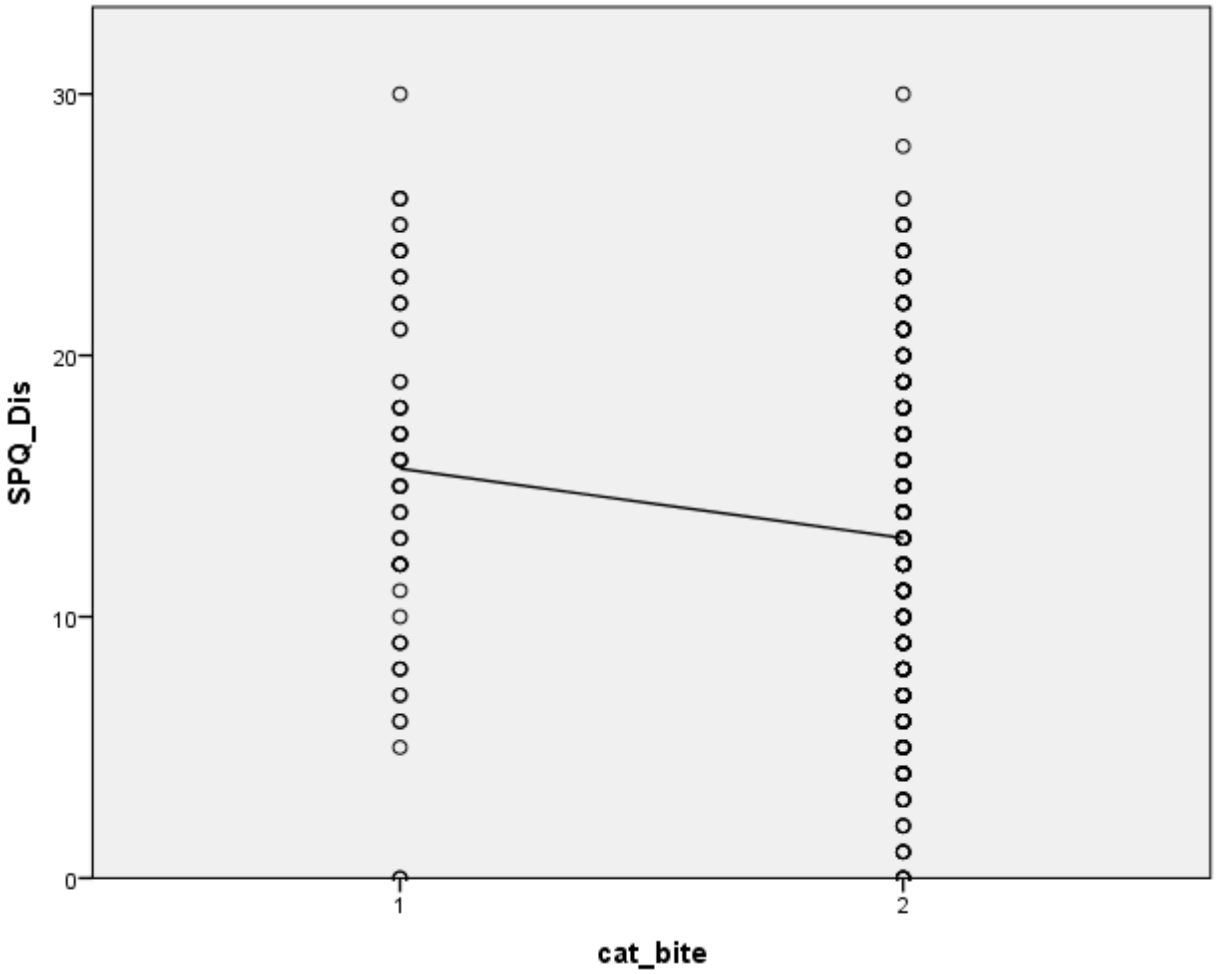

Figure 1: The score distribution of SPQ Disorganized type between being bitten (1) and not bitten by cat (2)

APPENDIX B: A note from author

A note from the author.

The original design of the study also involved a questionnaire for the mothers of the participants, to report prenatal and early childhood infectious history along with the cat interaction and bite questions. Such a design would give a more comprehensive overview of the issue at hand, since the research to date only looked at cohort studies of flu involvement in prenatal etiology of schizotypal individuals. Unfortunately, there were not enough mothers who responded to the invitation to participant in order to conduct appropriate statistical analyses. Out of 354 students who received our email to invite their mothers to participate, only 28 mothers' surveys were received.

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