

Published in final edited form as:

Early Interv Psychiatry. 2013 August ; 7(3): 261–269. doi:10.1111/j.1751-7893.2012.00390.x.

Internet addiction, Reality Substitution, and Longitudinal Changes in Psychotic-like Experiences in Young Adults

Vijay A. Mittal, Ph.D.^{a,b}, Derek J. Dean, B.A.^a, and Andrea Pelletier, B.A.^a

^aDepartment of Psychology and Neuroscience, University of Colorado at Boulder

^bCenter for Neuroscience, University of Colorado at Boulder

Abstract

Aim—Internet use has grown exponentially in the past decade, but there has been little systematic research to inform our understanding of how this phenomenon may relate to mental illness.

Although several characteristics of individuals experiencing psychotic-like experiences (PLEs) may render this group particularly susceptible to problematic Internet use, to date there have been no studies examining Internet use in this group. Because the experience of PLEs is considered a risk behavior for formal psychosis, it is crucial to understand how patterns of Internet use may be tied to the progression of illness.

Methods—A total of 170 young adults were followed for two months, and grouped into those showing a steady/improved course of PLEs (*PLE-Improved/Constant*) and those showing an exacerbation in PLEs (*PLE-Increase*). Internet addiction and a factor “Reality Substitute” were examined within and between the two groups.

Results—Findings indicated that while both groups reported a similar level of Internet addiction and Reality Substitute at baseline, the *PLE-Improved/Constant* group showed longitudinal declines in both domains of problematic Internet usage whereas the *PLE-Increase* group’s reported level remained constant. Further, there were moderate correlations between PLEs and domains of problematic Internet use, and the magnitude of association with Reality Substitute for the *PLE-Increase* group grew significantly over time.

Conclusions—Taken together, results implicate a close link between continued problematic Internet use and the phenomena of PLEs.

Keywords

Internet Addiction; Psychotic-Like Experiences; Psychosis; Reality Substitute; ADAPT

Internet use is a rapidly growing technological and social phenomenon that has increased from roughly 26.2% of U.S. homes having access in 1998 to 71% in 2010.¹ Given this rate of expansion, it is not surprising that the consequences of these changes are largely unknown. This is particularly concerning when considering mental health, where there is evidence to suggest that problematic Internet use (e.g., Internet addiction and/or using the Internet several hours a day for non work related activities) is linked with psychiatric symptoms and syndromes.^{2–4} Although Internet addiction has been found to be associated

Corresponding Author: Vijay A. Mittal, Ph.D., Assistant Professor, Department of Psychology and Neuroscience, Center for Neuroscience, University of Colorado at Boulder, 345 UCB, Boulder, Colorado 80309, vijay.mittal@colorado.edu, Phone: 303-492-3303, Fax: 303-492-2967.

There are no potential conflicts of interest to report.

All authors contributed to and have approved the final manuscript.

with elevated symptoms of depression and anxiety,^{5–8} to date, there have been no investigations into how problematic Internet use may be related to risk for psychotic disorders such as schizophrenia. Within this context, it is noteworthy that accumulating evidence shows that non-clinical psychotic-like experiences (PLEs) (e.g., fleeting auditory hallucinations) are commonly experienced by otherwise healthy individuals⁹ and are considered to be a risk factor for formal psychosis.^{10, 11} There is also considerable evidence to suggest that a myriad of other characteristics, such as interpersonal deficits,^{12–14} social anhedonia¹⁵ (promoting a preference for interacting in an online atmosphere), proneness to magical thinking (leading to a susceptibility to internet fantasy games and reality substitution), and impulsivity (leading to internet addiction)¹⁶ may increase susceptibility to problematic Internet use and also be common amongst individuals experiencing PLEs.

Recent studies in different countries suggest that the population prevalence of Internet addiction ranges from .3% in the United States to 1% in Norway.^{17, 18} However, among adolescents and young adults the prevalence of internet addiction is considerably higher, ranging from 6% up to 11%.^{19, 20} Some mental health experts have expressed concern that excessive Internet use may have a negative impact and contribute to psychiatric symptoms.^{21–24} For example, Shapira and colleagues⁸ argue that heavy Internet use may negatively impact social and emotional functioning. Further, researchers have observed that a subsection of individuals use the Internet environment as a reality substitute and depend on it for relieving real life problems.²⁵ Many studies have suggested that people may use the Internet addictively and that this can exert harmful effects on individuals, altering their social behavior, habits, and abilities in a negative way.²⁶ For example, Internet use can interfere with one's academic performance and daily life routines,^{27, 28} and investigators have observed that student's excessive internet use can lead students to ignore schoolwork.^{29, 30} Young³¹ links excessive Internet use to DSM-IV criteria and considers it a behavioral addiction similar to pathological gambling; she characterizes Internet addiction as an impulse-control disorder that mainly involves psychological dependence on the Internet. As a reflection of these concerns, it has been suggested that heavy Internet use should be considered a disorder in its own right; and researchers have variously labeled it "Internet addiction disorder", "Internetomania", and "pathological Internet use"³².

Accumulating evidence shows that non-clinical psychotic-like experiences (PLEs) (e.g., fleeting auditory hallucinations) are commonly experienced not just by patients with psychiatric disorders, but also by a substantial proportion of the general population of otherwise healthy individuals.⁹ More specifically, evidence showing that PLEs occur in 5–8% (median prevalence) of the general population suggests that psychosis may occur as a continuous phenotype.¹³ Further, it is noteworthy that researchers have observed that PLEs appear to follow discrete developmental trajectories (e.g., persistent, worse), and that those individuals whose symptoms increase over time show an increased exposure to environmental stressors.¹³ Understanding this non-clinical end of a continuum is particularly vital as it may provide a new perspective into vulnerability for disorders such as schizophrenia, during a viable period for early intervention. Within this framework, it is noteworthy that there is a considerable amount of evidence to suggest a relationship between the incidence of PLEs and Internet addiction among young adults. In a non-clinical sample, individuals reporting PLEs such as persecutory ideas showed significantly poorer peer and family functioning³³ and dovetailing this finding, researchers have observed that loneliness is positively correlated with the rate of Internet use.^{34, 35} Indeed, Campbell and Morrison¹² note that it is possible that a well-replicated association between PLEs and being bullied indicates that experiencing PLEs increases the likelihood that a person's interpersonal context is characterized by peer hostility and rejection. Further, research suggests an association between PLEs and receptive language deficits.³⁶ It is highly plausible that individuals with PLEs would be drawn to the Internet because it is a venue in which

receptive and expressive interpersonal deficits are less likely to reciprocate in exclusionary behavior from peers. Another point to consider is that symptoms such as excessive social anxiety, withdraw or social anhedonia, which characterizes PLE samples,^{15, 37} may lead individuals with PLEs to choose gaming, emailing, and chatting as a social platform. Consistent with this notion, problematic Internet use has been documented in youth with schizotypal personality disorder.³⁸ However, to date there have been no empirical investigations to determine if problematic Internet use is linked with PLEs, or how persistent patterns of this use might influence course of illness.

Given that experiences and traits common to individuals experiencing PLEs may lead this population to problematic Internet use, and that a number of recent reports have suggested PLEs are predictive of more serious schizophrenia spectrum psychopathology,^{10, 11} it is important that we understand the nature of the relationship between problematic Internet and the course of PLEs. For example, it is possible that the experience of PLEs might render individuals prone to Internet addiction, and that problematic Internet use over time, may in turn exacerbate the course of PLEs. In this study, 170 individuals were assessed for PLEs and domains of problematic Internet use (i.e., Internet addiction, Reality Substitute) at baseline and two-month follow up time points to test the hypothesis that PLEs will be significantly associated with domains of problematic Internet use. Further it is predicted that those individuals exhibiting a longitudinal increase in PLEs will show a course of increased problematic Internet behaviors, whereas those individuals showing a level or improving course of PLEs will exhibit a corresponding improvement in Internet addiction behaviors. Finally, it is predicted that the associations between PLEs and domains of problematic Internet will increase in magnitude for the group of participants defined by a longitudinal increase in PLEs.

Methods

Recruitment

Participants were recruited at the University of Colorado Boulder's Adolescent Development and Preventive Treatment (ADAPT) research program. All participants were young adults (aged 18 and older) in the University of Colorado Boulder's human subject recruitment pool (consisting of students and community members from the general population), and there were no exclusion criteria. The protocol and informed consent procedures were approved by the University Institutional Review Board. See Table 1 for demographic characteristics of the sample.

Psychotic-Like Experiences

PLEs were measured with the Prodromal Questionnaire-Brief (PQ-B),³⁹ a 21- dichotomous item self-report questionnaire comprised of attenuated positive symptoms items. For each PLE endorsed as "yes", the participant was asked to rate the statement, "When this happens, I feel frightened, concerned, or it causes problems for me" on an impact scale ranging from 1–5 (*strongly disagree-strongly agree*).⁴⁰ This strategy gauges the presence of PLEs while concurrently accounting for the degree of meaning/impact experienced by the participant (those marking "no" on the dichotomous item scale receive a score of 0 whereas those marking "yes" receive a score of 1–5 based on the subjective experience of the respective PLE). The scores for this scale can range from 0–105 and are the focus of the study, as they reflect the overall level of impactful or meaningful PLEs. Subjects were asked to indicate experiences in the past month, and asked not to include experiences that occurred only while under the influence of alcohol, drugs, or medications that were not prescribed. This instrument has been validated for use in young adults, and used in studies to examine PLEs in healthy populations.^{41–43}

Problematic Internet Use

The Internet Addiction Test (IAT)⁴⁴ includes 20-items, presented on a five point Likert scale, concerning the degree to which Internet use affects daily routine, social life, productivity, sleeping pattern, and feelings. The minimum score is 0, and the maximum is 100; higher scores represent greater problems caused by Internet use. Scores of 20–39 points represent an average online user who has complete control over his/her usage; a score of 40–69 signifies frequent problems due to internet usage; a score of 70–100 means that the internet is causing significant problems.³¹ The IAT has been employed in several recent studies designed to investigate the relationship between different kinds of addictions,⁴⁵ psychiatric comorbidity,²² and other correlates with Internet addiction.⁴⁶ Further, the IAT has been validated in young adult populations and demonstrates strong internal reliability across studies.^{47–49} The factor structure of the inventory has also been evaluated, and researchers have observed a dimension titled “Reality Substitute” (the extent to which an individual regards the internet environment as another reality and over-dependes on it for relieving real-life problems).²⁵ Problematic Internet use was examined by calculating the IAT Total (a total score on the internet abuse scale) and the noted Reality Substitute factor.

Data Analyses

This sample was split into two groups: those who’s PLE weighted scores stayed the same or showed improvement (*PLEs Improved/Constant*; $n = 127$), and those who’s scores showed an escalation in PLEs over two months (*PLE-Increase*; $n = 43$). Independent t-tests and chi-square tests were employed to examine differences in continuous and categorical demographic variables (respectively) between participants partitioned into the two groups. Two separate $2(\text{time points}) \times 2(\text{group})$ mixed repeated measures ANOVAs were conducted to examine changes in IAT Total/Reality Substitute. Bivariate correlations were used to examine relationships between PLEs and IAT Total/Reality Substitute for the two distinct groups at each time point, and Fisher Z transformation analyses were employed to check for meaningful changes in the magnitude of these respective associations over time.

Results

A total of 170 participants (mean age 19.1; $SD = 2.5$; range 17–30) were followed over a two-month period, and 9.4% of the sample reported to experience at least one impactful PLE in the month leading up to baseline. The most commonly endorsed PLEs, where participants rated impact scores of 5 (strongly agreeing that event was relevant), were: “Do you feel that other people are watching you or talking about you?” (3.5%), “Have you been confused at times whether something you experienced was real or imaginary?” (3.5%), “Do you worry at times that something may be wrong with your mind?” (2.4%), and “Have you ever felt that you don’t exist, the world does not, exist, or that you are dead?” (1.8%)

As noted above, the sample was partitioned into those who stayed the same or showed improvement on reported PLEs (*PLEs Improved/Constant*; $n = 127$), and those who showed an escalation in PLEs over two months (*PLE-Increase*; $n = 43$). At baseline the mean PLE score for the sample was 12.63 ($SD = 12.37$; Range = 71) and at follow-up, the mean was 9.39 ($SD = 10.66$; Range = 55). The mean PLE scores for each group at both time points are provided in Figure 1, which illustrates that while the two groups did not show a significant difference in reported PLEs at baseline ($p = .25$), the *PLE-Increase* group was significantly elevated when compared to the *PLE-Improved/Constant* group at two months, $t(168) = -3.73$, $p = .01$. There were no significant demographic differences between these groups in gender distribution, age, or parental education (See Table 1 for demographic characteristics).

Results suggest that 5% of the *PLE-Improved/Constant* group met criteria for problematic Internet use (IAT Total > 40) at baseline although no participants in this group fell in the most extreme (IAT Total > 70) category. In the *PLE-Increase* group, 7% met criteria for problematic Internet use, and 2.3% fell into the most extreme category. The *PLE-Increase* (mean = 3.65; SD = 1.70) and *PLE-Improved/Constant* (mean = 3.41; SD = 1.77) groups did not report significant differences in the hours on the internet each day, $t(168) = -.78$, $p = .43$ although on a scale of 1–5 (1 being distant, 5 being intimate) the *PLE-Improved/Constant* group (mean = 2.17; SD = .90) reported the quality of internet interactions significantly greater, $t(168) = 2.14$, $p = .01$, than the *PLE-Increase* group (mean = 1.84; SD = .81).

Group differences in Internet addiction domains at both time points

As noted above, $2(\text{group}) \times 2(\text{time point})$ mixed repeated measures ANOVAs with each respective Internet addiction domain (IAT Total and Reality Substitute) as the dependent variable were conducted. For IAT Total, results revealed a significant interaction effect $F(1,168) = 3.35$, $p = .03$; when examined independently, results showed that while both groups started with similar levels of IAT Total, the *PLE-Improved/Constant* group improved on this scale over time, $t(126) = 5.16$, $p = .01$, whereas the *PLE-Increase* group stayed the same (See Table 2 for means standard deviations for IAT domains for both groups and time points). Consistent with this pattern, there was a significant interaction for Reality Substitute, $F(1,168) = 4.41$, $p = .02$, and independent group analyses indicated that there were significant improvements for *PLE-Improved/Constant*, $t(126) = 4.35$, $p = .01$, but no changes over time of the *PLE-Increase* group.

Because of the grouping strategy, it is possible that participants scoring lower or higher on the PLE scale might be included in the same group (based on a respective pattern of symptom change). As noted above, analyses comparing the *PLE-Improved/Constant* and *PLE-Increase* group did not reveal a significant difference in PLEs between the two groups at baseline ($p = .25$) (see Figure 1). To supplement this strategy, and employ an approach that directly accounts the level of PLEs, the mixed repeated measures analyses were conducted again, including baseline PLE scores as a covariate. The results for these mixed repeated measures ANCOVAs did not change in terms of significance or the direction of results from the analyses noted above. Taken together, this suggests that the present findings are not influenced by potential confounds related to individual differences in the level of reported PLEs.

Relationships between PLEs and Internet Addiction Factors

Bivariate correlations were conducted to examine the relationship between IAT Total/ Reality Substitute and PLEs in both groups (see Table 3). At baseline, there were significant positive correlations between PLEs and IAT Total for the *PLE-Increase* group, and moderate positive correlations between PLEs and both domains of problematic Internet use for the *PLE-Improved/Constant* group. At 2-months, the *PLE-Increase* group showed magnitude increases across domains, and each of the associations were significant. Further, Fisher Z transformation analyses indicated that the magnitude of association between PLEs and Reality Substitute became significantly greater over time for the *PLE-Increase*, $z = -1.63$, $p = .05$. The *PLE-Improved/Constant* group did not show any significant changes over time although each of the correlations remained significant at two-months.

Discussion

Because Internet use is a relatively new and burgeoning phenomenon, systematic research aimed at characterizing problematic Internet use and understanding its relation with psychiatric disorders is in its infancy.⁵⁰ The present study provides the first direct empirical

evidence to suggest that elevated PLEs and domains of problematic Internet use are positively associated. Although the hypothesis that the *PLE-Increase* group would show an increase in problematic Internet use was not supported, findings that this group's Internet use remained constant whereas the *PLE-Improved/Constant* group showed significant improvements on both total IAT and the Reality Substitute domains, provide an important glimpse into a heretofore-unexamined phenomena. Further, given that PLEs have been found to confer significant risk for developing formal psychotic disorders (e.g., schizophrenia),^{10, 51} and present findings show that a longitudinal increase in PLEs is accompanied by persisting patterns of problematic Internet use, it is possible that Internet abuse represents a new environmental stressor in the etiology of serious mental illness. It is also equally possible that the problematic Internet use may reflect a coping mechanism for escaping disturbing experiences or countering social isolation.

Taken together, the results paint a nuanced picture of problematic Internet use and PLEs in a sample of young adults from the general population. Participants in both of the groups showed similar rates of hourly Internet use, but the *PLE-Improved/Constant* group reported substantially higher quality interactions, which replicates a finding in a sample of adolescents with schizotypal personality disorder.³⁸ Further, it appears that while there were no significant differences in age, gender, or parental education, and that both groups showed comparable levels of reported PLEs and domains of problematic Internet use (i.e., IAT total, Reality Substitute) at baseline, the pattern of endorsed PLEs and Internet use changed over the two-month period. Specifically, over the course of this study those participants in the *PLE-Increase* group held to a steady level of problematic Internet use, whereas those participants in the *PLEs-Improved/Constant* group showed a significant decline in problematic Internet use.

One interpretation is that continued problematic Internet use is associated with worsening PLEs whereas a cease in problematic Internet corresponds with an accompanying improvement in PLEs. In support of this idea, it has been proposed that exposure to environmental risk factors might increase the likelihood of persistent PLEs in individuals predisposed to the development of schizophrenia.⁵² Given a diathesis-stress conceptualization of psychosis,^{53, 54} where a constitutional vulnerability (e.g., a confluence of genetic and early environmental factors) later interacts with social stressors, it is possible that the Internet serves as an environmental factor that may, in part, unmask the subtle vulnerability. Indeed, recent reports that Internet addiction is associated with significant brain changes⁵⁵ in areas that are also highly implicated with schizophrenia⁵⁶ and PLEs,⁵⁷ suggest that problematic Internet use may be placing further strain on an already compromised neural system. This picture is consistent with the noted evidence that suggests that the occurrence of PLEs in the general population confers significant risk for developing more serious formal psychotic disorder (e.g., schizophrenia).^{10, 51}

Alternatively, it is possible that those individuals who are becoming increasingly prone to psychosis choose to spend more and more time using the Internet in a problematic way. As noted, investigators have observed that a number of individuals use the Internet environment as a substitute for real-life interactions and for relieving real-life problems.²⁵ Consistent with this notion, a study examining Internet use in adolescents with schizotypal personality disorder found that the participants were attempting to utilize the Internet as a resource to combat social isolation.³⁸ Certainly, it is possible that the experience of PLEs may prove frightening, and as noted, individuals reporting these experiences show a range of interpersonal deficits.^{33, 36} For these persons, the Internet may provide a "safe" place where meaningful communication is not contingent upon interpersonal skills.

Findings that PLEs are positively associated with IAT Total and Reality Substitute support the notion that aspects associated with PLEs may also lead to proneness for problematic Internet use. The longitudinal increase in magnitude for the relationship between PLEs and utilizing the Internet for Reality Substitution is particularly noteworthy because of the unique nature of the Internet. Many significant activities conducted in the real world – shopping, studying, social interaction – can be accomplished through the Internet where some more difficult aspects of offline interaction, such as the awkwardness of meeting new people, can be avoided.²⁵ This might explain how individuals experiencing PLEs can come to use the Internet in a way that encourages them to, in some respects, live in a virtual world.

These findings highlight the need to examine problematic Internet use in high-risk populations, which may be an important target for intervention, particularly during a developmental period when social and role functioning behaviors are becoming increasingly central to ones' identity.^{58–60} In addition, if adolescents who are prone to psychosis are drawn to the Internet to escape problems or to replace/supplement real-life interactions, then novel intervention strategies that use the Internet as a platform might be designed to exploit this tendency and consequently improve motivation/adherence. Within this context, it is noteworthy that psychosocial treatments play a critical role in habilitation of schizophrenia patients,^{61, 62} and intervention prior to the onset of illness, during the adolescent/young adult period when social, academic, and occupational skills are acquired and solidified, shows promise.⁶³

Because the present study does not explicitly test for formal psychotic disorders, the findings should be considered as preliminary until future studies control for these potential confounds and replicate the results in an unselected general population sample. However, it is unlikely that a subgroup of formally psychotic individuals accounted for the observed effect, as no subjects scored in the upper 32% of the possible attenuated symptom weighted distress score range of 1–5 (an instrument already designed to measure subclinical symptoms). It is also important to acknowledge that although the IAT has been used in other studies focusing clinical symptoms/disorders including attention deficit hyperactivity disorder (ADHD), and depression,^{22,27} the measure has not been explicitly validated for psychosis-spectrum populations. The relatively small sample size, which may have limited statistical power, is another significant limitation. With a larger sample it would also be possible to test additional trajectories of PLE course (same, better worse), which would help us to better understand characteristics of subgroups reporting PLEs. The use of a longitudinal design in the present study is a strength as it allows for a temporal perspective of the dynamic relationship between PLEs and domains of Internet use; however, it is not currently possible to make conclusions about a casual relationship between the variables. Future research involving an experimental manipulation (e.g., experimentally manipulating internet access) is needed. Further, although a casual relationship has not necessarily been established, pilot intervention studies examining Internet use and psychoeducation holds promise.

Acknowledgments

This work was supported by National Institute of Health Grant R01MH094650 to Dr. Mittal. Author Mittal conceptualized the study, attained funding, supervised data collection, conducted analyses and drafted the manuscript. Author Dean aided in data collection and drafting the manuscript. Author Pelletier aided in editing as well as proving conceptualization and theory used to integrate findings.

References

1. Phillips, LE. US Online Populations: eMarketer. Dignital Intellegence; 2008.

2. Treuer T, Fabian Z, Furedi J. Internet addiction associated with features of impulse control disorder: is it a real psychiatric disorder? *J Affect Disord.* 2001; 66(2–3):283. [PubMed: 11686127]
3. Sa'adiah R. The Internet as a means for promoting the recovery and empowerment of people with mental health problems. *Isr J Psychiatry Relat Sci.* 2002; 39(3):192–3. [PubMed: 12520722]
4. Iftene F. Internet use in adolescents: hobby or avoidance. *Can J Psychiatry.* 2004; 49(11):789–90. [PubMed: 15633865]
5. Wolak J, Mitchell KJ, Finkelhor D. Escaping or connecting? Characteristics of youth who form close online relationships. *J Adolesc.* 2003; 26(1):105–19. [PubMed: 12550824]
6. Black DW, Belsare G, Schlosser S. Clinical features, psychiatric comorbidity, and health-related quality of life in persons reporting compulsive computer use behavior. *J Clin Psychiatry.* 1999; 60(12):839–44. [PubMed: 10665630]
7. Shapira NA, Goldsmith TD, Keck PE Jr, Khosla UM, McElroy SL. Psychiatric features of individuals with problematic internet use. *J Affect Disord.* 2000; 57(1–3):267–72. [PubMed: 10708842]
8. Shapira NA, Lessig MC, Goldsmith TD, Szabo ST, Lazoritz M, Gold MS, et al. Problematic internet use: proposed classification and diagnostic criteria. *Depress Anxiety.* 2003; 17(4):207–16. [PubMed: 12820176]
9. van Os J, Hanssen M, Bijl RV, Vollebergh W. Prevalence of psychotic disorder and community level of psychotic symptoms: an urban-rural comparison. *Arch Gen Psychiatry.* 2001; 58(7):663–8. [PubMed: 11448373]
10. Poulton R, Caspi A, Moffitt TE, Cannon M, Murray R, Harrington H. Children's self-reported psychotic symptoms and adult schizophreniform disorder: a 15-year longitudinal study. *Arch Gen Psychiatry.* 2000; 57(11):1053–8. [PubMed: 11074871]
11. Hanssen M, Bak M, Bijl R, Vollebergh W, van Os J. The incidence and outcome of subclinical psychotic experiences in the general population. *Br J Clin Psychol.* 2005; 44(2):181–91. [PubMed: 16004653]
12. Campbell ML, Morrison AP. The relationship between bullying, psychotic-like experiences and appraisals in 14–16-year olds. *Behav Res Ther.* 2007; 45(7):1579–91. [PubMed: 17229400]
13. Kelleher I, Cannon M. Psychotic-like experiences in the general population: characterizing a high-risk group for psychosis. *Psychol Med.* 2011; 41(1):1–6. [PubMed: 20624328]
14. Laurens KR, Hodgins S, Maughan B, Murray RM, Rutter ML, Taylor EA. Community screening for psychotic-like experiences and other putative antecedents of schizophrenia in children aged 9–12 years. *Schizophr Res.* 2007; 90(1–3):130–46. [PubMed: 17207968]
15. Kwapil TR. Social anhedonia as a predictor of the development of schizophrenia-spectrum disorders. *J Abnorm Psychol.* 1998; 107(4):558–65. [PubMed: 9830243]
16. Chapman LJ, Chapman JP, Numbers JS, Edell WS, Carpenter BN, Beckfield D. Impulsive nonconformity as a trait contributing to the prediction of psychotic-like and schizotypal symptoms. *J Nerv Ment Dis.* 1984; 172(11):681–91. [PubMed: 6491653]
17. Shaw M, Black DW. Internet addiction: definition, assessment, epidemiology and clinical management. *CNS Drugs.* 2008; 22(5):353–65. [PubMed: 18399706]
18. Bakken I, Wenzel H, Gotestam K. Internet addiction among Norwegian adults: a stratified probability sample study. *Scandinavian Journal of Psychology.* 2009; 50:121–7. [PubMed: 18826420]
19. Siomos K, Dafouli E, Braimiotos D. Internet addiction among Greek adolescent students. *CyberPsychology and Behavior.* 2008; 11:653–7. [PubMed: 18991535]
20. Liu T, Potenza M. Problematic Internet use: clinical implications. *CNS Spectrums.* 2007; 12:453–66. [PubMed: 17545956]
21. Jang KS, Hwang SY, Choi JY. Internet addiction and psychiatric symptoms among Korean adolescence. *Journal of school health.* 2008; 78:165–71. [PubMed: 18307612]
22. Ha JH, Kim SY, Bae SC, et al. Depression and Internet addiction in adolescents. *Psychopathology.* 2007; 40(6):424–30. [PubMed: 17709972]
23. Kim K, Ryu E, Chon MY, et al. Internet addiction in Korean adolescents and its relation to depression and suicidal ideation: a questionnaire survey. *Int J Nurs Stud.* 2006; 43(2):185–92. [PubMed: 16427966]

24. Young K, Rogers R. The relationships between depression and Internet addiction. *Cyberpsychol Behav.* 1998; 1:25–8.
25. Chang MK, Law SPM. Factor structure for Young's Internet Addiction Test: A confirmatory study. *Computers in Human Behavior.* 2008; 24:2597–619.
26. Stanton JM. Web addict or happy employee? Computer profile of the frequent internet user. *Communications of the ACM.* 2002; 45(1):55–9.
27. Yoo HJ, Cho SC, Ha J, et al. Attention deficit hyperactivity symptoms and internet addiction. *Psychiatry Clin Neurosci.* 2004; 58(5):487–94. [PubMed: 15482579]
28. Chou C, Hsiao MC. Internet addiction, usage, gratification, and pleasure experience: The Taiwan college students' case. *Computers and Education.* 2000; 35(1):65–80.
29. Nalwa K, Anand AP. Internet addiction in students: a cause of concern. *Cyberpsychol Behav.* 2003; 6(6):653–6. [PubMed: 14756932]
30. Tsai CC, Lin SS. Internet addiction of adolescents in Taiwan: an interview study. *Cyberpsychol Behav.* 2003; 6(6):649–52. [PubMed: 14756931]
31. Young K. Psychology of computer use: XL. Addictive use of the Internet: A case that breaks the stereotype. *Psychological Reports.* 1996; 79(3):899–902. [PubMed: 8969098]
32. Orzack MH, Orzack DS. Treatment of computer addicts with complex co-morbid psychiatric disorders. *Cyberpsychol Behav.* 1999; 2(5):465–73. [PubMed: 19178219]
33. Yung AR, Buckby JA, Cotton SM, et al. Psychotic-like experiences in nonpsychotic help-seekers: associations with distress, depression, and disability. *Schizophr Bull.* 2006; 32(2):352–9. [PubMed: 16254060]
34. Engelberg E, Sijberg L. Internet use, social skills, and adjustment. *CyberPsychology and Behavior.* 2004; 7(1):41–7. [PubMed: 15006168]
35. Nichols LA, Nicki R. Development of a psychometrically sound internet addiction scale: a preliminary step. *Psychol Addict Behav.* 2004; 18(4):381–4. [PubMed: 15631611]
36. Blanchard MM, Jacobson S, Clarke MC, et al. Language, motor and speed of processing deficits in adolescents with subclinical psychotic symptoms. *Schizophr Res.* 2010; 123(1):71–6. [PubMed: 20580205]
37. Barragan M, Laurens KR, Navarro JB, Obiols JE. Psychotic-like experiences and depressive symptoms in a community sample of adolescents. *Eur Psychiatry.* 2011; 26(6):396–401. [PubMed: 21334860]
38. Mittal VA, Tessner KD, Walker EF. Elevated social Internet use and schizotypal personality disorder in adolescents. *Schizophr Res.* 2007; 94(1–3):50–7. [PubMed: 17532188]
39. Loewy, R.; Cannon, T. The Prodromal Questionnaire, Brief Version (PQ-B). University of California; 2010.
40. Loewy RL, Pearson R, Vinogradov S, Bearden CE, Cannon TD. Psychosis risk screening with the Prodromal Questionnaire - Brief Version (PQ-B). *Schizophr Res.* 2011; 129(1):42–6. [PubMed: 21511440]
41. Loewy RL, Johnson JK, Cannon TD. Self-report of attenuated psychotic experiences in a college population. *Schizophr Res.* 2007; 93(1–3):144–51. [PubMed: 17459662]
42. Loewy, R.; Stuart, B.; Schlosser, D.; Vinogradov, S.; Cannon, T. Prodromal psychosis screening with the Prodromal Questionnaire-Brief version (PQ-B). Paper presented at the meeting of the International Early Psychosis Association; Melbourne Australia. 2008.
43. Mittal VA, Dean DJ, Pelletier A, Caligiuri MP. Associations between instrumentally gauged movement abnormalities and attenuated psychotic symptoms in healthy young adults. *Schizophr Res.* 2011; 132:194–196. [PubMed: 21782390]
44. Young K. Internet addiction: The emergence of a new clinical disorder. *Cyberpsychol Behav.* 1998; 1(3):237–44.
45. Pallanti S, Bernardi S, Quercioli L. The Shorter PROMIS Questionnaire and the Internet Addiction Scale in the assessment of multiple addictions in a high-school population: prevalence and related disability. *CNS Spectr.* 2006; 11(12):966–74. [PubMed: 17146410]
46. Ferraro G, Caci B, D'Amico A, Di Blasi M. Internet addiction disorder: an Italian study. *Cyberpsychol Behav.* 2007; 10(2):170–5. [PubMed: 17474832]

47. Widyanto L, McMurrin M. The psychometric properties of the internet addiction test. *Cyberpsychol Behav.* 2004; 7(4):443–450. [PubMed: 15331031]
48. Yang CK, Choe BM, Baity M, Lee JH, Cho JS. SCL-90-R and 16PF profiles of senior high school students with excessive Internet use. *Can J Psychiatry.* 2005; 50(7):407–414. [PubMed: 16086538]
49. Yang LH, Wonpat-Borja AJ, Opler MG, Corcoran CM. Potential stigma associated with inclusion of the psychosis risk syndrome in the DSM-V: An empirical question. *Schizophr Res.* 2010; 120(1–3):42–8. [PubMed: 20399610]
50. Goldsmith, TD.; Shapira, NA. Problematic Internet Use. In: Hollander, E.; Stein, DJ., editors. *Clinical manual of impulse-control disorders.* Washington DC: American Psychiatric Publishing; 2006. p. 291-308.
51. Hanssen M, Krabbendam L, Vollema M, Delespaul P, Van Os J. Evidence for instrument and family-specific variation of subclinical psychosis dimensions in the general population. *J Abnorm Psychol.* 2006; 115(1):5–14. [PubMed: 16492091]
52. Cougnard A, Marcelis M, Myin-Germeys I, et al. Does normal developmental expression of psychosis combine with environmental risk to cause persistence of psychosis? A psychosis proneness-persistence model. *Psychol Med.* 2007; 37(4):513–27. [PubMed: 17288646]
53. Walker E, Mittal VA, Tessner K. Stress and the hypothalamic pituitary adrenal axis in the developmental course of schizophrenia. *Annu Rev Clin Psychol.* 2008; 4:189–216. [PubMed: 18370616]
54. Weinberger DR. Implications of normal brain development for the pathogenesis of schizophrenia. *Arch Gen Psychiatry.* 1987; 44(7):660–9. [PubMed: 3606332]
55. Yuan K, Qin W, Wang G, et al. Microstructure abnormalities in adolescents with internet addiction disorder. *PLoS One.* 2011; 6(6):e20708. [PubMed: 21677775]
56. Gur RE, Keshavan MS, Lawrie SM. Deconstructing psychosis with human brain imaging. *Schizophr Bull.* 2007; 33(4):921–31. [PubMed: 17548845]
57. Jacobson S, Kelleher I, Harley M, et al. Structural and functional brain correlates of subclinical psychotic symptoms in 11–13 year old schoolchildren. *Neuroimage.* 2010 Jan 15; 49(2):1875–85. [PubMed: 19770054]
58. McAnarney ER. Adolescent brain development: forging new links? *J Adolesc Health.* 2008; 42(4):321–3. [PubMed: 18346654]
59. Spear LP. Adolescent brain development and animal models. *Ann N Y Acad Sci.* 2004; 1021:23–6. [PubMed: 15251870]
60. Dahl RE. Adolescent brain development: a period of vulnerabilities and opportunities. Keynote address. *Ann N Y Acad Sci.* 2004; 1021:1–22. [PubMed: 15251869]
61. Kern RS, Glynn SM, Horan WP, Marder SR. Psychosocial treatments to promote functional recovery in schizophrenia. *Schizophr Bull.* 2009; 35(2):347–61. [PubMed: 19176470]
62. Bellack AS, Brown SA. Psychosocial treatments for schizophrenia. *Curr Psychiatry Rep.* 2001; 3(5):407–12. [PubMed: 11559478]
63. O'Brien MP, Zinberg JL, Ho L, et al. Family problem solving interactions and 6-month symptomatic and functional outcomes in youth at ultra-high risk for psychosis and with recent onset psychotic symptoms: a longitudinal study. *Schizophr Res.* 2009; 107(2–3):198–205. [PubMed: 18996681]

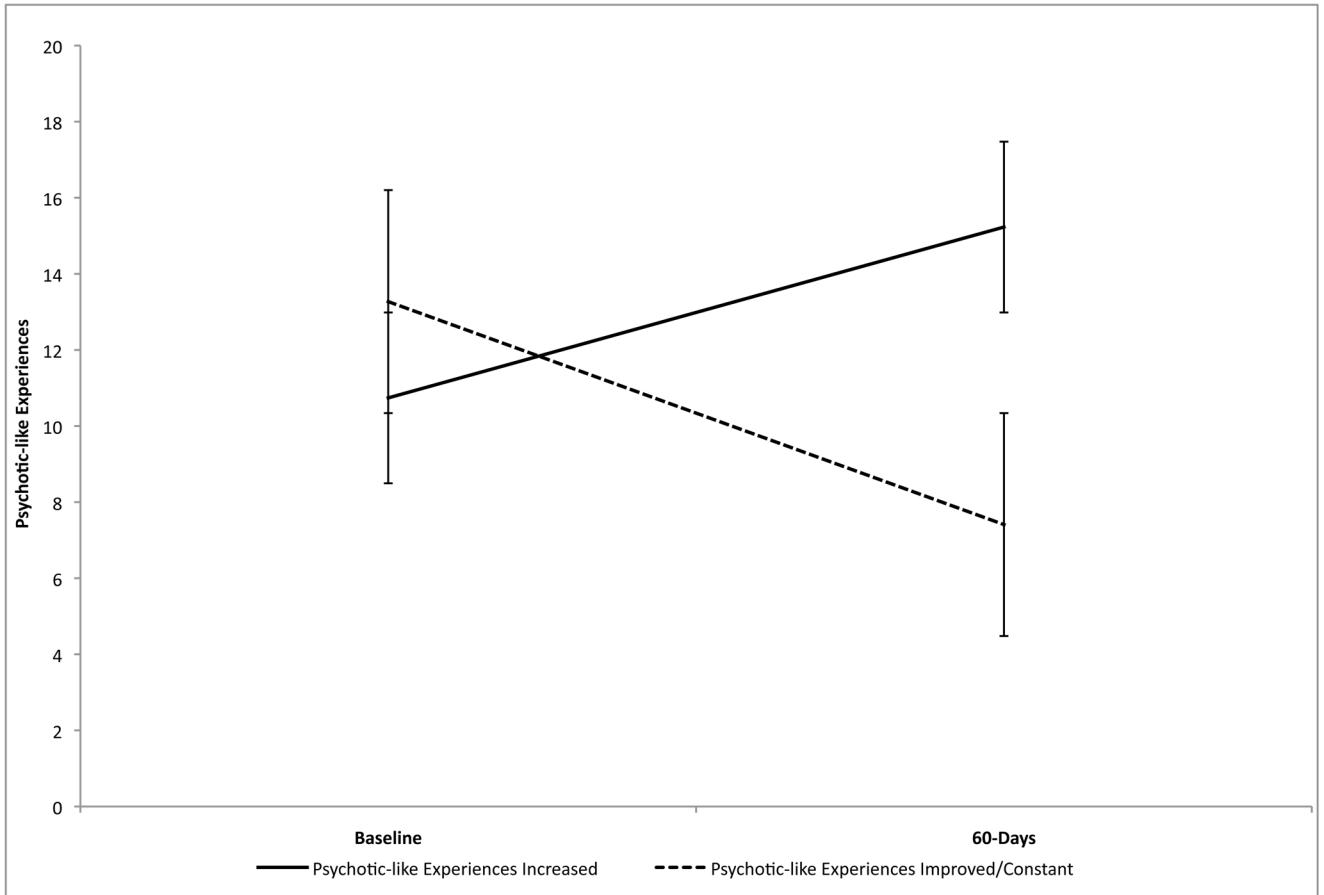


Figure 1. Participants who improved/stayed constant and who showed an increase in weighted psychotic-like experience scores over a two-month period

Participants were split into two groups: those who showed improvement or stayed constant on self-reported psychotic-like experiences (PLE) over a two-month period, and those who showed an increase in PLEs over this time. Although there were not significant differences in the level of reported PLEs at baseline, the *PLE-Increase* group showed significant increases in PLEs at the two-month follow-up. Note: The scores can range from 0 (indicating no reported PLEs)-105 (indicating severe impactful or distressful PLEs). Error bars reflect the standard error.

Table 1

Demographic characteristics for groups of participants who reported psychotic-like experiences that improved/stayed constant or got worse over a two-month period.

	PLE Improved/Constant	PLE Increase	Total	Differences
Males	81	26	107	
Females	46	17	63	
Total	127	43	170	NS
<u>Age (yrs./SD)</u>	18.9(2.5)	19.7(2.6)	19.1(2.5)	NS
<u>Parent Education(mean/SD)</u>	15.6(2.3)	15.1(1.9)	15.5(2.2)	NS

Note: NS = Not Significant

Domains of problematic Internet use for groups of participants who reported psychotic-like experiences that improved/stayed constant or got worse over a two-month period.

Table 2

Problematic Internet Use	Baseline		2-Month Follow-up		Total
	PLE Improved/Constant	PLE Increase	PLE Improved/Constant	PLE Increase	
Reality Substitute	3.1(2.1)	3.2(2.5)	2.4(2.2)	3.2(2.9)	2.5(2.4)
Internet Addiction Total	22.6(10.2)	22.1(13.1)	19.3(11.4)	21.0(14.0)	19.5(12.1)

Note: Internet Addiction Total can range from 0–100; Reality Substitute can range from 0–15

Table 3

Correlations between domains of problematic Internet use and psychotic-like experiences at baseline and at two-month follow-up

	1 Baseline PQB Total	2 Follow-up PQB Total	Changes in Magnitude
<u>PLE-Increase</u>			
Reality Substitute	.12	.45 **	2>1 *
Internet Addiction Total	.28 *	.41 **	NS
<u>PLE-Improved/Constant</u>			
Reality Substitute	.22 **	.25 **	NS
Internet Addiction Total	.30 **	.28 **	NS

Note: NS = Not Significant;

**
p<0.01,

*
p<0.05. Internet addiction problems were significantly associated with psychotic-like experiences at baseline for both the *PLE-Increase* and the *PLE-Improved/Constant* group at baseline (with the exception of Reality Substitute domain for the *PLE-Increase* group, which did not approach significance). At the follow-up time point, the magnitude of associations for the *PLE-Increase* group grew (significantly so for the Reality Substitute domain; $z = -1.63$, $p = .05$) whereas the correlations remained level for the *PLE-Improved/Constant* group.