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Attention Deficit Hyperactivity symptoms, Impulsivity, and Cyberdeviance in an adult population

Abstract

Previous research suggests a link between Attention Deficit Hyperactivity Disorder (ADHD) and criminal behaviour. The present study explored the relationship between ADHD symptoms and cyberdeviance. 170 participants completed an online questionnaire measuring computer crime behaviour, ADHD symptoms, and impulsivity. A statistically significant relationship was found between Cyberdeviance, ADHD symptoms and impulsivity. Regression analysis showed that hyperactivity and gender (male) could predict self-reported computer crime. Our findings suggest a role of individual differences in cybercrime, thus leading to the development of potential interventions and preventive mechanisms.

Introduction

ADHD is a behavioural disorder defined by either an attentional dysfunction, hyperactive/impulsive behaviour or both (DSM-5, American Psychiatric Association, 2013). It is a common neurodevelopmental disorder and its worldwide prevalence in children and adolescents is between is between 2% and 7%, with an average of around 5% (Sayal et al., 2018). ADHD psychopathology can be viewed dimensionally, with inattentive and hyperactive-impulsive symptoms distributed continuously in the general population (Hudzian et al., 1998; Panagiotidi, Overton, & Stafford, 2017a; Panagiotidi, Overton, & Stafford, 2017b). Previous studies have found links between ADHD symptoms and criminal behaviour (Fletcher & Wolfe, 2009; White et al., 1994; Skeem & Cooke, 2010). In particular, UK studies among offenders have shown that ADHD is the most powerful predictor of violent offending, even when controlling for other factors such as substance abuse (Young & Thome, 2011).

Even though the link between ADHD and delinquency is clear, most theoretical perspectives do not account for it. According to Gottfredson & Hirschi's (1990) 'general theory' low self-control can lead to delinquency and crime (Pratt & Cullen, 2000). Studies have found that individuals with ADHD have lower self-control (Schweitzer & Sulzer-Azaroff, 1995). This could potentially explain the positive relationship between the disorder and crime.

Impulsivity is a trait linked to ADHD (Winstanley et al., 2006). Impulsivity refers to behaviour characterized by action without foresight, deficits in inhibitory control, intolerance of delay to rewards and quick decision-making due to lack of consideration (Winstanley, Eagle, & Robbins, 2006). High impulsivity has also been associated with traditional criminal behaviour (DeJong, Virkkunen, & Linnoila, 1992) and recidivism (Prentky, Knight, Lee, & Cerce, 1995).

The rise of technology, which has become an essential part of our everyday lives and has become more widespread and sophisticated, has led to a new form of crime, cybercrime. Cybercrime incidents have increased in frequency and severity and have evolved into an increasingly serious threat to society. For example, victims of cybercrime report significantly lower levels of subjective well-being (Kaakinen et al., 2018). In addition to this, incidents of cybercrime can have a negative impact on the financial sector (Lagazio, Sherif, & Cushman, 2014). The majority of research in computer crime so far has been focussed on technology related factors, such as information security (Seigfried-Spellar, Rogers, & Lynam ,2010) and the development of better technological tools for crime prevention. This traditional approach to cybercrime, however, is gradually changing and the focus has been shifted to human factors (Crossler et al., 2012; Rogers, Seigfried & Tidke, 2006; Seigfried-Spellar & Treadway, 2014; Wiederhold, 2014). It has become clear that understanding the personality and cognitive factors of people who commit cybercime is essential in order to prevent incidents of cybercrime.

ADHD could be a risk factor for cyberdeviance. In particular, characteristics associated with such as low self-control and impulsivity have been linked to various forms of computer criminal behaviour (Burruss, Bossler, & Holt, 2013). No studies so far have examined the relationship between impulsivity and ADHD traits and cybercrime. One of the aims of the current study was to explore this relationship. It is proposed based on previous findings that individuals reporting cyberdeviant behaviours will self-report higher level of impulsivity and ADHD symptoms.

Growing evidence suggests that a number of individuals display signs of problematic internet related behaviours, which resemble symptoms of other behavioural addictions (Young, 1998). Internet addiction (IA), also known as pathological internet use, refers to an individual's inability to control their use of the internet resulting in marked distress and/or functional impairment (Young, 1996; Douglas et al., 2008). A positive relationship has been

found between ADHD and addictive use of substances (Robbins, 2002; Biederman et al., 1998), as well as problematic media and internet use (Panagiotidi, 2017; Yen et al., 2009). Previous research examining the relationship between excessive internet use and risky cybersecurity behaviours has found that individuals who exhibit compulsive internet use take more risks online and are less likely to follow good cybersecurity practice (Hadlington, 2017). Such behaviour could potentially develop into cybercrime in the form of intellectual property theft, distributing offensive material, and online piracy (Chen et al., 2008). More recently, Arasi and Praneetha (2016) reported a positive relationship between internet addiction and cybercrime engagement in undergraduate students.

Current study

The objective of this study was to evaluate the relationship between cybercrime and ADHD symptoms. In particular, the relationship between inattention, hyperactivity, and impulsivity and cyberdeviance was examined. The main hypothesis of the study was that self-reported deviant computer activities would correlate with higher levels of impulsivity and ADHD scores.

Method

Participants

170 participants took part in the study (57.7% females, 2.3% non-binary/other). Participants completed the survey online after receiving a personal email. Participants were recruited via the University's list of volunteers, which consists of all university employees, students, and members of the public interested in taking part in research, thus ensuring a representative sample of the population. Only individuals without any existing mental health conditions were eligible for the study. This was specified when recruiting participants.

Measures

Computer Crime Index (CCI)

The CCI measures the frequency and prevalence of self-reported criminal computer activity (e.g., virus writing, obtaining passwords, unauthorized use of a computer or account, etc.) (Rogers et al., 2006).

The participants were categorized as being computer deviant or non-computer deviant based on their self-reported online behaviours as measured by the computer crime index. More specifically, participants reporting that they had engaged in: guessing passwords, using another person's password without authorization, looking at others' files without authorization, changing others' files without authorization, using or writing a virus, obtaining someone else's credit information without authorization, digital piracy, or using a device to obtain free phone calls were classified as computer deviants. Individuals who reported no such activity were classified as non-computer deviants. This was similar to the methodology used in previous studies (Seigfried-Spellar, O'Quinn, & Treadway, 2015). The reliability (Cronbach's alpha) for the CCI scale was .7, consistent with previous studies (Rogers et al., 2006)

ADHD symptoms

ADHD symptoms were measured with the Adult ADHD Self-Report scale (ASRS) (Kessler et al., 2005). The ASRS is an instrument consisting of the 18 DSM-IV-TR criteria and was developed in conjunction with the World Health Organization (WHO), and the Workgroup on Adult ADHD. The scores obtained through the ASRS have been found to be predictive of symptoms consistent with ADHD (Kessler et al., 2005; Reuter, Kirsch, & Hennig, 2006). The ASRS contains eighteen items from DSM-IV-TR (American Psychiatric Association, 2000) but measures the frequencies of the symptoms. Subjects are asked to report how often they experience each symptom in a period of six months on a five point Likert scale which ranges from 0 for never, 1 for rarely, 2 for sometimes, 3 for often, and 4

for very often (Kessler et al., 2005; Reuter, Kirsch, & Hennig, 2006). The ASRS has a two-factor structure which includes an inattention scale and a hyperactivity/impulsivity scale. Each subscale contains nine items. The ASRS examines only current adult symptoms of ADHD. Scores on the ASRS can range between 0 and 72. The reliabilities (Cronbach's alpha) for the two subscales of inattention (.83) and impulsivity (.86) as well as for the total ASRS (.91) were good. The original questionnaires are formatted with darkly shaded boxes in certain items which signify more severe symptoms, but these were removed from the questionnaire administered to our participants to avoid potential bias in the responses.

Barratt Impulsiveness scale (BIS-11)

The Barratt Impulsiveness Scale (BIS-11; Patton et al., 1995) was used to measure impulsivity. BIS-11 is composed of 30 items describing common impulsive or non-impulsive behaviours and has three subscales; attentional, motor, nonplanning. The reliability (Cronbach's alpha) for BIS-11 was excellent (.9).

Sociodemographic data

Demographics were collected for all participants. These details included age, gender, and level of education. Participants also reported how many hours per week they spend online (excluding time spent online for work/school).

Analysis

Only data from the participants who completed all questionnaires without any omissions and reported having no mental health disorders were selected for analysis (N = 137). First the relationship between the variables of interest were examined; computer crime, ADHD symptoms, impulsivity, age. Gender differences in the above variables were also examined.

Results

Demographics

The mean age was 31.2 (*SD* = 11.3, Range = 18 - 69). The majority of the participants were female (57.7%) and 2.3% non-binary/other. Most of the participants were British (84.6%) and all were native or excellent English speakers. 25.4% of the participants had an undergraduate degree, 29.2% had a postgraduate degree, and the rest of the participants did not have a degree. Participants reported spending an average of 23.1 hours per week online (*SD* = 15.8, Range = 1 – 84).

Descriptive Analysis

Of the 137 respondents, 54 (40%) self-reported engaging in some form of computer criminal behaviour. This is consistent to scores reported in previous studies using the CCI (Seigfried-Spellar et al., 2015). There was a significant negative relationship between CCI scores and age (*r* = -.2, *p*<.05). The effect of gender on CCI scores was also examined. Male participants reported higher levels of cyberdeviance (*M* = 3.7, *SD* = 4.3) than females (*M* = 2.2, *SD* = 3.3), *t* = 2.3, *p* <.05.

The average score on the ASRS was 32 (*SD* = 10.3, Min = 7, Max = 63). Participants reported more inattentive than hyperactive symptoms; the mean on the ASRS inattentive subscale was 17.4 (*SD* = 6.7) compared to 13.4 (*SD* = 4.8) on the hyperactive subscale. The two subscales were positively correlated, *r* (135) = .58, *p*<.01. No gender differences were found in the ASRS scores and in any subscales. A weak negative correlation was found between age and ADHD symptoms (*r* (135) = -.2, *p*<.05), with older participants reporting fewer ADHD symptoms.

The mean score on the BIS11 was 61.9 (*SD* = 13.3, Min = 38, Max = 96). No gender difference was observed in BIS11 scores or any of its subscales, *p*>.05. A weak negative

correlation was found between age and BIS11 overall scores (r (135) = -.23, $p<.05$). Detailed descriptive statistics for the key variables of the study are presented on Table 1.

Cybercrime, ADHD, and impulsivity

The relationship between CCI scores, ADHD, and impulsivity was examined. Statistically significant correlations were found between the above variables (Table 2). A moderate correlation was found between cybercrime scores and overall ADHD traits (r(135) = .34, $p<.01$) and the Hyperactivity subscale (r(135) = .37, $p<.01$). Inattention scores were also associated with cybercrime (r(135) =.2, $p<.05$). BIS11 scores were moderately correlated with CCI scores (r(135)= .34, $p<.01$). All BIS11 subscales (attentional, motor, non-planning) were also positively correlated with cybercrime (Table 2).

To determine the relative contribution of the examined variables to the CCI score, a stepwise linear regression was conducted with CCI score as the dependent variable and the following independent variables; overall ASRS, Hyperactivity, Inattention, BIS11, gender, and age. The results indicated that Hyperactivity scores (b= .381, t= 4.68, $p< .01$), and gender (b = -.249, t= -3.1, $p < .05$) remained significant predictors of CCI. The other variables (overall ASRS, Inattention, BIS1, age) were not significant predictors when controlling for the above variables ($p>.05$). The model could predict 18% of the variance in CCI scores.

Discussion

In this study we investigated the relationship between ADHD symptoms and cyberdeviance. In particular, the relationship between computer crime, ADHD symptoms, and impulsivity was examined. Positive correlations were found between self-reported ADHD symptoms, impulsivity, and cybercrime. Furthermore, our results revealed that higher level of

hyperactivity symptoms and male gender were predictors of self-reported computer crime behaviour.

Cyberdeviancy in our study was associated with impulsivity. Moderate correlations were found between two subscales of BIS-11 (Attentional and Motor), while a weak correlation was found between CCI and non-planning. Previous research has shown that individuals who exhibit higher levels of impulsivity tend to be less risk averse compared to those with lower levels (Coutlee et al., 2014; Zuckerman & Kuhlman, 2000). Furthermore, impulsivity is often associated with individual level explanations of traditional crime (Zimmerman, 2010).

Impulsivity is also a defining symptom of ADHD (Coutlee et al., 2014). ADHD symptoms were also associated with levels of self-reported cybercrime. In particular, hyperactivity symptoms and gender were the main predictor of cyberdeviance. This is consistent with findings from studies on offline crime (White et al., 1994; Skeem & Cooke, 2010). This could suggest that certain characteristics could be shared between computer and traditional crime. Future studies should also examine whether individuals with a clinical diagnosis of ADHD are more likely to commit computer crimes and whether treatment for these symptoms could prevent delinquency. In addition to this, ADHD often co-occurs with a number of developmental disorders (e.g. autism), which have also been linked to increased levels of delinquency (Underwood et al., 2016). This is true even in non-clinical populations (Panagiotidi, Overton, & Stafford, 2017c). Future research could examine the relationship between cyberdeviance, ADHD and other co-occurrent conditions. Considering the negative impact cybercrime has on both individuals and society (Lagazio et al., 2014; Kaakinen et al., 2018), preventing such incidences is of utmost importance.

Our sample consisted of a non-clinical population with varying levels of ADHD symptoms. Even though there is evidence supporting the dimensional approach in ADHD

research, it is worth noting that ADHD is a highly complex and heterogeneous disorder characterised by multiple potential etiological risk factors, diverse neurocognitive impairments and co-occurrent conditions (Luo et al., 2019; Bonvicini et al., 2018). In particular, a diagnosis of ADHD often presents with predominantly inattention symptoms without impulsivity and often impulsivity symptoms decrease with age (Biederman et al., 2000). In our study the relationship, hyperactivity symptoms and gender were the main predictors of self-reported cybercrime but they only accounted for 18% of the variance. As a result, the potential association between ADHD and cyberdeviance should be treated with caution.

The following limitations can be identified in our study. First, our study is based on self-reports. Even though participants were assured that their data would be anonymous, it is possible that computer crime was underreported. Furthermore, the sample in our study was unselected and is unlikely to contain many serious offenders. Future studies could administer the same questionnaires to a sample including more offenders (e.g. specific forums or events). A significant proportion of the participants (26%) had ASRS scores above 35, one of the proposed cut-off points for the ASRS suggesting they were likely to have ADHD (Panagiotidi et al., 2017c; Stark et al., 2011). Our methodology does not allow us to further investigate this and ascertain whether individuals with high ASRS scores in our sample have undiagnosed ADHD.

To our knowledge, this is the first study to investigate the relationship between computer crime, ADHD symptoms, and impulsivity. The results suggest that self-reported cyberdeviance is positively correlated with inattention, hyperactivity and impulsivity levels in a general population. In addition to this, hyperactivity and male gender appeared to be the best predictors of computer crime. The present results are expected to contribute to our understanding of human factors contributing to computer crime and could potentially lead to the development of preventive measures and interventions.

Declarations

Compliance with Ethical Standards

Conflicts of Interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

Ethical Statement and Informed consent

This research was approved by the University of Sheffield Psychology Ethics Research Committee and the Staffordshire University ethics research committee. Informed consent was obtained by all the individuals who took part in the study.

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