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Gaming-addicted teens identify more with their cyber-self than their own self: Neural evidence

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ABSTRACT

According to existing neuroimaging studies of social cognition, individuals use knowledge about themselves to infer the mental states of others and to mentalize in a different way when the other is perceived to be similar versus dissimilar to oneself. In this study, we examined whether adolescent boys make mental state inferences for their online game characters and whether adolescents who were diagnosed as addicted to the internet game perceived their personal game character to be similar to themselves. Twelve internet-addicted adolescents and fifteen adolescents without addiction reported whether short phrases described themselves, a well-known historical person, or their own game character while undergoing a functional magnetic resonance imaging (fMRI). Different patterns of activity emerged for adolescents with internet game addiction compared to healthy adolescents when they were thinking about themselves, another person, and their game characters. Specifically, when addicted adolescents were thinking about their own game characters, more global and significant medial prefrontal (MPFC) and anterior cingulate (ACC) activations were observed, than even when compared to thinking about themselves. The ACC activation was correlated with the symptom severity. The activation patterns demonstrated that addicted adolescents were most attached to their game characters and equated their game characters to human.

1. Introduction

1.1. Neural bases for cognition of self and other people

Self-concept, as a stable essence, is based on the beliefs of individual's cognitive uniqueness, constancy and continuity (Erikson, 1959; Yi, 2002). Recognizing oneself as a being with cognitive, social and emotional characteristics distinct from other people is a starting point of self-awareness and a basis of self-knowledge.

Since the 1970s, a considerable body of social cognition research has studied differences in processing information relevant to one's self versus information relevant to others. More recently, researchers have reached the conclusion that self-knowledge and knowledge about others are not separate but should be viewed along a continuum on which one extreme represents oneself, the other extreme represents a generalized other or a stranger of some kind, and in between are people with whom one has interactions and relationships (Aron and Aron, 1996). Thus, individuals recognize that others not only experience beliefs, feelings and desires, but that their mental states can be comparable to those experienced by oneself (Tomasello, 1999). This awareness that the inner workings of others' minds overlap meaningfully with one's own allows humans to use their own thoughts and feelings as a guide to those of others (Mitchell et al., 2006). In other words, "simulation" (or "projection") toward others' minds have posited that perceivers may infer mental states, in part, by assuming that others experience what they themselves would think or feel in a comparable situation (Adolphs, 2002).

Recent neuroimaging research has also investigated these

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constructs. Numerous studies related to the self have reported activation in the medial prefrontal cortex (MPFC) for conditions that involve some aspect of self (Cabeza et al., 2004; Heatherton, 2011; Macrae et al., 2004; Mitchell et al., 2006; Northoff et al., 2006; Pfeifer et al., 2007). Other neuroimaging studies have reported several regions of the brain that are activated when making inferences about the mental states of other people: MPFC, temporoparietal junction (TPJ), temporal poles, and medial parietal cortex (Amodio and Frith, 2006; Denny et al., 2012; Gallagher and Frith, 2003; Heatherton, 2011; Mitchell et al., 2006; Saxe, 2006; Saxe et al., 2004). The dorsomedial prefrontal cortex (DMPFC) is associated particularly with making inferences about the mental characteristics of others who have no similarities or relationships with the subject (De Brigard et al., 2015; Iacoboni et al., 2004; Mitchell et al., 2006). On the other hand, some researchers have studied whether a “familiar other” may become incorporated into one's self-concept on this spectrum (Krienen et al., 2010). They hypothesized that the frontal midline including the MPFC and ACC would be activated when individuals reflect upon familiar others such as parents, who have established close relationships with themselves. Some studies have demonstrated the MPFC and ACC activation for familiar others as well as the self (Krienen et al., 2010; Mitchell et al., 2006; Ochsner et al., 2005; Schmitz et al., 2004; Seger et al., 2004; Taylor et al., 2009; Wang et al., 2012; but see Heatherton et al., 2006), but with differences across family members (Arsalidou et al., 2010; Wang et al., 2012). This is associated more with the extent of attachment and familiarity than with similarity of appearance (Krienen et al., 2010).

1.2. One's own game character: is it me or is it someone else?

With the development of high-speed internet communications networks, the online role-playing game (typically called Massively Multiplayer Online Role-Playing Games; MMORPGs) has become a significant leisure activity for many adolescents. In MMORPGs, users organize virtual communities through a guild and cooperate with one another to achieve game-related goals. One of the most distinctive features of MMORPGs is that in-game characters, such as avatars in the form of magicians or warriors, are used to establish interactions among the game users (Kuss et al., 2012). The user's game character is the agent which interacts with other users in the virtual world; thus, the virtual character can be easily equated with the user (Israelashvili et al., 2012; Jin, 2011). However, it is still unclear to what extent the game user equates the game character to oneself. Moreover, a game user who is immersed excessively in these games may display a greater vulnerability to equating oneself with the game character (Allison et al., 2006; Bacchini et al., 2017; Bessiere et al., 2007; Yee et al., 2009). A few neuroimaging studies have investigated the neural processes mediating avatar-referencing compared with self- or other-referencing in addicted players of MMORPGs and reported bilateral activations of angular gyrus during avatar-perception (Dieter et al., 2015; Leménager et al., 2014, 2016). However, there has been a call for developmental study since there is a significant concern for gaming addiction in younger populations. According to one national study conducted in Korea (Ministry of Gender Equality and Family, 2011), more than 90% of male adolescents enjoy internet games as a leisure activity, while the average number of hours spent on games was 1.5 h per day. Over 10% of Korean adolescents were classified as definitive internet over-users, in that they spend an excessive amount of time in cyber communities as a game character with an entirely different appearance, personality, and abilities; this could be in contrast to their daily experience of themselves (e.g., Allison et al., 2006). In such cases where significant disparities exist between the real world and virtual world, these young gamers may have a higher chance of having significantly atypical perceptions of themselves and their game characters compared to non-addicted users; this study examined these possibilities.

The current study had three goals. First, we examined whether adolescent users of internet games make mental state inferences for their online game characters. Second, we determined whether adolescents diagnosed with the internet game addiction perceived their game character to be similar to themselves. Third, we compared the two groups (i.e., addicted vs. non-addicted group) in terms of their brain activity to their game characters versus themselves and another individual. We hypothesized that different neural patterns of activity would be observed in the addicted vs. non-addicted group when they thought about themselves, others and their game characters.

2. Material and methods

2.1. Participants

Seventeen right-handed male adolescents who were diagnosed with internet gaming addiction by board-certified child and adolescent psychiatrists were recruited from Seoul National University Children's Hospital via posted flyers among outpatients. Also, seventeen right-handed healthy male adolescents for comparison were recruited among the students currently enrolled in middle and high school in Seoul and played internet games more than 2 h a week. The internet game addicted adolescents ranged in age from 11 to 18 years (M = 13.83, SD = 2.69), and non-addicted healthy adolescents ranged in age from 14 to 17 years (M = 15.33, SD = 0.98). There was no significant difference in age between the two groups ($t = -1.837$, $p > 0.05$). This study was approved by the institutional review board for human subjects at the Seoul National University. All the adolescents and their parents provided written informed consent prior to study entry.

2.2. Diagnosis and neuropsychological assessments

Internet addiction has been defined as the inability of individuals to control their internet use, resulting in marked distress and functional impairment in five domains: academic, social, occupational, developmental and behavioural (Young, 1996). However, internet gaming disorder has not been included as a psychiatric disorder in the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) and was recommended for the further research. In this study, we used the definition of ‘Internet addiction’ that focuses on the abnormal use of online games considering the criteria of Internet gaming disorder in DSM-V. To establish the diagnosis of internet addiction and exclude other potentially comorbid psychiatric disorders, we used the Kiddie-Schedule for Affective Disorders and Schizophrenia-Present and Lifetime Version (K-SADS-PL) and the Young Internet Addiction Scale (YIAS). The K-SADS-PL is a semi-structured diagnostic interview tool based on the DSM-IV criteria; its validity and reliability have been established (Kaufman et al., 1997; Kim et al., 2004). Exclusion criteria were other axis I psychiatric disorders including substance abuse, epilepsy or other neurological disorders, and past history of severe head trauma. The YIAS is a 20-item scale with each item score based on a 5-point Likert scale evaluating the degree of problems caused by the usage of internet. Higher scores are indicative of more severe problems, and its validity and reliability have also been established (Widyanto and McMurran, 2004). The Korean version of this scale (YIAS-K) was validated in previous studies (internal consistency, alpha = 0.92) (Ha et al., 2006) and YIAS-K scores over 50 show internet addiction. In addition, participants in the internet addiction group were limited to those reporting to have experienced typical components of addiction with their online gaming: tolerance, withdrawal, preoccupation with playing, repeated unsuccessful attempts to reduce or stop playing, negatively influenced mood when attempting to reduce; and neglecting important relationships or activities because of playing (Christakis, 2010; Flisher, 2010). Healthy controls were screened using the same assessment tools described above.

Trained clinical psychologists conducted psychological intelligence quotient (IQ) assessments (Korean Educational Development Institute's Korean Wechsler Adult Intelligence Scale [K-WAIS] for those over 16