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The Relationship between Stress and Smartphone Addiction among Adolescents: The Mediating Effect of Grit

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Abstract

The Relationship between Stress and Smartphone Addiction among Adolescents: The Mediating Effect of Grit

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The purpose of this study was to investigate the mediating effect of grit on the relationship between stress and smartphone addiction. With the increased usage of smartphones among adolescents, numerous studies have examined smartphone addiction. However, most studies focused on the negative consequences of smartphone addiction, and relatively few studies

investigated how adolescents become addicted to smartphones. In fact, no known studies have reported the association between stress, grit, and smartphone addiction among adolescents. Therefore, the present study aimed to explore the relationship between stress, grit, and smartphone addiction among Korean adolescents from age 12 to 16. Particularly, we focused on the mediating effect of grit on the relationship between daily stress and smartphone addiction. Participants were 605 Korean adolescents (mean age = 13.97 years). They completed questionnaires measuring stress, grit, and smartphone addiction. Stress was assessed using the Daily Hassles Scales for Children in Korea developed by Han and Yoo (1995). Grit was measured by the Korean translated version of the Original Grit Scale (Duckworth et al., 2007; Park et al., 2020). Finally, smartphone addiction was measured by using the Smartphone Addiction Proneness Scale for Youth developed by the National Information Society Agency (2011). We analyzed the association of stress, grit, smartphone addiction through Pearson's correlation analysis. The mediating effect was analyzed by using PROCESS macro version 3.5, and bootstrapping was conducted to test the significance of the mediating effect. The main findings were as follows. First, adolescent stress significantly influenced smartphone addiction. Second, grit had a significant influence on smartphone addiction. Finally, grit partially mediated the relationship between stress and smartphone addiction. In other words, high levels of stress

reduced grit, which in turn increased the smartphone addiction proneness. In addition, two factors of grit (consistency of interest and perseverance of effort) both mediated the association between stress and smartphone addiction. These results indicate that adolescent's daily stress may be a potential risk factor for smartphone addiction. Furthermore, by demonstrating the mediating effect of grit on the relationship between stress and smartphone addiction, the present study revealed that stress leads to smartphone addiction through lowered grit. This suggests that high level of grit is an important personal factor that may prevent the path of stress to smartphone addiction. Our study is meaningful in that it is the first study to empirically investigate adolescent's grit in relation to stress and smartphone addiction. Moreover, this study can provide useful information about prevention and intervention strategies for smartphone addiction. Limitations and directions for future studies are discussed.

Keywords: stress, grit, smartphone addiction, adolescence, mediating effect

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Introduction

In the last decade, the number of people using smartphones dramatically increased worldwide, and more than 80% of people in the US own smartphones (Silver, 2019). Particularly, smartphone ownership was relatively high in South Korea than other countries (Silver, 2019). According to data from Korea Communications Commission (2020), 91% of Koreans were reported to own a smartphone. Through various applications on smartphones, people can listen to music, play games, watch videos, use social network services, shop, and even learn. Thus, smartphones have become an essential part of our lives. Although smartphones can provide convenience to everyday life, excessive use and over-dependence on them can lead to problematic smartphone use or smartphone addiction.

"Addiction" refers to a behavior that functions to generate pleasure and to escape from internal discomfort, which is characterized by "(1) recurrent failure to control the behavior (powerlessness) and (2) continuation of the behavior despite significant negative consequences (unmanageability)" (Goodman, 1990, p.1403). Addiction was once limited to drugs or alcohol use, but it is recently associated with behavioral addictions such as gambling, shopping, mobile phone usage, and internet use (De-Sola Gutiérrez et al.,

2016; Holden, 2001; Kuss & Griffiths, 2012). The Diagnostic and Statistical Manual of Mental Disorders (DSM-5) proposed criteria for "Internet gaming disorder," which is characterized by a preoccupation with internet games despite knowledge of psychosocial problems, withdrawal symptoms, unsuccessful attempts to control playing internet games, and more (American Psychiatric Association, 2013). This inclusion to the DSM-5 demonstrates that there is an important transition in the paradigm of addiction (Pontes & Griffiths, 2015), and studies on behavioral addictions are expanding to include various types of technological addictions (Kuss & Billieux, 2017). With the recent increase in smartphone usage, a new behavioral addiction called "smartphone addiction" has emerged and is drawing attention.

Smartphone addiction is characterized by repetitive failure to resist the impulse to use the smartphone, withdrawal, excessive time spent on smartphone usage, and recurrent physical or psychological problem, negative consequences on daily life caused by excessive smartphone use (Lin et al., 2016). Recently, smartphone addiction has notably increased. In fact, according to a recent systematic review about the prevalence of smartphone addiction (Sohn et al., 2019), approximately one in every four children and young people had smartphone addictions. Moreover, data from "2019 The survey on smartphone overdependence" reported that among people aged 3 to 69, 20% were at risk of smartphone overdependence in South Korea

(Ministry of Science and ICT & National Information Society Agency, 2020). Especially, smartphone overdependence rate of Korean adolescents (10 – 19 years old) was 30%, which was the highest of all ages. This pattern has also been confirmed in Western studies, where the prevalence of smartphone addiction was higher in children and adolescents compared with adults (De-Sola et al., 2017; Haug et al., 2015; Lopez-Fernandez et al., 2014).

Adolescents can easily be addicted to smartphones than adults for the following reasons. First, adolescents tend to accept and immerse themselves in the new media better than adults and therefore are more susceptible to smartphone addiction (Kim et al., 2012). Also, Kim et al. (2012) found that adolescents tended to use smartphones for entertainment purposes (i.e. listening to music, gaming) than adults. When people use smartphones for hedonic purposes (to gain pleasure), they obtain direct gratifications from the media and are more likely to indulge in the virtual world of smartphones, increasing the danger of addiction (Meng et al., 2020). In addition, Chambers et al. (2003) reported that adolescents can be more vulnerable to addiction due to their high impulsivity and novelty-seeking tendencies. In fact, a recent study found that high levels of impulsivity contributed to smartphone addiction in adolescents (Jo et al., 2018). Moreover, the development of brain regions related to motivation and control is immature in adolescents which makes them more prone to habitual addiction (Gladwin et al., 2011). Thus,

these results imply that it is necessary to examine smartphone addiction focusing on adolescents. Furthermore, according to Cha and Seo (2018), Korean adolescents appeared to be more susceptible to smartphone addiction. The study found that the prevalence of smartphone addiction in Korean adolescents was 30.9%, which is higher than other countries, compared to "10% in England, 21% in the Philippines, and 18% in Hong Kong (Lopez-Fernandez et al., 2014; Mak et al., 2014)" (as cited in Cha & Seo, 2018, p.10). Therefore, Korean adolescents would be an appropriate target when investigating smartphone addiction.

Numerous studies revealed the negative consequences of smartphone addiction. For instance, Kim et al. (2015) showed negative association between smartphone addiction and physical health. The researchers found out that excessive smartphone users showed lower average number of walking steps and consumed calories per day. Also, smartphone addiction can lead to poor academic performance (Domoff et al., 2020; Hawi & Samaha, 2016). According to Hawi and Samaha (2016), university students with high risk of smartphone addiction were less likely to have distinctive GPAs. Possible explanation is that smartphone multitasking while studying can impede the cognitive processes required for learning, which in turn can decrease academic achievement (Hawi & Samaha, 2016). Similar result was reported in a recent study of adolescents, where students who excessively used

smartphones tended to show poorer academic performance (Domoff et al., 2020). Other than these findings, studies also argued that smartphone addiction is associated with lower productivity (Duke & Montag, 2017), poor mental health (depression, anxiety, suicidal ideation) (Thomée, 2018; Wang et al., 2019), and sleep disturbance (Foerster et al., 2019). Although many studies emphasized the danger of smartphone addiction by stressing the negative consequences, relatively few studies investigated how adolescents become addicted to smartphones. Thus, further work is needed to examine the predictive factors and mechanism of how smartphone addiction is developed in adolescents.

Among various factors that predict smartphone addiction, many previous studies reported that stress is related to problematic smartphone usage and smartphone addiction (Chiu, 2014; Liu et al., 2018; Samaha & Hawi, 2016; Wang et al., 2015). Individuals with high levels of stress tended to excessively use smartphones to escape from life problems and alleviate stress (Wang et al., 2015). Especially, adolescents in Korea grow in a competitive society, where the academic performance of children is highly valued. Thus, Korean adolescents are more likely to experience greater academic stress than adolescents from other countries, which might have contributed to the high prevalence of smartphone addiction in Korea (Cha & Seo, 2018). Other studies also showed positive correlations between stress

and smartphone addiction which would be discussed later (Cho et al., 2017; Liu et al., 2018; Wang et al., 2015). However, relatively limited studies explored the psychological mechanism of the relationship between stress and smartphone addiction.

Stress can lead to smartphone addiction through various pathways. For example, according to previous studies, factors such as self-esteem (Kim et al., 2017), self-efficacy (Chiu, 2014), resilience (Park & Kwon, 2019), self-control (Cho et al., 2017; Liu et al., 2018), and grit (Yoo & Choi, 2019) had significant mediating effects on stress and smartphone addiction. However, most of the studies were conducted on university students, and few studies targeted adolescents. Among the various factors that influenced smartphone addiction, this study will be focusing on grit which is a relatively new psychological concept defined as "perseverance and passion for long-term goals" (Duckworth et al., 2007, p.1087).

Grit was first introduced as a non-cognitive skill that leads to success (Duckworth et al., 2007). Grit is characterized by the combination of consistency of interest and perseverance of effort. Gritty people sustain effort and pursue consistent interest to accomplish long-term goals even in the face of failure and adversity. In the past, grit was predominantly considered as an indicator of academic or professional success (Duckworth et al., 2011; Lee & Sohn, 2013). However, recent studies started to associate grit with mental

health and expand the importance of grit beyond academic success. For instance, gritty individuals experienced less depressive symptoms (Datu et al., 2019), showed increased psychological well-being (Salles et al., 2014), and reported higher life satisfaction and positive affect (Li et al., 2018). Furthermore, some studies confirmed the mediating and moderating effect of grit on the relationship between stress and negative outcomes, suggesting that grit could serve as a buffer against negative outcomes of stress (Jung et al., 2020; Marie et al., 2019). Marie et al. (2019) examined the moderating effect of grit on the relationship between posttraumatic stress disorder (PTSD) symptoms and suicidal ideation. As a result, individuals with high levels of grit had a weaker association of PTSD symptoms and suicidal ideation. The study argued that grit may remediate the impact of PTSD symptoms and reduce the danger of suicide. Furthermore, Jung et al. (2020) examined the mediating effect of grit in the relationship between occupational stress and burnout among firefighters. As a result, grit partially mediated stress and burnout. This means that high occupational stress leads to lower girt, which in turn increases the occupational burnout. This study implies that high levels of grit could function as a protective factor against the negative consequences of occupational stress. These results suggest that grit might have a mediating effect on stress and various negative outcomes. Thus, based on these previous findings, the current study aimed to examine the relationship between stress,

grit, and smartphone addiction. In particular, we tried to identify the psychological mechanism of stress and smartphone addiction by exploring the mediating effect of grit on the relationship between stress and smartphone addiction among adolescents.

The Current Study

With the recent increase in smartphone usage, various studies have investigated smartphone addiction. However, these have several limitations. First, as discussed earlier, most of the studies focused on the negative consequences of smartphone addiction (Domoff et al., 2020; Hawi & Samaha, 2016; Wang et al., 2019), and relatively few studies aimed to explore how and why adolescents become addicted to smartphones. Thus, it is necessary to examine the factors that contribute to smartphone addiction and psychological mechanism of how adolescents develop smartphone addiction.

Second, although grit has been widely studied as a strong predictor of academic and professional success (Duckworth, 2016; Duckworth et al., 2011; Eskreis-Winkler et al., 2014; Robertson-Kraft & Duckworth, 2014), little work has been conducted to examine the role of grit in relation to maladaptive behaviors (Brozikowsky & Bernhardt, 2018; Guerrero et al., 2016). In fact, no known studies have associated grit with smartphone addiction among adolescents. Prior studies showed the protective function of grit in maladaptive behaviors such as online game addiction, drug use, and alcohol use (Brozikowsky & Bernhardt, 2018; Guerrero et al., 2016). As gritty individuals tend to sustain effort and focus on consistent interest to accomplish long-term goals (Duckworth et al., 2007), they might regulate

their thoughts and behaviors to make more responsible choices and invest in the future even in the face of failure and adversity (Guerrero et al., 2016). Based on these previous findings, we assumed that grit might also be connected to smartphone addiction. Thus, the current study tried to associate grit with stress and smartphone addiction in a sample of Korean adolescents.

Furthermore, while the majority of grit studies used the total score of grit (Eskreis Winkler et al., 2014; Roberston-Kraft & Duckworth, 2014), recent studies argued that two components of grit can cause different consequences (Disabato et al, 2019; Wolters & Hussain, 2015) and therefore should be investigated separately (Datu et al., 2016). As mentioned earlier, grit comprises two factors: consistency of interest and perseverance of effort. Consistency of interest refers to continued interest toward a long-term goal. Perseverance of effort refers to the ability to work hard in accomplishing long-term goals (Duckworth & Quinn, 2009). According to prior studies, these two components of grit were found to generate different outcomes (Datu et al., 2016; Wolters & Hussain, 2015). For instance, Wolters and Hussain (2015) discovered that only perseverance of effort predicted self-regulated learning which was associated with improved academic outcomes among college students. On the contrary, consistency of interest was not significantly associated with academic achievement. Also, according to Datu et al. (2016), perseverance of effort positively predicted overall well-being and academic

performances while consistency of interest did not. Therefore, the current study sought to separately analyze the mediating effects of consistency of interest and perseverance of effort in the relationship between stress and smartphone addiction and contribute to the knowledge of this topic. By exploring how grit is related to stress and smartphone addiction, we expect to deeply understand grit's function in maladaptive behaviors among adolescents. In addition, such an investigation will shed light on the prevention and intervention of smartphone addiction.

Theoretical Background

Stress and Smartphone Addiction

As mentioned earlier, stress is one of the major factors that can lead to smartphone addiction. When individuals experience stress, they tend to engage in repetitive behaviors such as drinking, gambling, and overeating to escape from stress (Jacobs, 1986). Perceived stress is a well-known risk factor for not only substance use but also behavioral addictions such as cyber addiction and eating disorders (Tavolacci et al., 2013). Students with high levels of stress were more likely to depend on alcohol, smoke cigarettes, and inadequately use the internet.

Similarly, recent studies demonstrated the positive relationship between stress and smartphone addiction (Chiu, 2014; Samaha & Hawi, 2016; Xie et al., 2020). For example, Samaha and Hawi (2016) investigated perceived stress and smartphone addiction of 249 college students and found that students with high risk of smartphone addiction reported higher levels of stress. Moreover, according to a longitudinal study on Chinese adolescents (Xie et al., 2020), stressful life events were associated with problematic smartphone usage. When adolescents experienced stressful life events, they reported more depressive symptoms, which led to problematic smartphone

usage. Researchers argued that adolescents can rely on smartphones to seek temporary release from negative emotions (Xie et al., 2020). Likewise, Chiu (2014) described that family and emotional stress were predictive factors for smartphone addiction. To relieve various life stress and alleviate negative emotions and experiences, university students tended to develop an addiction to their mobile phones (Chiu, 2014). Moreover, Panova and Lleras (2016) discovered a "security blanket effect" of smartphones among university students. The participants who had access to their mobile phones were more likely to show increased resilience in a stressful situation. Researchers related this effect to the security blanket effect in that it is similar to how children hold on to blankets or other objects to obtain a sense of comfort and safety in a threatening environment. However, the results showed that depending on mobile phones is detrimental to long-term psychological health and thus it may be a maladaptive coping mechanism (Panova & Lleras, 2016).

Similar patterns have been shown in Korean studies (Jeon & Jang, 2014; Kim, 2016; Kim & Shin, 2016). For instance, Kim (2016) conducted a study on South Korean adolescents and identified the relationship between perceived stress and smartphone usage. As a result, stress and smartphone usage time had a positive correlation among adolescents. When students are exposed to stressful situations, they can easily access and depend on the internet to avoid negative situations. Also, the study discovered that students

with emotion-focused coping style of stress tended to use smartphones for longer periods of time which can lead to an increased risk of smartphone addiction. In other words, students who tried to alleviate negative emotional states caused by stress through using smartphones were more likely to be addicted to smartphones. These findings indicate that stress is an important risk factor for smartphone addiction.

The relationship between stress and smartphone addiction can be explained by the Compensatory Internet Use theory, which was first introduced to explain why people continue using the internet despite harmful consequences. According to Compensatory Internet Use theory, negative life situations can motivate people to "go online to escape real life issues or alleviate dysphoric moods" (Kardefelt-Winther, 2014a, p.351). To empirically test his theory, Kardefelt-Winther (2014b) investigated stress, self-esteem, and escapism motivation (using the internet to avoid real life problems) and discovered that both stress and self-esteem moderated the relationship between escapism and negative outcomes of excessive online gaming. Individuals with higher level of stress and lower self-esteem used online gaming as a coping strategy for psychosocial issues and were more likely to excessively play online gaming. Based on this theory, Wang et al. (2015) examined the moderating role of stress on the relationship between motivation (entertainment or escapism) and smartphone addiction. This study

demonstrated that people with high escapism and entertainment motivations and with higher levels of stress tended to have problematic outcomes from smartphone use than those with lower levels of stress.

Other researchers explained the psychological mechanism between stress and smartphone addiction with reduced self-control ability (Cho et al., 2017; Liu et al., 2018). In other words, when stress increases, self-control ability decreases, and the possibility for smartphone addiction increases. Cho et al. (2017) investigated the mediating effect of self-control on stress and smartphone addiction. They found that as stress level increased, self-control decreased, which consequently led to increased susceptibility to smartphone addiction. Furthermore, Liu and his colleagues (2018) discovered that self-control partially mediated the association between perceived stress and mobile phone addiction. Researchers explained this result based on the strength model of self-control (Baumeister et al., 2007). According to the strength model of self-control, energy resources for self-control are limited. Thus, controlling thoughts and behaviors may consume the limited resources and decrease self-control. Liu et al. (2018) argued that stress can deplete resources of self-control through the following ways. First, stress can induce negative emotions such as anxiety and depression, and thus stressed people use energy resources to control these negative feelings. Also, stressful situations can cause maladaptive cognition such as rumination, which is

repetitively thinking about the causes and consequences of negative emotions. Suppressing these ruminative thoughts also depletes the limited resources and can lead to decreased self-control ability. Then, low self-control can contribute to the development of mobile phone addiction (Liu et al., 2018). These results imply that unresolved, stressful real-life problems can facilitate smartphone addiction.

Adolescence is a period with many physical, psychological, environmental changes and thus adolescents can experience various kinds of stress such as family-related stress and academic stress. In particular, adolescents in South Korea grow in a competitive social atmosphere that emphasizes greatly on children's academic performance. Thus, they tend to experience high academic and daily stress which may lead to suicide, lower psychological well-being, and many other problems (Kwak & Ickovics, 2019; Song & Jo, 2018). Therefore, it would be important to consider stress as a risk factor and examine how it is related to increased smartphone addiction among Korean adolescents.

Grit and Smartphone Addiction

Grit refers to "perseverance and passion for long-term goals" and was first introduced as a non-cognitive skill that leads to success (Duckworth et al., 2007, p.1087). Grit comprises consistency of interest and perseverance of effort. First, consistency of interest refers to the ability to continuously pursue focused interest over a long period of time without frequently changing goals. Second, perseverance of effort refers to the tendency to sustain effort in accomplishing long-term goals even in the face of adversity and challenges (Duckworth & Quinn, 2009). In other words, grit encompasses "working strenuously toward challenges, maintaining effort and interest over years despite failure, adversity, and plateaus in progress" (Duckworth et al., 2007, p.1087-1088). Duckworth and Quinn (2009) found that perseverance of effort was a better predictor of GPA, extracurricular activities among adolescents while consistency of interest was inversely related to career changes among adults. Duckworth (2016) explained that grit develops with age. According to the maturity principle, psychological maturity increases over development as most people become more conscientious, agreeable, and emotionally stable over the course of lives (Caspi et al., 2005). In this context, grit develops over the life course as we learn valuable life lessons and how to adapt to new situations from cumulative experiences (Duckworth, 2016).

Grit has many significant implications, especially for adolescents. For example, gritty students spent a lot more time in deliberate practice, which contributed to better performance in Spelling Bee competitions (Duckworth et al., 2011). Even though students perceived the preparation process as more effortful and less enjoyable than other preparation activities, gritty students continued to engage in deliberate practice than less gritty students and achieved better performance (Duckworth et al., 2011). Since then, many studies have examined the relationship between grit and academic achievement. Luthans et al. (2019) investigated grit and academic performance of 176 university students and discovered that grittier students had higher GPAs. This is because students with high grit can overcome short-term setbacks in the pursuit of long-term academic performance, and maintain confidence about their abilities to successfully accomplish tasks (Luthans et al., 2019). Moreover, gritty students tended to engage in self-regulated learning, which positively influenced academic achievement (Wolters & Hussain, 2015). The study showed that grittier students considered themselves as having the ability to succeed and did not unnecessarily delay beginning and completing academic tasks. Similarly, in South Korea, Lee and Sohn (2013) conducted a study on 99 high school students and found that grit was associated with higher grades, even when controlling for intelligence and personality traits. In addition to its relevance with academic performance, grit

is also related to graduation (Eskreis-Winkler et al., 2014), peer relationship (Lan, 2020), and school adjustment (Shin et al., 2019). Thus, grit is an important skill for adolescents in that it benefits not only adolescent's academic performance but also their overall development.

Although majority of grit studies investigated the predictive power of grit in academic success, recent studies associated grit with mental health and expanded its functions. For instance, Blalock et al. (2015) argued that people with grit are less influenced by stressful situations. They examined the buffering effect of grit on the relation between negative life events and suicidal ideation and revealed that individuals high in grit were less likely to have suicidal ideation in negative situations than individuals low in grit. This is because gritty people focus more on long-term goals and minimize their attention to stress. Also, grit might enable people to reframe negative situations more positively and use more effective problem-solving strategies during highly stressful situations (Blalock et al., 2015). Similarly, as mentioned earlier, another recent study (Marie et al., 2019) tested the associations between trauma, grit, and suicidal ideation and discovered that high levels of grit buffered the severity of suicidal ideation for those with PTSD symptoms. Also, a Korean study conducted by Lee et al. (2016) revealed that people with higher grit reported decreased negative emotion and increased positive emotion after receiving negative feedback. When

individuals receive negative feedback, some may feel offended and express hostility, while others may try harder to improve their abilities from the feedback. Lee et al. (2016) found that when given negative feedbacks, gritty individuals reacted more positively and tended to accept useful information from negative feedbacks in order to achieve long-term goals. These findings imply that people high with grit are less influenced by negative and stressful situations and react more positively.

Furthermore, several studies have associated grit with maladaptive behaviors. For instance, grittier adolescents were less likely to be involved in alcohol use, drug use, fighting, and delinquent behavior (Guerrero et al., 2016). Although Guerrero et al. (2016) could not precisely determine the mechanism of grit and adolescent's risky behaviors, they suggested some possible explanations. First, grit can contribute to the confidence and self-efficacy of teenagers, and motivate them to invest in the future through responsible decisions. Also, another possible explanation is that grit is closely associated with self-control, which also pertains to delay of gratification and less engaging in risky behaviors (Guerrero et al., 2016). In addition, grit appeared to be related to eating disorders (Knauft et al., 2019). The study showed that grit was negatively associated with bulimia and body dissatisfaction, which indicates that grit could serve as a buffer against disordered eating attitudes and behaviors. This might be because the concept

of grit is opposite to impulsivity which is a well-known risk factor for eating disorders (Knauft et al., 2019).

Moreover, recent studies started to connect grit with addiction such as drug use, internet, and smartphone addiction and broaden the importance of grit (Brozikowsky & Bernhardt, 2019; Griffin et al., 2016; Yoo & Choi, 2019). For instance, Griffin et al. (2016) found that grit was related to the recovery of patients with substance use disorder, as patients who were unemployed, diagnosed with a co-occurring psychiatric disorder, or who had used heroin during the past month had lower grit score. Also, Brozikowsky and Bernhardt (2018) examined grit among online gamers. As a result, grittier people were less likely to become addicted to online games, which indicates that grit could be negatively associated with overall addiction and could operate as a protective factor for addiction. Since there are limited studies about grit and addiction, Brozikowsky and Bernhardt (2018) suggested that more research in this area is necessary to fully understand how grit is associated with addictive behaviors. More recently, one study (Yoo & Choi, 2019) in South Korea related grit with smartphone addiction and discovered that grit was negatively associated with smartphone addiction. The researchers explained that this might be because smartphone addiction is related to a lack of patience, and the concept of grit encompasses the notion of perseverance (Yoo & Choi, 2019).

Furthermore, as mentioned earlier, recent studies suggested that two components of grit – consistency of interest and perseverance of effort – should be examined separately as they seemed to generate different consequences (Bowman et al., 2015; Datu et al., 2016; Disabato et al., 2019). For instance, Datu et al. (2016) discovered that the correlation between two factors of grit was very weak, and the perseverance of effort predicted academic engagement, life satisfaction, and positive affect more strongly than consistency of interest. Also, Bowman et al. (2015) separately examined the predictive utility of the two components and revealed that perseverance predicted greater academic adjustment, GPA, and sense of belonging than consistency among college students. Similarly, Disabato et al. (2019) investigated how differently each facet of grit is related to subjective well-being and personality strength. The study found out that perseverance of effort was associated with goal-directed thinking, meaning in life, and subjective happiness more strongly than consistency of interest. Studies in South Korea also reported that perseverance was significantly correlated with academic achievement, creative thinking, while consistency had a weak or non-significant correlation (Hwang et al., 2017; Lim, 2017). These prior findings indicate that positive academic and psychological outcomes are mostly driven by the perseverance of effort component of grit. In fact, consistency of interest dimension of grit is controversial in that the predictive

function of consistency of interest was weaker than that of perseverance of effort (Bowman et al., 2015; Datu et al., 2016; Disabato et al., 2019), and the items measuring consistency of interest are all negative statements which require the reverse calculation of the scores, reducing the reliability of the measurements (Lim, 2019). However, Knauft et al. (2019) demonstrated that consistency of interest, not perseverance of effort, was related to lower bulimia and body dissatisfaction scores. The study could not identify the specific mechanism but explained that individuals with continued interest in enduring goals would focus on long-term goals even when immediate rewards are absent, which could lead to lower eating disorder-related attitudes and behaviors (Knauft et al., 2019). This result indicates that consistency of interest dimension of grit can also contribute to positive outcomes. Therefore, two components of grit should be analyzed independently to better understand the functions of grit. However, most of the studies used the total score of grit in the past (Eskreis-Winkler et al., 2014; Roberston-Kraft & Duckworth, 2014). Thus, we planned to analyze the two facets of grit separately and complement the previous findings.

In sum, these previous findings suggest that grit may operate as a buffer against stressful situations and be negatively related to addictive behavior. Unfortunately, most of the studies associated grit with academic success and mental well-being, and limited studies examined the roles of grit in addictive

behaviors. In fact, the study conducted by Yoo and Choi (2019) is the only study that examined the relationship between grit and smartphone addiction, which was done on limited community samples of college students. However, as smartphone addiction is increasing and can lead to detrimental consequences, it is important to identify the factors that contribute to smartphone addiction. Thus, the current study sought to investigate the association between grit and smartphone addiction among adolescents. Particularly, we tried to analyze whether grit has a mediating effect between stress and smartphone addiction. Also, while Yoo and Choi (2019) failed to separately analyze the effect of consistency of interest and perseverance of effort on smartphone addiction, we aimed to investigate how each component of grit is related to smartphone addiction.

Stress and Grit

As mentioned earlier, prior studies discovered that grit can alleviate the negative outcomes of stressful situations. Gritty individuals tended to minimize attention to stress, focus more on success, and reframe negative situations more positively than less gritty individuals (Blalock et al., 2015; Lee et al., 2016; Marie et al., 2019). Also, Jung and Yang (2019) found that job-seeking stress mediated the relationship between grit and mental well-being. In other words, higher grit led to lower job-seeking stress, which subsequently led to better mental well-being. This result indicates that grit enables people to pursue goals and prevent them from being frustrated even in stressful situations. Moreover, Lee (2017) investigated the relationship between grit and stress among 345 college students. Grit negatively influenced stress, and thus the study argued that grit alleviated the stress experienced by students. Similar results were reported in other studies where grit appeared to have negative correlations with various kinds of stress (Kann angara et al., 2018; Shin et al., 2018).

However, relatively few studies investigated how stress influences grit. Although there are limited studies that examined the impact of stress on grit, some studies reported that stress had a negative influence on grit. For instance, as discussed earlier, Jung et al. (2020) discovered that occupational

stress had negatively predicted grit among firefighters. Also, O'Neal (2018) found that stress negatively impacted grit among elementary school students. On the contrary, other studies reported no significant correlation between stress and grit (Jeong & Jung, 2018; Wong et al., 2018). Since the results are inconsistent, more studies examining the effect of stress on grit are required.

Furthermore, several studies revealed that stress negatively impacts self-control ability (Cho et al., 2017; Duckworth et al., 2013), which is closely related to grit (Credé et al., 2017). Self-control refers to the ability to regulate attention, emotion, and behaviors to accomplish certain goals. Self-control is similar to grit in that both involve pursuing valued goals in the face of obstacles and challenges (Duckworth & Gross, 2014). As stated earlier, stress induces negative emotions such as depression or anxiety, and stressed individuals consume the limited resources for self-control to regulate the negative emotions, which in turn decreases the self-control ability (Cho et al., 2017). Also, Duckworth et al. (2013) examined the longitudinal effect of negative life events on self-control behaviors in early adolescence and found that psychological distress caused by the negative life events predicted lower self-control ability. Furthermore, a neuroimaging study conducted by Maier et al. (2015) revealed that stressed individuals had an increased preference for immediate rewards, and stress influenced goal-directed choices. Stressed participants were more likely to choose short-term rewarding tasty food over

less tasty but healthier food. These results indicate that stress impairs self-control ability. Based on these findings, we predicted that stress might also negatively influence grit, which includes the ability to control thoughts and behaviors to achieve goals.

Research Questions and Hypotheses

As reviewed above, stress appeared to be related to smartphone addiction, and grit may influence the relationship between stress and smartphone addiction. Based on the previous findings, the current study aimed to examine the relationship between stress, grit, and smartphone addiction among Korean adolescents. In particular, this study focused on exploring the mediating effect of grit on the relationship between stress and smartphone addiction. The present study's three research questions are as follows:

(1) Does stress predict smartphone addiction among adolescents?

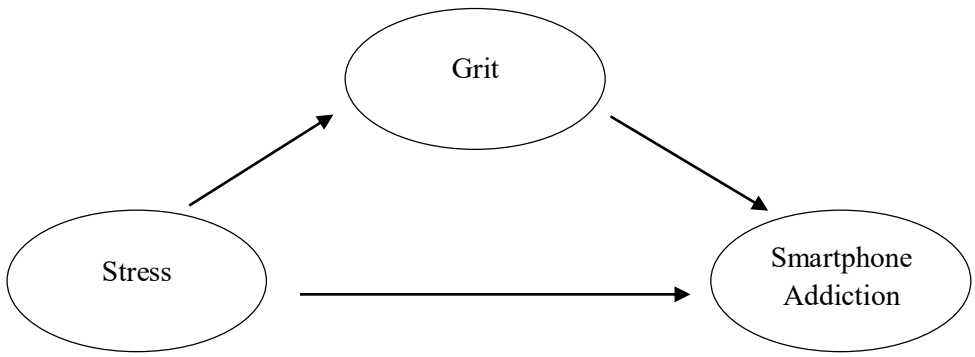
(2) Does grit predict smartphone addiction among adolescents?

(3) Do grit and components of grit mediate the relationship between stress and smartphone addiction among adolescents?

Concerning the first question, we expected that stress would positively predict smartphone addiction among adolescents. Regarding the second question, we anticipated that grit would negatively predict smartphone addiction among adolescents. Finally, regarding the third question, we hypothesized that grit would partially mediate the relationship between stress and smartphone addiction. In other words, when levels of stress increase, grit would decrease, which will increase the risk of smartphone addiction. The research model of the current study is presented in Figure 1.

Figure 1.

Research Model for Stress, Grit, and Smartphone Addiction



Method

Participants

Participants were 605 adolescents (315 boys and 290 girls) from 12 to 16 years old, and the mean age was 13.97 years. The participants consisted of 136 people aged 12, 101 people aged 13, 130 people aged 14, 121 people aged 15, 117 people aged 16. Most of the participants resided in Seoul and Gyeonggi province of the Republic of Korea.

Measures

Stress

Stress was measured using the Daily Hassles Scales for Children in Korea, developed by Han and Yoo (1995) to measure daily stress that is generally experienced by children in Korea. The scale comprises 42 items (sample items: “I am upset because my parents often argue” and “I am worried about what I have to study in the future”). A 6-point Likert scale is used for each item: 1 = *Strongly disagree*, 2 = *Disagree*, 3 = *Slightly disagree*, 4 = *Slightly agree*, 5 = *Agree*, 6 = *Strongly agree*. The scale consists of 6 factors: parent-

related stress, home environment stress, friend-related stress, academic stress, teachers & school related stress, and surroundings related stress. Among these factors, items of parent-related stress (8 items), home environment stress (7 items), and academic stress (7 items) were selected for this study. Higher scores represented higher levels of stress. The Cronbach's alpha of the scale was .85 in Han and Yoo's (1995) study, and .92 in Song and Jo's (2018) study. The Cronbach's alpha for the items used in the current study was .91.

Grit

Grit was measured by the Korean version of the Original Grit Scale (Duckworth et al., 2007; Park et al., 2020). The scale consists of 12 items (sample items: "I have achieved a goal that took years of work" and "My interests change from year to year") assessing consistency of interest (6 items) and perseverance of effort (6 items). Consistency of interest measures the tendency to pursue focused interests (not frequently changing goals) over a long period of time. Perseverance of effort measures the tendency to sustain the effort for long-term goals even in the face of failure and obstacles. Answers were given on a 5-point Likert scale for each item: 1 = *not at all like me,* 2 = *not much like me,* 3 = *somewhat like me,* 4 = *mostly like me,* 5 = *very much like me.* Items for consistency of interest factor were reverse calculated. The higher the total score, the higher the level of grit. The reported

Cronbach's alpha in Duckworth et al. (2007) was .85 (Consistency of Interests, α = .84; Perseverance of Effort, α = .78). The Cronbach's alpha in the current sample was .74 (Consistency of Interests, α = .67; Perseverance of Effort, α = .75).

Smartphone Addiction

Smartphone addiction was assessed by Smartphone Addiction Proneness Scale for Youth developed by the National Information Society Agency (2011). The scale consists of 15 items (sample items: "My grades went down due to excessive smartphone use" and "I feel anxious and nervous without my smartphone"). The scale includes 4 factors: disturbance of adaptive functions, virtual life orientation, withdrawal, and tolerance. Participants answered items on a 4-point Likert scale ranging from 1 = *not at all like me* to 4 = *very much like me.* The higher the score, the more likely participants are to be addicted to smartphones. The Cronbach's alpha demonstrated by National Information Society Agency (2011) was .88. The Cronbach's alpha in the current study was .88.

Procedures

Participants arrived at the laboratory and entered a private room. A brief

explanation of the purpose of the study and storage of the data were informed to the participants. Then they signed the consent form and agreed to participate in the study. They answered the questionnaires measuring stress, grit, and smartphone addiction. It took approximately 10 minutes for the participants to complete the questionnaires. Before the study was conducted, all procedures and measurement tools for this study were reviewed and approved by Seoul National University's Institutional Review Board (IRB).

Results

The present study examined the relationship between stress, grit, and smartphone addiction among adolescents aged 12 to 16. We also investigated grit as a mediating factor in the relationship between stress and smartphone addiction.

For statistical analysis, we used the Statistical Package for Social Science version 25 (SPSS 25). First, we analyzed the means, standard deviations, and range of stress, grit, and smartphone addiction. Second, Pearson's correlation analysis was conducted to examine the association of stress, grit, and smartphone addiction. To investigate the mediating effect of grit on the relationship between stress and smartphone addiction, we used model 4 of PROCESS macro version 3.5 developed by Hayes (2017). Finally, bootstrapping was performed to test the statistical significance of the mediating effect.

Descriptive Statistics among Stress, Grit, and Smartphone Addiction

Descriptive statistics of the variables, including stress, grit, and smartphone addiction were as follows (see Table 1). The mean of stress was 54.57 (*SD* = 16.93) with range 22.00 - 106.00. The means of each subscale were as follows: parent related stress (*M* = 17.80, *SD* = 7.80), home environment stress (*M* = 12.66, *SD* = 5.69), and academic stress (*M* = 24.09, *SD* = 7.26). Moreover, the mean of grit was 36.70 (*SD* = 5.95) with range 13.00 - 56.00. The means of each subscale were as follows: consistency of interest (*M* = 16.91, *SD* = 3.64) and perseverance of effort (*M* = 19.80, *SD* = 3.88). Finally, the mean of smartphone addiction was 29.76 (*SD* = 7.35) with range 15.00 - 60.00. The means of each subscale were as follows: disturbance of adaptive functions (*M* = 10.75, *SD* = 3.11), virtual life orientation (*M* = 3.17, *SD* = 1.09), withdrawal (*M* = 6.92, *SD* = 2.18), and tolerance (*M* = 8.91, *SD* = 2.52).

Table 1. *Descriptive Statistics of Stress, Grit, and Smartphone Addiction*

Measure	Mean	SD	Range	Minimum	Maximum	Skewness		Kurtosis	
						Statistic	Std. Error	Statistic	Std. Error
Stress	54.57	16.93	84	22	106	.34	.10	-.32	.20
Parent	17.80	7.80	33	8	41	.57	.10	-.51	.20
Home environment	12.66	5.69	28	7	35	1.14	.10	1.05	.20
Academic	24.09	7.26	36	7	42	-.12	.10	-.47	.20
Grit	36.70	5.95	43	13	56	.14	.10	.59	.20
Consistency of interest	16.91	3.64	22	6	28	.06	.10	.01	.20
Perseverance of effort	19.80	3.88	24	6	30	.12	.10	.17	.20
Smartphone addiction	29.76	7.35	45	15	60	.05	.10	.14	.20
Disturbance of adaptive functions	10.75	3.11	15	5	20	.08	.10	-.28	.20
Virtual life orientation	3.17	1.09	6	2	8	.68	.10	.21	.20

(Continued Table 1.)

Measure	Mean	SD	Range	Minimum	Maximum	Skewness		Kurtosis	
						Statistic	Std. Error	Statistic	Std. Error
Withdrawal	6.92	2.18	12	4	16	.58	.10	.25	.20
Tolerance	8.91	2.52	12	4	16	-.12	.10	-.32	.20

Correlations between Stress, Grit, and Smartphone Addiction

The correlations between stress, grit, and smartphone addiction are presented in Table 2. Correlations among variables were analyzed using Pearson's correlation analysis. As shown in Table 2, all of the variables significantly correlated with each other. Stress positively correlated with smartphone addiction (r = .37, p < .01) and negatively correlated with grit (r = -.35, p < .01). Negative correlation was found between grit and smartphone addiction (r = -.45, p < .01). Likewise, consistency of interest (r = -.37, p < .01) and perseverance of effort (r = -.35, p < .01) both negatively correlated with smartphone addiction. Other variables also showed significant correlations with each other, which are summarized in Table 2.

Table 2. *Correlations among Stress, Grit, and Smartphone Addiction*

		1	2	3	4	5	6	7	8	9	10	11	12
1.	Stress	1	.891**	.789**	.750**	-.351**	-.242**	-.316**	.371**	.286**	.368**	.339**	.280**
2.	Parent		1	.681**	.463**	-.268**	-.181**	-.246**	.265**	.208**	.322**	.236**	.178**
3.	Home environment			1	.318**	-.315**	-.178**	-.318**	.361**	.256**	.383**	.371**	.252**
4.	Academic				1	-.266**	-.214**	-.211**	.295**	.240**	.209**	.245**	.257**
5.	Grit					1	.775**	.806**	-.449**	-.445**	-.249**	-.222**	-.454**
6.	Consistency of Interest						1	.249**	-.368**	-.382**	-.183**	-.160**	-.377**
7.	Perseverance of Effort							1	-.347**	-.328**	-.214**	-.194**	-.346**
8.	Smartphone addiction								1	.879**	.670**	.766**	.876**
9.	Disturbance of adaptive functions									1	.428**	.460**	.747**
10.	Virtual life orientation										1	.657**	.427**

(Continued Table 2.)

		1	2	3	4	5	6	7	8	9	10	11	12
11.	Withdrawal											1	.517**
12.	Tolerance												1

** $p < .01$ (two-tailed)

Grit as a Mediator in the Relationship between Stress and Smartphone Addiction

To examine the mediating effect of grit on the relationship between stress and smartphone addiction, model 4 of PROCESS macro version 3.5 developed by Hayes (2017) was conducted. As shown in Table 3, adolescent stress significantly influenced grit (β = -.121, p < .000), and grit significantly influenced smartphone addiction (β = -.449, p < .000), which means that grit mediated the relationship between stress and smartphone addiction. Also, the total effect of stress on smartphone addiction (β = .158, p < .000) was significant. When controlling for the mediation variable grit, the direct effect of stress and smartphone addiction became lower (β = .103, p < .000). Thus, grit appeared to partially mediate the relationship between stress and smartphone addiction. The results are summarized in Figure 2.

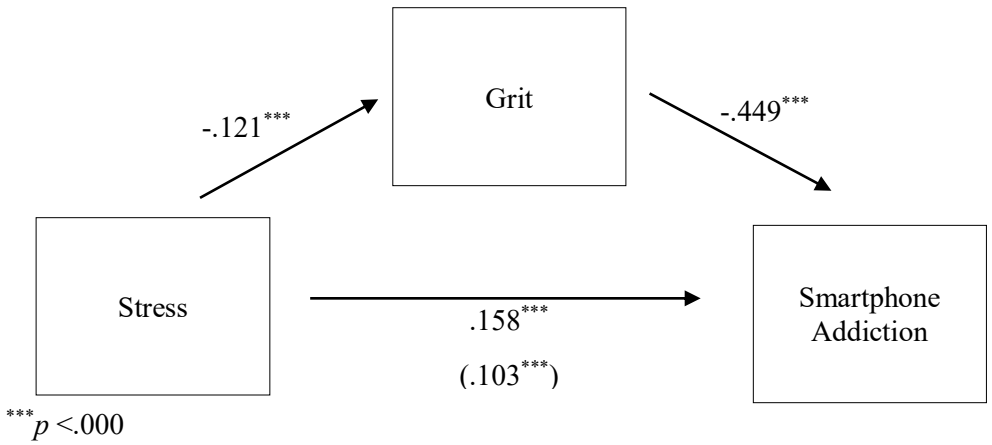
Table 3. *Mediating Effect of Grit in the Relationship between Stress and Smartphone Addiction*

Path	*β*	*se*	*t*	*p*	*LLCI*	*ULCI*
Stress → Grit	-.121	.014	-8.845	.0000	41.949	45.115
Grit → Smartphone addiction	-.449	.047	-9.488	.0000	-.542	-.356
Stress → Smartphone addiction	.103	.017	6.096	.0000	.070	.136
Stress → Grit → Smartphone addiction	.158	.017	9.324	.0000	.125	.192

Note. LLCI = lower limit confidence interval, ULCI = upper limit confidence interval

Figure 2.

Mediation Model for Stress, Grit, and Smartphone Addiction



After examining the mediation effect, we conducted bootstrapping using the PROCESS macro to test the significance of the mediation effect. Bootstrapping was based on 5,000 samples with 95% confidence intervals. The results are presented in Table 4. The mediation effect of grit on the relationship between stress and smartphone addiction was statistically significant because the bootstrapped confidence intervals did not contain zero (CI = .0371 - .0755).

Table 4. *Bootstrap Test of Mediating Effect of Grit*

	β	Boot. SE	95% CI	
Mediating effect	.056	.009	lower	upper
			.037	.076

Moreover, the mediating effects of two components of grit were separately analyzed. Similar to the previous result of the mediating effect of grit, consistency of interest and perseverance of effort both significantly mediated the relationship between stress and smartphone addiction.

First, the mediating effect of consistency of interest is shown in Table 5. Stress negatively predicted consistency of interest (β = -.052, p < .000), and consistency of interest negatively predicted smartphone addiction (β = -.598, p < .000). Thus, consistency of interest component of grit was found to mediate the relationship between stress and smartphone addiction. Also, the total effect of stress on smartphone addiction (β = .161, p < .000) decreased when the mediation variable consistency of interest was controlled (β = .130, p < .000). These results indicate that consistency of interest partially mediated the relationship between stress and smartphone addiction. In addition, bootstrapping was conducted in order to test the mediation effect. It was based on 5,000 samples with 95% confidence intervals. The mediation effect was

statistically significant because the bootstrapped confidence interval (CI = .0186 - .0461) excluded zero (see Table 6).

Table 5. *Mediating Effect of Consistency of Interest in the Relationship between Stress and Smartphone Addiction*

Path	*β*	*se*	*t*	*p*	*LLCI*	*ULCI*
Stress → Consistency of Interest	-.052	.009	-5.850	.0000	-.096	-.034
Consistency of Interest → Smartphone addiction	-.598	.076	-7.833	.0000	-.748	-.448
Stress → Smartphone addiction	.130	.017	7.851	.0000	.098	.163
Stress → Consistency of Interest → Smartphone addiction	.161	.017	9.513	.0000	.128	.194

Note. LLCI = lower limit confidence interval, ULCI = upper limit confidence interval

Table 6. *Bootstrap Test of Mediating Effect of Consistency of Interest*

	β	Boot. SE	95% CI	
			lower	upper
Mediating effect	.031	.007	.019	.046

Table 7 presents the mediating effect of perseverance of effort. First, stress significantly influenced perseverance of effort ($\beta = -.073$, $p < .000$), and perseverance of effort significantly influenced smartphone addiction ($\beta = -.486$, $p < .000$). These results show that perseverance of effort mediated the

relationship between stress and smartphone addiction. In addition, the effect of stress on smartphone addiction (β = .159, p < .000) decreased when perseverance of effort was controlled (β = .123, p < .000). Therefore, a partial mediation effect of perseverance of effort in stress and smartphone addiction was observed. Also, to test the significance of the mediation effect, we conducted bootstrapping with 5,000 samples and 95% confidence interval. The mediation effect was statistically significant as the bootstrapped confidence intervals (CI = .0215 - .0529) did not include zero (see Table 8).

Table 7. *Mediating Effect of Perseverance of Effort in the Relationship between Stress and Smartphone Addiction*

Path	*β*	*se*	*t*	*p*	*LLCI*	*ULCI*
Stress → Perseverance of Effort	-.073	.010	-7.941	.0000	-.092	-.055
Perseverance of Effort → Smartphone addiction	-.486	.075	-6.528	.0000	-.632	-.340
Stress → Smartphone addiction	.123	.017	7.133	.0000	.089	.157
Stress → Perseverance of Effort → Smartphone addiction	.159	.017	9.357	.0000	.125	.192

Table 8. *Bootstrap Test of Mediating Effect of Perseverance of Effort*

	β	Boot. SE	95% CI	
			lower	upper
Mediating effect	.036	.008	.022	.053

Discussion

The current study was conducted to shed light on the prevention and intervention of smartphone addiction among adolescents. In particular, we focused on grit, which is defined as "working strenuously toward challenges, maintaining effort and interest over years despite failure, adversity, and plateaus in progress" (Duckworth et al., 2007, p.1087-1088) and investigated its association with stress and smartphone addiction. Based on the previous findings (Brozikowsky & Bernhardt, 2018; Griffin et al., 2016; Yoo & Choi, 2019), we hypothesized that grit would be negatively associated with smartphone addiction and mediate the relationship between stress and smartphone addiction. The main findings were as follows.

First, adolescents' daily stress (parent-related stress, home environment stress, and academic stress) was significantly associated with smartphone addiction. This means that the higher the stress, the higher the possibility of smartphone addiction. This is consistent with previous studies, which reported that stress positively predicted smartphone addiction (Chiu, 2014; Samaha & Hawi, 2016; Wang et al., 2015). When people experience high levels of stress, they were more likely use the internet or smartphones to relieve stress and escape from internal discomfort (Wang et al., 2015).

Moreover, stress may reduce the ability to self-control, which in turn may increase the possibility of excessive smartphone use (Cho et al., 2017; Liu et al., 2018). In line with these findings, our study revealed that high levels of stress can lead to increased possibility of smartphone addiction among adolescents.

Second, the adolescent's grit negatively predicted smartphone addiction. This result indicates that the lower the grit level, the higher the tendency for smartphone addiction. Also, both components of grit – consistency of interest and perseverance of effort – were negatively related to smartphone addiction. As reviewed earlier, previous studies reported that grit was negatively related to maladaptive behaviors such as delinquent behaviors among adolescents, substance use disorder, online game addiction, and more (Brozikowsky & Bernhardt, 2018; Griffin et al., 2016; Guerrero et al., 2016; Knauft et al., 2019). As grit refers to perseverance and sustained effort despite failure and adversity, it can contribute to focusing on long-term goals and making responsible life choices (Guerrero et al., 2016). Thus, grit may lead to less engaging in risky and maladaptive behaviors. The current result corroborates these previous findings in that lower grit was related to higher possibility of being addicted to smartphones, adding to a growing body of literature about the relationship between grit and addictive behaviors.

Furthermore, grit partially mediated the relationship between stress and smartphone addiction among adolescents. This finding showed that as levels of stress increased, grit decreased, which in turn increased the risk of smartphone addiction. In other words, higher stress led to smartphone addiction through lower grit. This is consistent with the previous finding (Yoo & Choi, 2019) that demonstrated the mediating effect of grit on the relationship between academic stress and smartphone addiction among college students. However, unlike Yoo and Choi's (2019) study, which was conducted on a limited community sample of college students, our study targeted adolescents (12 to 16 years old) who are more vulnerable to smartphone addiction (Haug et al., 2015). According to the current study, adolescents' daily stress can not only directly lead to smartphone addiction but also lower the level of grit, which may lead to increased smartphone addiction. This result implies that high levels of grit can serve as a protective factor against smartphone addiction even under stressful situations. As gritty people minimize their attention to stress and focus on success, not failure, they are less influenced by stressful situations and tend to use more effective problem-solving strategies (Blalock et al., 2015; Lee et al., 2016; Marie et al., 2019). The salient presence of long-term goals may also motivate gritty people to engage in more effortful and less enjoyable activities toward long-term goals (Blalock et al., 2015; Duckworth et al., 2011). Thus, high grit may

motivate adolescents not to indulge themselves in smartphones and to focus more on constructive behaviors for long-term goals. Moreover, as discussed earlier, recent studies revealed the mediating and moderating effect of grit on the relationship between stress and negative outcomes (Jung et al., 2020; Marie et al., 2019). Jung et al. (2020) argued that firefighters with high grit were more likely to strengthen their identity and expertise, and thus they were less likely to be frustrated by adversity or failure. They tend to use failures as opportunities for growth and cope with job burnout under occupational stress. Therefore, the study considered grit as an important internal capacity that could reduce job burnout among firefighters. Likewise, grit appeared to function as a resilience factor in the relationship between posttraumatic stress disorder symptoms and suicidal ideation (Marie et al., 2019). The present study supports these findings and indicates that although high levels of stress can lead to smartphone addiction among adolescents, grit can serve as a personal factor that may prevent stress from leading to smartphone addiction. Furthermore, recent study revealed that grit was associated with health care management skills such as managing medication, keeping an appointment, and managing daily activities among college students (Sharkey et al., 2017). Gritty college students tended to engage in greater health care management skills, which led to better health-related quality of life. This means that grit can contribute to more responsible decisions and behaviors. As gritty

individuals tend to focus on long-term goals and make more responsible choices rather than seeking immediate reward and satisfaction, gritty adolescents might not indulge in maladaptive coping behavior such as excessively using smartphones to relieve stress.

In addition, when two components of grit (consistency of interest and perseverance of effort) were analyzed separately, they both partially mediated stress and smartphone addiction. As reviewed earlier, several studies argued that consistency of interest and perseverance of effort may bring different results (Datu et al., 2016; Disabato et al., 2019; Wolters & Hussain, 2015). However, our study found that consistency of interest and perseverance of effort were both negatively related to smartphone addiction and mediated the relationship between stress and smartphone addiction. This means that adolescents' daily stress can reduce consistent passion and continued effort for long-term goals, which might subsequently lead to engaging in excessive use of smartphones. Thus, these results indicate that possessing high levels of grit might block the path of stress leading to smartphone addiction.

This study has following limitations and suggestions for further research. First, our study was based on self-reported questionnaires, which assume that participants answered the questions truthfully. However, participants' emotional state, social desirability, and other factors may have influenced the response. Second, this study relied on non-experimental cross-

sectional data, and findings were based on data from one period. Therefore, future longitudinal or experimental studies should be conducted to examine a more direct causal relationship between stress, grit, and smartphone addiction. Third, our study only focused on grit as a mediating factor of stress and smartphone addiction. However, several previous studies suggested the mediating effect of self-control (Cho et al., 2017; Liu et al., 2018) and resilience (Park & Kwon, 2019) on the relationship between stress and smartphone addiction. Thus, we recommend future research to comprehensively explore the mediating functions of personal factors, including not only grit but also self-control and resilience on the relationship between stress and smartphone addiction. Finally, as the importance of grit was found to extend beyond academic performance, it would be meaningful to investigate the predictive factors of grit. For instance, a recent longitudinal study by Park et al. (2020) demonstrated that the ability to delay immediate gratification at age four predicted greater grit at age 14. Unfortunately, most studies have rarely examined the predictive factors of grit in a longitudinal study. Thus, it is necessary for more studies to explore the predictors of grit in longitudinal settings (Park et al., 2020).

However, despite these limitations, as the first empirical study to investigate the relationship between stress, grit, and smartphone addiction among adolescents, the current study has following implications. First, by

exploring grit in relation to smartphone addiction, our study went one step further than relating grit with academic success and contributed to a growing body of literature that highlighted the protective function of grit against maladaptive behaviors (Brozikowsky & Bernhardt, 2018; Griffin et al., 2016; Guerrero et al., 2016; Knauft et al., 2019). As previously discussed, grit has significant implications for adolescents in that it leads to better academic performance (Duckworth et al., 2011; Lee & Sohn, 2013) and mental health (Blalock et al., 2015; Marie et al., 2019). However, to the best of our knowledge, this is the first empirical study that examined the influence of grit on adolescent's smartphone addiction. Thus, the present study is meaningful in that we showed the negative relation between grit and smartphone addiction of adolescents and contributed to expanding the function of grit among adolescents. Moreover, by exploring the mediating effect of grit on stress and smartphone addiction, our study revealed the mechanism of how stress influences smartphone addiction and provided a personal factor that can prevent the path of stress leading to smartphone addiction. Therefore, to reduce adolescents' smartphone addiction due to daily stress, educational programs fostering grit among adolescents would be helpful for the prevention and intervention of smartphone addiction.

Recently, several studies investigated how grit can be developed and improved. For instance, a longitudinal study by Park et al. (2018) showed that

grit can be developed in a school environment that focuses on learning and improving new skills for their own sake (mastery) rather than that focuses on demonstrating ability in relation to others (performance). Students who perceived their schools as emphasizing mastery were more likely to have higher grit, which subsequently led to higher grades. Also, Tang et al. (2019) suggested that promoting goal commitment would enhance grit, particularly for adolescents. Goal commitment refers to a dedication to a specific goal, and high goal commitment encourages people to stick to their goals and sustain persistence and consistency in goal achieving process. Tang et al. (2019) found that adolescents who have high goal commitment were more likely to have higher perseverance of effort. Moreover, another recent study discovered that parent's mindset about failure appeared to influence student's grit development (An et al., 2020). According to An et al. (2020), parents who considered failure as a constructive and growing experience were more likely to strengthen their children's failure tolerance, which positively influenced the development of grit. These results indicate that grit is a malleable personal trait and it can be developed through internal and external factors such as academic environment and parental attitude. As grit appeared to mediate the relationship between stress and smartphone addiction in the current study, further research could investigate how to encourage grit in adolescents to prevent smartphone addiction and alleviate the negative effects of stress.

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Appendix

Appendix 1. 스트레스 척도

Appendix 2. 그릿 척도

Appendix 3. 스마트폰 중독 척도

Appendix 1. 스트레스 척도

※ 다음은 스트레스에 대한 여러분들의 생각을 알아보기 위한 문항들입니다. 솔직하게 표시해 주세요.

		전혀 그렇지 않다	그렇지 않다	약간 그렇지 않다	약간 그렇다	그렇다	매우 그렇다
1	앞으로 해야 할 공부를 생각하면 걱정이 앞선다	1	2	3	4	5	6
2	내가 장차 어떤 일을 할 수 있을지 고민이 된다	1	2	3	4	5	6
3	우리 집이 가난해서 속상하다	1	2	3	4	5	6
4	부모님이 내 일에 지나치게 간섭하고 참견하셔서 짜증난다	1	2	3	4	5	6
5	나는 부모님이 늘 공부하라고 말씀하셔서 짜증이 난다	1	2	3	4	5	6
6	나는 부모님이 자주 다투셔서 속상하다	1	2	3	4	5	6
7	가족들이 나에게 관심을 보이지 않아 불만이다	1	2	3	4	5	6
8	우리 가족은 그다지 화목한 편이 못되어서 속상하다	1	2	3	4	5	6
9	내게 거는 부모님의 기대와 요구가 너무 커서 부담스럽다	1	2	3	4	5	6
10	나는 집이 좁아서 속상하다	1	2	3	4	5	6
11	내가 갖고 싶어 하는 것들을 부모님이 잘 사주지 않아 불만이다	1	2	3	4	5	6
12	나는 필요한 물건들을 제대로 살 수가 없어서 속상하다	1	2	3	4	5	6
13	나는 학업성적 때문에 신경이 많이 쓰인다	1	2	3	4	5	6
14	나는 다니고 있는 학원이나 과외활동이 많아 힘들다	1	2	3	4	5	6

15	나는 시험을 볼 때마다 초조하고 긴장이 된다	1	2	3	4	5	6
16	부모님이 내 성적에 너무 신경쓰셔서 부담스럽다	1	2	3	4	5	6
17	열심히 노력해도 성적이 잘 오르지 않아 걱정이 된다	1	2	3	4	5	6
18	나는 부모님과 충분한 이야기를 나누지 못해 불만이다	1	2	3	4	5	6
19	부모님이 나에게 시키는 일이 많아 피곤하다	1	2	3	4	5	6
20	우리 집 분위기가 마음에 안든다	1	2	3	4	5	6
21	부모님이 내 생각이나 의견을 존중해주지 않아 불만이다	1	2	3	4	5	6
22	대학에 못 들어가면 안된다는 생각에 벌써부터 걱정이 된다	1	2	3	4	5	6

Appendix 2. 그릿 척도

※ 다음을 잘 읽고 각 문항에 대해서 자신과 얼마나 비슷한지를 표시해 주세요.

		전혀 그렇지 않다	그렇지 않다	보통이다	그렇다	매우 그렇다
1	나는 종종 목표를 세우지만, 나중에 그것과는 다른 일을 하곤 한다	1	2	3	4	5
2	나는 부지런하다	1	2	3	4	5
3	나의 관심사는 매년 바뀐다	1	2	3	4	5
4	좌절은 나의 의욕을 꺾지 못한다	1	2	3	4	5
5	나는 몇 개월마다 새로운 목표나 관심사에 흥미를 갖게 된다	1	2	3	4	5
6	나는 수년의 노력을 요구하는 목표를 달성해 본 적이 있다	1	2	3	4	5
7	때때로 새로운 생각이나 일 때문에 기존에 하고 있는 생각이나 일이 방해를 받는다	1	2	3	4	5
8	나는 내가 시작한 것은 무엇이든 끝낸다	1	2	3	4	5
9	나는 열심히 하는 사람이다	1	2	3	4	5
10	나는 한동안 새로운 생각이나 계획에 사로잡히지만 곧 관심을 잃게 된다	1	2	3	4	5
11	나는 중요한 도전을 위해 좌절을 극복해 왔다	1	2	3	4	5
12	나는 달성하는데 몇 개월이 걸리는 일에 꾸준히 집중하기 어렵다	1	2	3	4	5

Appendix 3. 스마트폰 중독 척도

※ 다음 질문에 답해 주세요.

		전혀 그렇지 않다	그렇지 않다	그렇다	매우 그렇다
1	스마트폰의 지나친 사용으로 학교 성적이 떨어졌다.	1	2	3	4
2	가족이나 친구들과 함께 있는 것보다 스마트폰을 사용하고 있는 것이 더 즐겁다.	1	2	3	4
3	스마트폰을 사용하지 못하게 된다면 견디기 힘들 것이다.	1	2	3	4
4	스마트폰 사용시간을 줄이려고 해보았지만 실패했다.	1	2	3	4
5	스마트폰 사용으로 계획한 일(공부, 숙제 또는 학원수강 등)을 하기 어렵다.	1	2	3	4
6	스마트폰을 사용하지 못하면 온 세상을 잃는 것 같은 생각이 든다.	1	2	3	4
7	스마트폰이 없으면 안절부절 못하고 초조해진다.	1	2	3	4
8	스마트폰 사용시간을 스스로 조절할 수 있다.	1	2	3	4
9	수시로 스마트폰을 사용하다가 지적을 받은 적이 있다.	1	2	3	4
10	스마트폰이 없어도 불안하지 않다.	1	2	3	4
11	스마트폰을 사용할 때 그만해야지 라고 생각은 하면서도 계속한다.	1	2	3	4
12	스마트폰을 너무 자주 또는 오래한다고 가족이나 친구들로부터 불평을 들은 적이 있다.	1	2	3	4
13	스마트폰 사용이 지금하고 있는 공부에 방해가 되지 않는다.	1	2	3	4
14	스마트폰을 사용할 수 없을 때 패닉상태에 빠진다.	1	2	3	4

15	스마트폰 사용에 많은 시간을 보내는 것이 습관화되었다.	1	2	3	4

국문초록

본 연구의 목적은 청소년의 스트레스와 스마트폰 중독의 관계에서 그릿의 매개효과가 나타나는지 알아보는 것이다. 청소년의 스마트폰 이용이 증가함에 따라 많은 선행 연구들은 스마트폰 중독의 관련 요인에 대해 연구해왔다. 그러나 대부분의 연구는 스마트폰 중독으로 인한 부정적 결과를 중심적으로 다루었으며 청소년들이 어떻게 스마트폰 중독에 이르게 되는지 그 경로에 대한 탐색은 상대적으로 부족한 실정이다. 특히 한국 청소년들을 대상으로 스트레스, 그릿, 그리고 스마트폰 중독의 관계를 탐색한 연구는 전무하다. 따라서 본 연구에서는 12 세에서 16 세 한국 청소년들을 대상으로 스트레스, 그릿, 스마트폰 중독의 관계를 알아보았다. 더불어 스트레스와 스마트폰 중독의 관계에서 그릿의 매개효과가 나타나는지 알아보았다. 본 연구에는 605 명의 한국 청소년들이 참여하였으며 (평균 연령 = 13.97 세), 참여자들은 스트레스, 그릿, 스마트폰 중독을 측정하는 설문지를 완료하였다. 스트레스는 한국아동의 일상적 스트레스 척도(Han & Yoo, 1995)를 사용하여 측정하였으며, 그릿은 Original Grit Scale 의 번안된 척도(Duckworth et al., 2007; Park et al., 2020)로 측정하였다. 마지막으로, 스마트폰 중독은 한국정보화진흥원(2011)에서 개발한 청소년용 스마트폰 중독 자가진단 척도를 사용하여 측정하였다.

먼저 Pearson 의 상관분석을 사용하여 스트레스, 그릿, 스마트폰 중독의 상관관계를 분석하였다. 또한, 스트레스와 스마트폰 중독의 관계에서 그릿의 매개효과가 나타나는지 검증하기 위하여 Hayes(2017)의 PROCESS macro 를 실시하였고, 매개효과의 유의성을 검증하기 위해 부트스트래핑(Bootstrapping)을 실시하였다. 본 연구의 주요 결과는 다음과 같다. 첫째, 청소년의 스트레스는 스마트폰 중독에 유의미한 영향을 미쳤다. 둘째, 청소년의 그릿은 스마트폰 중독에 유의미한 영향을 미쳤다. 마지막으로, 그릿은 스트레스와 스마트폰 중독의 관계를 부분 매개하는 것으로 나타났다. 즉, 스트레스가 높을수록, 그릿은 낮아지고, 이는 청소년의 스마트폰 중독 성향을 높이는 경향이 있었다. 게다가, 그릿의 두 하위 요소 (노력 지속과 흥미 유지) 모두 스트레스와 스마트폰 중독의 관계를 부분 매개하였다. 이러한 결과는 청소년의 일상적 스트레스가 스마트폰 중독의 잠재적 위험 요인이 될 수 있다는 것을 의미한다. 더불어 스트레스와 스마트폰 중독의 관계에서 그릿이 매개 역할을 한다는 것을 검증함으로써 본 연구는 스트레스가 스마트폰 중독으로 이어지는 기제를 밝혔으며 그릿이 청소년기 스마트폰 중독 위험성을 완화하는 개인적 요인이 될 수 있다는 것을 밝혔다. 본 연구는 청소년기 그릿을 스트레스, 스마트폰 중독과 연관시켜 탐색한 첫번째 경험적 연구이며 스마트폰 중독의 예방과 개입에 도움을 줄 수 있는

정보를 제공할 수 있다는 점에서 학문적 의의가 있다. 논의에는 이 연구의 한계점과 추후 연구 방향에 대한 제언을 제시하였다.

주요어: 스트레스, 그릿, 스마트폰 중독, 청소년기, 매개효과

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