Smart Phone Addiction Characteristics and Development Mechanism of Deaf or Hard-of-Hearing Students: a Mediating Effect Interpretive Model

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Research Article

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Abstract

The overuse of smart phone may cause addiction, however, the deaf or hard-of-hearing addicts haven't gained enough attention. The purpose of this study is to address the characteristics of mobile phone addiction of students who are deaf or hard-of-hearing(hereafter DHH), and to explore the possible formation mechanism of mobile phone addiction of Chinese DHH students through a mediating model. The data were collected by recruiting 570 Chinese DHH students in junior high schools, senior high schools and universities to finish questionnaires of Mobile Phone Addiction Index, Perceived Discrimination Questionnaire and Sense of Security Questionnaire. The results show that: (1) 47.4% of DHH students have mobile phone addiction tendency; (2) the degree of mobile phone addiction of girls is significantly higher than that of boys; (3) the degree of mobile phone addiction of DHH students who can successfully communicate with ordinary people is significantly lower than that of those who can communicate at an acceptable dis-fluency and those who suffer apraxia; (4) there is a significant positive correlation between the discrimination perception of DHH students and their mobile phone addiction; (5) the sense of security plays a complete mediating role between the perception of discrimination and mobile phone addiction of DHH students. It shows that some deaf or hard-of-hearing people may have obvious problems of smart phone addiction. The perception of discrimination is the possible cause of smart phone addiction of the DHH people, and plays an indirect role through the sense of security. In conclusion, this study proposes a possible explanatory model of mobile phone addiction in DHH people, which can provide reference for early intervention in the prevention and intervention of mobile phone addiction in DHH people.

Public Significance Statement:

The research has put forward an explaining model for Chinese DHH students' smart phone addiction,which may offer suggestions towards this phenomenon's early intervention.

Introduction

The 47th Statistical Report on China's Internet Development released by China Internet Network Information Center in 2021 shows that by December 2020, the number of Chinese internet users has amounted to 989 million, which has been as many as 70.4% of Chinese total population, and smart phone is the most widely used internet surfing device, accounting for 93.9% (China Internet Network Information Center, 2019).Being much more sophisticated and advanced than the early cell phones, smart phones can offer the users both synchronous and asynchronous connections on the cyberspace, which provide social, entertaining, shopping, learning and other opportunities free from spacial-temporal boundaries. With its increasing popularity, smart phone has permeated deeper and wider in people's lives. As a "double-edged sword", smart phones can facilitate people's daily lives, expand their social channels and increase their social frequency,while the psychological problems caused by smart phones should not be ignored. One of the most typical is the smart phone addiction caused by overuse and dependence. Compared with traditional mobile phone addiction, smart phone addiction is more extensive and tacit,

and is more harmful to both individuals' physical and mental health. In serious cases, it may cause many syndromes, such as sleeping disorder, personality disorder, attention deficit, decreased willpower, poor self control,fast blurred vision, physiological cycle disorder, academic procrastination,etc.(Liu et al., 2017; Eun et al., 2017; Kircaburun & Griffiths, 2018; Sharma, et al., 2019; Hawi & Samaha, 2016). Research shows that the rate of smart phone addiction among Chinese youngsters is about 22.8%, almost twice that of adults (Zou, et al., 2019).

Deaf or hard-of-hearing refers to the disease that individuals can not hear or can not hear clearly due to different degrees of permanent hearing loss in both ears caused by congenital or acquired reasons, and it is difficult for sufferers to communicate with ordinary people. According to the data of the second Chinese national sample survey of the disabled, there are about 20.54 million deaf or hard-of-hearing people in China, nearly 24.2% of the total population of the disabled (85.02 million) (CDPF, 2021). Although there are few empirical comparative studies at home and abroad on whether DHH people suffer more serious smart phone addiction than the ordinary population, it's apparent that due to their limitations in hearing and language competence, DHH people have more difficulties and are more dependent on smart phones in their daily lives, entertainment and social interactions(especially in socializing with the general population). This often forms a risking factor leading to smart phone addiction, but fails to clearly explain the formation mechanism of smart phone addiction of DHH people. Relevant research needs to be conducted to further analyze and explore the combining cognitive, psychological and behavioral characteristics of DHH people.

The "Social Anxiety Model" proposed by Wells (1995) and the "ACE model" proposed by Young (1996) believe that individuals who have received negative evaluations are prone to regard social situations as uneasy sites, which will further lead to anxiety symptoms (such as reduced or missing sense of security), so they would regard the Internet as a safer space to escape their pressure and distress in real life contexts and to seek psychological comforts (Jos é, et al., 2016). In severe cases, it is also easy to lead to excessive Internet Dependence and even Internet addiction (Shapira, Goldsmith, keck, Khosla, & McElroy, 1997; Shin, Kim, & Jang, 2011). Studies on DHH people have consistently pointed out that most of them have experienced exclusion and discrimination more or less in their social activities (Fan, Fu, & Liu, 2020), and they are often more prone to develop negative emotions such as anxiety, reduced sense of security,etc, in social situations (Chou, 2008). So, what are the overall characteristics of smart phone addiction of DHH people? Will the negative experience and cognition in social activities cause smart phone addiction? What role do emotional factors play? Based on the above two theories, this study intends to firstly investigate the basic characteristics of mobile phone addiction of Chinese DHH students and then comprehensively investigate the cognitive factors (discrimination perception) and emotional factors (sense of security) on their mobile phone addiction to better understand the causes of mobile phone addiction of DHH people.

Literature Review And Hypotheses

Demographic attributes in smart phone addiction

Similar to Internet addiction, smart phone addiction is also a typical behavioral addiction, which is characterized by high-frequency, repetitive and uncontrollable usage and long-term dependence. Consequently, it causes damage to individual's mental and physical health (Lopez Fernandez, Honrubia Serrano, Freixa Blanxart, & Gibson, 2014). It should be noted that before falling into smart phone addiction, individuals generally experience two states: one is a controllable long-term use of mobile phones, and the other is the tendency of losing control with mobile phone addiction. Compared with the later two states, mobile phone addiction reflects the individual's self-control failure and more severe physical and mental damages.

The study on the ordinary people shows that there are significant differences in the performance of mobile phone addiction among individuals with different demographic attributes. For example, Csibi et al. (2019) investigated the use of smart phones among 1603 individuals of different age groups and found that preschool children and young people show a high risk of smart phone addiction; Walsh (2011) investigated young people in Australia and found that women are more prone to smart phone addiction than men; Pew Research Center (2016) showed that compared with low education and low-income groups, high education and high-income groups have a higher risk of smart phone addiction; Cha (2018) also found that teenagers whose parents are busy with work show a higher risk of smart phone addiction. These studies on the general population have basically revealed the characteristics of mobile phone addiction of different groups. However, compared with the ordinary population, DHH people have different degrees of hearing compensation due to different hearing loss, and their language ability and social ability also show significant differences. This may also play certain effect in whether they have mobile phone addiction or show the tendency. Therefore, this study puts forward the first hypothesis, H1: there are significant differences in smart phone addiction among different DHH groups.

Perception of discrimination and smart phone addiction

The perception of discrimination is the individual's perception of different or unfair treatment to his/her group identity. Compared with objective discrimination, this is a kind of subjective negative experience (Liu, Zhao & Shi, 2011). As a long-term stress source, discrimination perception will have a destructive impact on individual's social life, especially on inter-group relations. Research shows that disadvantaged groups who often suffer or experience discrimination and exclusion have significantly higher social alienation, social withdrawal and social avoidance tendencies, and even some individuals who cannot tolerate will take aggressive behaviors (Genberg, et. al, 2009; Li, 2013; Zhang, et. al, 2017).

When the disadvantaged groups who have experienced long term discrimination and can not smoothly and equally participate in real social life or establish normal inter-group relations, it has become the common choice for most to seek compensation or to release their pressure in the virtual network world where they can hide personal characteristics. This often leads to their Internet addiction or smart phone addiction. Ahmadi et al. (2014) and Jocelyne et al. (2017) further pointed out that excessive use of the Internet or smart phones has become an important way for individuals to alleviate stress and anxiety. In addition, studies have found that the proportion of Internet addiction or smart phone addiction among the

disadvantaged groups (such as the disabled and left behind children in Chinese rural areas) who have been discriminated and excluded for a long time is significantly higher than that of the general population (GE, 2014; Ren, 2017; mart í Nez, 2015). Due to the limited hearing competence and verbal ability, DHH people are vulnerable to discrimination and exclusion in communications with the ordinary people. Failing to integrate well into the mainstream social communication, and often drifting away from the edge of the mainstream society, they are of the typical vulnerable group. Liu (2018) found that in order to escape the perceived discrimination in real lives, many DHH people prefer to indulge in the Internet to seek understanding, respect and recognition. So, does DHH people's perception of discrimination lead to a higher risk of their smart phone addiction? Based on this, the study puts forward the second hypothesis, H2: there is a significant correlation between perception of discrimination and smart phone addiction.

The mediating effects of sense of security

A sense of security is an individual's premonition of a possible crisis that endangers his/her own psychological and physical stability. It is the individual's subjective cognition and response to their own security state (Cong & an, 2004). Individuals with low sense of security often feel that they are not accepted and are prone to show unstable emotions, and in serious cases some even have neurotic tendencies (Shen, Wang, & Geng, 2011); while individuals with high sense of security will accept themselves more and are easier to experience more sense of belonging and control(Wu, et. al ,2019).

It has been found that the perception of discrimination that individuals have experienced or are experiencing will have a negative impact on their sense of security. For example, Liu et al. (2012) found that there is a significant negative correlation between discrimination perception and migrant children's sense of security; Moses(2010) found that 62% of the disabled have suffered peer discrimination and 46% of the disabled have suffered discrimination from family members. These discrimination perceptions and experiences will strengthen their emotional feelings of loneliness and depression, which will in turn develop to the lack of sense of security. Relevant studies further pointed out that individuals with low sense of security are easy to turn their attention to the virtual network from where to seek social support and construct peer relationships to satisfy their psychological need that has been blocked in real social life (Shapira, et.al, 2000; ye, et.al, 2017). This shows that the sense of security may have a mediating effect in the direct effects of discrimination perception and mobile phone addiction. Combined with the aforementioned "Social Anxiety model" and "ACE model" , this study puts forward the third hypothesis, namely H3: security plays a mediating role in the relationship between discrimination perception and mobile phone addiction of DHH people (Fig. 1).

Methods

Participants

In Shandong, Xinjiang and other seven Chinese mainland provinces and cities (autonomous regions), the cluster sampling method was deployed to select DHH students from junior middle schools, senior high schools (including secondary vocational school) and universities as the participants. A total of 588

questionnaires were distributed and 570 valid ones were recovered, with an effective recovery rate of 96.9%. Among the participants, there were 270 boys and 300 girls, 161 junior middle school students, 270 senior high school and secondary vocational school students, 139 universities students. Among whom, 306 were with hearing aids, 68 with cochlear implants, 196 without any hearing assistance. And 62 were of mild hearing loss (20-40 dB), 101 people of moderate hearing loss (41-55 dB), 40 people of moderate and severe hearing loss (56 dB and above). 40 of the total could communicate with ordinary people successfully, 265 could communicate at an acceptable dis-fluency, while 265 others suffered apraxia ; 371 people were from rural areas and 199 people from cities; the age span was between 12-25 years old, with an average age of 18.5 ± 2.07 (see Table 1 for details).

Research instruments

Mobile Phone Addiction Index

This study has adopted the mobile phone addiction index (MPAI) revised by Leung (2008) [24]. The scale includes out-of-control (e.g. "you find yourself using your mobile phone longer than you originally intended"), withdrawal (e.g. "if you don't check your SMS or turn on your mobile phone for a while, you will become anxious"), avoidance (e.g. "when you are depressed, you will play your mobile phone to get relieved"), and inefficiency (e.g "The time spent on the mobile phone directly leads to your inefficiency") four dimensions,with a total of 17 questions. Likert 5-point scoring is adopted, and 1-5 means "very inconsistent" and "very consistent" respectively. When the score of 8 or more items is ≥ 4, it is considered that the participant has the tendency of mobile phone addiction. The higher the total score, the higher the degree of individual’s mobile phone addiction. Previous studies have shown that the scale has good reliability and validity (Zhang, Zhou, & Pei, 2015; Huang, Jin, & Zhao, 2015) In this study, Cronbach's α value is 0.92. And in the four dimensions of out-of-control, withdrawal, evasion and inefficiency, the Cronbach's values are 0.86, 0.84, 0.83 and 0.82 respectively.

Sense of Security Questionnaire

The safety scale compiled by An & Cong (2004) was adopted. The scale includes two dimensions: interpersonal security (such as "I never dare to take the initiative to express my own views") and certainty control (such as "I feel that life is always full of uncertainty and unpredictability"), with a total of 16 items. The results are rated on the Likert 5-point scoring and 1-5 means "very inconsistent" to "very consistent" respectively. The higher the score, the lower the individual's sense of security. Previous studies have shown that the scale has good reliability and validity (Wang, Fang, & Yao, 2009; Jia, 2017).In this study, the Cronbach's α value is 0.93, Cronbach's α values of interpersonal security and deterministic control are 0.85 and 0.90 respectively.

Perceived Discrimination Questionnaire

The discrimination perception questionnaire for DHH students prepared by Xue (2015) was adopted. The questionnaire includes two dimensions of discrimination perception (such as "everyone thinks my

hearing is atypical, so they don't like to communicate with me") and discrimination attribution (such as "the teacher thinks I'm hearing disabled, so I'm not smart enough"), with a total of 10 items. The items are rated on Likert 4-point scoring, and 1-4 means "completely inconsistent" to "very consistent" respectively. The higher the score, the higher the level of perceived discrimination. In this study, Cronbach's α value is 0.89, the Cronbach's α values of both perceived discrimination and discrimination attribution are 0.86.

Data collection

The survey was conducted from November to December 2019. All the DHH students participated voluntarily and anonymously. During the survey, the investigators emphasized the authenticity of the answers and the confidentiality of their personal information. The survey collected data by class, and the study has been reviewed and approved by the ethics committee of Xinjiang Normal University, China.

Data analysis

SPSS 25.0 was deployed for descriptive statistics, common method deviation test and difference comparison. And Mplus 7.0 was used for structural equation model analysis to test the mediating effect of sense of security between perceived discrimination and smart phone addiction

Results

Common method deviation inspection

In this study, the self-report method was deployed to collect data, which may lead to the common method deviation caused by the same subject's report. Therefore, before data analysis, it is necessary to test the common method deviation of the sample data (Podsakoff, Mackenzie, Lee, & Podsakoff, 2003). This study uses single factor confirmatory factor analysis to test the common method deviation of all self-assessment items (Richardson, et.al, 2009). The results showed that the model fitting results are poor:

$$\chi^2 / df$$

= 15.68, CFI = 0.61, Ili = 0.66, TLI = 0.56, GFI = 0.64, SRMR = 0.12, RMSEA = 0.16. It showed that there is no serious common method deviation in this study.

Basic situation of mobile phone addiction of students with different levels of atypical hearing

Mobile phone addiction tendency and distribution of DHH students

According to the smart phone addiction criteria, when an individual's 8 or more items' score is ≥ 4, it can be considered that he has the tendency of being a smart phone addict. According to this, this study filtered 270 smart phone addicts, accounting for 47.4% of the total. The distribution on different demographics attributes is shown in Table 2.

Comparison of mobile phone addiction among DHH students

T-test, one-way ANOVA and LSD post comparison were used to compare the degree of smart phone addiction of DHH students at different levels(Table 2). The results showed that the degree of smart phone addicts among DHH girls was significantly higher than that of boys ($t = -2.00$, $p < 0.05$); The degree of smart phone addiction of DHH students who can successfully communicate with ordinary people was significantly lower than that of those who can communicate at an acceptable dis-fluency level and those who suffer apraxia ($f (2267) = -3.38$, $p < 0.05$); As for other demographics attributes, there was no significant difference in the degree of smart phone addiction among the DHH students.

Correlation analysis of perception of discrimination, sense of security and mobile phone addiction

Pearson correlation analysis was conducted on the perception of discrimination, sense of security and mobile phone addiction of students with DHH. The results are shown in Table 4.

Table 4 shows that there is a significant positive correlation between perceived discrimination and smart phone addiction($r = 0.36$, $p < 0.05$), a significant negative correlation between the sense of security and smart phone addiction ($r = -0.52$, $p < 0.05$), and a significant negative correlation between perceived discrimination and the sense of security ($r = -0.63$, $p < 0.05$). Perceived discrimination and the sense of security are positively correlated with social avoidance. There is a positive correlation between perceived discrimination and sense of security. Thus,hypothesis 1 is verified.

Canonical correlation coefficient analysis between discrimination perception and mobile phone addiction

Simple correlation can only preliminarily reveal the interaction between variables, while canonical correlation analysis treats each group of variables as a whole,and can describe the overall correlation between the two variable groups. Therefore, canonical correlation analysis can more comprehensively reveal the co-variant relationship between discrimination perception and mobile phone addiction of DHH students and then obtain the essential internal relationship. In this study, two dimensions of perceived discrimination were taken as one group of variables and three dimensions of smart phone addiction were considered as another group of variables for canonical correlation analysis. The results showed that two canonical correlation variables were obtained (Table 5). After test, the two canonical variables reached a very significant level ($P < 0.001$).

Table 6 shows that among the first typical related variables, the variation of discrimination perception that can be explained by its own typical variables is 53.7%, and the variation that can be explained by relative typical variables is 10.2%; The variation of mobile phone addiction can be explained by its own typical variables is 64.4%, and the variation can be explained by relative typical variables is 8.6%; The square of the canonical correlation coefficient is 0.159, indicating that the shared variance of the two groups of variables is 15.9%. In the second canonical related variable, the variation of discrimination perception that can be explained by its own canonical variables is 46.3%, and the variation that can be

explained by relative canonical variables is 0.4%; The variation of mobile phone addiction is 12.0% explained by its own typical variables and 1.5% explained by relative typical variables; The square of the canonical correlation coefficient is 0.032, indicating that the shared variance of the two groups of variables is 3.2%.

Through further analyzing the essence of the overall correlation between the two groups of variables, this study found that in the first canonical correlation variables, the canonical coefficient and canonical load of discrimination perception are higher for discrimination perception, while for mobile phone addiction, the canonical coefficient and canonical load of out-of-control are higher. Therefore, it can be considered that the first typical correlation variable mainly represents the correlation between discrimination perception and out-of-control. In the second canonical correlation variable, as for discrimination perception, the canonical coefficient and canonical load of discrimination attribution are higher, while for mobile phone addiction, the inefficient canonical coefficient and canonical load are higher. Therefore, it can be considered that the second typical related variable mainly represents the correlation between discrimination attribution and inefficiency. In other words, in the correlation between discrimination perception and mobile phone addiction, discrimination perception plays a greater role in explaining out-of-control, and discrimination attribution plays a greater role in explaining low efficiency.

Mediating effect test of sense of security

This study used structural equation model to test the mediating effect of security between discrimination perception and mobile phone addiction of DHH students. According to the mediating effect test procedure proposed by Wen, Hou & Marsh (2004), firstly, Mplus7.0 was used to assess the direct effect of perceived discrimination on smart phone addiction. The results showed that the perceived discrimination of DHH students can significantly predict their smart phone addiction（r= 0.271, $p < 0.001$), and the model fits well. The specific indexes are: x2/df = 2.07, RMSEA = 0.04, CFI = 0.99, TLI = 0.99, SRMR = 0.01.

Then, after adding the sense of security as a mediating variable, and Mplus 7.0 was used to further confirm the fitting degree of the model. The non-parametric percentile bootstrap program for deviation correction was used to test the significance of mediation effect. Using 1000 samples in the bootstrap re-sampling procedure and calculating 95% confidence interval, the results showed that (Fig. 2) the model fits well, and the indexes are: x2/df = 3.20, RMSEA = 0.06, CFI = 0.99, TLI = 0.98, SRMR = 0.02. After adding the mediator variable— —the sense of security, the mediator path effect value of sense of security in perceived discrimination and smart phone addiction of DHH students is 0.276, and the 95% confidence interval did not include 0, indicating that there is a mediating effect. After the mediator variable is added, the direct effect value becomes 0.07, and the 95% confidence interval contains 0. The direct effect is not significant, indicating that the sense of security plays a full mediator role.

See Table 7 for the mediation effect value, the amount of mediation effect and the proportion of mediation effect in each analysis path. Table 7 shows that the sense of security plays a complete mediating role between discrimination perception and mobile phone addiction, and the mediating effect accounts for 83.7% of the total effect.

Discussion

Basic characteristics of mobile phone addiction of Chinese DHH students

According to the relevant investigation and research conducted by Mpai compiled by Leung (2008), the detection rate of mobile phone addiction tendency of Chinese teenagers is roughly between 37.1% and 49.8% (Sun & Hu, 2018; Wu, et.al, 2019). This study is aimed at Chinese DHH students. It is found that the proportion of Chinese DHH students who show obvious mobile phone addiction tendency is as high as 47.4%. This proportion is consistent with the survey results of the ordinary teenagers. Although DHH students show obvious mobile phone addiction tendency, it does not show that they have been mobile phone addicts, but the results still suggest that Chinese DHH students have shown a high risk of mobile phone addiction, which calls for effective intervention to be carried out to prevent more serious consequences.

From the analysis of different groups' mobile phone addiction, the degree of mobile phone addiction of DHH girls is significantly higher than that of boys. This result is consistent with the research conclusion of Hassanzadeh et al. (2011) on the general population. The possible reason is that compared with men, women are more likely to produce more negative emotions and psychological stress in their social interaction (Liu & Tao, 2005; Atlanta, 2005), and are more inclined to rely on mobile phones to seek entertainment and leisure in cyberspace to alleviate their negative emotions (Jos é, et.al, 2016; Yayan et. al, 2019), which will reduce the psychological pressure brought by social activities. Therefore, the risk of mobile phone addiction of DHH girls is relatively high. Although the test of mobile phone addiction of DHH students in different school stages does not show statistically significant differences, from the specific data, with the improvement of school stages, the mobile phone addiction of DHH students becomes more and more serious.And the trend of increasing addiction is very obvious. This result is also basically consistent with the research on ordinary students. Raman & Pramod (2014) found that the rate of teenagers' mobile phone addiction increases with the increase of grade; Meltem, t ü lay & Kurt (2020) also found this conclusion in their studies. These studies reflect the common law that teenagers' mobile phone addiction will increase with age. In addition, this study also found that the degree of mobile phone addiction of DHH students who can fully communicate with ordinary people is significantly lower than that of those who can communicate at an acceptable dis-fluency and those who suffer apraxia. This shows whether DHH students can communicate well with ordinary people plays an important role in reducing their mobile phone addiction. This reminds us that the problem of mobile phone addiction of DHH students requires to be paid great attention by schools and families. It is an urgent task for mental health education for DHH students to intervene in the prevention and intervention of mobile phone addiction of DHH students as soon as possible and avoid the resulting physical and mental harm.

Effect of discrimination perception on mobile phone addiction of DHH students

Most people with disabilities have experienced or are suffering from discrimination and exclusion in their life and/or learning, which will bring many negative effects on their daily life and interpersonal communication, and reduce or even block their social will with the general population. Williams (2007)

pointed out that the long-term experience of rejection leads to depression and helplessness due to the depletion of coping resources, which may further lead to social withdrawal behavior; Li et al. (2016) further pointed out that when individuals perceive and experience more and more negative evaluations and perceptions in real life, they are more likely to seek a safe experience in the virtual online world. The relevant results of this study further confirm these views. Specifically, the higher the discrimination perception level of DHH students, the higher their risk of mobile phone addiction.

Canonical correlation analysis further revealed the overall relationship between discrimination perception and mobile phone addiction of DHH students. The results of this study show that there is a significant overall correlation between discrimination perception and mobile phone addiction. And in the deep correlation between discrimination perception and mobile phone addiction, discrimination perception plays a greater role in explaining out-of-control, while discrimination attribution plays a greater role in explaining inefficiency. This shows that DHH students' higher perception of discrimination may reduce their self-control over the use of smart phones; and their negative discrimination attribution will further increase their dependence on the use of smart phones, and then affect their daily life and learning efficiency. Therefore, we should guide the general public to establish positive cognition and evaluation towards DHH people,to reduce their perception of discrimination; In school and family education, it is important to strengthen DHH students' rational attribution education to instruct them deal with discrimination and exclusion appropriately so as to resolve their negative experience and cognition, and then improve their self-control ability, in the hope that this can effectively reduce the mobile phone addiction of DHH students.

Mediating effect of sense of security

The "Stress coping model" proposed by Wills et al. (1986) holds that substance use is a response to life stress. After the environmental stress stimulus acts upon the individual, if the individual experiences much negative emotions or cognition, it is easy to lead to related substance addiction (wills & Thomas, 1986). Previous studies have found that when the individual is faced with greater environmental stress (such as experiencing strong rejection, threat, etc.), the emotional state will often be greatly affected, which will lead to serious substance abuse and addictive behavior (such as drug addiction, sexual addiction, etc.) (Hong, yuan, & Lin, 2008; Kershaw, et al., 2003; Wu, et al., 2018). smart phone use can be classified as technology addiction in addictive behavior. The results of this study show that security plays a mediating role between discrimination perception and mobile phone addiction of DHH students. This conclusion is a strong support for the "stress coping model". The interpretation of this result can be further combined with "Social anxiety model" and "Ace model" .

The Social anxiety model holds that individuals who experience negative evaluation are easy to regard social situations as dangerous situations, which will lead to negative emotional states such as anxiety, reduced sense of security and so on; ACE model further points out that when individuals are threatened in the real world, they often regard the Internet as a safe space to escape the pressure and trouble in reality. Relevant studies also show that the higher the level of social anxiety, the higher the risk of becoming a

mobile phone addict (Liu, & et al., 2017; Zhang, & et al., 2018); when an individual's regular experience in the real world is rejected, excluded or resented and discriminated against, he is more likely to obtain a sense of security in communications in the virtual world (Liu & et al., 2016). Due to long-term exclusion and discrimination, most DHH people may have much higher social anxiety than the general population (Zuo, Jia & Chen, 2014). Therefore, when the needs of DHH people to communicate with the general population are restrained, they often turn to seek relief in the virtual world; where coupled with the anonymity and deheterogeneity of cyberspace (Peng, et.al, 2011), DHH people are less likely to be discriminated against and excluded, and are more likely to establish social relations with the online community on an equal status. However, with the continuous growth of mobile phone use time, they often have excessive dependence on mobile phones, which will lead to serious mobile phone addiction.

In addition, "Defective self regulation model" proposed by Tokunaga & Rains (2010) also pointed out that individuals with high level of loneliness and lack of security need to use a lot of psychological energy to deal with the negative emotions, so it is easy to lead to more ego-depletion, which may reduce their self-awareness and self-control. Studies have shown that, Addictive behavior is often highly correlated with the level of individual self-control (Kim, 2019). Individuals with a high level of self-control can fully mobilize a variety of resources to fight addictive behavior and eliminate negative emotions. Individuals with a low level of control tend to indulge in uncontrolled substance abuse or addictive behavior to seek temporary or long-term psychological peace. For DHH people who have been discriminated and excluded for a long time, their failure in self-control, which is caused by their lack of sense of security, may also be an important factor in their high risk of smart phone addiction.

Limitations and future research

Firstly, since there are still great difficulties in reading and understanding the written language of DHH kids of early primary schools, this group were not included in the sampling during the questionnaire survey, which will affect the objectivity and accuracy of the detection rate of the study to certain extent. The following-up research can be improved and revised by means of oral report, one-on-one test,etc. Secondly, adopting a cross-sectional research design, the results of relevant variables in this research cannot be inferred by causality, so results explanatory power is relatively low. In future research, experiments is recommended to be used to shed light on the causal relationship between discrimination awareness and smart phone addiction. Finally, the focus of this study is on the general laws, typical characteristics and possible explanatory models of the smart phone addiction of Chinese DHH students. But future research should also pay high attention to the prevention and intervention work through offering effective strategies based on empirical research.

Conclusions

The main conclusions of this study are as follows: (1) 47.4% of Chinese DHH students have the tendency of mobile phone addiction; (2) the degree of mobile phone addiction of DHH girls is significantly higher than that of boys; (3) the degree of mobile phone addiction of Chinese DHH students who can

successfully communicate with ordinary people is significantly lower than that of those who can communicate at an acceptable dis-fluency and those who suffer apraxia; (4)there is a significant positive correlation between discrimination perception and mobile phone addiction among Chinese DHH students; (5) the sense of security plays a complete mediating role between the perception of discrimination and mobile phone addiction of Chinese DHH students.

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Tables

Tables 1-7 are in the supplementary files section.

Figures

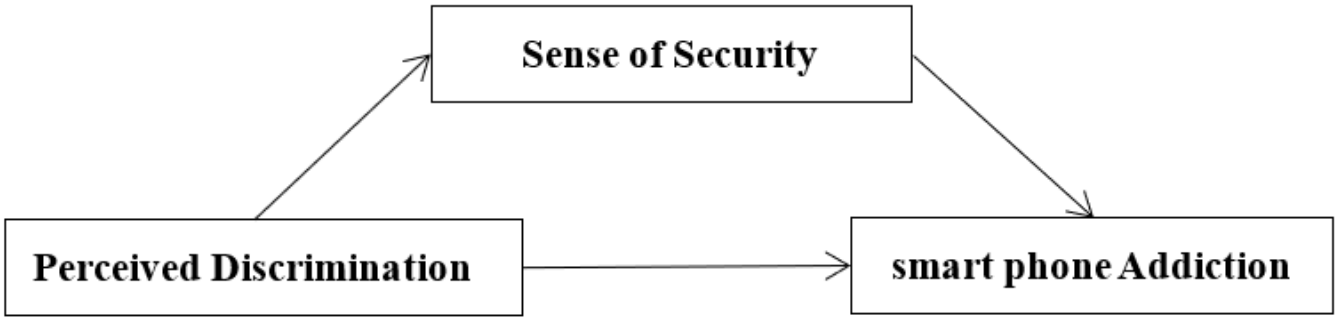

Figure 1

Mediating Effect Model

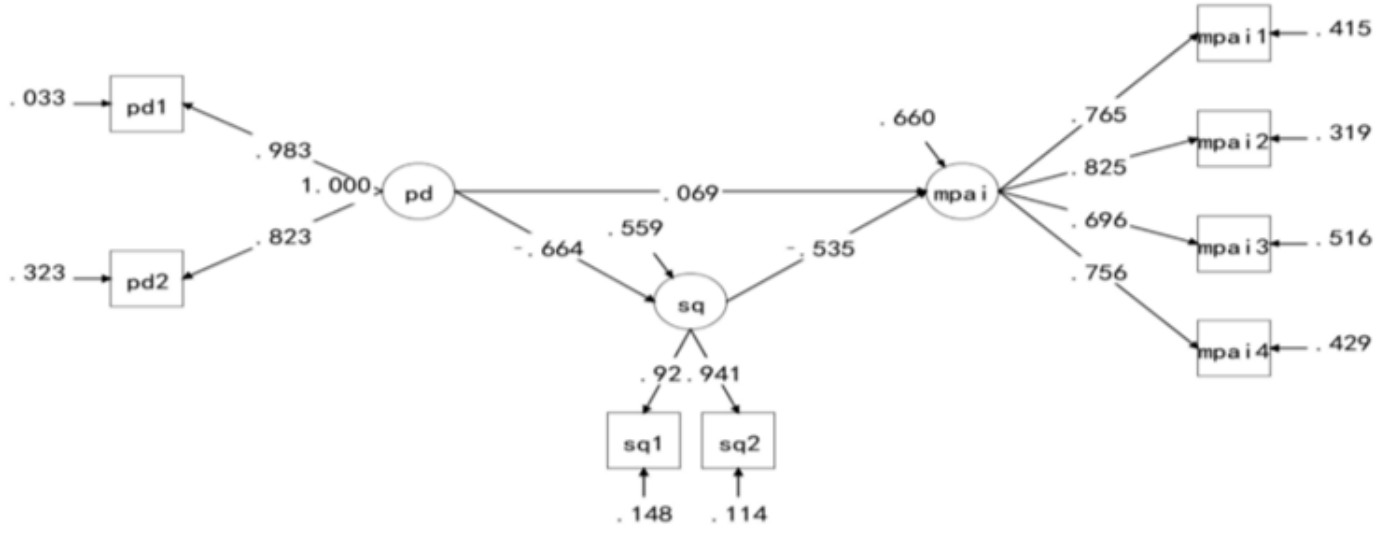

Figure 2

Model for perceived discrimination, sense of security and smart phone addiction

Note. pd:the perceived discrimination, sq:the sense of security, mpai:mobile phone addiction index; pd1: perceived discrimination, pd2: discrimination attribution, sq1:interpersonal security, sq2: definite control, mpai1: out-of-control, mapi2; withdrawal,mpai3: evasion, and mapi4: inefficient.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Tables.docx