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**Effects of materialism on problematic smartphone dependency among adolescents: The
role of gender and gratifications**

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Abstract

We study youth materialism as an antecedent of problematic smartphone dependency among adolescents. Based on Uses and Gratifications theory and the I-PACE framework, we consider process- and social-oriented smartphones as mediators in the relationship between youth materialism and problematic smartphone dependency. Using data from 463 French late adolescents (mean 16.8 years; 58% female), known as digital natives, we demonstrate that paths differ depending on gender. For girls, youth materialism is positively related to problematic smartphone dependency via social-oriented smartphone use, whereas this relationship is nonsignificant for boys. Moreover, youth materialism is positively related to problematic smartphone dependency via process-oriented smartphone use for both boys and girls, but the relationship is stronger for boys than for girls. We discuss the implications of these results for business and social policies.

Keywords: Digital natives adolescents; youth materialism; problematic smartphone dependency process; social-oriented smartphone use; gender effect; gratifications.

1. INTRODUCTION

Research on smartphone addiction, or what we will call and justify as problematic smartphone dependency, has increased in recent years; prior studies mainly focused on the factors that influence smartphone addiction (Lee, Chang, Lin, & Cheng, 2014; Zhigi, Zhang, Zhang, Xu, & Chen, 2019). These studies have shown that smartphone addiction, defined as “the excessive use of smartphones in a way that is difficult to control” (Gökçearsan, Mumcu, Haşlaman, & Çevik, 2016, p. 4), is associated with numerous factors such as loneliness (Bian, & Leung, 2015), social network intensity (Cha & Seo, 2018) social anxiety (Zhigi et al., 2019), personality traits (Cocoradăa, Maicanb, Cazana, & Maicanc, 2018), technology-family conflict and strain (Zheng & Lee, 2016). Particularly for adolescents, smartphone addiction can lead to harmful consequences such as cognitive disorders and school withdrawal.

According to IPSOS (2017), 81% of French adolescents ages 13 to 18 own a smartphone. Adolescents today typically socialize with peers on the internet (Zhou & Fang, 2015) through online applications available on smartphones such as Facebook, Tinder or WhatsApp. Many adolescents consider smartphones integral parts of their lives and can hardly imagine living without them (Roberts, Yaya, & Manolis, 2014). For example, adolescents in the United States use their smartphones 15.4 hours per week, more than any other type of device (Kleinschmit, 2019). In France, the focal country in this study, adolescents spend on average more than three hours per day (21 hours per week) on their smartphone, suggesting that smartphone addiction among adolescents is a prevalent problem in that country (Gentina & Delécluse, 2018).

Several studies have strived to explain smartphone addiction among adolescents (Chang et al., 2019; Haug et al., 2015; Kwak, Kim, & Yoon, 2018) and students (Chen et al., 2017a); the number of factors that influence this form of addiction is sizable. Personality traits (Chen et

al., 2017a), flow and gratifications (Chen et al., 2017a) and parental neglect (Haug et al., 2015; Kwak et al., 2018) all appear to influence smartphone addiction positively. Adolescents undergo important transformations including discovering love and projecting oneself into adulthood, with its inherent professional and social images and responsibilities (Erikson, 1968). This period is full of hope and expectations, but also fraught with issues and difficulties. During this particularly vulnerable period of life, addictive behavior can weaken adolescents and have further consequences such as social isolation or depression, and health issues (Horwood & Anglim, 2019).

Adolescence is a crucial transition period when self-esteem decreases, due to different factors such as physical changes accompanying puberty that make adolescence critical, discrepancies between an ideal self and how they see themselves, and moving from middle school to high school, which requires establishing new relationships and losing old ones (Chaplin & John 2010). During adolescence, materialistic values develop to compensate for unstable self-esteem and feelings of insecurity (Chaplin & John, 2007, 2014).

Further, materialism, that is the value individuals place on the acquisition and possession of material objects (Burroughs & Rindfleisch, 2002), may be a primary antecedent of problematic smartphone dependency. Indeed, studies show that materialism causes addictive behaviors, such as drug addiction (Kasser & Ryan, 2001) or addictive buying (Otero-Lopez, Villardefrancos, Bolano, Marino, 2011; Claes, Müller, & Luyckx, 2016). Hence, higher levels of materialism may also prompt smartphone addiction (Lee et al., 2014; Long, Wang, Liu, & Lei, 2019). For example, Roberts and Pirog (2013) note that a materialistic lifestyle inspires immediate gratification through communication technology. However, what remains unclear is the process through which (youth) materialism leads to problematic smartphone dependency during adolescence. To address this gap in the literature,

we aim to clarify this process, explore different gratification routes through which youth materialism may prompt problematic smartphone dependency among adolescents, and how and why gender plays a role in these mechanisms.

Researchers differentiate two main types of smartphone use, process- and social-oriented (Elhai, Dvorak, Levine, & Hall, 2017; Song, Larose, Eastin, & Lin, 2004; Van Deursen, Bolle, Hegner, & Kommers, 2015; Rozgonjuk et al., 2019). Process-oriented refers to using smartphones for consuming news and for entertainment, hence purposes that are primarily non-social. In contrast, social-oriented refers to using smartphones for social activities such as networking, messaging, making phone calls or cultivating interpersonal relationships. Several studies found that social-oriented smartphone usage explains problematic smartphone dependency more effectively than process-oriented smartphone usage (Lopez-Fernandez, Honrubia-Serrano, Freixa-Blanxart, & Gibson, 2014; Roberts et al., 2014). Other research affirmed that process, but not social-oriented smartphone use can lead to problematic smartphone dependency (Song et al., 2014; van Deursen et al., 2015).

Building on Katz, Blumler and Gurevitch's (1974) Uses and Gratifications Theory (UGT), we study the role of youth materialism (Goldberg, Gorn, Peracchio & Bamossy, 2003) as an antecedent of problematic smartphone dependency; we consider process- and social-oriented smartphone use as mediator variables. We test our conceptual model with survey data collected from 471 French adolescents. The focus on adolescents (ages 15 to 18) is topical; this generation, known as "digital natives" or "Generation Z," has grown up in a digital-driven world and has abandoned traditional computers for smartphones (Gentina & Delécluse, 2018). Unlike members of previous generations, who are "digital immigrants," digital natives, born in the early 2000s, are the first true digital natives (Dingli & Seychell 2015).

Most studies treat adolescents as a homogenous entity, ignoring potential group

differences and notably the distinction between females and males (Gentina & Delécluse, 2018). Some studies of adolescents include only males or, even more often, females exclusively (Haytko & Baker, 2004; Yalkin & Elliott, 2006), and justify this choice with differences in consumption without, however, attempting to contrast them. Therefore, in these studies, gender is construed as more of a biological fact than a research topic, although the recent “gender studies” seek to explore the foundations for the development of gender through smartphone adoption (Nisreen, Willis, & Shah, 2018). Based on construal and social role theories (Cross & Madson, 1997), our research objective is to show how problematic smartphone dependency may be linked to materialism and to two types of gratification (process and socio-oriented usage), and to how gender influences these relationships (van Deursen et al., 2015; Weiser, 2000).

Our research offers several contributions to understanding how materialism influences problematic smartphone dependency in adolescents: First, prior studies focus on adolescents and young adults (ages 17-30) (Chen et al., 2017a and b), rather than adults specifically. The present study offers an initial investigation of gender differences in problematic smartphone dependency among adolescents. Second, whereas authors in the field of smartphone addiction frequently build on gratification theory to differentiate two types of smartphone usage: process- and social-oriented (Chen et al., 2017b; Lopez-Fernandez et al., 2014; van Deursen et al., 2015) in adult populations, other authors in this field emphasize the role of materialism in the transition to problematic smartphone dependency (Chen et al., 2017a; Long et al., 2019).

This study draws on both explanations to specifically address how gender differences manifest in process- and social-oriented smartphone use among adolescents, and how these types of use mediate the relationship between materialism and problematic smartphone

dependency.

2 LITERATURE REVIEW

2.1 Addiction behavior, problematic use and problematic smartphone dependency

Smartphone addiction is potentially a contentious issue. It is often conceptualized as a problematic use (Billieux, Van der Linden, & Rochat, 2008; Horwood, & Anglim, 2019) and more simply as a dependency (Kuss, Kanjo, Crook-Rumsey, Kibowski, & Wang, 2018; Park, Kim, Shon, & Shim, 2013). In this section we explain why we use the term problematic smartphone dependency.

In their study of online game addiction among adolescents, Xu, Turel and Yuan (2012, p.321) define technology addiction as “a user’s psychological state of maladaptive dependency on IT use that is manifested through the obsessive-compulsive pattern of IT-seeking and IT-use behaviors that take place at the expense of other important activities.” We value this definition for smartphone addiction because we think that obsessive-compulsive disorder is at the core of addictive behavior (see, for instance, measures by Turel, Serenko and Giles (2011) manifested by “diminished impulse control” (Davis, Flett, & Besser, 2002)). However, to qualify addiction more precisely, appearance of a *systematic* negative component (e.g. conflict) is important because it signals “functional impairment (i.e. significant deleterious impact on the daily life) and stability of the dysfunctional behavior” (Billieux, Shimmienti, Khazaaal, Maurage, & Heeren, 2015, p.122). Recently, other studies in major information systems journals have used a very similar definition (e.g. Venkatesh, Sykes, Chan, Thong, & Jen-Hwa Hu, 2019). For instance, this dependency becomes an addiction to the extent “that the following typical behavioral addiction symptoms arise: salience, withdrawal, conflict, relapse and reinstatement, tolerance, mood modification” (Turel et al., 2011b, p.1044). Such symptoms or components were studied by

Brown (1993, 1997) and Griffiths (2005), and were included, albeit with euphoria replacing mood modification, in an instrument presented as measuring potentially excessive “mobile phone involvement” by Walsh, White and Young (2010), which we use in the present study to measure what we will call problematic smartphone dependency.

We justify the problematic smartphone dependency concept for three main reasons. First, we refer to dependency rather than addiction, which is more precise and complex and denotes a behavior. In *Decision Support Systems*, Wang, Lee and Hua (2015, p.41) emphasize that “dependence refers to the psychological state and addiction describes the related behavior.” Although the authors admit that the two terms could be used interchangeably, they caution that, in clinical psychology, addiction behavior describes the actions resulting from dependency. Technology addiction, as a state, denotes a more precise form of dependency, which the above definition by Xu et al. (2012) characterizes particularly well.

Second, and more importantly, we recognize that there is considerable debate in psychology and psychiatry regarding addiction, which reflects whether the observed phenomenon is that of only excessive but contextual use or truly pathological use with severe negative consequences (Billieux et al., 2015; Panova & Carbonell 2018). Therefore, many researchers in psychology and psychiatry prefer to speak of problematic smartphone use rather than employ the term addiction (e.g. Billieux et al., 2008; Kuss et al., 2018; Panova & Carbonell 2018), because it is not evident that excessive use can be truly qualified as an addiction, as gambling was in 2013 by DSM-5. They also consider the inclusion of another type of behavioral addiction, namely “Internet Gaming Disorder,” in DSM-5 Section III as disputable, notably because of the lack of enduring similarities with substance addictions, including neurobiological alterations, but also because of “classification inconsistencies and poor evidence regarding its etiology and course” (Billieux et al., 2015). Constructing a reliable measure of tolerance is notoriously difficult; and

most scales are based on an atheoretical and confirmatory approach (with respect to substance use, gambling, and Internet gaming disorders) that lacks specificity (*idem*).

Third, problematic smartphone use is a very broad concept encompassing diverse negative consequences such as dangerous use (Bianchi and Philipps, 2005), prohibited use and financial problems (Billieux et al., 2008) in addition to psychological dependency. In this paper we focus only on problematic smartphone dependency which is more specific; it is a problematic psychological dependency on this tool, but it does not necessarily encompass other types of problematic use. One can drive dangerously using a smartphone and yet not be dependent to his or her smartphone. Problematic smartphone dependency is characterized by compulsive use (Chang et al., 2019; Chen et al., 2017; Lee et al., 2014; Walsh, White, & Young, 2010; Takao, Takahashi, & Kitamura, 2009) and loss of control (Roberts et al., 2014), which should be distinguished from potential ensuing effects such as health issues and associated risks (Kuss et al., 2018). In this paper, we view problematic dependency as compulsive use with loss of control accompanied by conflicts with others or inability to accomplish one's duties (Walsh et al., 2010). Problematic smartphone dependency does not include other types of negative consequences. However, whether the dependency is pathological or not, and whether human autonomy, i.e. the ability to resist human pressure to act or think in a certain way (Ryff & Keyes, 1995) or technology autonomy (Markus & Rowe, 2018), i.e. the fact that technology can operate with little human intervention, are decreasing or increasing remain open questions related to precise medical and behavioral aspects of dependency that are not treated in this paper.

Ontologically problematic smartphone use and problematic smartphone dependency lack specificity, because smartphones encompass a set of tools that vary according to the user, some built in the smartphone from its inception, such as a browser, email and phone, while many others are downloaded apps. Hence, if proven, problematic smartphone dependency could be related to

the addiction to a particular tool or application such as email (Turel, Serenko, & Bontis, 2011) or mobile social apps (i.e. social networking sites and social games) (Kwon, So, Han, & Oh, 2016). For adolescents, specifically such dependency could be related to the internet (Adiele & Olatokun, 2014; Gunuc & Dogan 2013; Hawi, 2012; Zhou & Fang, 2015; Kuss et al., 2013), to online games (Xu et al., 2012; Hawi et al., 2018) or to Instant Messaging (Neo & Skoric, 2009). Further, studying problematic smartphone dependency is interesting because the number of triggers that can generate problematic smartphone dependency is much greater than for a specific single app (e.g. Kwon, So, Han, & Oh, 2016), and exposure to triggers tends to make vulnerable targets particularly at risk of smartphone addiction. Hence, smartphone addiction has been defined as “the collective pathological interactions between user and applications embedded in smartphones” (Vaghefi, Lapointe, & Boudreau-Pinsonneault, 2017, p. 136). As we have seen above, defining the addictive symptoms for the use of a single application is not evident, especially for a tool embedding several symptoms. Vaghefi et al. (2017) note that the literature on dependency and addiction treats the entire population’s liability to IT addiction as either below the threshold of addiction, and then refers to their propensity to addiction, or above the threshold. The authors then refer to their severity of addiction (measured by obsessive-compulsive behavior). They propose to theorize the concept of liability to IT addiction as the product of the multiplication of the propensity to develop an IT addiction (the risk of developing extreme addiction) by its severity (i.e. the gravity of the compulsive behavior) akin to the notion of exposure to risk (e.g. Baskerville, Rowe, & Wolff, 2018). Their proposition is intended to avoid perpetuating the dichotomous view of addicts vs non-addicts, which does not allow one to anticipate and examine both propensity and severity for all smartphone users.

2.2 Uses and Gratification theory and I-PACE model

Uses and gratification theory (UGT) is an influential sociological theory that explains why people use certain media to achieve satisfaction (or gratification) of their needs (Katz et al., 1974). Following this theory, behavior is directly related to reward or gratification. Because usage achieves its goal, it is gratifying and induces potentially reinforcing behavior. This gratification mechanism can further create a habit and ultimately a form of addiction. This theory assumes a form of circular causality in the sense that gratification is expected, and when reached through usage, expectations will be reinforced (Li, Guo, & Bai, 2016). Thus UGT can effectively explain different forms of technology or media addiction, such as internet addiction (Kim & Haridakis, 2009), microblogging addiction (Li et al., 2016; Liu, Cheung, & Lee, 2016), social network sites addiction (James, Lowry, Wallace, & Warkentin, 2017) and smartphone addiction (Elhai et al., 2017; Lopez-Fernandez et al., 2014). Although smartphone addiction resembles other technological addictions such as social networking site addiction (Andreassen, 2015), online gaming addiction (Xu et al., 2012), or internet gaming addiction (Rehbein, Kliem, Baier, Mößle, & Petry, 2015), those who experience it are more vulnerable because smartphones offer unique features such as portability and ease-of-connectivity (Demirci, Orhan, Demirdas, Akpınar, & Sert, 2014), which reinforces the possibility of using the smartphone more often when a stimulus is present.

However, beyond gratification reinforcement, UGT does not explain how habits transform into problematic behavior and ultimately into addictive behavior. To grasp these dynamics, we can begin by considering our cognition system. In fact, habits are often considered as a first behavioral step toward addiction when volitions cannot be controlled (Turel & Serenko, 2012; Soror, Hammer, Steelman, Davis, & Limayem, 2015), and even a root-cause of dependency (Wang et al., 2015). Interestingly, in the extended cognitive-affective-behavioral model of dependency (Wang et al., 2015), deficient self-regulation also plays an important role in

explaining addictive behavior. Dual systems cognition theory states that we are equipped with a reflective (control) system and with reflexive (automatic) system (Soror et al., 2015; Turel & Qahri-Saremi, 2016; Vaghefi et al., 2017). It is when self-regulation is deficient, i.e. when our reflective system is impaired, that we may develop addictive behavior (Wang et al., 2015; van Deursen et al., 2015; Turel & Qahri-Saremi, 2016; Gong, Zhang, Cheung, Chen, & Lee, 2019), but also when maladaptive cognitions (Davis, 2001), such as perceived irreplaceability of the value of the addictive behavior, increase negative affect anticipation due to non-use and ultimately lead to reinforcement (Wang et al., 2015).

The I-PACE model (Brand et al., 2016) is probably the most elaborate model built to explain the antecedents and mechanisms of problematic digital technology use today (Rozgonjuk, 2019). It has been argued that UGT fits in the I-PACE model (Rozgonjuk, 2019). Considering an interaction of person-affect-cognition-execution (I-PACE; Brand et al., 2016), this model fundamentally takes the person's core characteristics as the root of the whole addictive disorder (Brand, Young, Laier, Wölfling, & Potenza, 2016, Brand et al., 2019). It notably considers both generalized predisposition variables such as genetics, early childhood experience, temperament features and general cognitive style, along with behavior-specific predisposing variables such as specific needs, motives and values. In particular, those characteristics include values, such as materialism, that may lead to perceptions of external and internal triggers and ensuing affective and cognitive responses to these triggers, which will heighten gratification. At later stages these responses to triggers may become cue-reactivity and craving, leading to lower gratification and need for higher compensation and ultimately diminished control over the behavior. Hence the latest version of I-PACE theorization (Brand et al., 2019) offers a good theoretical background for the general logic of our simplified model that comprises a mediation hypotheses (see 3.5).

Authors in the field of smartphone addiction frequently build on UGT to differentiate two types of smartphone usage: process and social (Lopez-Fernandez et al., 2014; van Deursen et al., 2015; Rozgonjuk, & Elhai, 2019; Rozgonjuk et al., 2019). Process smartphone usage relates to enjoyment of the act of using a smartphone (entertainment, relaxation, escape, reassurance and other primarily non-social purposes), whereas social smartphone usage encompasses a wide range of actions linked to forming and deepening social ties (through social networking, messaging, phone, etc.) (Elhai et al., 2017). While a variety of gratifications have been the focus of research into actual smartphone use, relationship building and enjoyment are among the most common gratifications attributed to SNN use (Krasnova, Spiekermann, Koroleva, & Hildebrand, 2010; Krasnova, Veltri, Eling, & Bruxmann, 2017) or smartphone use (Elhai et al., 2017). Following this theory, in addition to social purposes, several works distinguish between process and content, arguing that people use a medium either for the experience of the usage process or for the content that the medium delivers (Kim, Lee, & Contractor, 2019). Accordingly, “content gratification includes use of the messages carried by the medium, and process gratification relates to enjoyment of the act of using the medium, as opposed to interest in its content” (Stafford, & Stafford, 2001, p. 96). However, for adolescents, we contend that process is the major functional motive and gratification. In this study, we focus on two groups of gratifications obtained from smartphone use as key determinants of problematic smartphone dependency by adolescents. The two groups are social, which emphasizes relationship building, and process/content, which we will label simply as process, which focuses on the enjoyment of the act of using the medium.

2.3 Self-construal and social role theory

A number of theoretical frameworks have been used to explain differences in the perceptions and behaviors of males and females in offline settings, wherein self-construal (Cross, & Madson, 1997) and Social Role Theory (Eagly, Wood, & Diekmann, 2000) have been particularly

emphasized. Building on the self-construal theory, Cross and Madson (1997) attribute independent self-construal to men and interdependent self-construal to women. From a very early age, girls are expected to be social and nurturing whereas boys are encouraged to be independent and assertive. Such behaviors are natural, as the essentialist perspective on gender maintains, but they are largely socially constructed.

Moreover, Social Role Theory (SRT) (Cross & Madson, 1997) suggests that males and females gradually acquire different skills and resources to best fulfill gender-specific role requirements. As a consequence, males become characterized by more agentic behaviors (behaviors that enable self-assertion and self-expansion), a greater sense of competitiveness and the urge to exert power, traits that also tend to discourage males from developing friendly and sensitive behaviors. Women, in contrast, become characterized by more communal behaviors, meaning that they are more socially oriented and more likely strive to maintain close social relationships (Lee et al., 2014; Roberts et al., 2014).

These gender differences, in turn, affect the types of smartphone use in general. Females are more socially oriented and are more attracted by social-oriented usage types when they use their smartphone, such as seeking to multiply their social contacts, and creating formal relationships (van Deursen et al., 2015). Males, in contrast, are not responsive to social relationship motives. For instance, Chen et al. (2017b) predicted that the association between social relationships and smartphone addiction was stronger for males than for females, but results have shown a non-significant relationship. Males are more attracted by process-oriented usage types such as enjoyment, gambling (Frangos, Frangos, & Kiohos, 2010) and escaping reality (van Deursen et al., 2015).

Regarding motivations fueling Internet use, research has also demonstrated gender differences: females' online use and behavior are primarily driven by relationship maintenance

and social connections, while men use the Internet primarily for task-oriented activities such as information gathering (Lim & Kumar, 2019) and for entertainment (Fedorowicz, Vilvovsky, & Golibersuch, 2010; Weiser, 2000). Similarly, in French society in the 1980s, landline home phone use showed sharp contrasts between men and women (Claisse & Rowe, 1987). Schoolchildren's habits were very similar across the genders, and typically mix both functional and social uses. During adolescence, males developed more functional (typically content gratifications) and individual purposes, whereas females developed more social and collective uses (Claisse & Rowe, 1987). Studies in middle and high schools found that male and female middle-school students in the US also had similar uses of information technologies in 2007. However, during high school, uses become differentiated (Fedorowicz et al., 2010), and may be strongly contrasted across gender in college (Roberts et al., 2014).

3 HYPOTHESIS DEVELOPMENT

The conceptual model that illustrates our theoretical developments is shown in Figure 1. In short, we submit that adolescents with high levels of materialistic values (the belief that possessing objects can make you happy) tend to engage more in process- and social-oriented smartphone usage, leading to more problematic smartphone dependency.

-----Insert Fig. 1 here-----

3.1. Youth Materialism and Problematic Smartphone dependency

Materialism has been shown to prompt addictive behaviors such as drug addictions (Kasser & Ryan, 2001), pathological gambling (Mowen, Fang, & Scott, 2009) and addictive buying (Otero-Lopez et al., 2011; Claes et al., 2016). Studies also show that higher levels of materialism trigger excessive smartphone use and addiction among adult populations (Lee et al., 2014), college student populations (Roberts & Pirog, 2013) and even middle-school students in China

(mean age 16.8) (Long et al., 2019). A significant statistical association between youth materialism and smartphone addiction has also been found for 748 Chinese middle-school students (mean age 16.8) (Wang et al., 2018). All these studies rely on cross-sectional data and cannot assess causality. While the former studies theorized that smartphone addiction was the dependent variable, the Chinese study theorized that higher smartphone addiction levels expose students to more numerous materialistic messages that influence their values (Wang et al. 2018). However, like many studies on smartphone addiction (Richard et al., 2020), this study did not use a theoretical lens. In line with the I-PACE theorization, we consider personality traits, such as materialism, as possible antecedents of problematic smartphone use or addiction (Brand et al., 2016; 2019). Even though the argument that more materialistic than idealistic messages are transmitted through smartphone use may be valid functionally, it remains that more materialistic students will be more prone to use a smartphone to exhibit the fact to possess. In line with this last argument, consistent with the I-PACE model and the majority of the literature, we expect that:

H1: Higher levels of youth materialism increase problematic smartphone dependency.

3.2 Youth Materialism and Process-Oriented Smartphone Usage

Entertainment (downloading of movies, listening to music, or browsing the Internet) is a major motivator of smartphone use in adolescents (Roberts et al., 2014). Such types of smartphone use fulfill goals that are processual in nature (Elhai et al., 2017). Reflecting the value users derive from having pleasant and enjoyable experiences with their smartphone, entertainment is often seen as a gratification (Krasnova et al., 2017), motivating smartphone use. As Shrum et al. (2013) maintain, materialists are more likely than non-materialists to believe that the use of acquired products offers pleasure. Accordingly, process smartphone usage may serve identity construction through the pleasure it provides adolescents who exhibit high youth

materialism. Therefore, we suppose that higher levels of youth materialism lead to greater process-related gratification from smartphone use, such as pleasure, entertainment, mobility, and reassurance.

H2: Higher levels of youth materialism lead to greater process-related gratification from smartphone use.

3.3 Youth Materialism and Social-Oriented Smartphone Usage

When individuals enter adolescence, their materialistic values and their need to be recognized by others tend to increase (Chaplin & John, 2007). Kasser and Ryan (2001) found that adolescents associate material possessions with extrinsic social benefits such as social conformity, image, and popularity. Individuals with high levels of materialism place higher value on items that can be seen in public, which enables them to gain social standing and power, improve the impression they make on others, and facilitate relationships with others (Shrum et al., 2013). Smartphones are products that are typically used in public, and that fulfill social needs, such as the acquisition of social status among peers (Gentina & Delécluse, 2018). Therefore, we suppose that adolescents with higher levels of materialism may use their smartphones for social purposes (interpersonal communication, networking), which allows them to obtain social gratification. Hence:

H3: Higher levels of youth materialism lead to greater social-oriented gratification from smartphone use.

3.4 Types of Smartphone Usage and Problematic Smartphone dependency

As previously discussed, the use of a smartphone for pleasure (process-related usage) or social (social-related usage) goals is rewarding. Some studies have shown that both process- and social-oriented smartphone usages can be related to smartphone addictive use, with a stronger effect for process use (Elhai et al., 2017). Other research found that smartphone addictive use is

positively related to process-oriented smartphone usage, but not to social-oriented smartphone usage (Song et al., 2004; van Deursen et al., 2015). Yang and Tung (2007) demonstrate that process-related gratification is a pleasurable experience, increasing the probability of developing dependent behaviors. Therefore, we assume that:

H4: Higher process-oriented smartphone use increases problematic smartphone dependency.

Further, social-oriented smartphone usage can be related to smartphone addictive use (Elhai et al., 2017). Beyond a certain extent, socially oriented smartphone use can be the symptom of a form of social dependency, either by driving the individual to constantly build new relationships (extraversion pathway) or by seeking reassurance for existing relationships (reassurance pathway) (Billieux et al., 2015). Recent research investigating the relationship between materialism and problematic smartphone dependency in middle-school students in China found that Fear of Missing Out mediated this relationship (Long et al., 2019). This may also indicate that a form of social insecurity is compensated by greater use for social needs which may induce dependency. This leads us to propose that:

H5: Higher social-related smartphone use increases problematic smartphone dependency.

3.5 Mediation Hypotheses

The preceding hypotheses suggest that the influence of youth materialism on problematic smartphone dependency may be mediated by process- and social-oriented smartphone use. In particular, we propose that for adolescents, youth materialism increases both process and social-oriented smartphone use, which, in turn, leads to increased problematic smartphone dependency. Whereas several studies have investigated a direct effect with an adult sample in a city in Taiwan (Lee et al., 2014) or with college students (Roberts and Pirog, 2013), the only study on adolescents at school that has investigated mediation did not consider types of use

but rather FoMO (Long et al., 2019). Our paper contributes to explaining the youth materialism- smartphone problematic dependency relationship by providing an explanation underpinned by gratification theory. We argue that people with high materialistic values tend to develop problematic smartphone dependency via two different processes, process- and social-oriented smartphone use. Hence.

H6a: The positive relationship between youth materialism and problematic smartphone dependency is mediated by adolescents' process-oriented smartphone use.

H6b: The positive relationship between youth materialism and problematic smartphone dependency is mediated by adolescents' social-oriented smartphone use.

3.6 Moderating Role of Gender

In line with SRT and self-construal theory, we expect that gender moderates the preceding relationships. Girls are more likely to engage in social-oriented smartphone use, whereas boys express a greater tendency to engage in process-oriented smartphone use (van Deursen et al, 2015; Frangos et al.,2010). Among males, youth materialism may be manifested by enhanced process-oriented smartphone use, suggesting that the relationship between youth materialism and process-oriented smartphone use is stronger for males than for females. Among females, youth materialism may be expressed through behaviors that help build and maintain social relationships (Roberts et al., 2014), suggesting that materialism reinforces social-oriented smartphone use more strongly among females than among males.

If social-oriented smartphone use is more likely among girls than boys, we would expect the mediating effect of social-oriented smartphone use on the relationship between materialism and problematic smartphone dependency to be stronger for girls than for boys. Further, if process-oriented smartphone use is more likely among boys than girls, the mediating effect of process-oriented smartphone use should be stronger among boys.

Therefore, we expect that:

H7a: The mediation effect of process-oriented smartphone use between youth materialism and problematic smartphone dependency is stronger for boys than for girls.

H7b: The mediation effect of social-oriented smartphone use between youth materialism and problematic smartphone dependency is stronger for girls than for boys.

4 METHODOLOGY

4.1 Data collection

Because adolescent populations have been identified as vulnerable within the research context (Batat & Tanner, 2019), prior research informs the ethical conduct that researchers should follow when they work with adolescents (Crane & Broome, 2017). Prior to administration of the survey, parents received letters inviting their children to participate. The study participation required signed parental consent and the participants' own individual assent. The adolescent students were assured that all information provided was strictly confidential. Both verbally and in writing, we pledged their completed questionnaires would "never be shown to parents, teachers, or anyone else, except the researcher." After this introduction, a paper-and-pencil survey was administered in classrooms during regular class hours, in the presence of one of the authors. The physical presence of the researcher not only limited the bias linked to information dissemination, by controlling the fact that teen informants reply individually to the questionnaire, but also provided efficient answers to teen informants' questions. Participants first completed a task designed to measure youth materialism, followed by process use, social use, problematic smartphone dependency, and relevant socio-demographic data (gender, age, grade). After completing the study, participants were debriefed, thanked for their participation, and asked not to discuss their responses with classmates. Participants completed the study voluntarily and

anonymously, without financial reward, which reduced social desirability and “honest” answers (Joinson, 1999).

Adolescence can be divided into three stages: early adolescence, generally ages 12 to 13; middle adolescence; ages 14-15 (both corresponding to middle school) and late adolescence, ages to 18 (corresponding to high school) (Chaplin & John, 2007). We focused our research on late adolescents in high school because of higher likelihood of smartphone ownership, higher likelihood of dependency and higher likelihood of materialism. First, 95% of French teens, aged between 16 and 18 reported having their own smartphone, compared with 49% of teens ages 12 and 13 and with 72% of teens ages 14 and 15 (Gentina & Delécluse, 2018). Second when comparing, grades 10 and 11 show greater internet addiction than grades 7 and 8 (Zhou & Fang, 2015). Third, at the age of 16, French adolescents move from middle school to high school, where they become the youngest and least important members of the school, which requires establishing new relationships with others and losing old ones. These late adolescents are more independent and more likely to use possessions, such as their smartphone, in order to assert their self-identity as their self-esteem tends to decrease (Chaplin & John, 2007). Since most of this age group are students, we distributed questionnaires to 17 classes in three public high schools in France, and collected data from 471 middle adolescents in high school (grade 10-11 and 12) (58% female). We deleted 6 respondents from the final sample due to missing data, so the results are based on responses from a sample of N=463 respondents (Table 1). The average age was 16.8 years. We also checked that, consistent with descriptive statistics at national level, students in these classes were indeed equipped with smartphones and not mere mobile phones.

-----Insert Table 1 here-----

4.2 Construct Measures

The questionnaire was administered during regular class hours with a teacher present. After completion, the participants were debriefed about the purpose of the study. We used established multi-item measures to examine the constructs of interest (see the Appendix 1).

The measurement scales were translated from English into French using a translation-back translation procedure with two translators fluent in English and in French. We used Goldberg, et al.'s (2003) 10-item scale to assess youth materialism. The Youth Materialism Scale was specifically developed for an adolescent population; this scale has been validated in research with adolescents (e.g., Chaplin & John 2007, 2010; Gentina, Shrum, Lowrey, Rose, & Vitell, 2018; Gentina, Tang, & Gu, 2018). Walsh et al.'s (2010) 8-item scale was used to measure smartphone problematic dependency. This scale was specifically developed for young people, aged between 15 and 24. Finally, we measured process and social smartphone use with the scale developed previously by Van Deursen et al. (1985) who tested it among 946 young people aged 15 to 24. We conducted 10 semi-structured interviews with French adolescents in March 2018 in order to understand their motives when using a smartphone. Our qualitative results do not support the perspective that content use plays a significant role in the motivation for smartphone usage among French adolescents. Adolescents reported using their laptop more often to search for information content on the Internet (related to content use) and use their smartphones to surf the Internet (related to process use). Social networking and messaging, which are related to social usage, and entertainment and relaxation, which are related to process usage, were found to be the strongest motives in predicting the use of smartphones. Consistent with our findings, previous usage and gratification research on smartphones has focused on the categorization based on process and social uses to empirically study smartphone usage among adolescents (Elhai et al. 2017). In a study involving 300 young people between ages 17 and 35, Hoştut (2010) also found that sociability and relaxation were the most significant motives when explaining the use of

smartphones. We assessed all constructs using the five-point Likert-type scale (*1 = strongly disagree to 5 = strongly agree*).

4.3 Data analysis

Following the prominent literature on technology addiction (e.g. Xu et al., 2012) and recommendations for causal theorizing made by Markus and Rowe (2018), H1 to H5 were framed in a causal manner. This clarifies the theoretical reasoning. However, our data are cross-sectional in nature. Therefore our empirical analysis will test only the positive or negative association part of the hypotheses, not their directionality. In what follows when we state that results support the hypothesis, we refer only to the statistical significance of the evidence, but we cannot affirm its direction. In other words, due to methodological limitations, causality cannot be tested and directional reasoning is based solely on theoretical arguments.

5 RESULTS

5.1 Exploratory and confirmatory factor analyses

In the first step, we conducted exploratory factor analyses with SPSS version 24 software. Prior to testing our hypotheses, exploratory factor analyses (EFA, principal components) were conducted using an Oblimin rotation in SPSS in order to evaluate the measures in terms of their dimensionality. We eliminated items from the scales based on their measurement properties (i.e., items that loaded on more than one factor and items with factor loadings below 5.0): two items from the youth materialism scale; two items from the process use scale, one item from the social use scale and three items from the problematic smartphone dependency scale. The resulting four-factor structure (youth materialism, process use, social use and problematic smartphone dependency) offered satisfactory fit indices and coefficient alpha values (.81 to .85).

In a second step, we used confirmatory factor analyses with AMOS version 24 to analyze

the four-scale structure. The confirmatory factor analyses converged to the expected four-scale structure. The following criteria were used to assess fit indicators (Vandenberg & Lance, 2000): 1) Chi-square and degrees of freedom ($\chi^2/df < 5$), 2) Goodness of Fit Index ($GFI > .90$), 3) Tucker–Lewis Index ($TLI > .90$), 4) comparative fit index ($CFI > .90$), 5) root mean square error of approximation ($RMSEA < .10$), 6) Standardized RMR ($SRMR < .10$), and 7) Normed Fit Index ($NFI > .90$). The CFA with the remaining items shows a good model fit ($\chi^2 = 509.856$, $df = 203$, $\chi^2/df = 2.512$; $p < 0.01$; $[GFI] = .907$; $[TLI] = .916$; $[CFI] = .926$; $[RMSEA] = .057$; $[SRMR] = .053$). All factor loadings are statistically significant ($p < .01$) and most items load strongly ($\lambda > .70$) on their respective factors. The composite reliability coefficients were adequate (Jöreskog rho greater than .81), and the average variances extracted (AVEs) are greater than .50 for each latent variable, in support of convergent validity (Table 2). Moreover, the square roots of the AVEs of all variables are greater than the correlations between the constructs, in support of discriminant validity (Fornell & Larcker, 1981). We assessed measurement reliability using composite reliability (Werts, Linn, & Joreskog, 1974) and Cronbach’s α . As shown in Table 2, the internal consistencies of all variables are acceptable, because the composite reliability scores are all greater than .70 (Fornell & Larcker, 1981).

-----Insert Table 2 here-----

The comparison of Model 1 (22 items, 1 factor) with Model 2 (22 items, 4 factors) reveals that Model 2 fits significantly better than Model 1 ($\Delta\chi^2 = 2,259.733$, $\Delta df = 7$, $p < .001$). Model 2 also indicates good configural invariance (Table 3).

-----Insert Table 3 here-----

5.2 Common Method Variance

Since we had cross-sectional data collected at one time, we examined the CMV issue (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). First, we adopted Harman's single-factor test and examined the unrotated factor solution involving all measures of interest in this study: 22-items, 8-item youth materialism, 5-item process use, and 4-item social use and 5-item problematic smartphone dependency in an exploratory factor analysis (EFA). The amount of variance explained by Factor 1 was 24.36%, which was significantly less than 50%, followed by three other factors: 14.01%, 11.60%, and 10.45 respectively.

Second, a measurement model with the addition of a latent common method variance (CMV) factor must not significantly improve the fit over our measurement model without CMV. With a latent common method variance factor, we add a CMV factor to determine if it significantly improves the fit compared with a measurement model without this factor. Podsakoff et al. (2003) explain that with a latent CMV factor, the variance of responses to a measure contains three components: (1) trait, (2) method, and (3) random error. We compared Models 5 and 6 (Table 3); the differences were non-significant ($\Delta\text{CFI}/\Delta\text{RMSEA} < .01$).

5.3 Measurement invariance across gender

Because we compare the models across genders, we verified configural (factor structure) and metric (factor loading) invariance for all the measurement scales. We used four criteria for configural invariance: chi-square and degrees of freedom ($\chi^2/\text{df} < 5$), CFI $> .90$, RMSEA $< .10$, and SRMR $< .10$. Metric invariance exists when the differences between unconstrained and constrained multigroup analyses are not significant ($\Delta\text{CFI}/\Delta\text{RMSEA} < .01$). We applied the same theoretical model to check for measurement invariance across genders, using a multigroup confirmatory factor analysis (MGCFA), which produced Model 3 (Table 3). Finally, we set all the factor loadings to be equal across genders (Model 4, Table 3) in a constrained MGCFA. We obtain measurement invariance across genders ($\Delta\text{CFI}/\Delta\text{RMSEA} < .01$). Having demonstrated

measurement invariance across genders and no concern for CMV, we can test our model. All the results are presented in Table 3, demonstrating metric and scalar invariances.

5.4 Hypothesis test

Before proceeding to hypothesis testing, the assumptions of normality must be tested. Although variables do not show an extreme deviation from the normal distribution (Mertler & Vannatta, 2005), skewness and kurtosis coefficients of our some variables were close to the ± 2 range (Appendix 2). While some consider below +1.5 and above -1.5 as necessary (Tabachnick & Fidell, 2013), values for skewness and kurtosis between -2 and +2 are considered acceptable by other researchers (e.g., Bryne, 2010; George & Mallery, 2010; Hair et al., 2010) in order to prove normal univariate distribution. A basic assumption underlying the use of structural equation modeling (SEM) is that variables assumes normality/ multivariate normality, and when normality is violated, it is largely recommended to use alternative estimation method, such as Brown (1984)'s asymptotic distribution free (ADF). Therefore, we tested the conceptual model among the whole sample with AMOS using ADF estimation. Moreover, we used Preacher, Rucker, and Hayes's (2007) PROCESS tool (Model 7, Table 3) to test the mediation hypotheses among the whole model (H6a, H6b) and across gender (H7a, H7b).

5.4.1 General Model. We first tested the full conceptual model ($n = 463$ using ADF in AMOS). Global fit measures suggested a good fit of the structural model (model 7) ($\chi^2 = 805.683$, $df = 205$, $\chi^2/df = 3.930$; $p < .01$; [GFI] = .901; [TLI] = .889; [CFI] = .901; [RMSEA] = .070; [SRMR] = .065) (Model 7, Table 3).

The SEM results show that problematic smartphone dependency is positively related to youth materialism ($\gamma = .233$; $t = 2.254$ $p < .05$), in support of *H1*. Moreover, process-oriented smartphone use is positively related to youth materialism ($\gamma = .554$; $t = 12.151$, $p < .001$), in support of *H2*. Unexpectedly, social-oriented smartphone use is not related to youth materialism

($\gamma = .110$; $t = 1.546$, $p = .122$); *H3* is therefore not supported by the data. Problematic smartphone dependency is positively related to both types of smartphone use (process-oriented use: $\gamma = .511$; $t = 7.752$, $p < .001$; social-oriented use: $\gamma = .355$; $t = 3.451$, $p < .001$), thereby supporting *H4* and *H5*.

5.4.2 Mediation Effects (*H6a*, *H6b*)

We next tested simple mediation hypotheses (*H6a*, *b*) using the SPSS macros developed by Preacher & Hayes (2007) and accessed from the website of Andrew F. Hayes (Model 4). The effect estimations rely on bootstrapping with 2,000 samples and 95% bias-corrected confidence intervals. The results show a positive and statistically significant indirect effect of youth materialism on problematic smartphone dependency via process-oriented smartphone use ($\gamma = .210$; [.065; .288]; $p < .05$) with social-oriented smartphone use as a covariate, in support of *H6a*. However, we find no such indirect effect for the route in which social-oriented smartphone use is considered a mediator ($\gamma = .016$; [-.031; .063]; $p > .05$), leading us to reject *H6b*. Youth materialism affects problematic smartphone dependency only via process-oriented smartphone use, not via social-oriented smartphone use—a result with significant implications. The results of the SEM analyses among the whole sample are shown in Table 4.

-----Insert Table 4 here-----

5.4.3 Moderated Effect of Gender

In order to test simple mediation hypotheses (*H7a*, *b*) among girls and boys, we used Preacher et al.'s (2007) PROCESS tool (Model 4) with AMOS. As, Table 5 shows, the confidence interval does not include zero, indicating mediation of process-oriented smartphone use between youth materialism and problematic smartphone dependency for boys but not girls, in support of *H7a* (girls $\gamma = .017$, [-.002; .006], $p > .05$; boys $\gamma = .112$, [.05; .20], $p = < .05$). Moreover, the multi-group analysis suggests that for girls, youth materialism leads to problematic

smartphone dependency directly. Youth materialism also encourages problematic smartphone dependency indirectly through the social-oriented smartphone process ($\gamma = .145, [.025; .155], p < .05$), but the indirect effect is not significant for boys ($\gamma = .009, [-.01; .04], p > .05$). We obtained a simple mediation effect of youth materialism on problematic smartphone dependency through social-oriented smartphone use among girls, in support of H7b. The results of the SEM and PROCESS analyses across genders are shown in Table 5.

-----Insert Table 5 here-----

6 DISCUSSION

6.1 Empirical and theoretical contributions

Based on uses and gratifications theory as well as on social role theory, we considered process and social-oriented smartphone use as mediators and gender as a moderator in the relationship between youth materialism and problematic smartphone dependency. This model was tested on a population of 463 adolescents in public schools in France. For girls, youth materialism is positively related to problematic smartphone dependency via social-oriented smartphone use, whereas this relationship is non-significant for boys. Moreover, youth materialism is positively related to problematic smartphone dependency via process-oriented smartphone use for both boys and girls, but the strength of the relationship is stronger for boys than for girls. These results tend to support all the hypotheses in the model, except H3 and H6b.

It remains that both process and social-oriented smartphone usages are strong determinants of increases in addictive smartphone behaviors. While research found that process- but not social-oriented smartphone use can lead to problematic smartphone dependency (Song et al., 2014; van Deursen et al., 2015; Rozgonjuk et al., 2019; Rozgonjuk & Elhai, 2019), our findings confirm that social-oriented smartphone usage can also include such effects (Lopez-Fernandez et al., 2014; Roberts et al., 2014). During adolescence, smartphone use offers both entertainment and

content (process) and interpersonal communication/networking gratifications (social), which increases the probability that both process and social-oriented use develop and can promote addictive smartphone behavior. Based on a review of the U&G theory literature, the present study not only sheds light on the smartphone gratification obtained (process vs. social) but also on the direct and indirect effects of smartphone gratifications on the formation of smartphone addiction during adolescence.

Most importantly, prior research highlights the importance of considering gender in studies of smartphone use and dependency (Chen et al., 2017b; van Deursen et al., 2015). To our knowledge, this is one of the first studies on this theme in Europe, and maybe the first on the population of adolescents to highlight the gender moderating effect, notably regarding the relationship between materialism and smartphone dependency mediated by process and social usage. The empirical results confirm that the mediation effect of process-oriented smartphone use between youth materialism and problematic smartphone dependency is significant among boys, but not among girls. This finding is consistent with Lee et al.'s hypothesis (2014) but not with the results they obtained in their Taiwanese study in an adult population, which found that the effect of materialism on compulsive smartphone usage was not stronger for males than for females. Moreover, the mediation effect of social-oriented smartphone use between youth materialism and problematic smartphone dependency is significant among girls, but not among boys. By revealing these distinctions between boys and girls, the current study creates new knowledge for gender studies; prior work paid little attention to gender differences with regard to how adolescents engage in smartphone-related addictive behavior (Roberts et al., 2014).

The other models investigating the mediators and moderators between materialism and smartphone dependency for Chinese middle-school students did not consider gender, but rather FoMO (Long et al., 2019) and self-esteem as mediators (Wang et al., 2018), and narcissism

(Long et al., 2019) and student-to-student relationships (Wang et al., 2018) as moderators. More importantly, these models were not framed in a theoretical manner, while ours appears to be consistent with the I-PACE theoretical model, which is compatible with gratification theory and social role theory.

Second, the models cited above did not consider use and gratifications as mediators of the relationship between materialism and problematic smartphone dependency. Unexpectedly, and in contrast to what we predicted for the whole population studied, youth materialism has no significant effect on social-oriented smartphone use. Thus, for this population, we find no empirical support for such a mechanism with social-oriented smartphone use as a mediator variable. One possible explanation is that materialistic teens have ample social interactions with their peers in their daily lives, and they do not necessarily express the need for social interaction and social presence through their smartphone use.

6.2 Implication for business and public policy

Although our theoretical model and empirical findings attempt to explain problematic smartphone dependency, they do not deal directly with interventions that may prevent or reduce the phenomenon (D'Arcy et al., 2014). However, we find it useful to reflect on potential prevention and harm-reduction strategies that decision makers could consider.

The first question is how can we curb youth materialism and reduce its harmful effects? Chaplin, John, Rindfleisch and Froh (2018, p. 2) assert that “calls for parents to educate their children about consumption values and restrict media access also face significant implementation challenges. In short, parents, social scientists, and child advocates know there is a problem, but workable solutions have been frustratingly slow to emerge.” Some interventionist strategies to decrease youth materialism may be encouraged, such as avoiding watching commercials and popular brand names, introducing school uniforms, or sensitizing young people to the risks and

dangers involved with the use of addictive products such as smartphones. Our research shows that the type of smartphone usage plays an important role in developing dependency to this tool. Policy makers, business people, and parents should understand what effects smartphones can have when they are used extensively for process- and social-oriented gratifications, and suggest actionable strategies for reducing smartphone addiction during adolescence. Xu et al. (2012) assess a number of harm reduction strategies for online gaming that may be more largely applicable and tailored to smartphone addiction prevention, such as attention switching, dissuasion, education, parental monitoring, resource restriction and perception of costs.

Given that problematic smartphone dependency is driven by youth materialism, a relationship mediated by type of use, legal guardians may pay particular attention to types of use depending on gender. Parents, teachers, and social policy makers should educate adolescents to pay attention to the time they spend using their smartphones, and the potential dangers of smartphone overuse on mental health. This can be done via a few specific messages targeting boys and girls respectively before they face similar but heightened risks at university. Instead of establishing strict boundaries, parents should clarify for what and how long smartphones may be used in order to empower adolescents and teach them how they should manage their free time. For instance, increasing opportunities for adolescents to get involved in meaningful and fulfilling pastimes, such as artistic or outdoor activities (e.g. singing, dancing, acting or trekking), should switch adolescents' attention away from using their mobile phones intensely while practicing such activities and refocus their attention on their fundamental bodily and social needs. Healthy smartphone habits start with parents, from whom children learn. Thus, parents act as role models of smartphone use and should therefore refrain from bad smartphone habits such as smartphone overuse or texting while driving (Hsieh, Cheng-Fang, & Wen-Jiun, 2019). Publicly available workshops, instructional conferences, and press releases could help parents and teachers educate

kids and students about what healthy smartphone use entails, and thus protect them against the risk of smartphone addiction.

In addition, responsible businesses should assume their ethical responsibility and avoid designing systems with hooks that may turn vulnerable populations such as adolescents into addicts (Eyal, 2014; Schull, 2012). Adolescents are overusing their smartphones because they are constantly stimulated and entertained by their devices. Further multitasking makes adolescents more connected than ever, but also more insecure (Turkle, 2017). Business people and Online Social Network (OSN) providers should also consider their social responsibility and values linked to their role in order to mitigate potential mental health risks.

6.3 Limitations and future research

This research develops an explanatory model of smartphone dependency based on youth materialism and gratifications. The first set of research avenues aims to increase the precision of how use and gratifications are measured. For instance, future research could assess which service categories offered on mobile platforms (e.g., online gaming, online social networking) may constitute the most likely mechanisms supporting process- or social-related use, leading to some form of smartphone addiction. This would allow researchers to go beyond broad gratification categories and distinguish the equipment (the smartphone) from mobile services and help identify which related gratifications and affordances represent a greater potential for addiction depending on gender and age. Future research could also explore use with time-related variables or intensity variables, such as smartphone frequency, duration and period (e.g. weekdays vs weekends; Li et al., 2016) and examine objectively measured smartphone use rather than self-reported smartphone use, which does not really align with actual behavior (Andrews, Ellis, Shaw, & Piwek, 2015; Ellis, 2019; Ellis, Davidson, Shaw, & Geyer, 2019; Rozgonjuk, Levine, Hall, & Elhai, 2018). Second, our cross-sectional data can be used to assess statistical associations, but

not to test recursive causality, which fundamentally characterizes phenomena involving positive and negative feedback loops such as addiction (Roberts et al., 2014). Future research may use longitudinal data to empirically test the causality between youth materialism and smartphone dependency. Third, this study focused on 16–18-year-old adolescents in France, so caution is needed when generalizing the results of this research. A larger study should explore this phenomenon in different cultural settings that may be less consumption-oriented. Finally, additional research could extend the proposed research model by testing the impact of moderators on the model, such as demographic variables (age, household structure, income) or personality variables (e.g. extraversion/introversion, conscientiousness, tolerance of uncertainty, neuroticism, narcissism, self-esteem, anxiety) that could further explain the impact of both social-/process-oriented smartphone use on problematic smartphone dependency. Finally, harm reduction and prevention strategies should be tested and should take into account youth materialism.

7 CONCLUSION

Smartphone use has become a massive societal phenomenon that exemplifies what we may call a digital society. Digital risks come with societal values in our digital age (Rowe, 2018). These risks are also higher at adolescence, when materialistic values become more important for youngsters in a consumption society (Chaplin & John, 2007; Gentina & Rui, 2019). Risks such as smartphone dependency are not benign; they have further negative social and health consequences. They should be anticipated from childhood, and notably when adolescents strive to emancipate themselves from their parents and families. Whereas smartphone dependency risk is higher for boys, this paper shows that it is significantly associated with higher process-oriented use of smartphones. This risk also exists for girls through higher socially oriented use of their smartphones. While psychopathologies and other contingencies might reinforce the vicious circle

of addiction (Davis, 2001; Adiele & Olatokun, 2014), all adolescents are potentially at risk (Vaghefi et al., 2017).

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Figure 1: Conceptual model

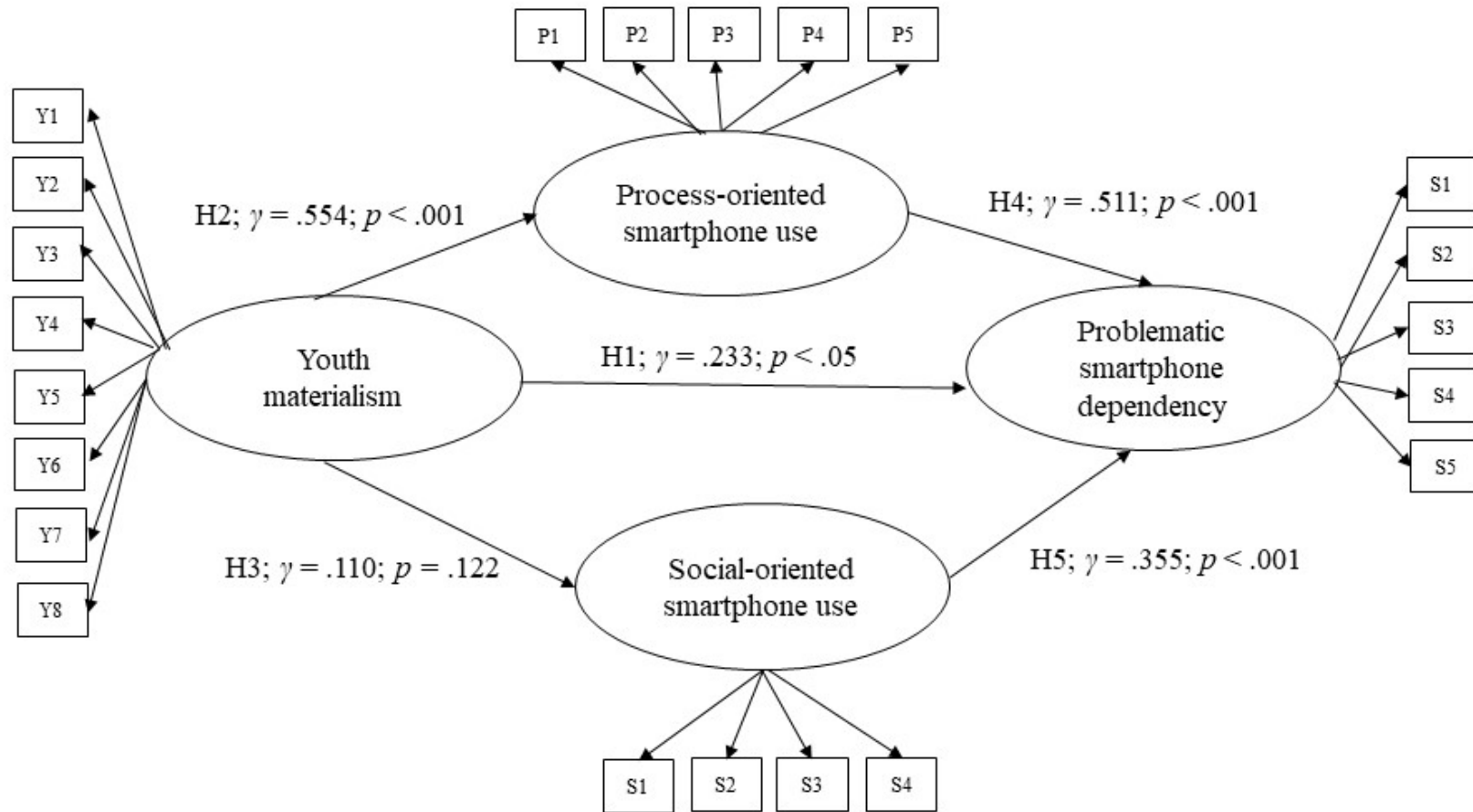


Table 1: Sample demographics

N	463
Females (%)	58.3%
Age in years (%)	16 : 31.2%
	17 : 51.6%
	18 : 17.2%
	10: 20,1%
Grade	11: 32,8%
(High School)	12: 47,2%

Table 2: Convergent and discriminant validity

	Cronbach Alpha	Reliability (Jöreskog Rhô)	Convergent Validity	(4)	(3)	(2)	(1)
(1) Problematic smartphone dependency	.81	.81	.52				X
(2) Youth materialism	.85	.86	.50			X	.05 (.23)
(3) Process use	.81	.83	.54		X	.07 (.28)	.19 (.44)
(4) Social use	.83	.84	.67	X	.19** (.44)***	.00 (.01)	.04 (.21)

Notes: SD=standard deviation; Values below the diagonal are correlations

** Shared variance among trait factors; *** Correlations among trait factors.

Table 3: Main Results of Measurement Model, Invariance, and Common Method Variance

Measurement Model														
	χ^2	<i>df</i>	<i>p</i>	χ^2/df	<i>CFI</i>	<i>GFI</i>	<i>TLI</i>	<i>RMSEA</i>	<i>SRMR</i>	<i>Models</i>	$\Delta\chi^2$	Δdf	ΔCFI	$\Delta RMSEA$
1. Model 1: Reflective one-factor (22-item)	2,769.589	210	.00	13.146	.383	.330	.315	.162	.182 μ	1 vs 2	2,259.733*	7	.546	.105
2. Model 2: Reflective four-factor (22-item, 4 factor)	509.856	203	.00	2.512	.926	.907	.916	.057	.053					
3. Model 3: Reflective across gender (22-item, 4 factor)	740.835	406	.00	1.825	.918	.902	.908	.042	.064	3 vs 4	36.794*	18	.000	.001
4. Model 4: Reflective across gender (22-item, 4 factor) + constraint (metric invariance)	777.629	424	.00	1.834	.918	.901	.907	.043	.067					
Common Method Variance														
5. Model 5: Reflective four-factor (22-item)	509.856	203	.00	2.512	.926	.907	.916	.057	.053	5 vs 6	25.382*	18	.000	.002
6. Model 6: Reflective four-factor (22-item) + CMV	484.474	185	.00	2.620	.926	.913	.924	.059	.051					
Theoretical Model														
7. Model 7: Theoretical model on the whole sample (ADF)	805.683	205	.00	3.930	.901	.901	.889	.070	.068					

* $p < .05$

Table 4: SEM Structural model among the whole sample

SEM Structural model (a, ADF)	Parameter estimates	Bootstrapped confidence interval	p-value	Results
Direct effect: Youth materialism ---> Problematic smartphone dependency	.122	[.006; .238]	< .05	H1 Supported
Direct effect: Youth materialism ---> Process-oriented smartphone use	.288	[.188; .397]	< .001	H2 Supported
Direct effect: Youth materialism ---> Social-oriented smartphone use	.020	[-.081; .131]	= .691	H3 Not supported
Direct effect: Process-oriented smartphone use ---> Problematic smartphone dependency	.392	[.282; .504]	< .01	H4 Supported
Direct effect: Social-oriented smartphone use ---> Problematic smartphone dependency	.144	[.030; .259]	< .05	H5 Supported
Path comparisons (PROCESS and SOCIAL) (b, PROCESS)	Parameter estimates	Bootstrapped confidence interval	p-value	
Indirect effect: Youth materialism ---> Process oriented smartphone use---> Problematic smartphone dependency	.210	[.064; .288]	< .05	H6a Supported
Indirect effect: Youth materialism ---> Social oriented smartphone use---> Problematic smartphone dependency	.016	[- .031; .062]	> .05	H6b Not supported

Table 5: Path comparisons (PROCESS) across gender

GIRLS				
	Parameter estimates	Bootstrapped confidence interval	p-value	
Indirect effect: Youth materialism ---> Process oriented smartphone use---> Problematic smartphone dependency	.017	[-.002; .006]	> .05	H7b supported
Indirect effect: Youth materialism ---> Socio oriented smartphone use---> Problematic smartphone dependency	.145	[.025; .155]	< .05	

BOYS				
	Parameter estimates	Bootstrapped confidence interval	p-value	Results
Indirect effect: Youth materialism ---> Process oriented smartphone use---> Problematic smartphone dependency	.112	[.05; .20]	< 0.05	H7a supported
Indirect effect: Youth materialism ---> Social oriented smartphone use---> Problematic smartphone dependency	.009	[-.01; .04]	> 0.05	