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# Smartphone Addiction and the G-DEEG Model: An Interdisciplinary Framework for Psychiatric Rehabilitation

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## 1. Abstract

### 1.1. Background

Smartphone addiction - often termed problematic smartphone use - has emerged as a growing behavioral health concern worldwide. Excessive smartphone use can lead to symptoms analogous to substance addictions (e.g. loss of control, tolerance, withdrawal), accompanied by detrimental effects on mental health, academic/work performance, and social functioningdoi.orgfrontiersin.org. However, consensus on diagnostic criteria is lacking and existing research has largely examined isolated factors (psychological, social, or neurobiological) in piecemeal fashionfrontiersin.orgfrontiersin.org. There is a need for a comprehensive, interdisciplinary model to understand smartphone addiction's multifaceted etiology and to guide effective psychiatric rehabilitation strategies.

### 1.2. Objectives

This article introduces the G-DEEG model, a novel framework that integrates Generational/Developmental, Digital/Technological, Emotional/Psychological, Environmental/Social, and Genetic/Biological factors. We aim to translate and restructure findings from a Turkish-language analysis of this model into fluent academic English, and to highlight the model's novelty, interdisciplinary nature, and relevance for psychiatric rehabilitation.

**Methods:** We conducted an extensive literature review spanning psychiatry, psychology, neuroscience, and technology studies to identify key determinants of smartphone addiction. Sources included recent reviews, empirical studies, and theoretical papers on behavioral addictions and technology use. The G-DEEG model was synthesized by integrating these findings into five thematic domains. Schematic representations from the original analysis were converted into English tables for clarity. All content was translated and edited to meet the standards of Q1-level international journals, with APA-style citations and references.

### 1.3. Results

G-DEEG is a five-domain conceptual model positing that smartphone addiction arises from an interplay of: (1) Generational/Developmental factors - age and developmental stage influences (e.g. adolescent neurodevelopment and identity formation); (2) Digital/Technological factors smartphone design, app algorithms, and 24/7 connectivity that reinforce habitual use; (3) Emotional/Psychological factors - individual traits and mental health (e.g. anxiety, depression, poor emotion regulation) that drive compulsive phone use; (4) Environmental/Social factors - family, peer, and cultural context that can enable or buffer excessive use; and (5) Genetic/Biological factors - genetic predispositions and neurobiological processes that may confer vulnerability to addictive behaviors. We present a structured overview of each domain with supporting evidence and illustrate how the model can inform comprehensive intervention approaches. Table 1 summarizes the domains and their core components.

### 1.4. Conclusions

Smartphone addiction is a complex, interdisciplinary phenomenon best understood through a synthesis of biological, psychological, social, and technological perspectives. The G-DEEG model provides a robust framework for clinicians and researchers, emphasizing that effective psychiatric rehabilitation should address all five domains rather than focusing on a single facet. By acknowledging factors ranging from genes to culture - and the dynamic interactions between them - this model offers novel insights into prevention and treatment. Interventions derived from G-DEEG (e.g. developmentally tailored therapy, digital habit re-training, family involvement, and even consideration of biological predispositions) could improve outcomes for individuals struggling with problematic smartphone use. The model's comprehensive scope underscores its potential to guide future research and to inspire multi-modal rehabilitation programs in psychiatric settings.

## 2. Introduction

Smartphones have become ubiquitous in modern life, delivering unprecedented convenience alongside growing concerns about overuse. Smartphone addiction, also referred to as problematic smartphone use or smartphone use disorder, is characterized by excessive, compulsive smartphone engagement that interferes with daily functioning and mental healthfrontiersin.orgdoi.org. Affected individuals typically exhibit behavioral addiction symptoms such as impaired control over usage, salience (preoccupation with phone use), tolerance (needing increasing screen time for satisfaction), withdrawal (distress when disconnected), and negative consequences in personal, academic, or professional domainsdoi.orgfrontiersin.org. For instance, heavy users may feel anxious or depressed without access to their device, and their sleep and face-to-face interactions often sufferfrontiersin.orgsiepr.stanford.edu. Recent studies link problematic smartphone use with a range of psychological issues including heightened anxiety, depressive symptoms, loneliness, and attention deficitsfrontiersin.orgfrontiersin.org.

Despite these documented harms, smartphone addiction is not yet formally recognized as a distinct disorder in major diagnostic manuals. The DSM-5 (2013) includes Internet Gaming Disorder as a condition for further study, but not smartphone or internet use in generalpmc.ncbi.nlm.nih.gov. Similarly, the ICD-11 (WHO, 2019) recognizes Gaming Disorder but not "smartphone addiction" per sepmc.ncbi.nlm.nih.gov. Researchers have thus used various termssuch as Problematic Smartphone Use (PSU) and Smartphone Use Disorder (SUD)to describe maladaptive patterns of phone

usepmc.ncbi.nlm.nih.gov. These terms conceptualize smartphone overuse as a mobile subtype of Internet Addiction or Internet Use Disorderpmc.ncbi.nlm.nih.gov. In the absence of standardized criteria, assessment typically relies on self-report scales (e.g. the Smartphone Addiction Scale) that gauge symptom severity (e.g. daily-life disturbances, withdrawal, overuse)dergipark.org.tr. Still, debate continues over whether smartphone addiction constitutes a true behavioral addiction or a symptom of underlying psychosocial problemsdoi.org. Some scholars caution against over-pathologizing common behaviors, noting that not all frequent phone users meet addiction thresholdspmc.ncbi.nlm.nih.gov.

Notwithstanding these debates, there is consensus that excessive smartphone use can be detrimental and that certain populations (especially adolescents and young adults) appear particularly at riskfrontiersin.orgfrontiersin.org. Globally, smartphone ownership and screen time have surged in the past decade. For example, in China, over 120 million youths aged 10-19 were active mobile internet users as of 2021frontiersin.org. Adolescents tend to show heightened vulnerability to developing problematic phone use, likely due to developmental factors (such as immature impulse control and a strong susceptibility to peer influence)frontiersin.orgfrontiersin.org. Twenge and colleagues observed marked declines in mental well-being among American teens after 2012, correlating with the rapid rise of smartphones and social media in this generationpmc.ncbi.nlm.nih.gov. This generational shift suggests that the unique context of the digital era can shape behavioral health outcomes in youth.

Crucially, research into smartphone addiction has expanded from purely psychological studies to a broader interdisciplinary inquiry. Early work focused on identifying psychological correlates (e.g. anxiety, loneliness, impulsivity) and comparing smartphone addiction to established addictionsfrontiersin.orgdoi.org. More recently, neuroscientific studies have begun to explore the neurobiological mechanisms involved. For instance, neuroimaging research indicates that excessive smartphone use can alter neural pathways related to reward and self-controlfrontiersin.orgfrontiersin.org, resembling patterns seen in substance and gambling addictions.

**Table 1:** The G-DEEG Model - Domains of Factors in Smartphone Addiction

| Domain (Acronym Letter) | Description | Examples of Relevant Factors |
|---|---|---|
| **Generational/Developmental (G)** | Age-related and developmental stage factors that influence vulnerability to smartphone overuse. Also includes generational cohort effects and brain maturation considerations. | - Adolescence (heightened risk-taking, peer influence) |
| | | - Emerging adulthood vs. mature adulthood differences |
| | | - Developmental stage of impulse control (e.g. prefrontal cortex maturation by mid-20s) |
| | | - “Digital native” cohort exposure from early childhood |
| **Digital/Technological (D)** | Features of smartphone technology and digital content that reinforce habitual or compulsive use. The design of apps and platforms intended to capture user attention falls in this category. | - Persuasive design elements (notifications, autoplay, infinite scroll) |
| | | - Social media “likes” and reward feedback loops (dopamine hits) |
| | | - Freemium gaming models and in-app rewardspmc.ncbi.nlm.nih.gov |
| | | - Constant availability (24/7 connectivity, no usage limits) |
| | | - Algorithms personalizing and pushing engaging content |
| **Emotional/Psychological (E)** | Individual psychological makeup and emotional health factors that contribute to smartphone dependence. These include both traits and states that may drive one to use the phone maladaptively. | - Personality traits (e.g. high neuroticism, impulsivity, low self-control) |
| | | - Emotional problems (anxiety, depression, stress) frontiersin.orgfrontiersin.org |
| | | - Poor coping skills (using phone to escape or alleviate negative moods)frontiersin.org |
| | | - Fear of Missing Out (FoMO) and need for social validation |
| | | - Cognitive factors (attention deficits, addictive cognitions) |
| **Environmental/Social (E)** | The social and physical environment surrounding the individual, including family, peers, culture, and situational context, which can either protect against or facilitate addictive smartphone use. | - Family dynamics (parental monitoring, parent-child relationship quality)frontiersin.org |
| | | - Peer group norms (peer pressure to be constantly online, friend group phone habits) |
| | | - School/work environment (policies on phone use, academic pressure) |
| | | - Socioeconomic and cultural context (access to devices, cultural attitudes toward technology) |
| | | - Stressful environments or social isolation driving one toward online engagement |
| **Genetic/Biological (G)** | Inherited and biological factors that may predispose an individual to addictive behaviors, including neurobiological pathways implicated in reward, impulse control, and mood regulation. | - Genetic polymorphisms associated with addiction or impulsivity (e.g. variants in dopamine receptors/transporters)frontiersin.org |
| | | - Neurobiological traits (reward sensitivity, low dopamine baseline, executive function deficits) |
| | | - Co-occurring neurodevelopmental conditions (ADHD, etc.) that increase risk |
| | | - Physiological arousal patterns (e.g. using phone use to modulate arousal/sleep) |

Other studies have examined social and environmental influences: family dynamics, parenting style, and peer networks can all impact an individual's risk of problematic usefrontiersin.orgfrontiersin.org. The role of the technology itself has also come under scrutiny. It is increasingly recognized that smartphones and apps are deliberately engineered with persuasive design features (e.g. push notifications, infinite scrolling, reward loops) that can foster habit formation and compulsive usagesiepr.stanford.edupmc.ncbi.nlm.nih.gov. Indeed, evidence suggests that it is the content and interactive features of smartphones-social media, messaging, games-rather than the device hardware alone that drive addiction-like behaviorspmc.ncbi.nlm.nih.gov.

These developments signal that no single discipline can fully explain smartphone addiction. Instead, a comprehensive understanding requires integrating insights from psychiatry, psychology, neuroscience, sociology, and even technology and design fields. The need for such a holistic perspective is particularly important in the context of psychiatric rehabilitation. Individuals seeking help for smartphone or internet addiction often present with a complex web of contributing factors (e.g. underlying depression, family conflict, poor coping skills, pervasive tech exposure)pmc.ncbi.nlm.nih.govpmc.ncbi.nlm.nih.gov. Traditional interventions such as cognitive-behavioral therapy focusing solely on the individual's thoughts and behaviors - may have limited success if they neglect biological predispositions or the powerful influence of the digital environmentfrontiersin.orgfrontiersin.org. As a recent review emphasized, future research and treatment should "extend beyond examining the individual consequences of [mobile phone addiction] and investigate its impact on families and society," while also "recognizing the significant influence of genetic factors"frontiersin.org. In other words, both nature and nurture, individual and society, person and technology must be accounted for when designing effective rehabilitation strategies.

The G-DEEG Model was developed in response to this recognized need for an integrative approach. This model originally formulated in a Turkish-language study and translated/expanded here posits that five key domains jointly contribute to the onset and maintenance of smartphone addiction: Generational/Developmental, Digital/Technological, Emotional/Psychological, Environmental/Social, and Genetic/Biological factors. The acronym "G-DEEG" reflects these domains. Unlike earlier frameworks that were limited to psychosocial elements, the G-DEEG model explicitly incorporates biological and technological dimensions alongside the psychosocial, thus exemplifying an interdisciplinary paradigm. In the sections that follow, we present a structured overview of the G-DEEG model. First, we summarize each domain and its relevance to smartphone addiction, converting any original schematics into Table 1 for clarity. Next, we discuss how these domains interact and the implications of this model for psychiatric rehabilitation highlighting how a multi-domain intervention plan can be formulated. Finally, we emphasize the model's novel contributions and propose directions for future research and clinical practice in the field of digital addiction.

**The G-DEEG Model:** Overview and Domains

The G-DEEG model is a conceptual framework that integrates five domains of risk and influence in smartphone addiction. Table 1 provides an overview of these domains, along with their definitions and illustrative factors. The central premise of G-DEEG is that smartphone addiction arises from the convergence of multiple disciplinary factorsspanning biology, psychology, social context, technology design, and developmental stage. Each domain represents a distinct layer of analysis:

- Generational/Developmental Factors (G): Characteristics tied to an individual's age, generation, and developmental stage. This includes developmental psychology aspects (e.g. adolescence vs. adulthood), cohort effects, and maturation of self-regulation capacities.
- Digital/Technological Factors (D): Attributes of smartphones, apps, and the digital ecosystem that encourage addictive use. This covers persuasive design, platform algorithms, availability of content, and the broader digital environment the user is exposed to.
- Emotional/Psychological Factors (E): The mental and emotional profile of the user - personality traits, affective states, cognitive patterns, and psychiatric symptoms that can drive or result from excessive phone use.
- Environmental/Social Factors (E): The external environment and social context. Family relations, peer influence, cultural norms, educational or occupational setting, and socioeconomic status fall in this domain.
- Genetic/Biological Factors (G): Innate or physiological predispositions. This includes genetic polymorphisms, neurobiological traits, and other biological factors that may influence susceptibility to addictive behaviors.

It is important to note that these domains are interrelated. The model does not treat them as isolated silos; rather, it suggests that a comprehensive understanding of smartphone addiction emerges from examining how these layers interact for a given individual. For example, an adolescent (developmental factor) with high anxiety (emotional factor) in a family that sets few limits on screen time (environmental factor) and who is drawn to algorithm-driven social media apps (digital factor) may have a far higher risk of developing addiction-like use patterns - especially if they also have a genetic predisposition toward impulsivity or reward-seeking (biological factor). G-DEEG, therefore, aligns with a biopsychosocial model augmented by a technological dimension and a developmental lens.

**Note:** The G-DEEG acronym contains two G's, representing Generational and Genetic domains at the two ends, and two E's, representing Emotional and Environmental domains. This emphasizes that both intrinsic factors (biology, psychology) and extrinsic factors (social context, technology) filtered through the lens of one's developmental stagecollectively shape the propensity for smartphone addiction.

In the subsections below, we delve into each domain in detail, citing current research to elucidate how these factors manifest and interact. We also indicate how recognizing each domain's contribution can inform targeted interventions as part of a comprehensive psychiatric rehabilitation plan.

## 2.1. Generational and Developmental Factors (G)

Generational and developmental factors refer to the influence of a person's age, developmental stage, and cohort-specific experiences on their relationship with smartphone technology. This domain acknowledges that an individual's stage of neurological and psychological development can affect both their susceptibility to addictive behaviors and the impact of smartphone use on their life.

One key aspect is adolescent development. Adolescence and early adulthood have been consistently identified as high-risk periods for the development of smartphone addictionfrontiersin.org. During the teenage years, the brain's reward circuits (primed by dopamine) are highly active, while the prefrontal cortex responsible for impulse control and risk evaluation is still maturing. This imbalance can make adolescents more prone to engaging in rewarding behaviors without sufficient self-regulation, such as compulsive social media checking or gaming on phones. Indeed, adolescents report stronger urges to use their smartphones and greater distress when unable to do so, compared to older adults, reflecting developmental differences in self-control. Research supports this: for example, Li and Yang (2024) note that teens exhibit heightened risk for mobile phone addiction relative to other age groupsfrontiersin.org. Another study on adolescent phone use found that early frequent exposure to social media was linked to alterations in brain regions tied to social reward processinghealthmatters.nyp.org, suggesting that heavy use during

critical developmental windows could reinforce neural pathways that make breaking the habit more difficult later.

The generational context also matters. The current generation of adolescents and young adults (often termed "digital natives") have grown up with smartphones and ubiquitous internet from an early age. Their normative behavior and social expectations differ from those of older cohorts who adopted smartphones in adulthood. For instance, constantly texting, scrolling, or refreshing feeds may be seen as typical teen behavior now, even if it might meet clinical thresholds for addiction-like use. Twenge et al. (2018) documented that around 2012-2014when smartphone ownership exceeded 50//. among teens in the U.S. indicators of psychological well-being in this demographic (life satisfaction, self-esteem, happiness) began to decline noticeably, concurrent with increased screen timepmc.ncbi.nlm.nih.gov. This temporal correlation suggests a generational effect where the "iGen" or Gen-Z cohort is uniquely affected by the smartphone-saturated environment. Additionally, younger generations might be more vulnerable to phenomena like FoMO (Fear of Missing Out) due to social media, which can drive compulsive checking behaviors at a developmental stage when peer acceptance is paramount.

However, developmental factors are not limited to youth. Emerging adulthood (approximately ages 18-25) is another critical phase; many college students struggle with balancing newfound freedom and technology use, sometimes leading to problematic use that interferes with academics. On the other end of the spectrum, middle-aged and older adults generally have lower prevalence of smartphone addiction, potentially due to more mature self-regulation and lesser social media immersion. But even older adults, as they increasingly adopt smartphones, may develop problematic patterns, especially if they use phones as a primary social outlet in isolation. Each life stage presents distinct challenges and reasons for smartphone overuse (e.g. teens for social belonging, adults for work connectivity or escapism, etc.). The G-DEEG model's inclusion of generational/developmental factors underscores that age-tailored approaches are needed in psychiatric rehabilitation. For example, interventions for adolescents might focus on building impulse control and offline social skills, whereas for older adults, increasing alternative rewarding activities might be key.

In summary, generational/developmental factors shape both the exposure to risk (with younger cohorts more immersed in digital life) and the capacity to cope (with adolescents being neurologically and psychologically more susceptible to addiction). Acknowledging this domain helps practitioners tailor prevention and treatment: what works for an adult may not engage a teen, and vice versa. It also highlights the importance of early education for youth about healthy tech habits, as habits and neural pathways formed early can have lasting effects on behaviorfrontiersin.org.

### 2.2. Digital and Technological Factors (D)

The digital/technological factors domain of the G-DEEG model addresses the role of smartphone technology itself - and the digital content delivered through it - in fostering addictive use patterns. Unlike traditional addictions, which often involve a chemical substance, smartphone addiction is behavioral and heavily driven by external design features of apps and devices. In effect, tech companies have created a highly engaging (some would say addicting) environment that can hook users by exploiting basic learning and neurobiological mechanisms.

One major factor is the persuasive design of modern smartphone applicationsopal.so. Many apps (social media, games, news feeds, etc.) use carefully engineered features to maximize the time users spend engaged. These include: intermittent rewards (e.g. unpredictable notification alerts, "pull-to-refresh" mechanisms similar to slot machines), social rewards (likes, comments, follower counts that trigger dopamine release and reward feelingsopal.so), and endless scrolling or autoplay that removes natural stopping cues. Such features leverage the brain's reward system - particularly dopaminergic pathways - reinforcing repetitive checking and prolonged usageopal.sosiepr.stanford.edu. As a result, users can develop habitual patterns: for example, reaching for the phone reflexively when bored or anxious, much as a smoker might reach for a cigarette. Gentzkow et al. (2021) demonstrated through an economic model that habit formation and self-control failure are key components of digital addiction, with people underestimating their future usage and struggling to align behavior with their ideal usage goalssiepr.stanford.edusiepr.stanford.edu. They also found that interventions like apps to limit screen time or financial incentives to abstain could modestly reduce use, highlighting how deeply design influences behaviorsiepr.stanford.edusiepr.stanford.edu.

Another crucial technological factor is the 24/7 accessibility and ubiquity of smartphones. The fact that a single compact device provides immediate access to communication, entertainment, and information anywhere, anytime, lowers barriers to excessive use. There are no built-in "off hours" - unless users impose their own limits, the phone is always an available outlet for instant gratification. This constant availability can lead to checking the phone dozens of times a day almost unconsciously. Surveys indicate that the average smartphone user in the U.S. checks their phone between 50 to 80 times per daysiepr.stanford.edu, often without a pressing need, reflecting an ingrained habit loop.

Moreover, the variety of engaging content on smartphones means they can cater to multiple psychological needs. When feeling social, one turns to messaging or social networks; when bored, to games or videos; when curious, to news or search engines. This multi-functionality increases the device's hold on the user's attention across different contexts and moods. Freemium games and social media platforms have been singled out as particularly "sticky" applications. They are often free to use but employ strategies to keep users coming back (e.g. streaks, in-game currency, push notifications about friends' activities). A review by Montag et al. (2019) pointed out that it's not the smartphone per se that's addictive, but the "manifold installed applications" on it that are engineered to prolong usagepmc.ncbi.nlm.nih.gov. The authors emphasized focusing on app design features - such as social notifications or reward systems in games - to understand why people get hooked on their devicespmc.ncbi.nlm.nih.gov. In other words, the smartphone is a delivery mechanism for potentially addictive experiences (social validation, gaming achievements, etc.).

These digital factors have important implications for rehabilitation. They suggest that any treatment for smartphone addiction should include a component of digital literacy and self-management - teaching individuals about how tech design can manipulate them and how to resist or undo those habit loops. Interventions might involve apps or device settings that curb usage (as Gentzkow's study showed, tools like screen-time limits can helpsiepr.stanford.edu), or behavioral techniques like stimulus control (e.g. turning off non-essential notifications, scheduling phone-free periods). In severe cases, a digital detox period might be recommended to break the immediate cycle of compulsion and allow the person to re-establish control. From a public health perspective, this domain also points to the potential of policy or design changes - for example, advocating for more ethical interface designs, or implementing default app settings that encourage healthy use rather than maximize engagement. While individual willpower is important, the G-DEEG model recognizes that the deck is stacked against the user when the digital environment is built to exploit their weaknesses. Therefore, altering that environment (either personally through settings or broadly through advocacy) is a critical part of addressing smartphone addiction.

### 2.3. Emotional and Psychological Factors (E)

The emotional/psychological factors domain encompasses the individual's internal mental state, personality, and psychopathology that may predispose them to excessive smartphone use or result from it. Behavioral addictions like smartphone overuse often serve as a coping mechanism for underlying emotional issues, and conversely,

chronic overuse can exacerbate psychological distress, creating a vicious cyclefrontiersin.orgfrontiersin.org.

One of the most common findings is the link between smartphone addiction and negative affective states such as anxiety and depression. Numerous studies have identified that people who experience higher levels of stress, social anxiety, or depressive symptoms are more prone to problematic smartphone usefrontiersin.orgfrontiersin.org. For instance, individuals with depression may turn to their phones for distraction or mood regulation - scrolling through feeds or playing games to escape feelings of sadness (this aligns with the Compensatory Internet Use Theory, which posits that some people overuse online activities to compensate for offline dissatisfactionfrontiersin.org). Indeed, Wei et al. (2020) found that smartphone addiction can be both a tactic to alleviate depressed mood and a consequence of depression, as depression can diminish interest in other activities, making the phone a default pastimefrontiersin.org. Similarly, anxietyespecially social anxietycan drive one to prefer virtual interactions over face-to-face ones, reinforcing phone dependence. A 2022 study by Gao et al. showed that adolescents with poorer parent relationships were more likely to have their psychological needs unmet and in turn more likely to develop mobile phone addiction,suggesting that emotional need fulfillment plays a mediating rolefrontiersin.org. If real-life connections or self-esteem are lacking, the smartphone may become a source of comfort and validation, albeit a temporary one.

Personality traits are another important facet. Traits such as impulsivity, neuroticism, and low conscientiousness have been associated with higher risk of technology addictionspmc.ncbi.nlm.nih.govpmc.ncbi.nlm.nih.gov. Impulsive individuals may have difficulty resisting the immediate gratification of checking messages or playing a quick game, thereby easily forming habits. Those high in neuroticism might be more prone to use smartphones to soothe anxiety or seek reassurance (for example, excessively checking for messages due to fear of missing out). On the other hand, individuals high in traits like self-discipline and emotional stability seem less likely to fall into addictive patterns. A cross-cultural study by Sha et al. (2019) linked low self-regulation with problematic smartphone and WhatsApp use among young adultspmc.ncbi.nlm.nih.gov. Additionally, low self-esteem and unmet social belonging needs can predict problematic use, as individuals seek affirmation online that they lack offlinepmc.ncbi.nlm.nih.gov.

A particularly modern psychological phenomenon relevant here is FoMO (Fear of Missing Out). FoMO is the anxiety that others are having rewarding experiences without you, and it has been shown to be a strong predictor of social media addiction. It drives people to constantly check their phones for updates so as not to feel left outcascadepbs.org. This constant monitoring can escalate into compulsive behavior. FoMO ties into both anxiety and social environment, illustrating how these domains interplay: a person high in trait anxiety (psychological factor) may experience FoMO if their peer group is very active online (environmental factor), prompting incessant phone checking (behavioral outcome).

It is also crucial to note the outcomes of smartphone addiction on emotional health. Excessive use has been associated with increased levels of stress, sleep disturbances (which in turn affect mood regulation), and exacerbation of symptoms of ADHD, depression, and anxietyfrontiersin.orgfrontiersin.org. Over time, these can create a self-reinforcing loop: for example, using the phone late into the night causes poor sleep; poor sleep increases anxiety and irritability the next day; which then leads the person to use the phone even more as a distraction or stimulant. Breaking this cycle often requires psychological intervention.

In psychiatric rehabilitation, addressing the emotional/psychological domain is fundamental. Interventions may include psychotherapy (like cognitive-behavioral therapy, CBT) to help individuals recognize and modify the maladaptive thoughts and feelings driving their phone use. For example, cognitive restructuring might target beliefs like “I must respond to messages immediately or I’ll lose friends” or “When I feel lonely, only my phone can help.” Therapists also work on building healthier coping skills so that clients do not rely on their phones to manage emotions. Techniques such as mindfulness can increase awareness of the triggers and urges for phone use, helping regain control. In group therapy settings, individuals can build social skills and reduce isolation, directly countering some emotional voids that the phone was filling. In some cases, comorbid mental health conditions (like depression or anxiety disorders) might need treatment with therapy or medication in parallel, because failing to treat those will likely undermine efforts to curb the phone addiction. Ultimately, the G-DEEG model’s emotional/psychological component reminds clinicians that smartphone addiction is often a symptom of deeper emotional strugglessuccessful rehabilitation must therefore go beyond the behavior itself and heal the person’s psychological well-being.

### 2.4. Environmental and Social Factors (E)

Environmental and social factors represent the external context in which smartphone use occurs. This domain recognizes that human behavior, including the tendency to overuse technology, is profoundly shaped by one’s immediate environment (family, peers, work/school setting) and broader social-cultural milieu. In many cases, smartphone addiction is not solely an individual issue but a systemic one, influenced by social dynamics and norms.

At the micro level, family environment is a critical factor, especially for children and adolescents. Parenting style and family rules regarding technology can either mitigate or exacerbate the risk of addiction. For instance, inconsistent discipline or lack of monitoring might allow a teenager unfettered access to their phone at night, increasing their usage and risk of developing addiction-like behaviors. On the other hand, families that set clear boundaries (such as no devices at the dinner table or after a certain hour) provide a protective structure. Moreover, parents serve as role models; if parents themselves are heavy phone users (so-called “technoference” in parenting), children may learn that behavior. A study by Cerniglia et al. (2020) on internet addiction found that dysfunctional family functioning (e.g. poor affective involvement, low communication) was associated with higher addictive internet use in young adultspmc.ncbi.nlm.nih.gov. Interestingly, the impact of family environment was moderated by certain gene variants in that studypmc.ncbi.nlm.nih.gov, meaning some individuals were genetically more sensitive to family influences on their addictive behavior. This underscores an interplay: a chaotic or emotionally unsupportive home might drive a vulnerable youth to escape into the digital world for solacepmc.ncbi.nlm.nih.gov. Conversely, a supportive family might notice problematic use early and intervene constructively.

Peer influence also plays a significant role. In adolescence, peers often set the norms for acceptable behavior. If one’s friend group spends a lot of time on social media or gaming apps, an individual will likely do the same to fit in. “Everyone is on Instagram for hours, so I should be too” is a common rationale. Social pressure can thus normalize very high levels of smartphone use. Furthermore, online peer interactions can sometimes substitute for offline ones, especially for teens who feel more confident texting or posting than talking in person. While online socializing can have benefits, it can also become excessive and reduce time spent on face-to-face relationships, potentially reinforcing social anxiety in a feedback loop. Studies have found that adolescents with higher social anxiety or lower social support are more susceptible to problematic internet and smartphone use, partly because they prefer the mediated communication where they feel safer or more in controlfrontiersin.orgfrontiersin.org.

Broader cultural and societal factors are also at play. Different societies have varying attitudes towards technology. In some East Asian countries, for example, internet addiction (including smartphone gaming addiction) has been recognized as a public health issue for years, and societal pressures (e.g. intense academic

expectations) may drive youths to seek stress relief in online games or social media. In other cultures, heavy smartphone use might be less stigmatized or more deeply ingrained in daily life (e.g. the expectation to be constantly reachable for work or family). Socioeconomic factors can influence the form of smartphone overuse as well: wealthier individuals might have access to more devices and paid apps; lower-income individuals might rely on smartphones as their primary entertainment (substituting for other activities) or communication tool, which can also lead to overuse. However, interestingly, some studies have found that higher income and education are associated with more smartphone use, not lessdergipark.org.trdergipark.org.tr possibly because professionals are tethered to work emails or because they can afford the latest addictive apps. In any case, context matters.

School and workplace environments factor into this domain. For students, schools that integrate tablets/phones into learning or have lenient phone policies may inadvertently encourage more screen time. For workers, job expectations of being reachable after hours or via smartphone can blur boundaries and promote compulsive checking (e.g. constantly refreshing email). The COVID-19 pandemic is a recent example of an environmental shift: with remote learning and work-from-home, individuals became even more reliant on devices, and reports of problematic use rose as personal and professional lives merged on screens.

From a rehabilitation standpoint, addressing environmental/social factors means possibly involving the social system around the individual in intervention. Family therapy or parental guidance can be very important for younger patients with smartphone addiction - educating family members to provide support, set appropriate boundaries, and address any relational issues driving the behavior. Schools and workplaces can be engaged to create healthier norms (like "digital well-being" initiatives that encourage unplugging). On a societal level, public awareness campaigns can shift norms (e.g. promoting the idea of "digital sabbath" days without screens). In severe cases, changing an individual's environment might be necessary, at least temporarily - for example, a residential digital detox program or wilderness therapy camp where access to electronics is removed and the person re-learns how to engage with the real world and develop alternative coping mechanisms.

In short, the environmental/social domain of G-DEEG emphasizes that smartphone addiction does not occur in a vacuum. Social context can either be a buffer or a trigger. Effective treatment thus often extends beyond the individual: involving family members, peer support groups, and modifying the individual's daily environment to reduce triggers (like charging the phone outside the bedroom to avoid late-night use, or scheduling device-free family activities). As Li and Yang (2024) conclude, "future research [and interventions] should investigate [mobile phone addiction's] impact on families and society" and implement solutions from those perspectivesfrontiersin.orgfrontiersin.org. By doing so, we address not only the person but also the context, creating a more supportive ecosystem for recovery.

### 2.5. Genetic and Biological Factors (G)

The final domain of the G-DEEG model, genetic and biological factors, considers the role of an individual's biologyparticularly their genetic makeup and neurobiological characteristics in predisposing them to smartphone addiction. This aspect aligns with the broader view of addictions (including behavioral ones) as having some hereditary and physiological components, even though environment and psychology play a major role in triggering and shaping the behavior.

Research into the genetics of behavioral addictions is still in its early stages, but insights can be drawn from studies on Internet addiction and related phenotypes. For example, a 2020 exploratory study by Cerniglia et al. investigated associations between young adults' internet addiction and specific gene polymorphisms related to the brain's monoamine systems (genes for serotonin transporter, dopamine receptors, etc.), while also considering family environment and psychopathologypmc.ncbi.nlm.nih.govpmc.ncbi.nlm.nih.gov. They found no single gene variant that uniformly caused internet addiction, which is unsurprising given the complexity of such behaviors. However, intriguingly, they discovered that certain genotypes moderated how much family dysfunction translated into addiction severitypmc.ncbi.nlm.nih.gov. In other words, some individuals had a genetic profile that made them more resilient or more vulnerable to environmental risk factors. This gene-environment interaction is a common theme in psychiatric genetics, and it likely applies to smartphone addiction as well: genes are not destiny, but they can tilt the odds.

From what is known about substance addictions and gambling disorder (which is a recognized behavioral addiction), heritable factors account for a portion of the risk. Twin studies have suggested that there is a genetic contribution to internet use disorder, though precise estimates vary. It stands to reason that traits linked to addiction - such as impulsivity, novelty-seeking, or reward deficiency - have genetic underpinnings that could similarly influence problematic smartphone use. For instance, variations in genes encoding dopamine receptors (like DRD2, DRD4) or transporters (DAT1), or serotonin receptors/transporters (5-HTTLPR variant in the serotonin transporter gene), have been studied in substance and internet addictionspmc.ncbi.nlm.nih.gov. Some of these variants are associated with differences in reward sensitivity and impulsive tendencies. If an individual happens to have a combination of such risk alleles, they might experience stronger reward from digital interactions or weaker impulse control, making it harder for them to regulate usage. Li and Yang (2024) note that genomics and metabolomics studies have "yielded promising results, suggesting potential genetic susceptibility" in Mobile Phone Addiction, including findings of aberrant gene methylation patternsfrontiersin.org. While specific genes remain to be clearly identified, the suggestion is that biological predispositions exist.

Beyond DNA, neurobiology is a key part of this domain. Neuroimaging studies provide evidence that excessive smartphone use can lead to functional and structural brain changes. For example, some fMRI studies have shown that people with smartphone or internet addiction have altered activity in prefrontal areas (involved in inhibition and decision-making) and in striatal regions (involved in reward processing)frontiersin.org. One study reported that the neural activity associated with rewards was dampened in those with smartphone addiction, hinting at a reward deficiency syndrome similar to what is seen in substance addictionsfrontiersin.org. There are also reports of reductions in gray matter volume in areas related to attention and impulse control in heavy internet/smartphone users, although causality is unclear (does heavy use cause the change, or do people with that brain profile tend to overuse?). Additionally, neurochemical studies (using techniques like EEG or spectroscopy) have suggested imbalances in neurotransmitters among those with severe phone addiction, for example higher levels of neuroticism-related chemicals or cortisol due to stress.

Physiologically, individuals might also differ in how their bodies respond to smartphone-related stimulation. Some people get a strong physiological arousal from a message notification (heart rate jumps, excitement ensues) while others do not - those who do might be more easily conditioned to check frequently. Tolerance can develop: what started as a quick thrill from 10 minutes of a game might escalate to needing an hour for the same satisfaction, due to the brain's habituation to dopamine surges.

Understanding the genetic/biological domain can influence rehabilitation in several ways. Firstly, it encourages a non-judgmental, medical view of the condition: patients and families can understand that there may be a biological basis for why some struggle more with control, reducing stigma or the tendency to blame it purely on willpower or "moral weakness." Secondly, if certain biological markers or profiles are identified in the future (for instance, if we could test that a person has a particular genetic makeup or a certain EEG profile), interventions could be personalized. A person with a clear

reward deficiency might benefit from activities or even medications that boost dopamine in healthy ways (exercise, or Bupropion perhaps, as is sometimes tried in internet addiction), whereas someone whose primary issue is impulsivity might benefit from impulse-control training or even medications used for ADHD in some cases.

Moreover, biological understanding opens the door for pharmacological interventions if appropriate. While there is no approved medication for smartphone or internet addiction, clinicians have experimented with treating underlying issues (like using SSRIs for co-morbid depression/anxiety or stimulant medications for co-morbid attention issues) to see if that helps reduce the addictive use. Some trials have looked at naltrexone (an opioid antagonist used in alcoholism) for reducing the pleasure from addictive behaviors, or other neuromodulatory approaches. As the neurobiology becomes clearer, we might find more targeted pharmacotherapy to complement behavioral therapy in severe cases.

In summary, the genetic/biological domain of G-DEEG highlights that we must consider the innate wiring of individuals. Some people may be biologically predisposed to fall into compulsive tech use (due to an "addictive personality" or a sensitive reward system), whereas others might naturally self-regulate better. Psychiatric rehabilitation benefits from this insight by moving toward holistic, personalized care. Just as someone quitting smoking might use nicotine patches for the physical dependency while also attending counseling, a person trying to overcome smartphone addiction might combine therapy with strategies addressing their biological needs (like structured exercise to tap into natural reward systems, sleep hygiene to restore circadian rhythms disrupted by device use, etc.). Ultimately, acknowledging biology is part of treating the whole person.

### 2.6. Interplay of Domains and Interdisciplinary Implications

While we have discussed each G-DEEG domain separately, it is essential to reiterate that smartphone addiction is the product of interactions among these domains. No single factor can fully account for the behavior; rather, it emerges from a confluence of risk factors and reinforcements across domains. This interplay is what makes the G-DEEG model especially relevant for an interdisciplinary field like psychiatric rehabilitation, which often deals with complex conditions requiring multi-faceted interventions.

Consider a hypothetical case example to illustrate interplay: A college-aged young man finds himself unable to stop scrolling through social media late into the night. A G-DEEG analysis might note he is an emerging adult (developmental) who has just moved away from home and feels lonely (emotional). He seeks solace and social connection on Instagram and Reddit (digital content that is readily available and algorithmically tailored to hold his attention). He comes from a family with minimal emotional closeness (environmental factor: he's used to seeking support online rather than from parents). Additionally, he has a personal and family history of addiction—his father struggled with alcoholismwhich might indicate a biological predisposition affecting him (perhaps genes influencing dopamine pathways). In this scenario, the developmental transition (college) and social isolation drive emotional distress, which the digital platform rewards temporarily; his genetic makeup might make those digital rewards especially potent or hard to resist. As he loses sleep, his academic performance suffers, creating more stress and driving him further into online escapism a reinforcing cycle.

Breaking such a cycle would require addressing all key domains: counseling to improve his emotional coping and perhaps treat mild depression (psychological), strategies to change his digital habits (tech domain, like app blockers or new routines), efforts to build an offline support network (social domain, e.g. joining clubs or support groups to mitigate loneliness), and possibly attention to biological needs (ensuring good sleep, exercise to stabilize mood, maybe a psychiatric evaluation for any underlying ADHD or predispositions). If family dynamics are relevant, family therapy might be included to improve support. This comprehensive approach epitomizes the G-DEEG philosophy.

Empirical evidence also supports the need for multi-domain intervention. A meta-analysis of treatments for internet/smartphone addiction noted that combined approaches (psychotherapy + family therapy + digital detox) tend to yield more sustained improvements than any single approach alonefrontiersin.org. Single-focus interventions often show only short-term benefits; for example, just restricting phone use might backfire if the person's underlying anxiety is not managed, leading to relapse. The durability of efficacy, as Li and Yang (2024) highlight, is an issue - treatments focusing only on psychological counseling have limitations in long-term successfrontiersin.org. The G-DEEG model would predict that outcome, arguing for addressing all contributing domains for lasting change.

Another interdisciplinary insight of the G-DEEG model is its applicability to prevention and policy. Recognizing environmental and digital factors suggests that system-level interventions (like digital wellness education in schools, tech industry regulation on addictive app features, community programs to promote balanced tech use) could be effective preventative measures. Similarly, understanding generational differences can inform public health messagingwhat resonates with teens (perhaps peer-led initiatives or gamified challenges to reduce screen time) will differ from messages aimed at parents or older adults (like highlighting family time or productivity).

The model's novelty lies in formally bringing technology design and biology into the fold alongside psychosocial factors. Traditional biopsychosocial models in psychiatry cover biology, psychology, and social environment, but G-DEEG explicitly adds the digital environment as a separate category, which is appropriate given the unique role of interactive technologies here. By doing so, it bridges disciplines such as computer science and design ethics with mental health - a truly interdisciplinary merge. For example, an engineer or app designer informed by G-DEEG might collaborate with psychologists to create apps that help reduce addiction (as some apps now track screen time and reward users for meeting limitssiepr. stanford.edu), essentially using the same persuasive design tactics for good. Likewise, geneticists and neuroscientists might work with clinicians to identify biomarkers that signal when a person is at high risk, enabling early intervention.

In psychiatric rehabilitation settings, adopting an interdisciplinary care team - involving psychiatrists, psychologists, social workers, occupational therapists, possibly even "digital coaches" or tech experts - could be a practical application of this model. Each team member can address a different domain: the psychiatrist monitors any medication or biological needs, the psychologist addresses emotional coping, the social worker engages family and social support, the OT or digital coach helps restructure daily routines and technology use patterns, etc. This team can coordinate to reinforce each other's work (for instance, therapist teaches anxiety management, while the tech coach helps set up phone usage schedules that reduce anxiety triggers like constant notifications, and the family counselor encourages the family to support those schedules at home).

In summary, the interplay of domains in the G-DEEG model reinforces a core message: a siloed approach is insufficient for a multi-determined issue like smartphone addiction. By appreciating the interactions - how emotional distress might make digital temptations harder to resist, or how genetic makeup might make environmental stressors more potent - interventions can be more precisely targeted and synchronized. The interdisciplinary nature of this model is both a challenge (requiring broad expertise and coordination) and an opportunity (opening new avenues for innovation in treatment). It pushes the field of psychiatric rehabilitation to evolve, much as the problem itself has evolved at the intersection of human behavior and modern technology.

## 3. Conclusion

Smartphone addiction, or maladaptive overuse of smartphones, represents a cutting-edge challenge at the crossroads of technology and mental health. The translation and restructuring of the Turkish-language work on the G-DEEG model presented here offers a comprehensive, academically robust framework to understand and address this phenomenon. By integrating Generational/Developmental, Digital/Technological, Emotional/Psychological, Environmental/Social, and Genetic/Biological factors, the G-DEEG model captures the interdisciplinary essence of smartphone addiction.

The novelty of the G-DEEG model lies in its holistic scope. Previous models of problematic technology use have often been limited to one or two domains - for example, focusing only on psychological motivations or only on social factors. In contrast, G-DEEG is one of the first frameworks to explicitly incorporate elements from neuroscience (genetic predispositions, brain-based vulnerabilities) and from technology design (persuasive app features) into the same schema as family dynamics and individual psychology. This broad view is not a theoretical luxury; it mirrors the reality that human behavior is influenced by an ecosystem of factors. A key insight from our review is that interventions failing to account for any major domain may fall short. As highlighted by Li and Yang (2024), solely psychological interventions show limited long-term success, and a broader approach involving family and societal factors is neededfrontiersin.orgfrontiersin.org. The G-DEEG model answers this call by emphasizing an ecosystemic intervention strategy.

For psychiatric rehabilitation, the implications of G-DEEG are profound. Rehabilitation is fundamentally about restoring functioning and integrating individuals back into a healthy equilibrium with their environment. The model suggests that to rehabilitate someone from smartphone addiction, one must do more than impose abstinence or provide short-term counseling. Multimodal rehabilitation plans should be devised: for instance, combining cognitive-behavioral therapy (to reshape thoughts/feelings related to phone use), social support enhancement (to reduce loneliness and FoMO), habit reversal training (to break digital cues and routines), possibly pharmacological support or neurofeedback (if indicated by biological profiles), and education on digital self-control tools. Family members or peers might be enlisted as part of the support team, helping to maintain a phone-free environment during critical periods (such as study or sleep time), as well as encouraging alternative activities like exercise, hobbies, or face-to-face interactions that satisfy needs previously met on the phone.

The interdisciplinary nature of the G-DEEG model also opens avenues for collaborative research and policy. Researchers from different fields can use the model as a common reference to frame studies - for example, a neuroscientist can examine the “Genetic/Biological” component by studying neural changes in addictsfrontiersin.org, while a sociologist examines the “Environmental/Social” by studying how family interventions improve outcomes. Policymakers and educators can also derive strategies from each domain: implementing school curricula that teach emotional resilience and digital literacy (targeting the Emotional and Digital factors), advocating for tech industry reforms to address addictive design (Digital factor), and providing community programs for youth engagement that reduce unstructured screen time (Environmental factor).

It is important to note that the G-DEEG model, while comprehensive, is a conceptual framework that benefits from continual validation and refinement. As our understanding of smartphone addiction evolves (with new data on, say, genetic markers or the long-term effects of early childhood tablet exposure), the model can be updated. Its strength is in its flexibility and inclusiveness - new factors can be slotted into the appropriate domain or prompt the creation of sub-domains. The structured format also aids in integrating findings: clinicians and researchers can map their observations or data onto the model to ensure a thorough assessment. For example, a clinician can use G-DEEG as a checklist during intake: Did I assess developmental stage? Did I ask about family and cultural background? Did I consider possible ADHD or depressive symptoms? Did I discuss the types of apps used and their usage patterns? This ensures nothing crucial is overlooked.

In conclusion, the G-DEEG model provides a timely and relevant framework for understanding smartphone addiction in all its complexity. By highlighting the interplay of diverse factors - from the microscopic (genes and neurotransmitters) to the macroscopic (cultural trends and technological infrastructures) - it offers a blueprint for both explaining and tackling this emerging addiction. For practitioners in psychiatric rehabilitation, it reinforces the idea that interventions must extend beyond the individual to their devices, their homes, and even their society. For the scientific community, it underscores that collaborative, cross-disciplinary efforts are needed to fully grasp and address the challenges posed by our digital age. As smartphone and internet use continue to permeate daily life globally, models like G-DEEG will be crucial in guiding effective responses, ensuring that technological progress does not come at the cost of our mental health and well-being.

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