## Literature Review
# Interaction of Person-Affect-Cognition-Execution (I-PACE) Model on Addictive Behavior

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**Abstracts**
**Introductions:** Adiction is a pattern of substance abuse behavior characterized by overuse of the substance (compulsive use), the safety of its availability, and a high likelihood of relapse after discontinuation. There are 3 (three) stages of addiction, those are a stage of internal change, lifestyle change, and life breakdown. **Objectives:** This study aims to explore the I-PACE concepts about its components and their relation with the emergence of addictive usage of certain internet services including gaming, online gambling, pornography addiction, online shopping, and social networking. **Methods:** This study is a literature review that collects from various source of scientific journals related to the psychiatric management of the disorder. Several studies from the international database Pubmed Central including textbooks review papers, comments, and editorials are reviewed to evaluate I-PACE concepts concerning the components and their interaction with addictive behavior. **Results:** The findings show that the I-PACE model which includes the P component (person), the A component (affective), the C component (cognitive), and the E component (executive function) explains the disruption in a person's decision-making. The anatomy of the frontostriatal circuit, notably between the ventral striatum, amygdala, and dorsolateral prefrontal area, is particularly significant for the early stages of the addictive process and the dorsal striatum for the latter stages. **Conclusions:** Interactions between components that occur in certain situations will result in addictive behavior due to the formation of satisfaction and compensation related to that behavior .

## Introductions

Individual diagnoses that suggest excessive use of alcohol and other substances and general issues such as opiate usage led to the development and refinement of the concepts of addiction and dependence. Nowadays, the two terms are frequently used interchangeably. Tolerance, withdrawal, obsession, desire, decreased control, and continuing use despite obvious evidence of negative consequences are all indicators of this notion [1]. This paradigm shift coincided with the spread of the World Wide Web in the early 1990s and the advent of the iPhone in 2007. Digital technology has drastically changed the way we communicate faster and at a lower cost across long distances, finding our way or direction in the unknown, and finding ways how to entertain ourselves. In December 2017 approximately 54.4% of the world's population was online. In 2017 it was estimated that there were 2.3 billion smartphone users and this figure will increase to almost 3 (three) billion users by 2020. This means that currently, a large part of the global population has access to high-intensity technology devices [2].

Technology-related addiction seems to be quite common despite the many positive effects of technology on humans. A recent meta-analysis showed the prevalence rate of Internet addiction globally is around 6% and varies from country to country, from 2.6% to 10.9%. While the negative effects of addiction may not always be as damaging as that produced by substance or alcohol addiction. This addiction is found mostly in vulnerable populations, namely adolescents and young adults, and has many negative impacts related to work, school and social functioning, psychological well-being and well-being, hygiene, sleep disturbances, and long-term cardiometabolic health. Therefore, addiction is an important topic that needs to be investigated further. Psychological-neurobiological concept models as well as functional brain imaging studies show that such addictions involve the interaction of reward and cue reactivity processes with inhibitory control in the prefrontal cortex [3]. The number of studies on internet addiction has expanded dramatically during the previous two decades. These studies looked at the epidemiological features of Internet addiction, such as its prevalence in different countries, comorbidities, and personality connections. More than two years ago, the Interaction of Person-Affect-Cognition-Execution (I-PACE) model on specific Internet-use disorders was released. One of its goals is to characterize the psychological and neurological processes that underpin the development of addictive Internet applications including gaming, online gambling, pornography addiction, online shopping, and social networking [4].

## Factors of Addictive Behavior

## Genetic Factors

The contribution of genetic factors to internet use disorders is 48% with varying degrees of variability in several studies. Genetic variation in Internet use disorders is related to the dopamine system (specifically the COMT Val158Met and ANKK1/DRD2 Taq Ia polymorphisms) [5]. This finding is consistent with other findings that explain the possibility of polymorphism with other addictive behaviors, such as pathological gambling. The serotonin-transporter-associated polymorphic (5-HTTLPR) of the gene encoding the serotonin transporter (SLC6A3) has also been associated with impaired Internet use [6]. Montag et al (2012) found a link between genetic variation of the CHRNA4 gene (related to cholinergic/acetylcholine nicotine receptors) and aspects of internet use disorders using the cholinergic system as a potential neurochemical system. However, because the sample sizes in these studies were small, more study is needed to determine the genetic influence [7].

## Neurobiological factors

In addictive behavior, there is an im-

balance between increased drive and desire and decreased inhibitory control in certain situations. This increased sensitization to stimuli is the result of a conditioning process associated with attentional bias and cue reactivity in advanced addiction. A person with a reward deficiency has a susceptibility to developing sensitization to stimuli. This stimulation can trigger cue reactivity and craving which have a major contribution to the occurrence of addictive behavior [8].

A decrease in executive function can be a susceptibility factor and a result of addictive behavior, including substance use disorders. This decrease can occur due to cue reactivity and craving and possibly due to changes in addiction pathways in the brain [9]. While in the advanced stages of addictive behavior, the process of controlling the inhibition of certain stimuli is influenced by craving and the urge to dispel certain addiction-related stimuli. In this condition, a person shows an appearance as if it has become a habit or automatically happened [10].

Behavioral flexibility involves frontostriatal structures where this pathway also plays a role in emotion regulation. Changes in frontostriatal pathway connectivity will cause emotional dysregulation. Meanwhile, changes in the connectivity of certain structures in the frontostriatal pathway and reward pathways (limbic and subcortical structures) are predictors of the occurrence of abstinence conditions. The establishment of behavioral flexibility and decreased compulsiveness, which influences treatment outcomes, is based on the separation of two pathways related to executive control and the sensitivity of the reward system [11].

When the networks underlying behavioral flexibility and emotional regulation are disrupted, addiction develops. Dopaminergic pathways projecting from the ventral striatum and anterior cingulate gyrus, as well as serotonergic pathways projecting from the raphe nuclei to the prefrontal area, are related to this syndrome (particularly in the orbitofrontal region). The relationship between the striatal, thalamus, and prefrontal is highly dependent on glutamate and GABA (gamma-aminobutyric acid) and the neurochemical systems involved in frontostriatal loops will work together across regulation [7].

**I-Pace on Addictive Behavior**

Predisposing factors, affective and cognitive reactions to internal or external stimuli, executive control, and inhibition, behavior in decision-making that results in the selection of a particular application or internet site, and the consequences of its use are the main components of the I-PACE model [7].

**P Component (Person)**

The P component is a predisposing variable that describes the core traits of someone who might be addicted to anything. These risk factors, taken together, have a substantial role in all forms of addictive behaviors, including gambling disorders, gaming disorders, online shopping disorders, and pornography viewing disorders [7].

Negative experiences of children at a young age, such as trauma, emotional or physical abuse, and social isolation, have been linked to impaired internet use [12]. Negative life experiences in early childhood and insecure attachment also appear to be found in internet use disorders, including internet use, and pornography viewing disorders. A person with a secure attachment style shows high self-confidence and self-esteem, can more easily enter into social relationships, will use the right strategies to deal with stress and behave in a balanced way in relationships, and is open to new things [13]. The experience of stress in early childhood makes a person more prone to react intensively to stress during adolescence and adulthood which may de-

velop into mental disorders and addictive behavior. Children's experiences at an early age when combined with pathological parenting patterns (parent-child conflict), family conditions, ownership, and use of internet and media networks by parents also have an important impact on children and adolescents internet use in their development into use disorders internet [14].

High impulsivity, low self-esteem, low awareness, high shyness, high neurotic tendencies, procrastination tendencies, and low self-direction abilities were the most consistent connections associated with personality variables [15]. A study by Buckner et al (2012) says it was stated that five specific personality traits are strongly associated with excessive internet use disorder, they are openness to new experiences (openness to new experiences), conscientiousness, extraversion, agreeableness, and neuroticism [16]. In addition, psychosocial well-being, aggression, anxiety, sensation-seeking inclinations, risk-taking, schizotypical personality traits, self-reliance, self-control, and narcissism were all linked to symptoms of internet gaming disorder. Negative affect, detachment, hostility, disinhibition, and psychotic tendencies are all described in the DSM-5 as maladaptive personality traits that are maladaptive forms of the five-factor personality model outlined above. These personality characteristics have been linked to internet usage problems, as well as other psychological diseases like depression and alcohol abuse [17]. An impulse control disorder exacerbates internet addiction by causing a person to become more involved in it [18].

**A Component (Affective)**

Stress in everyday life, as well as using the internet as a means to cope with unpleasant or stressful life problems, have been identified as major elements that may contribute to the development of internet use disorders [19]. Impulsivity is one of the coping strategies that tend to be used when dealing with everyday stress. Someone who has a high vulnerability to stress and uses dysfunctional/impulsive coping strategies is likely to tend to react when there is an urge to immediately set the mood when faced with certain stressful situations. This interaction can result in a person being more likely to choose a particular application/site depending on the expectations (explicit or implicit) to be achieved that using the internet can relieve stress or have other internet-related cognitive biases [20]. Desire is one of the key factors contributing to a loss of behavioral control. The difficulty of resisting the impulse to ingest a substance was previously referred to as craving. Cue reactivity, which is the result of confronting conditioned addiction-related stimuli, can set off cravings. Cue responsiveness was created via the associative learning mechanism, namely the conditioning process, which is the physiological, emotional, and motivational basis for cravings. These two notions have progressed from drug abuse research to behavioral addictions like gambling problems [7]. When confronted with atypical moods, withdrawal symptoms, or cravings, the need to regulate emotion arises. This emotion-regulating process is crucial in a variety of psychopathological diseases, including addiction. As an aversive affective response to specific internal or external cues, addictive behavior can be a diversion [21]. The urge to regulate emotion is an important factor in internet use disorders because it can influence the decision to use certain internet websites in the early stages of the addiction process. This factor plays a more important role later in the addiction process because it is assumed that every problem experienced will affect the mood to become more aversive while coping skills decrease. The decreased coping is dysfunctional, namely by switching to the internet site of choice [7].

### C Component (Cognitive)

Cognitive factors in this model are termed cognitive biases. Cognitive bias is a false expectation of the effects of using a particular app or site. This expectation can be explicit or implicit. Implicit expectations are often related to certain cognitive processes to choose certain applications and have a reinforcing effect that makes someone choose to use the application repeatedly. Positive anticipation (e.g., experiencing pleasure) and expectation avoidance (eg running away from reality) can influence the appearance of Internet addiction. The stability and concrete effect show the difference. Motives are thought to be reasonably constant and have an impact on a person's conduct when it comes to certain applications. Expectations, on the other hand, are concepts and thoughts about the concrete outcomes that are anticipated to occur when using specific applications/sites in specific settings. This implicit relationship is also found in online gaming disorders, internet pornography disorders, and online gambling. Cognitive biases, both explicit and implicit, may affect accelerate the emergence of cue reactivity and craving when a person is faced with situations related to certain addictions or certain meaningful situations (positive emotions, negative emotions, or stress) [7].

### E Component (Executive Function)

Although most studies have revealed at least a slight executive impairment in people with Internet use disorders, research on inhibitory control in people with Internet use disorders has yielded inconsistent results. When a person is assigned the responsibility of assessing and making decisions in risky situations, they show a considerable reduction in decision-making [22]. When comparing persons with Internet or alcohol use disorders, both groups scored significantly lower than the control group in executive functioning [23]. Differences in brain structure in people

with and without online gaming disorders are found in gray matter and white matter in the prefrontal cortex and limbic system [24]. Changes in the dopaminergic system have also been known which may be related to reinforcement processing. Neuroimaging studies in individuals with online gaming disorder have shown that deficits in executive function and inhibitory control are associated with functional changes in the frontostriatal circuit [7].

### Interaction of P-A-C-E Components on Addictive Behavior

At least in the early phases of the addiction process, the decision to use a particular site and the behavior associated with it might lead to good experiences and short-term happiness. Cue reactivity and desire in reaction to particular stimuli will increase as a result of using certain websites and receiving gratification. Conditioning has a role in the development of addictive behavior in both substance addiction and non-addiction situations. According to new research, similar conditioning processes are involved in the development of cue reactivity and desire in Internet pornography disorder [25]. Positive reinforcement follows satisfaction with the internet application, which eventually stabilizes cue reactivity and desire. As a result, using the internet is linked to reinforcement learning, maladaptive coping methods, and cognitive biases. The reinforcement mechanism encourages a user to utilize the app/site of their choice repeatedly. Furthermore, similar to what is seen in substance addiction, this mechanism allows the site of choice to be exploited in a variety of contexts. The emergence of cue reactivity and desire will be triggered by the conditioning process in substance addiction and the generalization of situational aspects, and this addictive behavior will become habitual and/or compulsive [10].

There are two stages to an addictive behavior: the early stage and the advanced

level. Satisfaction is the key driving factor behind alterations in affective and cognitive reactions to online addiction-related stimuli in the early stages of the course of various internet use disorders. In certain conditions, someone may be exposed to external or internal triggers. This circumstance might elicit both affective and cognitive responses depending on how it is perceived. The level of enjoyment received lowers as the addiction process progresses. During addiction, however, the compensating effect risesBad outcomes such as social isolation and loneliness, confrontations with parents or classmates, feelings of being misunderstood, feelings of emptiness, and other negative emotions are more probable when control over the usage of particular internet websites is weakened. Repeated use of favorite online websites can increase these symptoms, as well as loss of social contact and other issues. Satisfaction becomes less crucial at this point, but remuneration becomes more vital. In this phase of the addiction process, the hypothesis moves from reward to compensation. [7,26].

In the later stages of the addiction process, the relationships that occur in the groove can increase and produce habitual behavior that may feel automatic in certain situations. Cue reactivity and craving can change from affective and cognitive responses to consequences of the conditioning process [26]. Subjective expectations can develop into affective and cognitive biases, including biases of automatic attention when stimuli and triggers of certain addictive behaviors arise. The compensatory effect becomes stronger than the gratification effect at this stage [7]. There is an effect that mediates the inhibitory control on the relationship between cue reactivity/craving and habitual behavior which is termed specific stimulus inhibitory control that acts in the advanced stages of the addiction process. These disturbances in inhibitory control and executive function are

found in gambling disorders, gaming disorders, and Internet use disorders. General inhibitory control will decrease during the addiction process, but in advanced stages of addiction control inhibition of certain stimuli is strongly related to the occurrence of addictive behavior. At this stage when external and internal triggers appear, cue reactivity and craving will become responses and will result in a decrease in the desire to control when faced with certain addictive stimuli which will increase the tendency of habitual behavior [27].

## Conclusions

More than two years ago, the Interaction of Person-Affect-Cognition-Execution (I-PACE) model on certain Internet use disorders was released. One goal is to identify the psychological and neurological mechanisms that contribute to the development of addictive Internet applications such as gaming, online gambling, pornography addiction, online shopping, and social networking. Researchers have used I-PACE to treat gaming disorders, gambling disorders, compulsive sexual behavior disorders (including problematic use of pornographic apps), online shopping disorders, excessive use of social networking apps, and excessive use of the Internet.

The main components of the I-PACE model are as follows: component P (person) which represents a person's particular personality, component A (affective) which describes a person's dysfunctional coping when dealing with stressful situations, component C (cognitive) which indicates a person's cognitive errors when dealing with stressful situations. there is cue reactivity and component E (executive function) which explains the disturbance in the decision-making of an addict, especially when faced with risky situations. Interactions between components that occur in certain situations will produce addictive behavior because satisfaction and compensation are formed related to certain behaviors.

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