Non-addictive Information Systems

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Abstract

Addiction in the context of information technology gained increased public interest within the last years. Only recently, companies like Apple, Google, and Instagram announced to fight smartphone addiction and integrated matching features in their systems. However, if and how these features really help is still an open question. At present, there is only a very rudimentary understanding of IT-triggered disorders and addictions in information systems. Even in clinical research, there is no consensus on the nature of these addictions yet. Nevertheless, the omnipresence of information technology in our daily lives and its unpredictable effects on our moods require this problem to be addressed in a profound manner. This paper links findings from psychology and neuroscience to the information systems terminology and derives the Four-Component Model for Non-addictive Information Systems (4-NAIS). The 4-NAIS allows locating how information technology interacts with the reinforcement cycle of addictions and provides a deeper understanding of where interventions and design decisions may really help tackle IT-triggered disorders.

1 Introduction

Probably not a single week passes without an article in the news magazines on the huge amount of time people spend on their smartphones, with online games, or using apps like *Instagram*, *Snapchat*, or *Facebook*. The consequences are almost always described as problematic. This behavior, which is almost obsessive, is not only specific for a certain age group (Common Sense Media 2016) but a general problem in our society and can range from mere increased use to almost addictive behavior. In developed countries, people seem to be addicted to their smartphones or other information and entertainment systems – often with negative consequences to their daily lives, as they ignore important professional and personal duties (Vaghefi et al. 2017). This issue is omnipresent and unsettling to such an extent that even the technology and service providers feel uncomfortable and only recently presented new features to, for example, stop smartphone addiction. For instance, Instagram announced the introduction of a feature indicating if all current posts were read ("you are up-to-date"), officially to prevent their users from wasting too much time on

the app with scrolling posts. Apple recently launched a feature that suppresses notifications when the holder sleeps or within predefined areas, such as on play sites. However, compared to the underlying problem, these initiatives seem rather small. Addiction to technology is increasingly perceived as an ethical issue for technology providers (Wakunuma and Stahl 2014). Numerous initiatives or non-profit organizations, as well as academic literature, already address this problem using multiple names: technological addiction (e.g. Griffiths 1995), internet addiction (e.g. Young 2004), smartphone addiction (e.g. Kwon et al. 2013), and many more. The Time Well Spent movement in the U.S. is one example of initiatives that accuse U.S. internet companies of intentionally leading their users into addiction. Besides the health risks, Shore (2012), found that social media's distractions and the related decrease in workplace productivity have cost the U.S. economy $650 billion each year. Common Sense Media,[1] as another example, is a non-profit organization that researches the phenomena of smartphone and internet addiction (Common Sense Media 2016). Common Sense Media (2016) reports that every second teen in the U. S. feels addicted to his/her smartphone. Knorr (2018) formulates the provocative hypothesis that while research still discusses if such a disorder exists at all and how it should be defined, companies and computer scientists successfully design to keep us addicted.

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Indeed, it is not yet quite clear how these mind-captivating design elements, features, and information technology (IT) have influenced our behavior. In 2017, former Facebook president Sean Parker put it like this[2]: "God only knows what it's doing to our children's brains." There is an urgent need to understand and address these IT-triggered disorders (e.g. Kwon et al. 2016), which are already done in certain academic fields like psychology and neuroscience. These fields often have a therapeutic or diagnostic viewpoint and extensively cover the IT-triggered disorders. These fields also provide an extensive amount on work regarding how to tackle/prevent the problem from a training or awareness perspective. However, there is almost no literature on how to design information systems (ISs)[3] to avoid and overcome addiction. The information systems discipline and especially the fields that research the IS design – although the subject is actually directly related to their object of research – is remarkably dormant. The findings of other disciplines have to be transferred to information systems research and transformed in order to tackle the problem also via design interventions and not only via treatments or policies. Kwon et al. (2016, p. 934) emphasize that "[...] [s]uccessful intervention may be [...] more an issue of understanding the root and nature of the problem" instead of mere policymaking.

Turel and Qahri-Saremi (2016) approached such a transfer by applying the dual-system theory to the phenomenon of problematic online social network usage, although this approach does not account for the addiction process itself. Thus far, there is very little research extant on this transfer in the information systems literature (Vaghefi et al. 2017). In order to develop IS that tackle IT-triggered disorders, however, information systems researchers require a framework that briefly explains (1) how addictive tendencies develop, (2) where IT interacts with this psychological and behavioral process, and (3) which presentation of information and features may promise successful intervention and decision support for the user. The objective of this paper is to introduce a first framework that allows transferring findings from psychology and neurosciences to the terminology and concepts of information systems research. Furthermore, such a framework will enable structuring current and future IS design efforts – for example, by non-profit organizations or companies – to reduce addictive tendencies and IT's effect on the addiction process. There are other efforts (therapeutic, educative, preventive) by other disciplines, which will not be covered by the framework. To contribute to information systems research and IS design, we keep an IS design perspective on the problem, meaning we consider in our framework how the technology may need to be adapted.

The remainder of this paper is structured as follows. Section 2 defines basic terminology, while Section 3 gives a brief introduction to what this paper subsumes under the term IT-triggered disorders and how they develop. Section 4 discusses the findings of a structured literature review of IS addictions and disorders in the senior scholar basket. Section 5 derives a framework from these findings and from previous research in psychology and neuroscience: the "Four-Component Model for Non-addictive ISs" (4-NAIS), which allows to map current and future efforts in designing IS to prevent and tackle addiction in the reinforcement cycle of developing addictions. Section 6 concludes with a brief summary and derives open research questions from the 4-NAIS model.

2 Terminology and Definitions

The literature yields a plethora of different phenomena that are somehow related to IS, IT, and their usage. We will later refer to these as *IT-triggered disorders*. Therefore, we define IT in accordance with Khan (2013) as "any technology through which we get information." IT-triggered disorders are subsequently defined as a behavioral disorder that involves excessive and compulsive use of IT despite significant negative consequences (adapted from Vaghefi et al. 2017).[4] This definition fulfills two criteria: First, it excludes all substance-related addictions, as well as all addictions and disorders that are not related to the consumption or generation of information. Second, it includes all addictions and disorders in which the IT potentially interacts with the addiction development process, and intervention from the IS design side is possible. In Section 3, a small collection of different IT-triggered disorders illustrates that our definition is quite wide and unspecific in contrast to technology or service-specific addictions. However, this is justified, as in Section 5 our definition allows us to map IT-triggered disorders and countermeasures on an abstract addiction reinforcement cycle, which is also not related to a certain technology. Nevertheless, we break down IT-triggered addictions and the difficulties with different definitions and understandings in Section 3.

Similar to substance-related addictions and behavioral disorders, IT-triggered disorders do not only manifest via technologies, gadgets, or services. Moreover, the person's context and personality, specific situation, resilience, and coping strategies interact with the development and conservation of addictions (e.g. Brand et al. 2016). Therefore, it is not enough to design non-addictive IT, but to consider the person and context as well in non-addictive ISs. In this paper, an IS is defined

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as the organization of defined processes and several IT components within the context of people or an organization in order to collect, filter, process, create, and distribute data or information, partly or fully automated (see Bourgeois and Bourgeois 2014).

3 Development of IT-Triggered Disorders

This section provides a brief summary of IT-triggered disorders and their history, as well as their pathology. Furthermore, the approach by Brand et al. (2016) to illustrate the process of disorder development is presented and briefly explained as a basis for further considerations.

In this paper, we include different phenomena under IT-triggered disorders. Historically, these phenomena were, however, independently developed and there is still hardly any consensus regarding their similarities, differences, and terminology (Kuss et al. 2014a).

According to Griffiths (1995), technological addictions, or cyber addictions, are defined as behavior that involves passive (e.g. television) or active (e.g. computer) human-machine interactions, which may promote addictive tendencies. Although the term addiction suggests the existence of a certain illness/disease, there is still no clinical diagnosis for these types of IT-triggered disorders. Internet addiction (Shaw and Black 2008) and other addictions in the context of IS are not currently listed in relevant collections among substance-related disorders (smoking, alcohol) and behavioral disorders (pathological gambling) and not included as a diagnosis in the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) or the International Statistical Classification of Diseases and Related Health Problems (ICD-10/ICD-11)[5] (Common Sense Media 2016; Kuss and Billieux 2017). Only recently, internet gaming addiction entered the DSM-V as the first IS-related addiction (Montag and Walla 2016) – and not without many skeptical comments (Kuss et al. 2017). Other IS-related additions are still only in the appendix of the DSM-V and under discussion. Due to a lack of pathological evidence and research – and probably consensus – on other IT-triggered disorders, they are still not in such collections.

There is an ongoing discussion whether IS-related addictions should enter these classifications faster. On the one hand, researchers criticize the lack of research and common sense of these phenomena. Starcevic et al. (2018), Billieux et al. (2015b), and Kardefelt-Winther et al. (2017) even problematize the tendency of popular science to overpathologize extensive use of IT and media by the use of medical terminology for phenomena that are not yet evaluated (e.g. Selfitis and Twitteritis). Indeed, there is an intense

discussion whether extensive use of IT is an addictive tendency or merely a rapid adoption to new social norms (e.g. in the context of smartphones) (Common Sense Media 2016; Petry and O'Brien 2013) or new coping strategies (Kardefelt-Winther 2017). Moreover, the symptoms have a strong overlap with tendencies toward depression and attention deficit hyperactivity disorder (ADHD) (e.g. attention deficit) (Montag and Walla 2016), which would even allow thefurther conclusion that such behavior is a mere symptom of other disorders.

However, on the other hand, IT-triggered disorders share certain symptoms with other behavioral addictions (e.g. antisocial and risky use, altered value-based decision making) (Billieux et al. 2015a; Meshi et al. 2019), and the World Health Organization (WHO) recognizes such addictions and disorders as a public health concern (World Health Organization 2015). Kuss et al. (2014b) introduced an Internet addiction model that summarizes all symptoms used to diagnose Internet addictions[6]: salience, mood modification, tolerance, withdrawal, relapse, and conflict (as in Griffiths 2005). These symptoms strongly resemble those observed in other substance and behavioral addictive disorders (Meshi et al. 2019; Montag et al. 2018). In sum, Kuss and Griffiths (2017) state that there is scientific evidence suggesting that excessive social network sites usage "[...] lead[s] to symptoms traditionally associated with substance-related addictions" (Kuss and Griffiths 2017, p. 317). Kuss and Billieux (2017) emphasize how important it would be to research and recognize such disorders in order to develop treatments and enable affected people finding help. James et al. (2017) classify the observed dependency as obsessive-compulsive disorder in the context of online social network usage. This approach tries to place the phenomena within known constructs of behavioral addictions. These approaches are, however, also not yet standard.

Still, research on technological addiction – its causes, drivers, and symptoms – is in its infancy (Billieux et al. 2015a; Montag et al. 2018). There are many research gaps that have not or that have only very recently been addressed, for example, regarding diagnostic measures or the neurophysical pattern for addictions related to the IT usage. In 2017, for example, Pontes and Griffiths (2017) introduced the Internet Disorder Scale (IDS-15) based on the Internet Gaming Disorder scale, a first measurement scale in order to measure Internet addiction. Only recently, Montag et al. (2018) showed similarities between Internet communication disorders and substance or behavioral addictions on a neurological level, using the example of *WeChat* addiction. D'Hondt and Maurage (2017) review the findings of several electroencephalography (EEG) studies in the context of Internet addiction and find a hypo-activated reflective-control system and a hyper-activated affective system. Both

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[5] The DSM-V and the ICD-10/ICD-11 are manuals that classify diseases' and disorders' comprehensive diagnostic criteria for all psychiatric disorders.

[6] A term that is currently replaced by Internet-use disorders.

observations indicate toward a reduction of inhibitory control and, therefore, an addiction. Both studies would argue in favor of an independent behavioral disorder.

Table 1 presents a short list of different phenomena that are subsumed under IT-triggered disorders. However, finding a shared definition or clear delimitation is beyond IS researchers' capabilities and subject to psychologists', neuroscientists', and medical experts' input.

The measurements used to diagnose these differentiated addictions only overlap in part (Kuss et al. 2014a; Kwon et al. 2013; Montag and Walla 2016), indicating that accumulating all of them under one term will not do justice to all of their particularities. Robertson et al. (2018) also showed that persons' general resilience intervenes differently in addiction in certain areas (games vs. *Facebook*). Nevertheless, there are reasonable arguments for considering all kinds of specific phenomena under one term. Brand et al. (2016), Turel et al. (2011), Vaghefi et al. (2017), and Meshi et al. (2019) are only a few examples of researchers who emphasize similarities between these specific phenomena, such as the risk factors, the addiction development process, and the symptoms. Especially the shared process of addiction development allows us to consider them under the same term. However, technological addictions are a complex phenomenon; they are not limited to the addictions listed in Table 1 and it is not conclusively clear which factors (e.g., fear of missing out) are related to the addiction tendency in which manner (Kuss and Griffiths 2017).

Brand et al. (2016) introduced the Interaction of Person-Affect-Cognition-Execution (I-PACE) model, which was developed to explain the relevant factors and their interaction for Internet-use disorders[7] on an abstract level. The I-PACE model was intentionally designed to be non-specific regarding a certain disorder (Brand et al. 2016) and, since its introduction, was consequently used as a reference model in several publications on a wide spectrum of IT-triggered disorders, for example, social network sites addiction (He et al. 2017; Oberst et al. 2017), gaming (Weinstein et al. 2017), smartphone addiction (Duke and Montag 2017), and Internet-communication disorder (Wegmann and Brand 2016)). The model is illustrated in Fig. 1.

The grey background area illustrates the process of disorder development and its interactions – often repeated – between a certain situation, i.e. a subjectively perceived situation, a decision to use a certain application, the perceived gratification/compensation, and its effect on a person's coping style and internet-related cognitive biases. This interaction largely occurs during IT usage. The subjectively perceived situation, as well as the coping style and the biases, interacts with or

depends on a person's core characteristics. These characteristics consist of quite stable (e.g. biopsychological constitution: genetics, early childhood experiences, and stress vulnerability; personality: impulsive, low self-esteem, low conscientiousness; psychopathology: depression, social anxiety, ADHD) and liquid (e.g. social cognition: loneliness, perceived social support, social distrust; specific motives for using: games, gambles, cybersex and pornography, shopping sites, communication sites/apps) parameters and are largely independent of the IT usage, although coping style and biases may have a number of interactions. A person's general susceptibility to an IT-triggered disorder depends on several factors: Kwon et al. (2016) emphasize social liquidity and resilient consumption inertia as crucial moderators for an excessive myopic use of IT and also demonstrate that demographic data are capable of describing subgroups with higher or less vulnerability to IT-triggered disorders. The person's characteristics and the repeated IT usage, however, may lead to the development of a specific disorder in the event of unfavorable combinations and frequent usage. The disorder itself largely influences several of the person's core characteristics negatively.

Based on this understanding of IT-triggered disorders and their development process, the next section aims to classify current IS approaches to tackle IT-triggered disorders.

4 Information Systems Approaches to tackle IT-Triggered Disorders

In order to identify information systems research's main current approaches in this field, we conduct a literature review following the process of Webster and Watson (2002). We focus our literature review on the senior scholar basket[8] and use Web of Science as the search database.[9] We filter the results based on the criteria listed in Table 2 and then conduct a forward/backward search within information systems outlets.

The literature search results in 17 relevant papers that researched IT-triggered disorders and provide hints regarding technical interventions. This result also shows that research on IT-triggered disorders is not yet very prominent in information systems research. Using the same search string only for the psychological journal *Computers in Human Behaviors* results in 538 articles.[10] Approximately one-third of the results

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[7] The original publication uses the term "Internet addiction." Nevertheless, in more recent publications the authors switched to the term "Internet-use disorder."

[8] https://aisnet.org/page/SeniorScholarBasket

[9] The full search term was: *ALL = (addiction OR disorder) AND (SO=INFORMATION SYSTEMS JOURNAL OR SO = EUROPEAN JOURNAL OF INFORMATION SYSTEMS OR SO=INFORMATION SYSTEMS RESEARCH OR SO = JOURNAL OF THE ASSOCIATION FOR INFORMATION SYSTEMS OR SO = JOURNAL OF INFORMATION TECHNOLOGY OR SO = JOURNAL OF MANAGEMENT INFORMATION SYSTEMS OR SO = JOURNAL OF STRATEGIC INFORMATION SYSTEMS OR SO = MIS QUARTERLY)*

[10] *ALL = (addiction OR disorder) AND (SO=COMPUTERS IN HUMAN BEHAVIOR)*

Table 1 A short summary of researched addictions and disorders, roughly grouped, in the context of IS to illustrate the plethora of different terminology and phenomena; adopted from Vaghefi et al. (2017) and extended. A further list can be found in Turel et al. (2011)

Addiction/Disorder	Reference(s)
Smartphone addiction	(Kwon et al. 2013)
Mobile email addiction	(Turel and Serenko 2010)
WeChat addiction	(Montag et al. 2018)
Internet-communication disorder	(Montag et al. 2018)
Problematic use of social networks	(Andreassen 2015; Kuss and Griffiths 2017)
Social network sites addiction	(Kuss and Griffiths 2017)
Media addictions	(LaRose et al. 2003)
Online auction addiction	(Turel et al. 2011)
Game addiction	(Lemmens et al. 2009)
Online game addiction	(Xu et al. 2012)
Internet gaming disorder	(Pontes and Griffiths 2017)
Internet and online gaming	(Ng and Wiemer-Hastings 2005)
Internet addiction	(Robertson et al. 2018)
Generalized Internet addiction	(Montag et al. 2015)
Problematic internet use	(Caplan 2007)
Pathological internet use	(Young 1998)
Technology Addiction	(Serenko and Turel 2015; Turel et al. 2011)
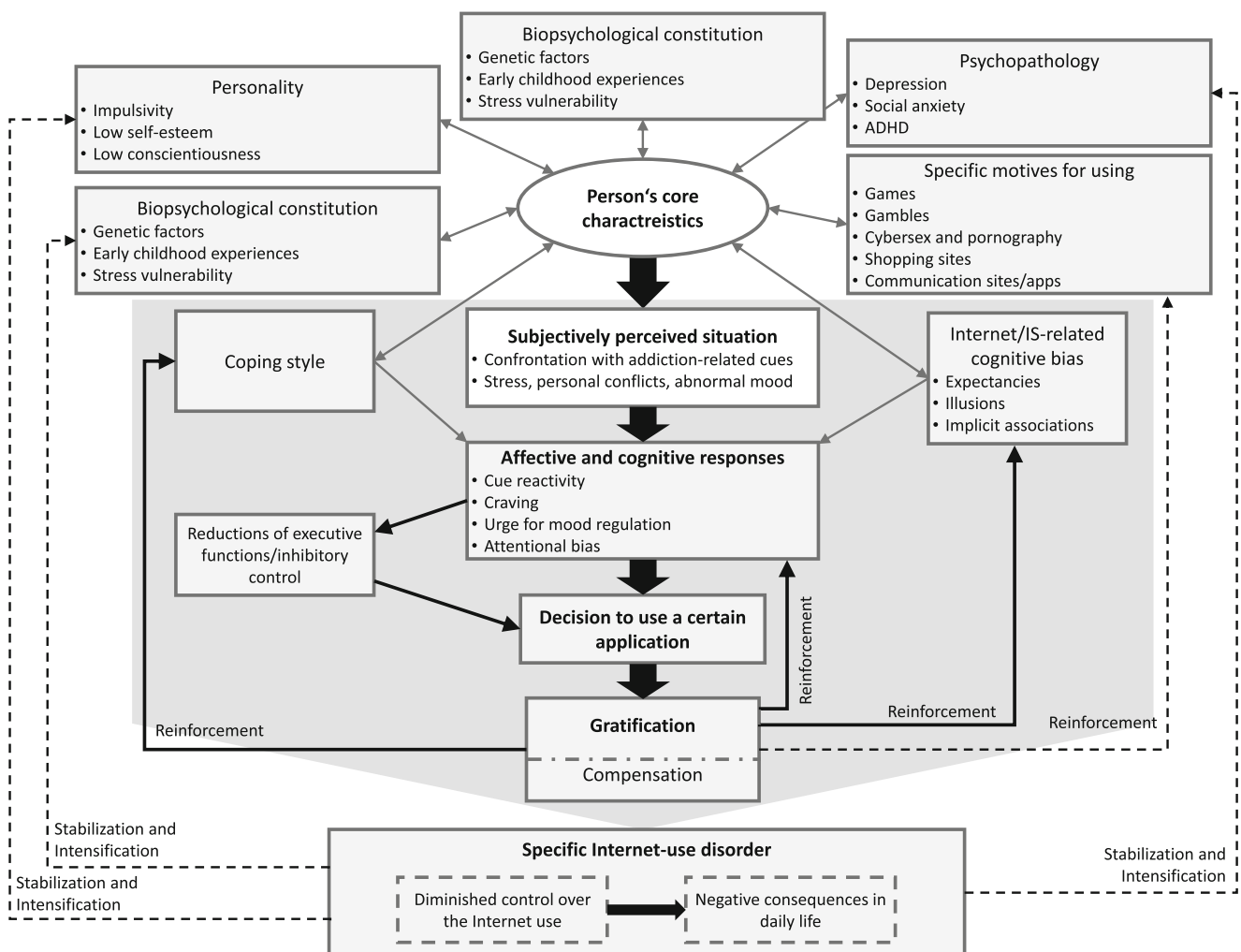
Fig. 1 The I-PACE model by Brand et al. (2016)

Table 2 Literature search criteria and summary

Criteria	No. of articles
Search Term: "addiction" OR "disorder"	20
Title or abstract relevant	17
Experiment, Survey, or Literature Review	15
Relevant content on treatment or prevention	12
+ 5 results from Forward/Backward Search	**17**

appear to be relevant, based on the title. This underscores the importance to transfer findings from other disciplines to information systems research. A brief list and classification of the relevant articles can be found in Table 3 in the Appendix. The results from the literature review can be summarized into four main findings:

First, while overall research on IT-triggered disorders identifies a variety of different disorders, information systems research has a rather narrow focus on social network sites addiction or similar phenomena (10 out of 17 studies) and problematic smartphone usage or similar phenomena (3 out of 17 studies). The other studies focus on special phenomena, such as online auction addiction (1 study) or online gambling addiction (1 study) or they do not specify the disorder. Regarding social network sites addiction, seven studies focus exclusively on *Facebook*.

Second, almost all the studies use survey-based methods, especially structural equation modeling, as methodology (14 out of 17 studies). Only two studies applied an experimental approach, another one panel data, and one paper accompanied its survey-based approach with interviews.

Third, most studies do not focus on the IS design, but on understanding the relations between disorders to personality traits/emotional conditions/technostress (6 out of 17 studies) or try to apply different concepts from prior information systems research on the new topic (Dual process theory: 4 studies; guilt and discontinued use: 5 studies; others: 2 studies).

Fourth, most studies name technical interventions within their practical implications or allow the inference of technical interventions based on their findings. These can be roughly classified into five categories. **Addressing the person:** Many studies highlight that certain personality traits and personal states make users vulnerable to addictive tendencies. **Addressing the situation:** Seven studies mention that ISs create situations – sometimes with certain design features – that trigger addictive tendencies (cues) and therefore need to be eliminated or warned off: notifications, interruptions, feature-rich IT, role ambiguity, uncertainty, technostress, changing content, hedonic features. **Addressing the access/ usage:** Three studies recommend restricting access to the system for certain users, while a further three studies recommend at least usage monitoring options to create awareness. **Addressing the gratification:** Three papers emphasize the role of gratification in the development of addictive tendencies and recommend to reduce gratification by shutting down features or by the presence of the parents during use. **Addressing the education/expectation:** Eight papers mention that in order to address the problem, it is required to ensure via policies, education, and therapy that the IS does not create false expectations and illusions.

5 A Model to Integrate IT-Triggered Disorders and IS Design

5.1 Derivation of the Four-Component Model for Non-addictive Information Systems

In order to identify the point at which information systems research can interact with IT-triggered disorders, we designate the tipping points of ISs with the development of IT-triggered disorders. Brand et al. (2016) and Turel (2015a) emphasize the cyclic nature of disorder development. Therefore, we visually shift the I-PACE model's components to fit the reinforcement cycle by Brand et al. (2016) such that the four edges match the last four of the categories of technical interventions in Section 4. We leave the person's core characteristics out, although they were part of the I-PACE model and of the categories. However, technical interventions are hardly capable of having an influence here. Instead, we emphasize the subjectively perceived situation. Furthermore, the four categories of technical interventions are renamed to their proactive form. The result is the 4-NAIS model illustrated in Fig. 2. The model is enriched by a few minor examples whereby ISs concretely promote the reinforcement cycle of disorder development.

The subject-specific constitution, i.e. the person's core characteristics, is paired or eventually leads to a certain subjectively perceived situation, for example, the confrontation with addiction-related cues or an abnormal mood. Depending on several factors – including the moderators for affective and cognitive responses, i.e. coping style and Internet-related cognitive biases – the person reacts to these cues and/or craves for the use of the IS, often accompanied by a reduction of the executive functions/inhibitory control. In this state of reduced control, the subject has to decide for or against the technology usage. Subsequent to usage, the gratification starts the reinforcement cycle (indicated with the red arrows) that alters the coping styles, expectations regarding the use, and the affective and cognitive responses. This reinforcement finally leads to an amplification of the IS usage and/or to a higher reactivity to cues. After several reinforcement cycles of use and gratification, a shift from gratification to compensation, as well as the development of tolerance regarding the gratification, occurs. The overall process results in a specific IT-triggered disorder. This disorder has several negative consequences to daily life, as elaborated above, and also results in stabilizing and
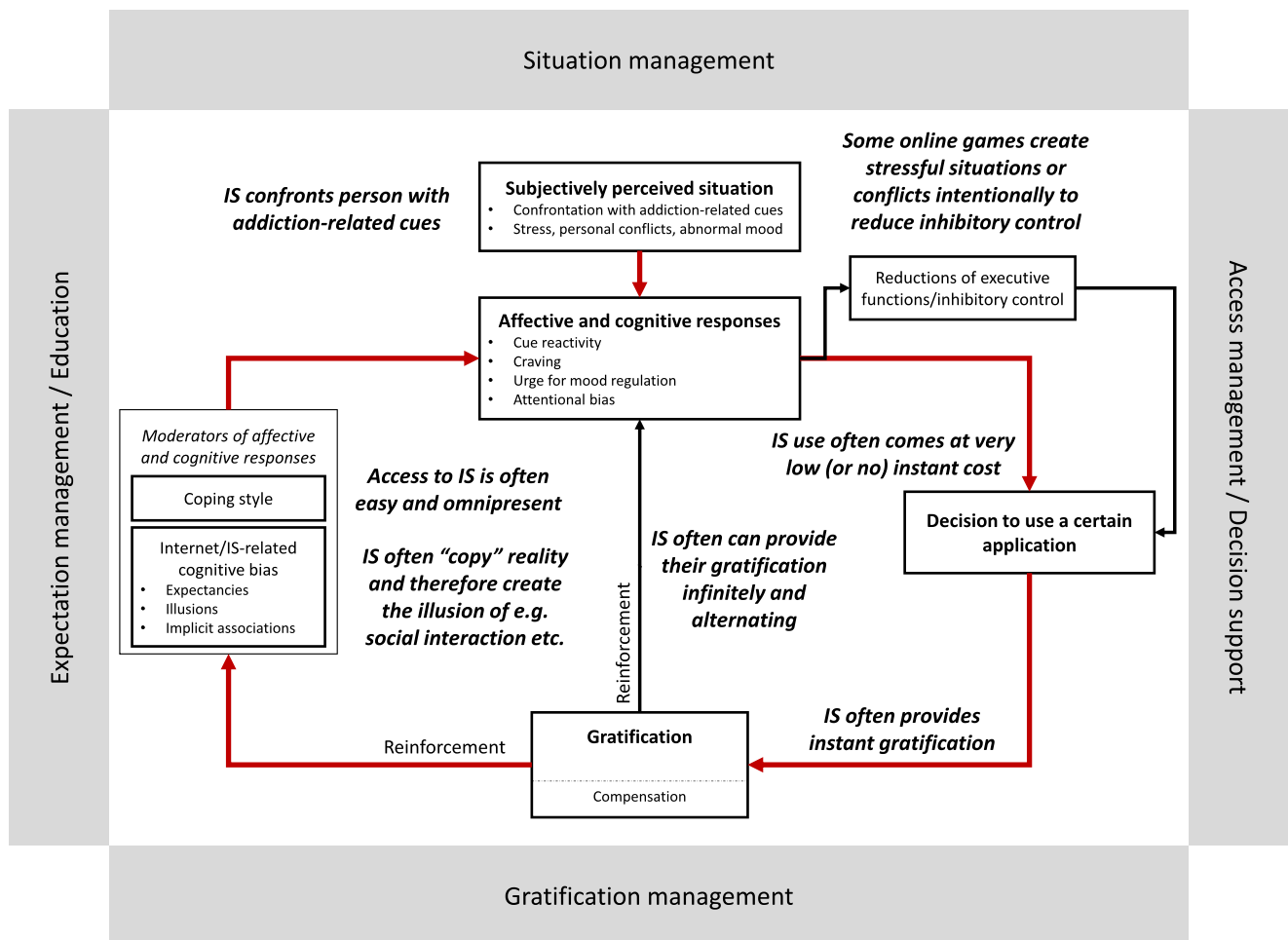
Fig. 2 The 4-component model for non-addictive ISs (4-NAIS). The red arrows indicate the effect path of the reinforcement cycle by Brand et al. (2016)

intensifying those person's core characteristics that promote susceptibility to IT-triggered disorders. Turel and Serenko (2012) give examples of such negative consequences in three examples of online gaming, social networks, and online bidding. Due to the interaction between the reinforcement cycle and the person's core characteristics it is necessary to consider them in the design as well, especially regarding how changed expectations and perceptions result in changed cue reactivity.

5.2 The Four Components of the Model

5.2.1 Situation Management

Many of today's ISs promote instead of hinder the reinforcement cycle. A big issue is that a number of these ISs are designed to confront their users and potential users with addiction-related cues or intentionally lead them into a stressful situation. Push notifications or update indicators are examples of these (Knorr 2018). The color (Filucci 2018) or other features like randomness (Harris 2016; Knorr 2018) can be

such cues as well. Moreover, the fear-of-missing-out is such a stressful situation or an abnormal mood that it is highly correlated with addictive tendencies (Elhai et al. 2016; Harris 2016; Kuss and Griffiths 2017). Especially online games with in-game purchases are often criticized, because they create situations that induce stress or conflicts in order to reduce inhibitory control and influence decisions, which include purchasing decisions (Rumpf et al. 2017).

Situation management integrates into the reinforcement cycle at the point where a person faces cues/triggers or where the cues/triggers occur during a risky state of moods (subjectively perceived situation). Previous research outlined the importance of specific situations that lead toward becoming trapped in the reinforcement cycle. These specific situations were, for example, being exposed to addictive cues or certain states of moods (stress, conflicts). A list of such states of moods and additional person-related determinants is defined in the I-PACE model by Brand et al. (2016) and more specifically with regard to ISs in the model of acceptance of social ISs by Theotokis and Doukidis (2009). While the I-PACE model has a focus on personal properties, such as personality,

diseases, mental diseases, and other risk factors that are more or less constant for a person, Theotokis and Doukidis's (2009) model extends this by a broad spectrum of utilitarian (effort and performance expectancy), hedonic (enjoyment), and social (social influence and self-expression) determinants, as well as use diffusion criteria and several further constructs that foster user stickiness with ISs and addictive tendencies. Situation management is intended to assess the user's current content (e.g. addictive cues) and his/her current susceptibility (e.g. stress) to the development or maintenance of an IT-triggered disorder and to defuse the situation. The intervention may then consist of either informing, suppressing, disturbing, or adapting:

- The technology may provide the user with information regarding current risks and how to avoid them (e.g. to calm down).
- The technology recognizes that a user is very anxious during the reading of an online news article. Situation management may suppress video auto-play to prevent additional addictive triggers.
- Flow is an important construct for the development of addictive tendencies (El-Masri and Tarhini 2015; Knorr 2018; Montag and Diefenbach 2018; Theotokis and Doukidis 2009). Situation management may intentionally introduce disturbance in order to hinder flow or modify the challenge level.

To summarize, situation management should be designed to avoid situations that promote addiction where possible. This means, for example, dispensing with addictive cues like notifications, randomness, or sometimes even specific colors (Ayyagari et al. 2011; Filucci 2018; Harris 2003; Knorr 2018; Kuss and Griffiths 2017; Turel and Qahri-Saremi 2016). Theotokis and Doukidis (2009) also suggest dispensing with flow and emotional attachment where these are not necessary. The role of stress is yet not finally clear. While it reduces inhibitory control, it may also create discontinuance tendencies, for example, in the case of social overload (Cao et al. 2019).

Technical Applicability There are several attempts to measure the current state of the user. Knierim et al. (2019) use EEG measurement to predict the occurrence of flow. Jung and Dorner (2018) interpret neurophysiological measures, such as the heartbeat, as arousal; Rouast et al. (2018) measure arousal using a webcam. Ferdous et al. (2015) try to predict the current stress level at the workplace based on smartphone and app usage patterns. Smartwatches and other gadgets will soon enable us to assess the current situation according to situation management requirements. The implementation of countermeasures basically depends on research regarding which interventions really provide positive effects.

5.2.2 Access Management / Decision Support

Once a person faces such a cue or situation, the IS guides the decision toward use, as its usage often comes at very low, or no, instant cost (Harris 2016; Kwon et al. 2016). The usage, therefore, can almost be regarded as the default option – or this is at least suggested by the technology or service. Such default options are characterized, for example, by the naming of buttons like "Click here to answer to this message instantly!" or "See who liked your post!" (Harris 2016).

Access management – and occasionally decision support – integrate into the reinforcement cycle at the point where the decision for usage is made (Decision to use a certain application). Access management's chief goal is to ensure that problematic use is not the default and that the decision to use the IS bases on complete information. Presently, the decision to use a certain IS is often based on incomplete information or framed as the default. The usage of technology and the consumption of addictive content over ISs is often perceived subjectively and comes at no or very low (initial) cost. However, downstream costs due to personalized advertisement, time consumption, or even addiction are not presented to the user in order for him/her to make an informed decision. The intervention from access management / decision support may then consist of either informing, modifying the default, raising the cost of usage, or prohibiting:

- Levy (2016), Soror et al. (2015), and Turel and Qahri-Saremi (2016) advocated features in operating systems that enable users to monitor their own usage. This is one example that provides the user with full information on his/her former usage and helps him/her make a more informed decision. Moreover, Markowetz et al. (2014) published the app *Menthal* to monitor smartphone usage. Usage-monitoring features, as well as the *Menthal* app, can help provide the user with a realistic picture and a valid, reliable, and complete set of information in order to help him/her make a right and informed decision.
- Access management can also help hinder the reinforcement cycle by modifying the default. This means, for example, dispensing with features like autoplay (Harris 2016; Knorr 2018) or other features that that take the decision away from the user. If a user has already developed an IT-triggered disorder, access management should raise the cost of usage, for example, by temporary locks after a certain amount of usage, clicks, or views.

There were also a number of references that considered the restriction of access, be it technical or enforced, as an opportunity to help (Turel 2015a; Turel and Serenko 2012), possibly based on an observation of raised usage. However, several studies found that this option may instead encourage more craving and, therefore, raises addictive tendencies (Davies

and Blake 2016; Polites et al. 2018). Khalili-Mahani et al. (2019) and Turel (2015a) indicate that the usage of multiple different devices is also associated with the risk of becoming addicted. The idea to limit access only on certain devices should be considered as potentially promising.

Technical Applicability The technical applicability for access management is generally difficult to assess. It depends on whether the exact subject of the IT-triggered disorder can be identified and if the conveying technology allows an intervention at this point. If both conditions are met, it may be quite easy. If one of the conditions is not met, and may it be because the technology provider does have a conflicting interest, it may be hard. In addition, a user may find a way to bypass the mechanisms. Nevertheless, the cost of usage increases. It is important to always include all responsible parties in the information distribution, for example, observing entities like parents or law enforcement in case of illegal usage.

5.2.3 Gratification Management

Another IT feature that promotes the reinforcement cycle is that the gratification is often provided instantly and that there is no natural limit of gratification. Indeed, ISs can provide gratifications that are often unlimited and, if the users develop a tolerance toward gratifications, the system can easily alter the intensity or type of gratification (Harris 2016).

Gratification management integrates into the reinforcement cycle at the point where gratification/compensation is provided to the user. Gratification management can have a very strong impact on the development of IT-triggered disorders. Davies and Blake (2016) conducted an experiment where three groups played the same video game for at least one hour. Afterwards, a first group was prohibited from playing (shutdown law). A second group could continue playing if they wanted to, but gratifications from the game were suppressed (fatigue law). A control group could continue playing if they wanted to, with no interference. The experiment revealed that the first group showed the highest intention to return to the game. This finding is in line with Xu et al. (2012), also concluding that time restrictions have a negative (worsening) effect on online game consumption. Davies and Blake (2016) concluded that gratification management may be a more effective design feature than the often applied shutdown laws (access control) to reduce harm caused by excessive use. The development of tolerances and the role of varying gratifications are, however, still open research questions in the context of IS. It may be interesting to find out if suppressing gratification variance results has the same hindering effect than the fatigue law by Davies and Blake (2016). However, a dilemma has to be resolved: Other than in games, which are mostly purely hedonic, many technology interactions provide hedonic and utilitarian utility that cannot be split in all

instances. Especially in social networks, the hedonic and utilitarian utility are often related. James et al. (2017) emphasize that if only purposive value and self-enhancement are gratified (instead of, e.g., social interaction and self-discovery), the risk for increasing addictive tendencies is increased. Furthermore, it is necessary to distinguish between cases where either the technology itself or the content provides utility. In both instances, implementing gratification management remains a very case sensitive endeavor. Gratification management also has to account for the personal surroundings, implicit assumptions, and individual emotions. Turel (2016) and Kwon et al. (2016) also highlight the complex role of guilt in this context that has a huge effect on how gratifications are perceived. The uses and gratification theory is also applied by a number of information systems researchers to account for such internal processes (e.g. Gan 2018; James et al. 2017). The gratification management intervention may then consist of either attenuating, suppressing, or filtering feedback:

- If hedonic and utilitarian utility can be distinguished, filtering can be a good measure to prevent the development of IT-triggered disorders. Consider a blog post that provides a "read by" and a "liked by" feedback for the author. Gratification management may filter the second feature.
- Randomness can also be considered as a form of gratification (Knorr 2018). Attenuation can, in this example, mean to trigger updates only up to a certain time such that the randomness will be more predictable. Another approach would be the "you are up to date" feature from *Instagram*.
- Davies and Blake's (2016) example shows how suppressing can be used to hinder the development of addictions. This is especially effective if the gratification itself is purely hedonic.
- Turel and Serenko (2012) suggest that the presence of parents may reduce gratification experiences for their children while using social networks. Although this concrete example may not be realistic to implement in the long term, one may think of other mechanisms that externally reduce gratification experiences. Harris (2016) recommends switching to grayscale mode as an option.

5.2.4 Technical Applicability

As for access management, the technical implementation of gratification management largely depends on the context. However, the difficulty is rather to understand what the gratification consists of and which parts of it may be filtered, attenuated, or suppressed without making the IS unproductive or worthless. Quite easy implementations of gratification management may turn off noise, colors (Knorr 2018), or notifications. In a guideline, Knorr (2018) list which of our

smartphone features and the installed apps captivate our mind and explain how to disable them.

5.2.5 Education / Expectation Management

In the reinforcement cycle's last phase, the omnipresence of and the dependency on ISs in daily life in developed countries make it very complicated to develop effective coping strategies or avoidance strategies. Moreover, as ISs often copy the reality (virtual reality, virtual social life, virtual friends, virtual money, etc.) (Chiu and Huang 2015), it is also difficult to explain to addicted people that their gratification underlies a bias and inhibits a negative consequence to their lives. Agarwal and Karhanna (2000) also show that the perception of flow (also see situation management) changes the perception of ISs regarding perceived ease of use and perceived usefulness, indicating that it may also lead to subjective misevaluations. Turel et al. (2011) confirmed this finding once again.

Expectation management and education integrate into the reinforcement cycle at the point where a user mirrors – or approximately mirrors – his/her usage and the received gratification, and updates his/her attitude and expectations regarding the technology usage. In the 4-NAIS model expectation management and education is, therefore, placed next to the box entitled "Moderators of affective and cognitive responses." However, this updating is often based on biases and incomplete information. Inflated expectations are one kind of moderator for the affective and cognitive responses to the Internet or IT, its addictive cues, and problematic situations. We find an underestimation of health problems and other risks on the user side (Kwon et al. 2016). Therefore, Kwon et al. (2016) suggest information enhancing (raise awareness of the problems) and capability enhancing (reinforcing self-disciplinary and rational management abilities), although they consider these measures to be subject to policies or other organizations. This view is shared by almost all information systems literature dealing with education / expectation management (Turel 2015b; Turel and Qahri-Saremi 2016; Turel et al. 2011). The expectation management component should contextualize and classify the received gratification in order to disillusion the user. For example, when a user accepts a friend request in a social network, the expectation management component may inform the user that he/she has just accepted a virtual friend request, but that the true relationship with this person may deviate and has to be proven outside of digital boundaries (Harris 2016). Psychological games are another example that app providers apply in order to captivate their users, for example, *Snapchat*'s *Snapstreaks* (Knorr 2018). When a user participates in such a game based on the rule of reciprocity, expectation management may inform the user that there is no real consequence if the rule is broken (Harris 2016; Knorr 2018). Furthermore, the IS may suggest

coping strategies to the user (education), such as avoiding certain situations or using the embedded features of his/her smartphone to reduce usage time and addictive cues. Kwon et al. (2016) argue that such features may also be of interest to app developers. There is also a certain group that withholds themselves from IS, as they have inflated fears of addiction. Reaching this group and responding to their inflated fears may help to gain long-term users. Reliable and sound information may, therefore, also be a component to increase usage or address new user groups. However, education should also occur outside of the IS.

Technical Applicability Expectation management and education should not be equated with education on the risks of technology in general. Expectation management and education occur exactly after the technology had been used and are context sensitive, meaning that the expectation management and education processes take the gratification that was just received into account and can help the user gain a healthy attitude toward it. Online content or apps almost always come with metadata that briefly describe the type of content (social media, movies, etc.) as well as a number of further properties that, for example, a smartphone can use to provide the user – after the usage – with adapted information. A deeper integration, however, would probably depend on the content, technology, and service provider.

6 Conclusion

In this work, we advocate the importance of information systems research starting to address IT-triggered disorders and related addictions from an IS design perspective. The omnipresence of technology in our daily lives and the unpredictability of its effects on our mood in the long-term demand that this problem be addressed. We argue that this is important, although research on IT-triggered disorders and related addictions is a very young field – even in clinical research areas – and there is not yet complete consensus on the definition and diagnosis of these disorders and related addictions (Kuss et al. 2017). With the 4-NAIS model, we introduce a first framework that helps translate findings from psychology and neurosciences into the field of information systems research. The following four abstract components are defined in this model and we suggest that they be implemented in ISs in order to hinder addictive tendencies and qualify the IS to be a non-addictive IS: situation management, access management / decision support, gratification management, expectation management / education. The framework integrates the addiction development and maintenance process with the technology and at the point where the addictions' reinforcement cycle is moderated by IT. The framework facilitates an understanding of the point at which an intervention from the IS design side is

possible and probably promising. However, this is only a first step and a starting point to understand the phenomenon. Much more research, experimentally and empirically, is required. Important constructs discussed in previous literature appear to be social liquidity, resilient consumption inertia, belongingness, and fear-of-missing-out (e.g. Elhai et al. 2016; James et al. 2017; Kwon et al. 2016) and at present the focus is often on online communication and online social networks. In addition, as many of the suggested technical interventions are context-sensitive and may be based on artificial intelligent services, issues regarding trust and ethics needs to be considered (Peukert and Kloker 2020). Our discipline must make

two contributions in order to resolve this problem: Find features that promote and hinder addictive tendencies in order to protect users from IT-triggered disorders, and provide coping strategies. Create a framework that allows easy assessment of an IS's addiction promoting properties. Although companies like Google, Apple, and Instagram introduced first features, the development and evaluation of Non-addictive ISs that effectively prevent addictions have to be based on a profound understanding of the addiction process and previous findings from other disciplines.

Appendix

Table 3 Results of the literature search

Reference	Outlet	Context	Method	Situation	Decision	Access	Gratification	Education/ Training
(Polites et al. 2018)	EJIS	SNS	Survey			●	●	●
(Turel 2016)	EJIS	SNS	Survey		●			
(Turel 2015b)	EJIS	SNS	Survey	●				●
(Turel and Serenko 2012)	EJIS	SNS	Survey			●	●	
(Xu et al. 2012)	EJIS	Gaming	Survey			●		
(Chiu and Huang 2015)	EJIS	SNS	Survey	●			●	●
(Tarafdar et al. 2019)	ISJ	SNS	Survey	●				
(Vaghefi et al. 2017)	ISJ	Smartphone	Interview, Survey			●		
(Soror et al. 2015)	ISJ	Smartphone	Survey		●			●
(Maier et al. 2015)	ISJ	SNS	Experiment	●				
(Kwon et al. 2016)	ISR	SNS/ Smartphone	Usage Data					●
(Jenkins et al. 2016)	ISR	–	Experiment	●				
(Turel 2015a)	JCIS	SNS	Survey	●		●		●
(James et al. 2017)	JMIS	SNS	Survey	●			●	
(Turel and Qahri-Saremi 2016)	JMIS	SNS	Survey	●	●			●
(Turel et al. 2011)	MISQ	eBay	Survey					●
(Ayyagari et al. 2011)	MISQ	Work	Survey	●				

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