



Universität Potsdam

Lehrstuhl für Wirtschaftsinformatik, insb. Social Media und Data Science
Chair of Business Information Systems, esp. Social Media and Data Science

Bachelorarbeit | Bachelor Thesis

“Technology Addiction Scales in the Areas of Internet,
Smartphone, Video Games and Social Network Sites – A
Systematic Literature Review”

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Location, Date	Potsdam, 11.07.2019
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Published online at the
Institutional Repository of the University of Potsdam:
<https://doi.org/10.25932/publishup-43555>
<https://nbn-resolving.org/urn:nbn:de:kobv:517-opus4-435559>

Abstract

As digital media infiltrate an increasingly greater proportion of our lives, concern about the possibility of various forms of technology addictions has emerged. For technology addiction, researchers have developed a variety of self-reported scales in areas such as Internet, smartphones, videogames, social network sites (SNS) or television. However, no uniform criteria or definition exists for technology addiction. Utilized dimensions of technology addiction, to measure specific outcomes, lack a conceptual standard. Therefore, linkages between technology areas dimensions have not been examined in a broader way by the research community, in order to develop a uniform technology addiction scale.

In this regard, firstly, a theoretical model was developed in order to extract common technology dimensions. Secondly, a systematic literature review in the areas of Internet, smartphone, video games and SNS was conducted in order to extract the dimensions used. To identify relevant studies, nine databases (GoogleScholar, ScienceDirect, PubMed, EmeraldInsight, Wiley, SpringerLink, ACM, iEEE and JSTOR) were searched, producing 4698 results, and 50 studies met the inclusion criteria. Thirdly, the developed theoretical model was utilized in order to determine the dimension in each of the identified scales.

Based on analysis of the dimensional distributions, the findings suggest that there are common dimensions across areas of technology such as “compulsive use” and “negative outcomes” but also differences in dimensions across areas such as “social comfort” and “mood regulation”, which are more used in the area of SNS. Moreover, new dimensions such as “cognitive absorption” or “utility and function loss” for technology addiction were extracted, which should be considered as these have not yet been researched in a broader way. In addition, no gold standard for the conceptual criteria or definition for technology addiction has been developed yet.

Keywords

Systematic Review, Technology Addiction Scales

Zusammenfassung

Digitale Medien durchdringen immer mehr das alltägliche Leben. Dadurch entsteht die Sorge, dass sich verschiedene Formen von Technologiesucht für Menschen herausbilden. Dabei haben Forscher eine Vielzahl von Messinstrumenten in den Bereichen Internet, Smartphones, Videospiele, Social Network Sites (SNS) oder Fernsehen entwickelt, um Süchte zu messen. Jedoch gibt es keine einheitlichen Kriterien oder eine standardisierte Definition der Technologiesucht, um diese für spezifische Dimensionen zu erfassen. Dies ist einer der Gründe warum die Forschungsgemeinschaft die Zusammenhänge zwischen den einzelnen Dimensionen nicht weiter untersucht hat, um einheitliche Messinstrumente zu entwickeln.

Aus diesem Grund hat diese Studie zunächst ein theoretisches Modell entwickelt, um gemeinsame technologische Dimensionen zu extrahieren. Danach wurde eine systematische Literaturrecherche in den Bereichen Internet, Smartphone, Videospiele und SNS durchgeführt, um die verwendeten Dimensionen zu ermitteln. Um relevante Studien zu identifizieren, wurden neun Datenbanken (GoogleScholar, ScienceDirect, PubMed, EmeraldInsight, Wiley, SpringerLink, ACM, iEEE und JSTOR) durchsucht, die 4698 Ergebnisse lieferten. 50 dieser Messinstrumente haben die gesetzten Kriterien erfüllt. Darauffolgend ist das entwickelte theoretische Modell verwendet worden, um die Dimension in den 50 identifizierten Messinstrumenten zu bestimmen.

Basierend auf der Analyse der dimensional Verteilung deuten die Ergebnisse darauf hin, dass es gemeinsame Dimensionen in Technologiebereichen wie z.B. "zwanghafte Nutzung" und "negative Ergebnisse" gibt. Aber es gibt auch Unterschiede in der Verteilung in den Dimensionen der Technologiebereiche. Zum Beispiel sind "sozialer Komfort" und "Stimmungsregulierung", im Bereich der SNS stärker vertreten. Zudem sind neue Dimensionen der Technologiesucht extrahiert worden. Zum Beispiel die "kognitive Absorption" oder der "Nutzen- und Funktionsverlust", welche noch nicht breiter erforscht worden sind. Darüber hinaus ist noch kein Standard für die konzeptionellen Kriterien oder die Definition der Technologiesucht entwickelt worden.

Schlüsselwörter

Systematische Literaturrecherche, Technologie Sucht Skalen

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LIST OF ABBREVIATIONS

APA	American Psychological Association
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders in the fourth Edition
DSM-IV-TR	Diagnostic and Statistical Manual of Mental Disorders in the fourth Edition, revised
DSM-V	Diagnostic and Statistical Manual of Mental Disorders in the fifth Edition
ICD-10	International Statistical Classification of Diseases and Related Health Problems in the tenth revision
ICD-11	International Statistical Classification of Diseases and Related Health Problems in the eleventh revision
ICT	Information-Communication Technology
IGD	Internet Gaming Disorder
SNS	Social Network Sites
WHO	World Health Organization

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1. INTRODUCTION

Digital media infiltrates our daily lives as well as the economy, and changes the way we interact, connect and work with each other. A life without technologies such as the Internet or smartphones are unimaginable in today's society, as they provide necessary information and a working ground for our daily activities. There is a growing concern about the possible forms of technology addiction, as people become dependent on them. For instance, the technology company Apple Inc. now shows weekly reports of their smartphone user's behaviour by displaying their screen time on applications in order to raise awareness of their behaviour. This shows that behavioral addiction to technology has become more prevalent (Apple Inc, 2018).

Technology addiction can be seen as a form of behavioural addiction that involves human-machine interaction, which can be passive or active (Griffiths, 1995). While there exists no uniform instrument of measurement for technology addiction, researchers have been studying various kinds of self-report scales, which focus on different technology areas. These areas include Internet, videogaming, smartphone, social network sites (SNS), television and other forms of technology, which were studied for a period of over 20 years. For the specific areas, there are commonly used scales but most of them lack conceptual definitions and criterias. The reason for this is that there exist various criteria and methodologies that make it difficult to constitute to one scale, leading to a large diversion of data (De-Sola et al., 2016).

There are certain classification manuals that group mental diseases such as behavioral addictions with criterias to provide a certain foundation for. Examples of such classification handbooks are the Diagnostic and Statistical Manual of Mental Disorders in the fifth Edition (DSM-V), which is the dominating classification handbook concerning mental disorders in the USA published by the American Psychological Association (APA); and the International Statistical Classification of Diseases and Related Health Problems in the tenth revision (ICD-10), which is the leading medical classification list by the World Health Organization (WHO). For instance, behavioral addictions such as pathological gambling or Internet gaming disorder are defined in the section of "substance-related disorders and addictive disorders" in the DSM-V.

When dealing with prevalence and cut-off points for technology addictions, studies in different areas were conducted. For Internet addiction, prevalence data ranges from 0.8% to 26.7% (Kuss et al., 2014), whereas for smartphone addiction, prevalence ranges from 0.4% to 64.5% (De-Sola et al., 2016). This prevalence spread exists as a result of different measuring instruments, which are not uniform to each other and based on differing criteria. Moreover, different cut-off points for the same instruments vary from study to study. In addition, different prevalences can also be explained as the samples of people being studied focus on different age groups (De-Sola et al., 2016; Kuss et al., 2014).

The current situation shows that different studies researched different kinds of technology addictions by providing various instruments to measure the addiction. However, no uniform criteria or definition exists for technology addiction. As a result, linkages between dimensions across different areas of technology addiction has not been investigated on a larger basis to develop a uniform measuring instrument.

Lortie and Guitton (2013) examined the dimensional structure between different Internet addiction scales in order to establish similar and dissimilar dimensions. Seven common Internet addiction dimensions were extracted and compared to criteria of common classification handbooks.

It is important to investigate the linkages between different areas of technology addiction. With that, better instruments can be developed to measure technology addiction, which can be used by the research community.

1.1 The Present Study

The objective of this study was to systematically review the current state of research concerning the dimensional structure of information-communication technology (ICT) use addiction scales. The primary focus was to determine the distribution of the dimensions of behavioural addiction across scales measuring ICT use addiction. Extending from this objective, three secondary objectives were identified:

1. Determine the dimensions of behavioural addiction relevant to ICT use.
2. Locate ICT use addiction scales utilised in research.
3. Apply a behavioural addiction model, developed on the basis of the first sub-objective, to determine the dimensions of behavioural addiction in each of the identified scales.

In order to fulfill the research objectives, a systematic literature search was conducted to extract relevant technology addiction instruments in the area of Internet, smartphone, video games and SNS.

2. A CONCEPTUAL MODEL OF THE DIMENSIONS OF TECHNOLOGY USE ADDICTION

To establish a conceptual model for technology addiction scales, the following section provides definitions for behavioral- as well as technology addictions and the classification of areas in this study. Moreover, an overview of clinical classification handbooks concerning substance abuse will be provided. Additionally, in this Section dimensions of models dealing with Internet-, behavioral- and technology addiction will be compared and matched to consider the alignment between these different criteria to provide a foundation for the subsequent analysis.

2.1. Behavioral Addiction

Substance abuse, as a form of addiction, has long been studied in a number of academic domains and, consequently, diagnostic criteria are well established (Griffiths, 1995; Lortie and Guitton, 2013). Examples of such diagnostic criteria include the International Statistical Classification of Diseases and Related Health Problems in the tenth revision (ICD-10), which is the leading medical classification list by the World Health Organization (WHO). Additionally, the Diagnostic and Statistical Manual of Mental Disorders in the fifth Edition (DSM-V) is the dominating classification handbook concerning mental disorders, such as substance abuse in the USA, which is published by the American Psychological Association (APA) and defines psychiatric diagnosis of mental disorders (APA, 2018).

In contrast, behavioural addictions have traditionally received less research attention. In a seminal article Griffiths (1995) provided one of the first definitions for technology addiction, as a class of behavioural addiction. In discussing the conceptual linkages with substance addictions Griffiths (1995) defines technology addiction as a form of behavioural addiction that involves human-machine interaction. The interaction can be either passive without active engagement or active with involvement. Passive interactions include watching television or listening to music, while active interactions can be playing video games or slot machines. The two forms of behavioral addiction contain certain characteristics to strengthen obsession. For example, video games are designed in a way to play more than intended. In considering the clinical diagnostic criteria of substance addiction Griffiths (2005) concluded that addictions consist of six common components: *salience*, *mood modification*, *tolerance*, *withdrawal symptoms*, *conflict*, and *relapse*. According to Griffiths, these components are also present in behavioural addictions. The given model of Griffiths (2005) is relevant, as it is the first model of its kind dealing with behavioural addiction and will be compared later on to another model dealing with Internet dimensions in this study. Table 1 provides necessary information about relevant classifications to give a brief overview.

Reference	Title	Description
WHO (1992)	ICD-10	International Statistical Classification of Diseases and Related Health Problems in the tenth revision, which is the leading medical classification list by the World Health Organization.
Griffiths (1995)	Technological addictions	One of the first definitions for technology addiction. Technology addiction is defined as a form of behavioural addiction that involves human-machine interaction, which can be either active or passive.
APA (1994)	DSM-IV	The Diagnostic and Statistical Manual of Mental Disorders (DSM) is the dominating classification handbook concerning mental disorders in the USA published by the American Psychological Association in the fourth edition.
APA (2000)	DSM-IV-TR	Diagnostic and Statistical Manual of Mental Disorders in the fourth edition, textrevision. Nine diagnostic criteria were added and diagnostic criteria were modified.
Griffiths (2005)	“Component” model	First model of its kind dealing with behavioural addiction. Consist of the following six components: salience, mood modification, tolerance, withdrawal symptoms, conflict, and relapse.
Lortie and Guitton (2013)	Internet addiction assessment tools	Examined the dimensional structure of Internet addiction scales by pooling them into seven dimensions and mapping these to the DSM-IV-TR and ICD-10. One of the seven dimension could not be mapped to the DSM-IV-TR or ICD-10.
APA (2013)	DSM-V	Diagnostic and Statistical Manual of Mental Disorders in the fifth edition, which is the dominating classification handbook in the USA published by the American Psychological Association. Changes are, that the section dealing with "substance-related disorders" now includes "addictive disorders".
(WHO (2018)	ICD-11	The current, internationally valid edition is ICD-10, but a first version of a future ICD-11 was published in June 2018. According to the WHO, this new version is to be adopted at the World Health Assembly in May 2019 and will come into effect in 2022.

Table 1. History of Classification

As this study mentioned the behavioural addiction model of Griffiths (2005) above, it is now important to move over to the model of Lortie and Guitton (2013) concerning Internet addiction, as it compares dimensions leading medical classification handbooks. Even though Internet addiction seems not to fit in perfectly, it is a form of technology addiction and will form the basis for further analysis.

Lortie and Guitton (2013) examined the dimensional structure of Internet addiction scales by analysing 14 such scales published between January 1993 and October 2011. The authors used a bottom-up approach, which is a method to sort specific groups into more general categories. The factors of the chosen Internet addiction scales were first identified. Then the dimensions were combined into broader dimensions of addiction, related to their theoretical analogy. After the process, the authors had 67 different factors, which then were pooled into the following seven dimensions: “compulsive Internet use”, “salience”, “withdrawal”, “mood regulation”, “escapism” and “social comfort”. For example, factors such as “excessive use” and “loss of control” were mapped to the dimension “compulsive use”. After the pooling of the dimensions, the authors compared the seven dimensions with the diagnostic criteria for substance use disorder and pathological gambling of the Diagnostic and Statistical Manual of Mental Disorders in the fourth textrevision (DSM-IV-TR) and ICD-10. The DSM-IV-TR and ICD-10 criteria were matched to six of the proposed seven dimensions. The dimension “social comfort” was not matched to the DSM-IV-TR or ICD-10 as the handbooks do not include criterias for a preference of online interaction. This is interesting, as it shows that the dimension “social comfort” is unique in Internet addiction and should be used as a dimension for scale development.

To establish a solid alignment for technology addiction scales, this review compared and extracted the dimensions used in Lortie and Guitton (2013)’s model against the DSM-V criteria for substance disorders as well as the dimensions proposed in the “Component” model of Griffiths (2005).

Subsequent to the publication of Lortie and Guitton (2013), a new version of the DSM, the DSM-V has been published. It contains four new criteria for substance use disorder in addition to the seven existing criteria. While seven of the 11 criteria in the DSM-V are the same as those in the DSM-IV-TR, four new dimensions are introduced. To consider this update, these four new criteria were compared in relation to Lortie and Guitton (2013)’s model. Table 2 indicates the criteria from the DSM-V of substance use disorder.

Additionally, owing to its prominence in the literature, Griffiths (2005) “Component” model was also mapped to Lortie and Guitton (2013)’s model. To consider the alignment between the different criteria and dimensions used in the various sources, this study extracted the criterions and description from the DSM-V (APA, 2013), the dimensions and descriptions from Lortie and Guitton (2013)’s model as well as the dimensions and description of the “Component” model from Griffiths (2005). Table 2-4, present a summary of the analysis. It shows, how the different kind of criterias and dimensions have similarities and divergences in their wording. This is important, as the descriptions will be considered to compare the dimensions. Considering the ICD-10, a new version, the eleventh revision of the ICD (ICD-11) will be published in late 2019. To this date, the ICD-11 criteria are not considered as it is not released yet.

Criteria		Description
Impaired control (IC)	IC1	The individual may take the substance in larger amounts or over a longer period than was originally intended.
	IC2	The individual may express a persistent desire to cut down or regulate substance use and may report multiple unsuccessful efforts to decrease or discontinue use.
	IC3	The individual may spend a great deal of time obtaining the substance, using the substance, or recovering from its effects.
	IC4	Craving is manifested by an intense desire or urge for the drug that may occur at any time but is more likely when in an environment where the drug previously was obtained or used. Craving has also been shown to involve classical conditioning and is associated with activation of specific reward structures in the brain. Craving is queried by asking if there has ever been a time when they had such strong urges to take the drug that they could not think of anything else. Current craving is often used as a treatment outcome measure because it may be a signal of impending relapse.
Social impairment (SI)	SI5	Recurrent substance use may result in a failure to fulfill major role obligations at work, school, or home.
	SI6	The individual may continue substance use despite having persistent or recurrent social or interpersonal problems caused or exacerbated by the effects of the substance.
	SI7	Important social, occupational, or recreational activities may be given up or reduced because of substance use.
Risky use of the substance (RS)	RS8	This may take the form of recurrent substance use in situations in which it is physically hazardous.
	RS9	The individual may continue substance use despite knowledge of having a persistent or recurrent physical or psychological problem that is likely to have been caused or exacerbated by the substance.
Pharmacological criteria (PC)	PC10	Tolerance, as defined by either of the following: (a) A need for markedly increased amounts of the substance to achieve intoxication or the desired effect or (b) Markedly diminished effect with continued use of the same amount of the substance.
	PC11	Withdrawal, as manifested by either of the following: (a) the characteristic withdrawal syndrome for the substance, or (b) the same (or closely related) substance is taken to relieve or avoid withdrawal symptoms.

Table 2. DSM-V Criteria – Substance Use Disorder (APA, 2010)

Dimension	Description
(1) Salience	This refers to when the particular activity becomes the most important activity in the person's life and dominates their thinking feelings (cravings) and behaviour (deterioration of socialized behaviour).
(2) Mood modification	This refers to the subjective experience that people report as a consequence of engaging in the particular activity (i.e. they experience an arousing 'buzz' or a 'high' or paradoxically a tranquillizing and/or destressing feel of 'escape' or 'numbing').
(3) Tolerance	This refers to the process whereby increasing amounts of the particular activity are required to achieve the former effects.
(4) Withdrawal symptoms	These refer to the unpleasant feeling states and/or physical effects which occur when the particular activity is discontinued or suddenly reduced. Such withdrawal effects may be psychological (e.g. extreme moodiness and irritability) or more physiological (e.g. nausea, sweats, headaches, insomnia and other stress-related reactions).
(5) Conflict	This refers to conflicts between the addict and those around them (interpersonal conflict) or from within the individual themselves (intrapsychic conflict) which are concerned with the particular activity. Continual choosing of short-term pleasure and relief leads to disregard of adverse consequences and long-term damage which in turn increases the apparent need for the addictive activity as a coping strategy. The conflict in the addict's life means that they end up compromising their (1) personal relationships (partner, children, relatives, friends, etc.), (2) working or educational lives (depending on what age they are) and (3) other social and recreational activities. Intrapsychic conflict may also be experienced in the form of addicts knowing that they are engaged heavily in the behaviour and want to cut down or stop – but find they are unable to do so, experiencing a subjective loss of control.
(6) Relapse	This refers to the tendency for repeated reversions to earlier patterns of the particular activity to recur and for even the most extreme patterns typical of the height of the addiction to be quickly restored after many years of abstinence or control.

Table 3. "Component" Model of (Griffiths, 2005)

Dimension	Description
(1) Compulsive Internet use	Compulsive use is synonym for tolerance and the inability to control, reduce or stop online behavior.
(2) Negative outcomes	Negative outcomes are deleterious consequences of excessive Internet use.
(3) Salience	Salience stands for salience and cognitive preoccupation.
(4) Withdrawal symptoms	Withdrawal symptoms are felt when not online.
(5) Mood regulation	Mood regulation means that the Internet is used to regulate the mood.
(6) Escapism	Escapism means that the Internet is used to escape from other problems.
(7) Social comfort	Social comfort refers to a preference for online social interaction.

Table 4. Lortie and Guitton's model (2013)

2.2. Mapping the Dimensional Structure

The review aims to find linkages between the described models below and their dimensions and criteria. For this, the process of mapping was done, where dimensions of one model were compared to each other and linked into a visual graph. The reason why the models were compared and matched is to find a basis for the main dimensions in the following analysis and to establish a solid justification. Lorties and Guittons (2013) dimensions fit the DSM-V criteria as well as the dimensions of Griffiths (2005) "Component" model in a commensurate way. This study used the proposed seven dimensions from Lortie and Guitton (2013) in the analysis to follow, to map the dimensions for the technology addiction scales in a top-down approach.

To map the DSM-V (APA, 2013) criteria and the dimensions of the "Component" model (Griffiths, 2005) to Lorties and Guittons (2013) model, Table 1-3 were used to compare the descriptions and wording of the dimensions. The result can be seen in Figure 1.

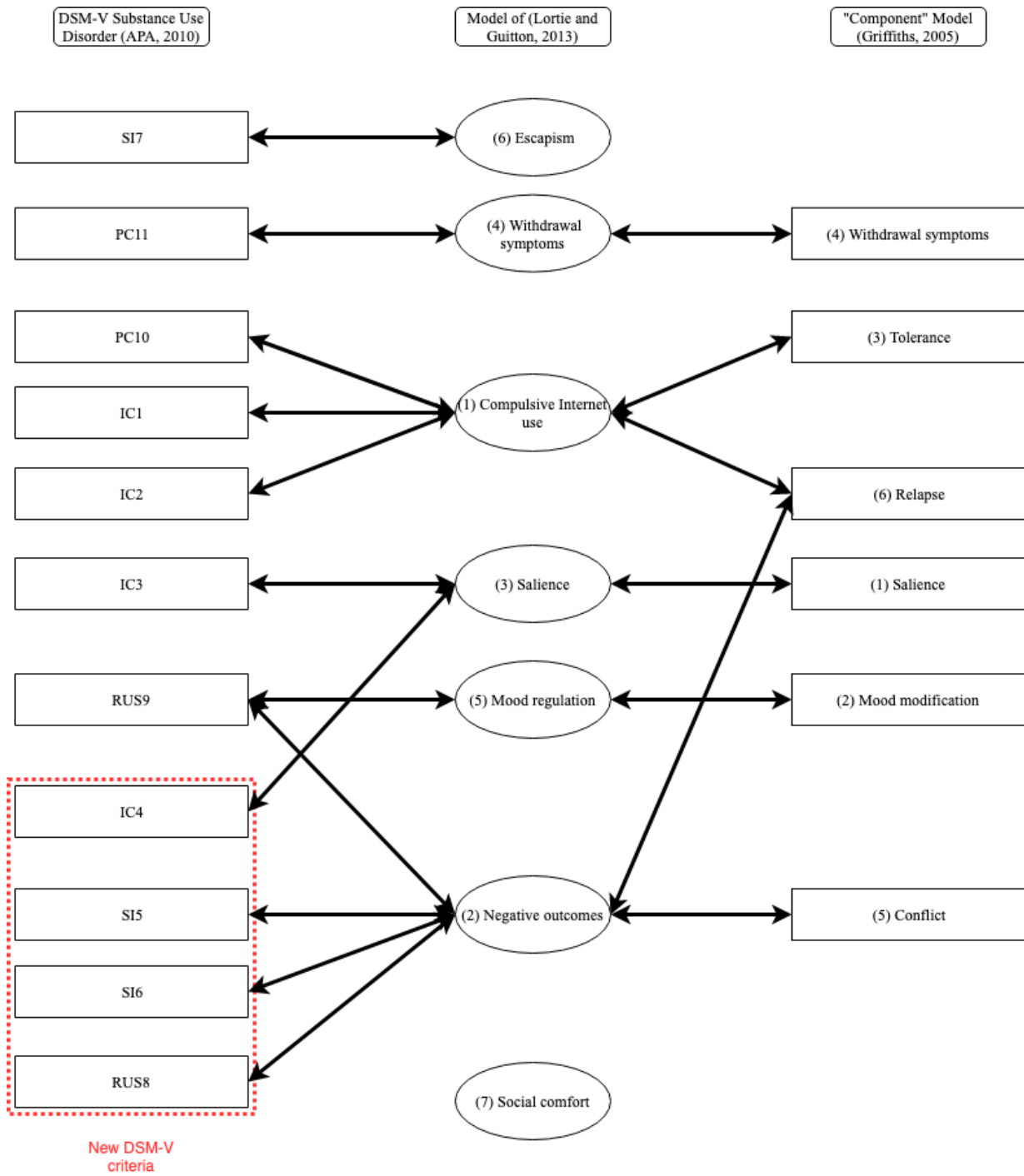


Figure 1. Comparison of Models

Due to the conceptual overlap in the constructs considered IC4 from the DSM-V -“craving”- was mapped to the “salience” dimension in Lortie and Guitton (2013). “Salience” is defined as a cognitive preoccupation, while, in the DSM-V, “craving” refers to a strong desire or urge to use a specific drug.

SI5 states that recurrent substance use leads to important obligations not being met at work, school or at home. It was mapped to the dimension "negative outcomes" as it is a consequence of the use. SI6 describing the continued use of substances despite persistent or reappearing negative consequences, was also mapped to the construct “negative outcomes”. RUS8 states that the substance is used repeatedly in conditions that are physically harmful. Therefore, it was mapped to the dimension of “negative outcomes”.

The dimension “salience” from Griffiths “component” model was mapped to “salience” within Lortie and Guitton’s model, as both dimensions refer to an individual’s cognitive preoccupation.

The dimension “tolerance” from Griffiths “component” model was mapped to “compulsive use” within Lortie and Guitton’s model. “compulsive use” as defined in Lortie and Guitton (2013) is a synonym for tolerance, which indicates that the person can not control, reduce or stop the behavior.

The dimension “withdrawal symptoms” from Griffiths “component” model was mapped to “withdrawal symptoms” of Lortie and Guitton model, as it describes the same perception when the activity is reduced. The “relapse” dimension from Griffiths’ “component” model was mapped to the dimensions “negative outcomes” and “compulsive use” from Lortie and Guitton (2013)’s model. “Relapse” means a tendency to recurrent patterns even after years of abstinence from the activity. That is why it fits negative outcomes because the person could fall into this pattern after a period of abstinence. Moreover, it fits “compulsive use” because it describes the inability to control. Similarly, Griffiths’ ‘conflict’ dimension was also mapped to “negative outcomes” of Lortie and Guitton’s model. “Conflict” is defined as the personal as well as external conflict with other persons, in which personal relationships, work or school activities and personal pursuits suffer. The dimension “mood modification” of Griffiths “component” model was mapped to “mood regulation” of Lortie and Guitton model as both dimensions change the subjective mood through the activity.

Lortie and Guitton (2013) included a seventh dimension, 'social comfort'---defined as the preferable way for online communication, which was not matched to any of the criteria of the DSM-V or to any dimensions of Griffiths (2005) “component” model.

2.3. Technology Addiction as a Form of Behavioural Addiction

As described in Section 2.1. Griffiths (1995) defined technology addiction as a form of behavioural addiction that involves human-machine interaction, which can be passive or active. This definition was established 24 years ago and is considered in this study to be too general, as new technology evolved through the time.

In order to establish technology addiction as an overarching category for behavioural addictions, two boundaries are made. Firstly, the used technology must be in the broadest way an information-communication technology (ICT). Parry (2019) refers to ICTs as technology artefacts, including two categories: hardware or devices (e.g. smartphones, laptops) and services or software (e.g. web

browsers, SNSs). Secondly, the behavioral addiction considered should imply the use of the technology as this study concerns ICT use behaviour as a form of behavioural addiction. Within ICT's this study considered technologies such as video gaming, virtual reality or SNS. Technologies like file transfer protocol or ethernet are not included as they do not imply the use of the technology.

Specifically, this review considers four categories of behavioural addiction within technology addiction: Internet-, smartphone-, SNS- and video gaming addiction. These technologies are used because they have a great influence on daily life. Currently worldwide, there are 4.38 billion Internet-, 2.53 billion smartphone-, 2.62 billion SNS and 2.2 billion videogaming users involved (McDonald, 2017; Miniwatts Marketing Group, 2019; Statistica Inc, 2019a; Statistica Inc, 2019b).

2.4. Areas of Technology Addiction

This section gives an overview about the definitions of the four proposed areas of technology addiction. There is a lack of conceptual definitions that deal with technology addiction, and therefore, established definitions of the individual areas have been determined by analyzing literature reviews.

Internet addiction is defined by a person using the Internet excessively and impulsively without controlling this usage which leads to interferences and distress in life (Shaw and Black, 2008), whereas smartphone addiction is defined as exorbitant use of smartphones which result in limitations of the social- as well as the working life. Reliance and tolerance factors as seen in addictive disorders are also included (Elhai et al., 2018). SNS addiction is defined by a person that is primarily occupied with SNS, having a strong desire to use SNS, and where overuse leads to impairments in relationships, mental health, working and study environments (Andreassen and Pallesen, 2014).

Whereas Internet, smartphone and SNS addiction lack a proper conceptual definition, videogaming addiction is defined in the DSM-V (APA, 2013). A new part of the DSM-V indicates that the section dealing with "substance-related disorders" was changed to "substance-related disorders and addictive disorders" (APA, 2013). It includes for the first time non-substance addictions like pathological gambling in the main text. Moreover, Internet gaming disorder (IGD) as a behavioral addiction was included and defined in the auxiliary section of the DSM-V, which needs further investigation to include in the main section. The reason for this, is that in contrast to pathological gambling, which is very well researched, IGD is not (Griffiths et al., 2014). IGD is defined as playing games by using the Internet in a repetitive and persistent way, often involving playing with other people. This leads to constraints when five or more of the following nine criteria are met over a 12 month period: (i) thinking about the gaming activity in daily life; (ii) symptoms of withdrawal when it is not possible to play games; (iii) more time is needed to spend with Internet games (tolerance); (iv) attempts to control the behavior has previously failed; (v) other recreational activities and hobbies are discarded; (vi) overuse despite of social problems; (vii) lying about the time spend with Internet games; (viii) using Internet games to change negative feelings or escape from problems; (ix) endangering or losing a working position or a personal relationship due to excessive Internet gaming. When the Internet is used for other activities in the profession or business world, it is not included. Moreover, gambling over the Internet is not included as the DSM-V puts it into the gambling disorder section (APA, 2013).

One could argue, that the areas are overlapping in some points, particularly between Internet- and SNS addiction, as well as Internet- and smartphone addiction. De-Sola et al. (2016) found out that smartphone addiction shows a significant difference in user behavior when compared to Internet addiction. Therefore, Internet- and smartphone addiction can be separated, whilst SNS and Internet-addiction are more intersecting. The Internet addiction scale “Problematic Internet Entertainment Use Scale for Adolescents” measures among other points the use of SNS (Lopez-Fernandez et al., 2013).

3. METHODOLOGY

In this study a systematic literature search was conducted following guidelines provided by Webster and Watson (2002) and von Brocke et al. (2009). According to Webster and Watson (2002) a systematic literature search involves searching for relevant scientific articles through either keyword searches in bibliographic databases or forward and backward searches from relevant articles. A forward search reviews sources that have cited the article whereas a backward search means that references cited in an article are examined. The search topic was defined as “Technology addiction scales in the areas of Internet, smartphone, video games and social network sites”. The following sections outline the procedures adopted to locate and extract relevant self-report scales for technology addiction.

3.1. Inclusion Criteria

Studies were included if they (i) developed a scale for technology addiction in the areas of Internet-, SNS-, video game- and smartphone addiction; (ii) did not only done entirely a validation and language translation to English of an existing scale; (iii) are reported in English; (iv) are either published in a research magazine or book; and (v) were conducted between 2007 and August 2018 except for Internet addiction scales. The time frame for (v) was adopted because the widespread adoption of the smartphone in 2007 marked the area for potential smartphone addiction and a new kind of communication (West and Mace, 2010). For Internet addiction scales, a time frame between 1996 and August 2018 (the time of data collection) was selected, as the first scales of Internet addiction were discussed and developed by Young (1996, 1998a, 1998b).

3.2. Search Strategy

A specific search string consisting of 12 components was developed (see Figure 2). These 12 components include three main clauses (1, 2 and 3), each containing a variable aiming at the four types of technology addiction (I, II, III, and IV) as defined in this study (Internet, smartphone, SNS and video games). The three main clauses are separated by two OR operators and contain specific keywords for each clause. Moreover, the variable included in each main clause contains specific keyword combinations for the four mentioned types of technology. These types are separated with three OR operators and use appropriate synonyms to yield more results.

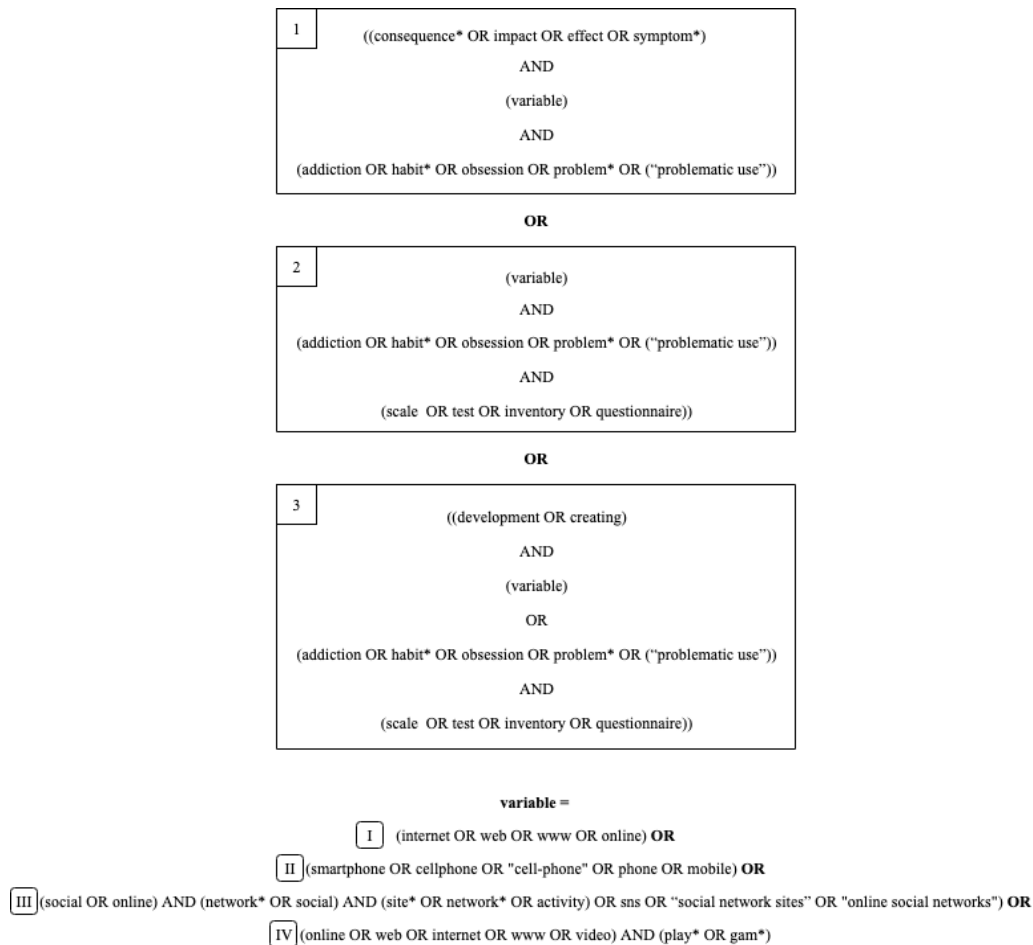


Figure 2. Search Query

As depicted in Figure 2, the first main clause concerns the consequences of specific technology addiction, and is formulated in a broader way due to the fact that most authors use existing scales in order to build new self-developed scales to measure technology addiction. The main clause contains three subparts which are separated with two AND operators. The AND operator means that all search terms must appear in the resulting records. The first subpart contains synonym keywords dealing with consequences, which are separated with an OR operator. Subpart two is the variable, containing the four areas of technology addiction. The last subpart contains search words aiming at addiction, separated by OR operators. Synonyms like habit or obsession are used.

The second main clause aims to yield results for technology addiction scales and contains three subparts, separated by two AND operators. Part one is the variable. Subpart two contains terms and synonyms dealing with addiction like in the main clause one and subpart three contains search words aiming at words and synonyms for 'scale' (e.g., scale, questionnaire, inventory).

The third main clause covers the development of technology addiction scales and contains four subparts, separated with two AND and one OR operator. The first subpart contains the keywords 'development' or 'creating' to find records which concerned the development of a new scale. Subpart two is the variable as described previously. The third subpart deals with search strings for addiction, which were described previously. The last subpart is a keyword combination of synonyms for 'scale' as described in the main clause two. The one OR operator is connected between the

variable and subpart three dealing with addiction. The reason for using one OR operator is to yield more results dealing with addiction.

Where appropriate search terms included an asterisk at the end as a wildcard operator to include prefixes for the given string. For instance, the database will search for the search word ‘problem*’ by including terms such as ‘problematic’ or ‘problems’ as well.

The literature search using the above mentioned search query was conducted within a three-week period in August 2018 using the following nine scientific databases to extract papers: GoogleScholar (n = 620), ScienceDirect (n = 1052), PubMed (n = 893), EmeraldInsight (n = 381), Wiley (n = 136), SpringerLink (n = 355), ACM (n = 225), iEEE (n = 532) and JSTOR (n = 504). Given the length of the search string, and the restrictions of the databases considered, the query was run separately for each of the variables (representing the technologies considered) where restrictions were implemented.

3.3. Data Extraction and Management

The bibliographic information and full-text records of each result were downloaded and stored reference management software (Zotero version 5). All duplicated results were noted and deleted. After that, titles and abstracts were reviewed against the inclusion criteria described in Section 3.1.

3.4. Search Results

4698 results were found using the search strategy. After removing duplicates (n = 1676), the remaining results (n = 3022) were examined by title and abstract for inclusion and ineligible papers (n = 2909) were removed. Next, the full-texts of the remaining papers (n = 114) were examined and a total of 58 papers met the inclusion criteria. After extracting relevant information of the scales for analyzing dimensions, papers (n = 8) were removed because of missing information, leaving a final sample of 50 papers (see Appendix 1 for an overview of the studies included). Figure 3 depicts the process of data collection.

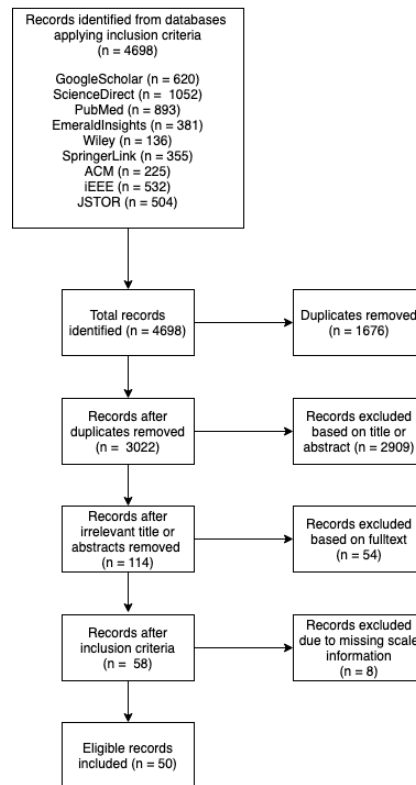


Figure 3. Flowchart for Study Inclusion

3.5. Included Scales

Initially, 58 scales were considered. Subsequently, two scales were excluded because they concerned the revision of an existing scale, without altering the dimensional structure (e.g., Kwon et al., 2013b; Lin et al., 2017). Additionally, Lemmens et al. (2009) developed a video gaming addiction scale and a shorter version of the proposed scale. The shorter version was not considered in this study. In contrast, the paper from Kuss et al. (2018), updated the “Problematic Mobile Phone Use Questionnaire” which was included in this review as the dimensional structure of the scale was altered. A dimension concerning finance was deleted and a new dimension dealing with dangerous use was added into the updated scale. Smetaniuk (2014) developed two scales for smartphone addiction, which both were included, as they target different dimensions.

After extracting relevant data concerning the scale dimensions and questionnaires, six scales did not contain the necessary information (Alabi, 2013; Buono et al., 2016; Cam, 2012; Chow et al., 2009; Nichols and Nicki, 2004; Wolniczak et al., 2013). After looking at the supplementary material as well as the appendix and not finding the information, the authors were contacted through ResearchGate on the 13.03.2019 to provide the information. After a time frame of two weeks, none of the authors replied and provided the necessary information. Therefore, these six scales were not taken into account.

3.6. Analysis Procedures

The purpose of this analysis was to determine firstly, the dimensional structure between different kinds of technology addiction scales and, secondly, to find linkages between these scales. The extracted data of the scale dimensions were categorized on the basis of Lortie and Guitton's (2013) dimensions as described before. For this, a table was created, with the scale name, dimensions of the developed scale and items assigned to the dimensions of the scale. Each of the assigned items were matched to one of the seven dimensions of Lortie and Guitton's (2013) model and, where a match was not possible, new dimensions were proposed. The outcomes of this mapping process are described in Section 4.2.1. In addition, to consider linkages between scales, the authors' descriptions of the basis for their scale were identified and mapped as a network. The outcomes of this process are presented in Section 4.3.

4. ANALYSIS AND RESULTS

The following sections outline the analysis and findings of the review. Firstly, the extracted data of the scales is analyzed. For that, demographic data as well as information about technology addiction scales are examined. Secondly, the dimensional linkages and structure of the scales are investigated by mapping the items to the models as described in 4.2.1. Thirdly, the relationships between the extracted technology scales are analyzed with a network graph to check which scale is influenced by other scales and given criteria.

4.1. Sample Description

The 50 extracted technology addiction scales were divided into four categories ---smartphone (20; 40%), Internet (14; 28%), video games (12; 24%), SNS (4; 8%)--- with each scale falling in only a single category. Figure 4 provides an overview of the year of publication and technology concerned for each of the scales considered. It is evident that the largest number of scales considered were published in 2012 and 2014 (each $n = 6$). Additionally, the figure illustrates the increase in the production of such scales over the period, with only 11 scales published between 1998 and 2008 and 39 between 2008 and 2018, an increase of 354.55%.

Of the 50 scales, 43 are using samples of only one country, whereas five scales use sample data from more than one country. Finally, the development of two scales did not involve the use of a relevant sample or dataset (Young, 1998b; Vadlin et al., 2015) and were, as a consequence, marked with 'NA'. Because five scales were using more than one country in their sample, the number of countries is greater than the 50 scales considered. 68 total and 27 unique countries distributed across 48 scales were used in the development of the scales considered. The scales samples were collected in Europe ($n = 28$) followed by Asia ($n = 10$) and North America ($n = 15$) whereas scales are least developed with samples on Africa and South America (both $n = 1$). Moreover, the scales were spread across 31 different publications, with the largest proportion of scales published in the journal "Cyberpsychology, Behaviour and Social Networking" ($n = 8$), followed by "PloS One" ($n = 6$) and "Computers in Human Behaviour" ($n = 3$).

Out of the 50 scales, 47 were modified, while three did not indicate an existing basis. From the 50 scales, a total of 971 items were extracted. The minimum number of items per scale is six, the maximum is 52 and the average is 19.42 ($SD = 8.91$). Concerning the number of items per scale, six of the scales were using 20 items, five scales were using 18 items and the other five scales were using eight items.

The extracted scales were analysed to determine the nature of the sample upon which they were tested. Overall, four sample groups were identified: Children, going to school and under the age of 18; students going to university; adults who are working; and the category 'other', which contains special groups that do not fit the above mentioned three groups. One example for the 'other' group are members of an internet addiction support group (Armstrong et al., 2000). Some scales were used with multiple groups. Of the 50 scales, 39 were used with one of the above-mentioned groups, ten with more than one group, and for one no empirical data were collected (Young, 1998a). The largest

proportion of the scales were used with students (n = 22), followed by adults (n = 17), children (n = 14) and ‘other ‘(n = 13).

In some cases, scales partially address addiction in their proposed dimensions and measured other dimensions as well. For instance, the “Mobile Phone Affinity Scale” (Bock et al., 2016a) not only measured addiction but also connectedness and productivity. These dimensions were also taken into account and mapped in the process as described in Section 4.2.1.

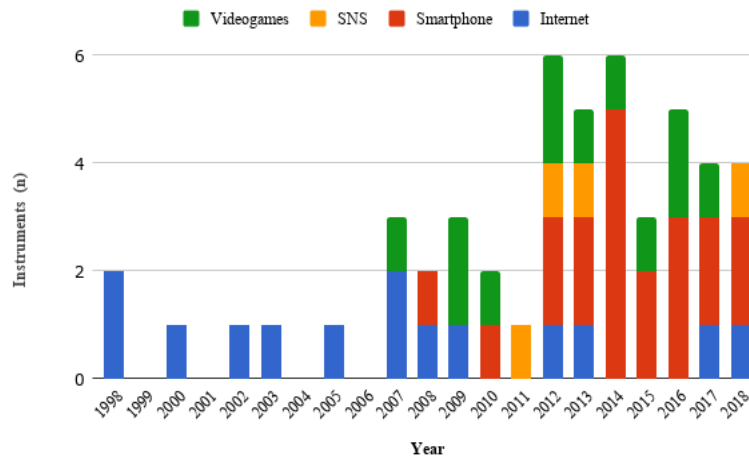


Figure 4. Technology Addiction scales per Year

4.2. Dimensional Foundation

The following section describes the process of the mapping and to what extent new dimensions emerged. Additionally, the data of the mapped items is described by providing an overview.

4.2.1. Dimensional Mapping

The basis of this study is the dimensional mapping and the foundation is provided by the dimensional models of Lortie and Guitton (2013), mapped to the DSM-V (APA, 2013) and Griffiths (2005)’s Component Model as described in Section 2.3. The 971 extracted items were mapped to one of the seven dimensions in Lortie and Guitton (2013)’s model, with each item only mapped to a single dimension. If the mapping from item to dimension was unclear, the mapped dimensions and descriptions of the DSM-V and Griffiths (2005) “Component” Model were considered as orientation points (see Figure 1, Table 1-3). When it was not possible to map an item to any of the proposed dimensions, the item was marked with the new dimension “no dimension”. Each mapped item was rated on a scale of confidence level (low, middle, high) by the primary researcher. After the initial mapping, a meeting with two independent coders was arranged to determine the accuracy of the mapping. Each item was checked from the lowest to the highest level of confidence. When there were discrepancies regarding the dimension, the suitable dimension was chosen by majority vote between the three researchers. After the initial review, 38 items were mapped to “no dimension” from 12 scales, divided into 5 Internet-, 3 smartphone-, 2 video game- and 2 SNS-addiction scales

(Armstrong et al., 2000; Bock et al., 2016a; Charlton and Danforth, 2007; Cho and Lee, 2015; Elphinston and Noller, 2011; Liu and Ma, 2018; Lopez-Fernandez et al., 2013; Lopez-Fernandez et al., 2014; Rotunda, et al., 2003; Thatcher and Goolam, 2005; Yılmaz et al., 2017; Young, 1998a). Figure 5 depicts the initial mapping.

When comparing the agreement between the two independent coders and the primary author, 828 out of the 971 items, were in agreement (85.27 %). To measure the inter-rater agreement, Cohen's kappa was calculated as it takes the possibility of agreement occurring by chance. The Cohen's kappa is 0.813, which provides a strong level of agreement (McHugh, 2012).

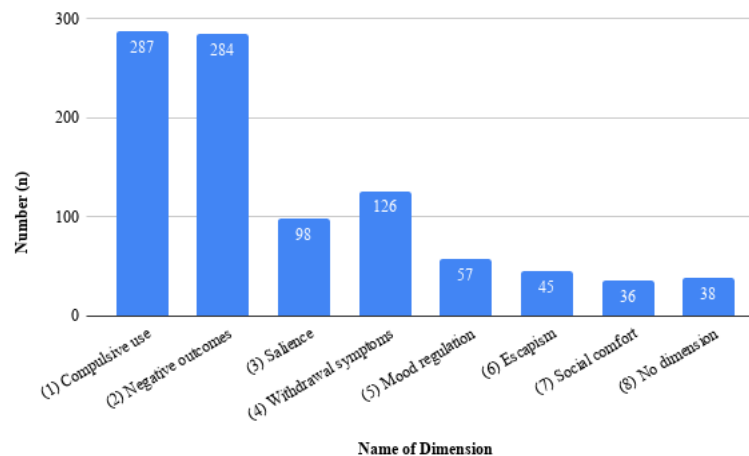


Figure 5. Dimensional distribution after initial reviewing

During three rounds of review new codes were developed to account for items not captured by the seven a priori dimensions. In the first round, six new codes were established. *Utility and function loss*, which refers to the limitation of an individual's functionality without a specific technology. For instance, an example of such an item is: "If I don't have a mobile phone, my friends would find it hard to get in touch with me off during a class, at the cinema, or in a theatre" (Lopez-Fernandez et al., 2014). *Intention to use in the future* which describes to use the ICT in the future. *Descriptive of use behaviour* describes how a person interacts with the technology, such as "I have met new people through this kind of entertainments OVG or SNS" (Lopez-Fernandez et al., 2013). *Personality*, was used to refer to when a person is more comfortable using technology than rather dealing with people. Finally, "*irrelevant*" was used to code items which were not relevant, such as "Asheron's Call jargon sounds stupid to me" (Charlton and Danforth, 2007). The author and the coders considered each of these codes and decided whether it was possible to extend them or to fit them into an existing dimension. Additionally, the new dimension code "futility" was established, describing, that life without technology is monotonous. Due to the issue, that five items from the salience dimension contained aspects of "futility", these items were changed to "futility".

The coders and the author noticed that some items of the "descriptive of use behaviour" code had a certain pattern dealing with *cognitive absorption*, which refers to "a state of deep involvement with software" (Agarwal and Karahanna, 2000, p. 665). An example of this would be: "I almost forget all the other things when using social media" (Koc and Gulyagci, 2013). The use of these items suggest that too be addicted to a specific use behaviour, it should be cognitively absorbing. This is because

the criteria, ‘cognitive absorption’ does not fit the general substance abuse addiction. According to Agarwal and Karahanna (2000), cognitive absorption involves five dimensions: (i) temporal resolution in which passage of time is not registered; (ii) total immersion in the activity where other basic needs are ignored; (iii) intensified pleasure in doing the activity; (iv) the user's perception of being responsible for the interaction; and (v) curiosity that responds to sensory and cognitive sensitivities. In round two, “cognitive absorption” was added as an additional category. From the originally 22 “descriptive of use behaviour” codes, nine were changed to “cognitive absorption” codes.

After mapping the new dimension of cognitive absorption, the author reconsidered the 971 mapped items and checked whether there were items to map to cognitive absorption (round 3). Seven were adjusted accordingly. The coders reconsidered the dimension “futility” in the third round and mapped these to the dimension “salience”. Table 5 summarises the three coding rounds.

Dimension	1. Round (n)	2. Round (n)	3. Round (n)
Descriptive of use behaviour	22	13	13
Utility and function loss	13	13	13
Intention to use in the Future	1	1	1
Personality	1	1	1
Irrelevant	1	1	1
Cognitive absorption	0	9	16
Futility	5	5	0
Total	43	43	45

Table 5. Coding Rounds

4.2.2. Description of Dimensional Structure

A total of 971 items were extracted and mapped to the dimensions considered, with 316 (32.54 %) Internet-, 408 (42.02 %) smartphone-, 197 (20.20 %) video game- and 50 (5.15 %) SNS-items. 13 dimensions were used, seven belonging to Lortie and Guitton’s model (2013) as described in Section 2.3 and six new dimensions as described in Section 4.2.1. The majority of items (n = 921) were mapped to the seven dimensions from Lortie and Guitton’s model (2013) while 50 items were mapped to the six new dimensions.

The three most used dimensions were compulsive use (n = 287), followed by negative outcomes (n = 279) and withdrawal symptoms (n = 126) while the three least used were “intention to use in the future”, “personality” and “irrelevant” with only one mapped item per dimension. Table 6 represents the distribution of the dimensions across the four technologies considered. The percentages represent the proportion of items for each technology mapped to a particular dimension. For instance, the Internet area contains 316 items, where 91 items belong to compulsive use with 28.80%.

The final column represents the mean score and standard deviation of a specific dimension across the four technology addiction areas in percentage. The dimensions “compulsive use” and “negative outcomes” accounts to 54.65% of the mean score, which is the majority. From Lortie and Guitton (2013)’s model, the dimensions “social comfort” and “escapism” were used less.

Dimension	Internet n (%)	Smartphone n (%)	SNS n (%)	Video game n (%)	Total n	Mean % (SD)
Compulsive use	91 (28.80)	123 (30.15)	9 (18.00)	64 (32.49)	287	27.36 (6.42)
Negative outcomes	85 (26.90)	130 (31.86)	12 (24.00)	52 (26.40)	279	27.29 (3.30)
Withdrawal symptoms	28 (8.86)	69 (16.91)	9 (18.00)	20 (10.15)	126	13.48 (4.64)
Saliency	42 (13.29)	26 (6.37)	3 (6.00)	25 (12.69)	96	9.59 (3.94)
Mood regulation	20 (6.33)	22 (5.39)	7 (14.00)	8 (4.06)	57	7.45 (4.47)
Escapism	25 (7.91)	4 (0.98)	0 (0.00)	16 (8.12)	45	4.25 (4.36)
Social comfort	15 (4.75)	15 (3.68)	6 (12.00)	0 (0.00)	36	5.11 (5.03)
Cognitive absorption	2 (0.63)	5 (1.23)	3 (6.00)	6 (3.05)	16	2.73 (2.41)
Descriptive of use behaviour	7 (2.22)	0 (0.00)	1 (2.00)	5 (2.54)	13	1.69 (1.15)
Utility and function loss	0 (0.00)	13 (3.19)	0 (0.00)	0 (0.00)	13	0.80 (1.60)
Irrelevant	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.51)	1	0.13 (0.26)
Intention to use in the future	0(0.00)	1 (0.25)	0 (0.00)	0 (0.00)	1	0.06 (0.13)
Personality	1 (0.32)	0 (0.00)	0 (0.00)	0 (0.00)	1	0.08 (0.16)
Total per area n (%)	316 (100)	408 (100)	50 (100)	197 (100)	971	

Table 6. Dimensional Distribution of Items

Smartphone addiction scales are using the dimensions “negative outcomes” and “utility and function loss” to a greater extent, whereas SNS addiction scales deal more with the dimensions of “withdrawal symptoms” and “social comfort”. Moreover, video game addiction scales deal more with dimensions of “escapism” and “compulsive use”. In addition, “escapism” did not appear in the area of SNS and barely in smartphones. Nine studies only included one dimension and seven studies only focused on three. As a consequence, this raises questions about the validity of some scales.

4.3. Relationship Network Mapping

In order to analyze on what kind source the 50 extracted scale were based on, necessary data was captured by reading the scale’s paper and, if possible, extracting the sources. Extracted sources were put into a table and a unique key was assigned. Two categories were identified, internal sources which are the 50 extracted scales of this study and external sources, which are different criteria or scales. Internal scales were assigned unique IDs as seen in Appendix 1. When an internal scale was based on the same scale or criteria, the unique key could be reused. Every external scale was given a unique key between 51-127 (see Appendix 2). Moreover, Appendix 3 shows which scales or criteria influenced the 50 extracted scales.

Thereafter, a network graph was produced to visualize the influence of the scales (see Figure 6). A graph is made up of nodes which are connected by edges. Nodes represent the scales whereas edges represent the relationship between the scales. In the graph, only direct edges are used, meaning that every edge is pointing to a node. A pointing arrow means that the outgoing node influences the node the arrow is pointing to. Blue nodes represent the internal scales whereas red and green nodes represent external criteria/scales. Moreover, green nodes represent DSM criteria. Internal (blue) and external (red) scales can point to internal (blue) scales, whereas internal (blue) scales can not point to external (red) scales. In other words, the graph only shows which other sources internal scales are

based on. The reason why the influence of external scales on each other is not measured, is that it would go beyond the scope of this study.

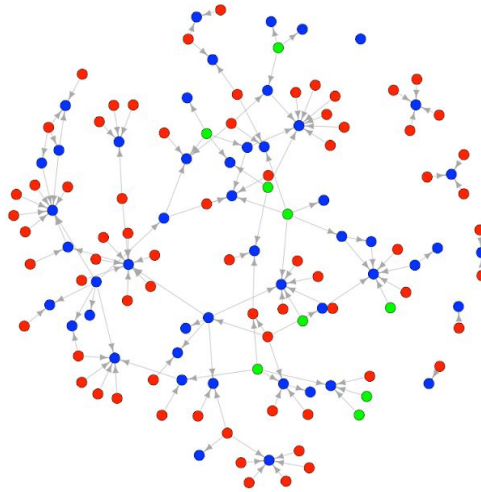


Figure 6. Network Graph

The 50 extracted scales are based on 104 external and 30 internal scales, of which 90 are unique. 20 extracted scales are based on DSM criteria: 11 are based on the DSM-V, eight on the DSM-IV and six on the DSM-IV-TR. The DSM disorder of pathological gambling was used five times in the DSM-IV-TR and four times in the DSM-IV. Table 7 gives an overview about the kind of disorder classified to the DSM. Moreover, six scales were based on Young's Diagnostic Questionnaire (1998b) and five were based on Young's Internet Addiction Test (1998a).

DSM-Edition	Type of Disorder	Count (n)
DSM-IV (APA, 1994)	Pathological gambling	4
	Substance use disorder	3
	Personality disorder	1
DSM-IV-TR (APA, 2000)	Pathological gambling	5
	Substance use disorder	1
DSM-V (APA, 2013)	Pathological gambling	4
	Internet gaming disorder (IGD)	3
	Substance use disorder	3
	Criteria for behavioural addiction	1

Table 7. DSM Distribution across extracted Scales

5. DISCUSSION

In the section which follows, the findings of the three research objectives are discussed, with emphasis falling on the overarching objective of the study - the determination of the dimensional distribution of behavioural addiction scales measuring ICT use addiction. The first section focuses on the identification and categorisation of the dimensions relevant to the measurement of ICT use as a form of behavioural addiction. The second section deals with findings relating to the technology scales that were identified and analysed in the study. The third section deals with the results of the application of dimension categorization in each of the identified scales. In addition, the fourth section deals with the main findings, which arose from the results of the three sub-objectives. Finally, a conclusion summarizing the core insights is provided, limitations of the study are stated and the implications of the findings for future research are considered.

The *first sub-objective* deals with the determination of technology addiction dimensions as they relate to ICT use behaviour. Currently, there does not exist an agreed upon set of dimensions for the measurement of technology addiction through self-report. Lortie and Guitton's (2013) model was compared and matched to Griffiths' "Component" model (2005) and the DSM-V criteria for substance use disorder as these are the prominent models in the literature (see Section 2.1.-2.2.). An interesting finding made in this regard is that the dimension "social comfort" identified by Lortie and Guitton (2013) does not align with the DSM-V criteria for substance use disorder or the "Component" model (see Figure 1). All other dimensions of Lortie and Guitton (2013) could be matched. This suggests that "social comfort", as a dimension of ICT use addiction, has not yet received much consideration. Moreover, the present study proposed 13 dimensions whereas the model of Lortie and Guitton (2013) contains only seven. New dimensions such as "cognitive absorption", "descriptive of use behaviour" and "utility and function loss" were introduced. A possible explanation might be that Lortie and Guitton (2013) only dealt with Internet addiction scales, whereas this study also considered smartphone-, video game- and SNS scales. However, while these dimensions capture an element of the items, they were used much less frequently than the other prominent dimensions (e.g., "compulsive use", "negative outcomes").

The *second sub-objective* concerned the identification of ICT use addiction scales for the purpose of dimensional analysis. Prior studies have extracted technology scales that relate to particular technologies or technology types with the aim of understanding concepts, prevalence and criteria relating to that particular sub-category. The main finding of these studies was that there seems to be a consensus about the existence of different forms of technology addiction, but that the criteria used to measure addiction across the technology areas are multifarious and inconsistently applied (Andreassen, 2015; De-Sola et al., 2016; Kuss et al., 2014; King et al., 2013; Lortie and Guitton, 2013). On the question of which kind of criteria the scales were based on, this study found that a large proportion is based on DSM criteria, especially those relating to the behavioural addiction of pathological gambling. Six scales were based on Young's Diagnostic Questionnaire (1998b) and five were based on Young's Internet Addiction Test (1998a). One potential reason could be that pathological gambling criteria were a first starting point to build technology scales as it is seen as a behavioural addiction with similar properties. In addition, Young's Internet addiction scales were the first to measure Internet addiction. As Internet addiction is one of the first scales to deal with

behaviour in a broader spectrum, it is not surprising that later scales adopted it as a reference point. Another promising finding was that the number of scales used in research has risen steadily since 2012. There are several possible explanations for this trend. The DSM-V, which was published in 2010, contains updates for disorders and IGD was introduced as a disorder for further study. Therefore, new scales developed contained the updated criteria of the DSM-V. When looking at the distribution scale adoption across continents it is evident that most scales were developed in Europe or Asia and fewer scales were developed in Africa and South America as opposed to. A plausible explanation for this pattern is that African and South American countries are facing a range of more immediate and urgent challenges which are more likely to receive attention from researchers. Another reason might be, that developing countries may have lower research productivity when compared to more developed countries.

The *third sub-objective* concerned the application of the theoretical model of addiction dimensions to the sample of scales identified. The analysis revealed that three dimensions ("compulsive use", "negative outcomes" and "withdrawal symptoms") are the most used dimensions (71.27 %). This pattern is consistent across the four technology areas and aligns with the findings of Lortie and Guitton (2013). However, in this study items categorised as referring to "withdrawal symptoms" occurred less frequently than in the findings of Lortie and Guitton (2013). A possible explanation for this might be that out of the 50 scales, 20 were based on DSM disorders, such as pathological gambling, substance use disorder or IGD (see Section 4.3). These types of disorders consist mostly of these three dimensions, which Figure 1 illustrates for substance use disorder criteria of the mapping. Four criteria (IC4, SI5, SI6, RUS8) are mapped to "compulsive use", three criteria (PC10, IC1, IC2) are mapped to "compulsive use" and only one criteria (PC11) is mapped to "withdrawal symptoms". Another possible explanation for this is that, when looking at the dimension of "compulsive use" of Lortie and Guitton's (2013) model, this dimension is used as a synonym for tolerance. Therefore, when a scale is measuring tolerance, it will be mapped to "compulsive use". That may be another reason, why "compulsive use" as a dimension was used more often than other dimensions. Another possible reason might be, that the dimension "negative outcomes" contains categories of different areas such as working and study life, social and psychological well-being. Therefore, this dimension could be too broad and should be subdivided.

One unanticipated finding was that the dimension "utility and function loss" is only used in the area of smartphones. This result may be explained by the fact that the smartphone includes features to support daily activities such as calendar, camera and applications. Without these functionalities people may experience a degree of frustration. This seems not to be the case for videogaming, SNS and Internet. Moreover, the dimensions "social comfort" and "mood regulation" are used more in the area of SNS, when compared to the overall sample. A reason for this might be that some people prefer online social interaction over face-to-face interaction. Another reason might be that SNS are used to counter or cope with experiences of stress.

Another important finding was the identification of the dimension "cognitive absorption" which is not present in the models of Lortie and Guitton (2013) and Griffiths (2005). As a dimension of ICT use addition, "cognitive absorption" serves to differentiate behavioural addictions which involve ICT use from behavioral addictions. The absence of "cognitive absorption" from the model of Lortie and Guitton (2013) can be explained by the fact that they only dealt with Internet addiction scales.

Moreover, only two extracted scales in this study contained dimensions dealing with “absorption” or “immersion” (Demetrovics et al., 2012; Lopez-Fernandez et al., 2013). This might be another reason, why “cognitive absorption” has largely been ignored as a dimension.

A potential question arises between the difference of pathological gambling when doing online and offline. Pathological gambling does not fall into the category of “Internet Gaming Disorder” when playing on the Internet. With the definition of technology addiction in this study (see Section 2.3.), it would fall into the category of technology addiction. The question arises how these forms should be handled. When comparing gambling to offline and online use, online gambling seems to be more dangerous and addictive (Hubert and Griffiths, 2018). This could be explained by the increased levels of cognitive absorption associated with online gambling.

5.1. Limitations

This study should be considered only as a first point of reference for further work dealing with conceptual development of technology addiction dimensions. It is characterised by several limitations which should be considered when researching technology addiction and their dimensions.

First of all, limitations for the constructed theoretical model are acknowledged. The model’s foundation was the model of Lortie and Guitton (2013) which compared Internet addiction dimensions which they grouped in seven dimensions. The authors did not compare other technology addiction scales for their proposed dimensional model. In addition, this theoretical model compared and mapped Lortie and Guitton’s (2013) model to the component model of Griffiths (2005) and to the dimensions of the DSM-V criteria of substance use disorder. This relates more to substance abuse than to behavioural addictions. The new proposed behavioural addiction IGD in the DSM-V would be a better fit.

Moreover, limitations in the data collection should be acknowledged. The keyword combination as described in Figure 2 was too long for most databases. The keyword search contained 213 words, of which 106 were connectors. The majority of the databases have limitations on the length of keyword strings and connectors. For this reason, the search string was divided into four separate parts as explained in 3.2 and entered separately into the database. The results of each database were merged. Moreover, the wildcard operator was not accepted in all databases. That is the reason why the search string had to be entered with different possible keyword combinations. As a result of limitations, 1676 duplicates were produced by the different searches. Therefore, scales fitting the inclusion criteria could have been missed. One concern involves the inclusion criteria of the selected year range. Internet addiction scales start in 1996 whereas the other three areas start in 2008. This may have resulted in uneven distribution across the different technology areas.

Another limitation involves the new dimensions identified. It could be argued that the items associated with the six new dimensions could have been coded differently. The dimension “compulsive use” also includes tolerance items due to Lortie and Guitton’s model (2013) treating these dimensions as synonymous. Therefore, tolerance is not treated as a separate dimension in this study. Additionally, the dimension “negative outcomes” contains negative aspects from various areas in life such as work, social and psychological well-being. Therefore, it is not possible to distinguish between these different aspects in order to group them. Moreover, the proposed dimensions

“intention to use in the future”, “personality” and “irrelevant” were only mapped to one item. Therefore, these dimensions require further investigation.

For the proposed areas in this study, SNS only represents five extracted scales and 50 items which is a low number compared to the other three areas. Additionally, the four proposed areas overlap in certain items and sometimes it is hard to distinguish between certain areas of technology, especially when dealing with Internet- and SNS addiction scales.

5.2. Prospects for Future Research

There is currently no gold standard for measuring technological addiction, as there are no suitable scales for this purpose. Therefore, further research should be undertaken to investigate potentially uniform scales for technology addiction. Moreover, the criteria, which the technology scales are based on lack uniformity. The research on IGD of the DSM-V seems to be prominent as criteria upon which to develop a uniform foundation. The ICD-11 will take effect in January 2022 and gaming disorder will be officially included as a behavioral addiction with that release (Kamenetz, 2019; WHO, 2019). To develop a full picture of all potential dimensions of technology addiction, additional studies will be needed. The dimension “cognitive absorption”, which was extracted as a new dimension, seems to be auspicious, as it describes a specific mental state. When looking at the demographic data, studies focus on students and adults. Further studies need to be conducted in order to find generational differences in relation to technology addiction. Moreover, studies should also be conducted in continents such as Africa and South America to identify potential cultural differences.

6. CONCLUSION

The purpose of this study was to explore and understand the dimensional distribution of technology addiction scales by systematically selecting and analysing 50 technology addiction scales in the areas of Internet, smartphone, video games and SNS.

The most substantial finding to emerge from this study is that there seems to be common dimensions used across different areas of technology. This includes dimensions like “compulsive use”, “negative outcomes” and “withdrawal symptoms”. There are also clear differences across dimensions. For instance, the dimensions “social comfort” and “mood regulation” are more used in the areas of SNS and the dimension “utility and function loss” is only used for smartphones. The second major finding was that new dimensions should be considered when dealing with technology addiction, which were not yet studied in a broader way. This includes dimensions like “cognitive absorption”, “descriptive of use behaviour” and “utility and function loss”. Especially “cognitive absorption” seem to be a promising dimension as it considers the mental state of a person when using an ICT. This seems to be different when comparing to behavioural addictions such as pathological gambling. The third major finding was that there is no gold standard for the conceptual criteria or definition for technology addiction. A large part of the 50 extracted scales were based on a combination of DSM criteria and Young’s Questionnaire (1998b) and Internet Addiction Test (1998a).

These findings are important, as this study lays the groundwork for future research into technology addiction scale development to design better instruments. Unanswered questions are, how scales should be handled, which only focus on one dimension and disregard other dimensions. Moreover, it is unclear, whether there is an overarching dimension for technology addiction.

In light of this, it is recommended that (i) dimension distribution across different areas is further investigated; (ii) more research concerning potentially new dimensions like “cognitive absorption”, “descriptive of use behaviour” and “utility and function loss” should be undertaken; (iii) an overarching definition of technology addiction should be constructed, which could be based on common criteria such as the proposed DSM-V criteria for IGD, in order to standardize assessment tools.

In summary, the field of technology addiction scale dimensions is well researched in the specific areas, however there is a need for a homogeneous approach to measurement in order to more accurately assess the constructs under investigation.

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APPENDIX

Appendix 1

Extracted Records representing Dimensional Distribution for each Scale n (%)

ID	Reference	Year	Technology	Name of Scale	Compulsive use	Negative outcomes	Withdrawal symptoms	Salience	Mood regulation	Escapism	Social comfort	Cognitive absorption	Descriptive of behaviour	Utility and functionality loss	Irrelevant	Intention to use in the future	Personality
1	Kwon et al., 2013a	2013	Smartphone	Smartphone Addiction Scale (SAS)	8 (24.24)	7 (21.21)	3 (9.09)	1 (3.03)	8 (24.24)	0 (0.00)	6 (18.18)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
2	Lin et al., 2014	2014	Smartphone	Smartphone Addiction Inventory (SPAI)	9 (34.62)	8 (30.77)	6 (23.08)	2 (7.69)	0 (0.00)	0 (0.00)	0 (0.00)	1 (3.85)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
3	Kim et al., 2014	2014	Smartphone	Smartphone Addiction Proneness Scale (SAPS)	4 (26.67)	5 (33.33)	5 (33.33)	0 (0.00)	0 (0.00)	1 (6.67)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
4	Lee et al., 2017	2017	Smartphone	Smartphone Overuse Screening Questionnaire (SOS-Q)	14 (50.00)	6 (21.43)	3 (10.71)	2 (7.14)	1 (3.57)	2 (7.14)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
5	Merlo et al., 2013	2013	Smartphone	Problematic Use of Mobile Phone (PUMP)	5 (25.00)	9 (45.00)	5 (25.00)	1 (5.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
6	Ezoe et al., 2016	2016	Smartphone	Smartphone Dependence Scale (J-SDS)	7 (24.14)	7 (24.14)	6 (20.69)	1 (3.45)	2 (6.90)	0 (0.00)	6 (20.69)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
7	Smetaniuk, 2014	2014	Smartphone	Adapted Mobile Phone Use Habits (AMPUH)	1 (10.00)	5 (50.00)	1 (10.00)	1 (10.00)	2 (20.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
8	Smetaniuk, 2014	2014	Smartphone	Adapted Cell Phone Addiction Test (ACPAT)	5 (25.00)	8 (40.00)	1 (5.00)	5 (25.00)	0 (0.00)	0 (0.00)	1 (5.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
9	Lopez-Fernandez et al., 2014	2014	Smartphone	Mobile Phone Problem Use Scale for Spanish Adolescent (MMPUSA)	7 (26.92)	8 (30.77)	4 (15.38)	1 (3.85)	2 (7.69)	1 (3.85)	0 (0.00)	1 (3.85)	0 (0.00)	2 (7.69)	0 (0.00)	0 (0.00)	0 (0.00)

10	Walsh et al., 2010	2010	Smartphone	Mobile Phone Involvement Questionnaire (MPIQ)	2 (25.00)	2 (25.00)	1 (12.5)	2 (25.00)	0 (0.00)	0 (0.00)	1 (12.50)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
11	Bian et al., 2015	2015	Smartphone	Smartphone Addiction Index (SPAI)	6 (31.58)	1 (5.26)	3 (15.79)	1 (5.26)	1 (5.26)	0 (0.00)	0 (0.00)	2 (10.53)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
12	Güzeller and Cosguner, 2012	2012	Smartphone	Problematic Phone Use Scale (PMPUS)	8 (44.44)	7 (38.89)	1 (5.56)	1 (5.56)	0 (0.00)	0 (0.00)	0 (0.00)	1 (5.56)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
13	Chóliz, 2012	2012	Smartphone	Mobile Phone Dependence (MPD)	11 (50.00)	6 (27.27)	2 (9.09)	1 (4.55)	2 (9.09)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
14	Kuss et al., 2018	2018	Smartphone	Problematic Mobile Phone Use Questionnaire Updated (PMPU-Q-R)	7 (43.75)	9 (56.25)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
15	De-Sola et al., 2017a	2017	Smartphone	Mobile Phone Addiction Craving Scale (MPACS)	0 (0.00)	0 (0.00)	8 (100)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
16	Bock et al., 2016	2016	Smartphone	Mobile Phone Affinity Scale (MPAS)	7 (29.17)	1 (4.17)	7 (29.17)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	9 (37.50)	0 (0.00)	0 (0.00)
17	Cho and Lee, 2015	2015	Smartphone	Smartphone Addiction Scale for Nurses	5 (26.32)	6 (31.58)	2 (10.53)	2 (10.53)	1 (5.26)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	2 (10.53)	0 (0.00)	1 (5.26)
18	Olivencia-Carrión et al., 2018	2018	Smartphone	Cuestionario de Abuso del Teléfono Móvil (ATEMO)	6 (24.00)	7 (28.00)	5 (20.00)	4 (16.00)	2 (8.00)	0 (0.00)	1 (4.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
19	Chóliz et al., 2016	2016	Smartphone	Multicultural Test of Mobile Phone Dependence (TMDBrief)	6 (50.00)	2 (16.67)	3 (25.00)	0 (0.00)	1 (8.33)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
20	Billieux et al., 2008	2008	Smartphone	Problematic Mobile Phone Use Questionnaire (PMPUQ)	5 (16.67)	21 (70.00)	3 (10.00)	1 (3.33)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
21	Young, 1998b	1998	Internet	Diagnostic Questionnaire (DQ)	3 (37.50)	2 (25.00)	1 (12.50)	1 (12.50)	0 (0.00)	1 (12.5)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
22	Young, 1998a	1998	Internet	Internet Addiction Test (IAT)	4 (20.00)	7 (35.00)	1 (5.00)	4 (20.00)	0 (0.00)	3 (15)	0 (0.00)	0 (0.00)	1 (5.00)	0 (0.00)	0 (0.00)	0 (0.00)

23	Meerkerk et al., 2009	2009	Internet	Compulsive Internet Use Scale (CIUS)	5 (35.71)	3 (21.43)	1 (7.14)	2 (14.29)	1 (7.14)	2 (14.29)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
24	Caplan, 2002	2002	Internet	Generalized Pathological Internet Use Scale (GPIUS)	8 (27.59)	3 (10.34)	2 (6.90)	3 (10.34)	4 (13.79)	0 (0.00)	9 (31.03)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
25	Lee et al., 2018	2018	Internet	Internet Overuse Screening Questionnaire (IOS-Q)	6 (35.29)	5 (29.41)	2 (11.76)	1 (5.88)	1 (5.88)	2 (11.76)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
26	Jenaro et al., 2007	2007	Internet	Internet Overuse Scale (IOS)	5 (45.45)	2 (18.18)	0 (0.00)	2 (18.18)	0 (0.00)	2 (18.18)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
27	Pontes and Griffiths, 2017	2017	Internet	Internet Disorder Scale (IDS-15)	5 (33.33)	2 (13.33)	4 (26.67)	0 (0.00)	3 (20.00)	1 (6.67)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
28	Demetrovics, et al., 2008	2008	Internet	Problematic Internet Use Questionnaire (PIUQ)	5 (27.78)	5 (27.78)	3 (16.67)	3 (16.67)	0 (0.00)	2 (11.11)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
29	Lopez-Fernandez et al., 2013	2013	Internet	Problematic Internet Entertainment Use Scale for Adolescents (PIEUSA)	10 (33.33)	10 (33.33)	1 (3.33)	5 (16.67)	0 (0.00)	2 (6.67)	0 (0.00)	0 (0.00)	2 (6.67)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
30	Xu et al., 2012	2012	Internet	DRM 52 Scale of Internet-use in Adolescent (DRM 52-Scale)	19 (36.54)	13 (25.00)	6 (11.54)	7 (13.46)	3 (5.77)	2 (3.85)	2 (3.85)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
31	Thatcher and Goolam, 2005	2005	Internet	Problematic Internet Use Questionnaire (PIUQ)	4 (20.00)	7 (35.00)	1 (5.00)	4 (20.00)	0 (0.00)	1 (5.00)	2 (10.00)	0 (0.00)	1 (5.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
32	Huang et al., 2007	2007	Internet	Chinese Internet Addiction Inventory (CIAI)	9 (29.03)	8 (25.81)	2 (6.45)	4 (12.90)	5 (16.13)	2 (6.45)	1 (3.23)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
33	Armstrong et al., 2000	2000	Internet	Internet Related Problem Questionnaire	5 (25.00)	5 (25.00)	1 (5.00)	4 (20.00)	2 (10.00)	2 (10.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (5.00)
34	Rotunda, et al., 2003	2003	Internet	Internet Use Survey (IUS)	3 (9.68)	13 (41.94)	3 (9.68)	2 (6.45)	1 (3.23)	3 (9.68)	1 (3.23)	2 (6.45)	3 (9.68)	0 (0.00)	2 (6.45)	0 (0.00)	0 (0.00)	0 (0.00)
35	Lemmens et al., 2009	2009	Video game	Game Addiction Scale for Adolescents	7 (33.33)	7 (33.33)	3 (14.29)	1 (4.76)	2 (9.52)	1 (4.76)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)

36	Rehbein et al., 2010	2010	Video game	Video Game Dependency Scale (KFNC-SAS II)	5 (35.71)	2 (14.29)	2 (14.29)	3 (21.43)	0 (0.00)	1 (7.14)	0 (0.00)	0 (0.00)	1 (7.14)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
37	van Rooij et al., 2012	2012	Video game	Video Game Addiction Test (VAT)	4 (28.57)	4 (28.57)	1 (7.14)	2 (14.29)	1 (7.14)	2 (14.29)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
38	Gentile, 2009	2009	Video game	Pathological-gaming scale	2 (18.18)	6 (54.55)	1 (9.09)	1 (9.09)	0 (0.00)	1 (9.09)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
39	Yilmaz et al., 2017	2017	Video game	Video Game Addiction Scale for Children (VASC)	6 (28.57)	4 (19.05)	0 (0.00)	3 (14.29)	0 (0.00)	1 (4.76)	0 (0.00)	0 (0.00)	4 (19.05)	3 (14.29)	0 (0.00)	0 (0.00)	0 (0.00)
40	Jap et al., 2013	2013	Video game	Indonesien Online Game Addiction Scale	1 (14.29)	3 (42.86)	1 (14.29)	1 (14.29)	0 (0.00)	1 (14.29)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
41	Forrest et al., 2016	2016	Video game	Maladaptive Cognition in Video Gaming Scale	9 (50.00)	2 (11.11)	1 (5.56)	4 (22.22)	0 (0.00)	2 (11.11)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
42	Pearcy et al., 2016	2016	Video game	Personal Disorder Evaluation (PIE-9)	2 (22.22)	3 (33.33)	1 (11.11)	0 (0.00)	1 (11.11)	1 (11.11)	0 (0.00)	0 (0.00)	1 (11.11)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
43	Vadlin et al., 2015	2015	Video game	Gaming Addiction Identification Test (GAIT)	8 (53.33)	4 (26.67)	1 (6.67)	1 (6.67)	0 (0.00)	1 (6.67)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
44	Pontes et al., 2014	2014	Video game	Internet Gaming Disorder (IGD-20)	6 (30.00)	5 (25.00)	3 (15)	2 (10.00)	3 (15.00)	1 (5.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
45	Demetrovics et al., 2012	2012	Video game	Problematic Online Gaming Questionnaire (POGQ)	5 (27.78)	4 (22.22)	4 (22.22)	2 (11.11)	0 (0.00)	3 (16.67)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
46	Charlton and Danforth, 2007	2007	Video game	Addiction – Engagement questionnaire	9 (31.03)	8 (27.59)	2 (6.90)	5 (17.24)	1 (3.45)	1 (3.45)	0 (0.00)	0 (0.00)	0 (0.00)	2 (6.90)	0 (0.00)	1 (3.45)	0 (0.00)
47	Elphinston and Noller, 2011	2011	SNS	Facebook Intrusion Scale	3 (37.50)	2 (25.00)	1 (12.50)	1 (12.50)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (12.50)	0 (0.00)	0 (0.00)	0 (0.00)
48	Andreassen et al., 2012	2012	SNS	Bergen Facebook Addiction Scale (BFAS)	2 (33.33)	1 (16.67)	1 (16.67)	1 (16.67)	1 (16.67)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
49	Koc and Gulyagci, 2013	2013	SNS	Facebook Addiction Scale (FAS)	1 (12.50)	4 (50.00)	1 (12.50)	1 (12.50)	1 (12.50)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)

50	Liu and Ma, 2018	SNS	Chinese Social Media Scale	3 (10.71)	5 (17.86)	6 (21.43)	0 (0.00)	5 (17.86)	0 (0.00)	6 (21.43)	3 (10.71)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
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Note: Extracted records representing dimensional distribution for each scale n (%). The sum of percent of each row is 100%.

Appendix 2

Paper, on which extracted Scales were based on

ID	Reference
51	Kim et al. 2008a
52	Yen et al. 2009
53	Chen et al. 2003
54	Tejeiro Salguero and Morán, 2002
55	Widyanto and McMurrin, 2004
56	Toda et al., 2004
57	Kwon et al., 2013b
58	Mok et al., 2014
59	Ching et al. 2015
60	Toda et al., 2015
61	Bianchi and Phillips, 2005
62	Cloninger et al., 1994
63	Brown, 1993
64	Brown, 1997
65	Horvath, 2004
66	Leung, 2008
67	DeVellis, 2016
68	Tavşancıl, 2006
69	Tezbaşaran, 1997
70	Bock et al., 2016b
71	National Information Society Agency, 2011
72	Meerkerk et al., 2003
73	Haagsma et al., 2013
74	Morahan-Martin and Schumacher, 2000
75	Pratarelli et al., 1999
76	Scherer, 1997
77	Shapira et al., 2003
78	Ko et al., 2005b
79	Ko et al., 2005a
80	Tao et al., 2010
81	Young, 1996

82	DRM Study Group, 2016
83	Weinstein and Lejoyeux, 2010
84	Ko et al., 2009
85	Lesieur and Blume, 1987
86	Brenner, 1997
87	Farmer and Sundberg, 1986
88	Hahn and Jerusalem, 2001
89	WHO, 1992
90	Gaetan et al., 2014
91	Khazaal et al., 2016
92	Mak et al., 2014
93	Lemos et al., 2016
94	Pontes and Griffiths, 2015
95	Spekman et al., 2013
96	Griffiths, 1996
97	Kim et al., 2008b
98	Caplan, 2010
99	Davis, 2001
100	Delfabbro and King, 2015
101	King and Delfabbro, 2014
102	Bush et al., 1998
103	Griffiths, 2005
104	Buchanan, 2001
105	Buchanan and Smith, 1999
106	Walsh et al., 2011
107	Griffiths, 2000
108	Hormes et al., 2014
109	Caplan, 2003
110	Casale et al., 2013
111	Chung, 2013
112	Fioravanti et al., 2012
113	Yu et al., 2017
114	Griffiths, 1999
115	Koo, 2009
116	Fargues et al., 2009

117	De-Sola et al., 2017b
118	Charlton, 2002
119	APA, 2013 (Criteria for behavioural addiction)
120	APA, 1994 (Substance use disorder)
121	APA, 2013 (Pathological gambling)
122	APA, 2013 (IGD)
123	APA, 1994 (Personality disorder)
124	APA, 2000 (Substance use disorder)
125	APA, 1994 (Pathological gambling)
126	APA, 2013 (Substance use disorder)
127	APA, 2000 (Pathological gambling)

Appendix 3

Extracted Scales mapped to Scale based on

ID Extracted Scales	ID Mapped Scales
1	51
2	50;52
3	51
4	NA
5	54;55;126
6	1;2;3;22;56;57;58;59;60
7	127
8	21
9	62
10	63;64
11	21;61;65
12	61;66;67;68;69;115
13	127
14	20
15	61
16	70
17	1;51;71
18	13;19;20;26;116;117;119

19	13
20	NA
21	125
22	NA
23	72;114;120;125
24	22;33;73;74;75;76
25	121;126
26	125
27	122
28	22
29	21;77;78;79;80;124;127
30	81;82;83;84
31	21;85
32	22;53
33	86;120
34	87;120;123;125
35	121
36	88;89
37	23
38	121
39	35;44;90;91;92;93;94;95;126

40	35;45;96;97;127
41	98;99;100;101
42	122
43	45;102;103;121
44	103;122
45	22
46	104;105;118
47	64;106
48	63;103;127
49	22;74
50	21;83;107;109;110;111;112;113

Note: NA means that the extracted scale
was not based on another scale.

SELBSTSTÄNDIGKEITSERKLÄRUNG

Hiermit versichere ich, dass ich die vorliegende Arbeit ohne Hilfe Dritter und ohne Zuhilfenahme anderer als der angegebenen Quellen und Hilfsmittel angefertigt habe. Die den benutzten Quellen wörtlich oder inhaltlich entnommenen Stellen sind als solche kenntlich gemacht. Diese Arbeit hat in gleicher oder ähnlicher Form noch keiner Prüfungsbehörde vorgelegen.

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