



AKADÉMIAI KIADÓ

The relationship between adolescent emotion dysregulation and problematic technology use: Systematic review of the empirical literature

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REVIEW ARTICLE



ABSTRACT

Background and aims: We aimed to systematically identify, evaluate and summarize the research on adolescent emotion dysregulation and problematic technology use. We critically appraise strengths and limitations and provide recommendations for future research. *Methods:* We followed the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) and conducted a systematic review of published original reports on adolescent emotion dysregulation and problematic technology use published until March 1, 2022. A thorough search preceded the selection of studies matching prespecified criteria. Strengths and limitations of selected studies, regarding design and reporting, were identified based on current best practices. *Results:* 39 studies met inclusion criteria. All of these studies provided on the relationship between adolescent emotion dysregulation and problematic technology use severity based on self-report data. *Discussion:* There was a positive correlation between adolescent emotion dysregulation and the severity of problematic technology use. Beyond this, other variables (such as anxiety, depression, self-esteem, etc.) were also closely related to emotion dysregulation and problematic technology use. Such studies are of importance to better understand cause-effect relations regarding both variables.

KEYWORDS

emotion dysregulation, adolescent, problematic technology use

INTRODUCTION

Emotion regulation refers to the psychological processes whereby individuals influence which emotions they have, when they have them, and how they experience and express these emotions (Carl, Soskin, Kerns, & Barlow, 2013; Gross, 1998). It is very important to regulate emotions well in daily life, especially for adolescents. Adolescents are often in a state of emotional “over-arousal” (Michel, Heuzey, Purper-Ouakil, & Mouren-Simeoni, 2001) and can be considered more emotional compared to adults (Montag & Panksepp, 2017). This may be because the hippocampus and amygdala of the human brain are still developing (to be discussed to be of high relevance to the regulation of emotions) (Xu, Zhou, Luo, Luo, & Qin, 2021). Despite humans undergoing neurodevelopment throughout their lives, individual

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differences in emotional regulation abilities already exist at a young age, and some children and adolescents show tendencies towards emotion dysregulation (Sanchis-Sanchis, 2020). This may also be due to their comparably (to adults) lower level of good emotional regulation. The limited effect of adolescents' internal regulation strategies and the many pressures and challenges they face, the reduced dependence on family support may lead to the emergence of this phenomenon (Young, Sandman, & Craske, 2019).

In emotion dysregulation (ED) research, ED has been conceptualized as difficulties in monitoring, evaluating, and adjusting emotional responses (Gross, 2008; Gross & Jazaieri, 2014). And in the study by Velotti, Rogier, Beomonte Zobel, and Billieux (2021), emotion dysregulation is used to refer to emotion dysregulation failures related to these deficits or regulation strategies. In a recent study by Beauchaine (2015a), emotion dysregulation was defined as a pattern of emotional experience and/or expression that interferes with appropriate goal-directed behavior. For the present research, the definition of Beauchaine (2015a) is reasonable, because this definition emphasizes the core content of emotion dysregulation. The purpose of emotion regulation among others is to express emotions more appropriately, and emotion dysregulation could be defined as the inability to properly regulate emotions and hold a tight grip upon showing strong emotional responses in inappropriate situations. Adolescent emotion dysregulation has been confirmed to be related to many kinds of problematic behaviors (Bjureberg et al., 2018; Lemaigre & Taylor, 2019), especially addictive behaviors with technology use (Casale, Caplan, & Fioravanti, 2016; Evren, Evren, Dalbudak, Topcu, & Kutlu, 2018; Montag & Elhai, 2020; Pettorruso et al., 2020; Sertbaş, Çutuk, Soyer, Çutuk, & Aydoğan, 2020).

Problematic technology use (PTU, i.e., Internet, video-games, and smartphones) refers to excessive use of technology as a critical part of life, going along with several consequences such as functional impairment (e.g., academic and social deficits), and is accompanied by emotional and behavioral problems (Amendola, Spensieri, Biuso, & Cerutti, 2020). Problematic technology use can be divided into two categories: tool-based (Internet, Smartphone) versus content-based (videogame, social media). We should emphasize that there is still controversy about how to properly name and categorize these phenomena (Elhai, Yang, & Levine, 2021; Montag, Wegmann, Sariyska, Demetrovics, & Brand, 2021). Of note, researchers have consistently confirmed the relationship between adolescent problematic technology use and a variety of behavioral problems (Huang & Leung, 2009; Kafali et al., 2020; Karma et al., 2019) and emotional disorders (Hussain, Wegmann, Yang, & Montag, 2020; Peterka-Bonetta, Sindermann, Sha, Zhou, & Montag, 2019; Zhang, Ding, & Wang, 2020).

Emotional disorders are psychopathologies characterized by “frequent experiences of strong negative emotions, aversion to negative emotions, and efforts to avoid these emotional experiences” (Bentley, Cassiello-Robbins, Vittorio, Sauer-Zavala, & Barlow, 2015). Both the I-PACE (Interaction of Person-Affect-Cognition-Execution) theoretical model

(Brand et al., 2016, 2019) and CIUT (Compensatory Internet Use Theory, Kardefelt-Winther, 2014) propose that emotional disorders are closely related to problematic technology use. Specifically this should be the case for individuals' use of Internet-related technologies, because by using such technology individuals can alleviate negative emotions, which may cause them to overuse the Internet and thus lead to problematic technology use. The more negative emotions individuals experienced, the higher their problematic technology use severity can be (Bonnaire & Baptista, 2019; Richardson, Hussain, & Griffiths, 2018; Yuan, Elhai, & Hall, 2020). It has been shown that emotion dysregulation can predict the occurrence of emotional disorders (Hofmann, Sawyer, Fang, & Asnaani, 2012; McLaughlin, Hatzenbuehler, Mennin, & Nolen-Hoeksema, 2011), and both emotion dysregulation and emotional disorders are strongly related to problematic technology use. These pieces of evidence suggest that it is necessary to clarify the relationship between emotion dysregulation and problematic technology use, especially for adolescents. The main purpose of this review is to systematically collect evidence about the relationship between adolescent emotion dysregulation and their problematic technology use. Finally, based on these existing research results, future research directions are proposed.

METHOD

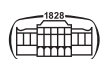
We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for our review (Moher, Liberati, Tetzlaff, & Altman, 2010). Our PRISMA checklist is also depicted in Fig. 1.

Search strategy

We used the Tianjin Normal University electronic library to simultaneously search electronic databases in CNKI, Web of Science (including Science Citation Index Expanded, Social Sciences Citation Index, Current Chemical Reactions, Index Chemicus, KCI-Korean Journal Database, MEDLINE, Russian Science Citation Index, and SciELO Citation Index) and Proquest (including PsycINFO and other psychological databases). Our comprehensive literature search of studies published until March 1, 2022, was used. The final search strategy was (child* OR adolescent* OR teen* OR juvenile* OR young* OR youth*) AND (problematic technology use OR addiction OR Internet OR Internet Gaming Disorder OR smartphone overuse OR online OR cybersex OR social network OR compulsive use OR excessive use OR pathological use OR game OR Computer OR abuse OR Gaming depend* OR virtual addiction) AND (emotion regulation OR emotional disorder OR emotion dysregulation). Additional manual searches were also conducted.

Study selection

According to the literature on adolescents, we define their age-range as 10–24 years old (Pozuelo, Desborough, Stein, &



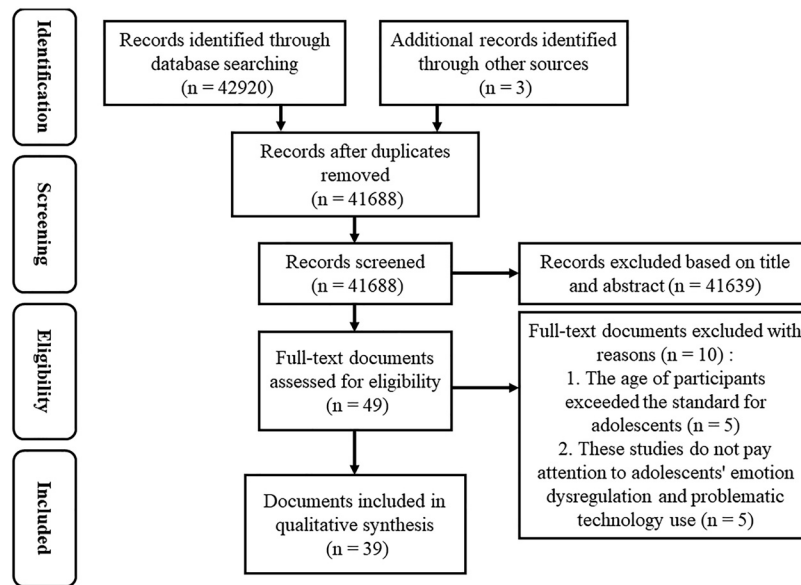


Fig. 1. PRISMA flow diagram of study selection

Cipriani, 2021; Sawyer, Azzopardi, Wickremarathne, & Patton, 2018). Studies were eligible for inclusion if they tested a relationship between adolescent emotion dysregulation and some type of problematic technology use measured, and all studies adhered to the foregoing conceptualizations. To identify as many studies as possible in our initial search, no restrictions were placed on academic discipline, publication date or status, language, country, participant demographics, or research design. All abstracts were reviewed and discussed when disagreement occurred as to whether to obtain the document's full text. The authors then reviewed full-text documents to determine if each document was relevant and if so, to extract findings of interest.

Study inclusion criteria

The studies included in this review met the following criteria: (1) published in a peer-reviewed journal; (2) participants are adolescents; (3) investigated at least adolescent emotion dysregulation and problematic technology use; (4) the research method is empirical.

RESULTS

A total of 39 articles met our eligibility criteria and were included in this review. Detailed information is available in Fig. 1, the PRISMA Flow Chart, and Table 1, with summaries and classifications of all articles. All articles represent empirical studies and are consistent with our broad search. All of the included studies were related to adolescent emotion dysregulation and their problematic technology use. In addition, we observed in the literature that also other variables play a role regarding the relationship between adolescent emotion dysregulation and their problematic

technology use (such as emotional disorders, behavioral problems). The exact measures are described in Table 1 of the literature.

A total of 39 articles included in the present systematic review originated mainly in Turkey (10), Italy (6), China (5), USA (5), Spain (3), Australia (2), Germany (2), South Korea (1), Iran (1), the Republic of Korea (1), France (1), Canada (1) and Poland (1). All studies discussed the relationship between emotion dysregulation and their problematic technology use using a self-report method, using correlation analysis, or variance analysis.

The relationship between adolescent ED and PTU

Table 1 describes the main content of all 39 studies. Twenty-six of the studies indicated that there was a significant positive correlation between the degree of adolescent emotion dysregulation and the severity of problematic technology use. Eight of these articles indicated that the severity of emotion dysregulation in problematic technology users was significantly higher than in non-problematic technology users. In addition to the aforementioned, there are some further notable findings in the literature: Chun's study (2016) indicated that the direct effect of emotion dysregulation and problematic technology use severity was not significant, but the indirect from emotion regulation to problematic technology use mediated by a third variable was significant. Liese, Kim, and Hodgins (2020) observed that emotion dysregulation mediated the relationship between anxious but not avoidant attachment and *Internet Gaming Disorder*. Karaer and Akdemir's study (2019) showed that Difficulties in Emotion Regulation Scale (DERS) scores in the adolescent "Internet Addiction" group were significantly higher than those in the control group. Estévez et al. (2020) indicated the highest emotion dysregulation scores and the highest scores for difficulties in coping

Table 1. Characteristics of included studies

Author (year), Country	Sample	Total N (% male participants)	Mean age (SD), Age range	Emotion Dysregulation measure	Problematic Technology Use measure	Associations between emotion dysregulation and PTU - r (* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$)
Austermann et al., (2021), Germany	Ordinary People	961 (53.5%)	13.36 (SD = 2.36), 10–17	Difficulties in Emotion Regulation Scale	Social Media Disorder Scale for Parents (SMDSP)	0.35***
Amendola et al., (2019), Italy	Students	280 (51.1%)	13.31 (SD = 2.33), 11–18	Difficulties in Emotion Regulation Scale	Internet Addiction Test (IAT) Video Game Dependency Scale (CSAS) Brief Multicultural Version of the Test of Mobile Phone Dependence (TMDbrief)	CSAS 0.372***; IAT 0.504***; TMDbrief 0.424***
Anita et al., (2014), USA	Students	272 (47.06%)	16.81 (SD = 0.39), 16–17	Difficulties in Emotion Regulation Scale	Hungarian Problematic Internet Use Questionnaire	
Casale et al., (2016), Italy	Students	293 (48.4%)	21.73 (SD = 2.17), none	Difficulties in Emotion Regulation Scale	Generalized Problematic Internet Use Scale 2	0.342**
Chang et al., (2020), China	Adolescent outpatients	IA [no 49 (77.6%)] [yes 52 (59.6%)]	None, 7–18		Chen Internet Addiction Scale	
Chun (2016), South Korea	Students	351 (60.6%)	13.5 (SD = 0.84), none	Difficulties in Emotion Regulation Scale	Korean Internet Addiction Proneness Scale	
Coco et al., (2020), Italy	Ordinary People	242 (45%)	14.16 (SD = 0.99), 12–16	Difficulties in Emotion Regulation Scale-Short Form	Smartphone Addiction Scale-short version	0.392**
Domoff et al., (2020), USA	Ordinary People	111 (44.1%)	14.57 (SD = 1.08), none	Difficulties in Emotion Regulation Scale	Addictive Patterns of Use (APU) Scale	0.29 **
Donald et al., (2020), Australia	Students	2809 (49.7%)	13.7 (SD = 0.45), none	Difficulties in emotion regulation scale	Compulsive Internet Use scale	
Estévez et al., (2017), Spain	Students	472 (48.4%)	15.6 (SD = 1.33), 13–21	Difficulties in Emotion Regulation Scale	Video Game-related Experience Questionnaire	0.43**
Estévez et al., (2020), Spain	Adolescent outpatients and Ordinary People	[outpatients 31 (90.3%)] [ordinary 250 (50.4%)]	[outpatients 20.8 (SD = 2.4)] [ordinary 18.2 (SD = 4.9)], none	Difficulties in Emotion Regulation Scale	MULTICAGE-ICT	
Evren et al., (2018), Turkey	Ordinary People	Probable ADHD [Absent 820 (40.49%)] [Present 190 (37.89%)]	Probable ADHD [Absent 21.89 (SD = 3.54)] [Present 21.67 (SD = 2.64)], none	Difficulties in Emotion Regulation Scale	Young's Internet Addiction Test - Short Form	
Evren et al., (2019), Turkey	Ordinary People	IA risk [Low 806 (33%)] [High 114 (28.95%)]	IA risk [Low 22.19 (SD = 4.26)] [High 21.69 (SD = 2.21)], none	Difficulties in Emotion Regulation Scale	Internet Addiction Test	
Faghani et al., (2019), Iran	Students	300 (40%)	[20.13 (SD = 1.555) men] [20.27 (SD = 1.467) women], none	Difficulties in Emotion Regulation Scale	Single-factor Internet abusive use questionnaire (IAUQ)	0.475**

(continued)





Table 1. Continued

Author (year), Country	Sample	Total N (% male participants)	Mean age (SD), Age range	Emotion Dysregulation measure	Problematic Technology Use measure	Associations between emotion dysregulation and PTU - <i>r</i> (* <i>P</i> < 0.05, ** <i>P</i> < 0.01, *** <i>P</i> < 0.001)
Giordano et al. (2020), Italy	Ordinary People	252 (42.5%)	13.54 (SD = 0.7), 12–17	Difficulties in Emotion Regulation Scale-Short Form	the 24-item Italian version of the Smartphone Addiction Inventory	0.438**
Gül et al. (2019), Turkey	Adolescent outpatients	150 (41.3%)	15.4 (SD = 1.4), 12–18	Difficulties in Emotion Regulation Scale	Problematic Mobile Phone Usage Scale	DERS-C(0.34**), DERS-NA(0.22*), DERS-S(0.56**), DERS-I(0.60**), DERS-G(0.50**) 0.33***
Günaydın et al., (2021), Turkey	Students	5916 (50.9%)	None	Difficulties in Emotion Regulation Scale	Problematic Internet Use Scale-Adolescent Form	
Gutiérrez et al., (2014), Spain	Ordinary People	1312 (57.4%)	17.28 (SD = 2.7), 12–30	Difficulties in Emotion Regulation Scale	MULTICAGE CAD-4	
Hormes et al., (2014), USA	Students	253 (37.2%)	19.68 (2.85), none	Difficulties in Emotion Regulation Scale	Young Internet Addiction Test	
Kafali et al. (2020), Turkey	Patients in hospital	123 (44.72%)	[OB 15 (SD = 1.9)] [HC 15.5 (SD = 1.8)], none	Difficulties in Emotion Regulation Scale	Internet Addiction Test	0.451**
Karaer and Akdemir (2019), Turkey	Adolescent outpatients	160 (34.6%)	[IA 15.4 (SD = 1.3)] [15.4 (SD = 1.1)], none	Difficulties in Emotion Regulation Scale	Young's Internet Addiction Test Young's Internet addiction diagnostic criteria	
Kim and Chun (2016), the Republic of Korea	Students	355 (60.6%)	None, 12–16	Difficulties in Emotion Regulation Scale	K-scale	0.34**
Liese et al., (2020), USA	Students	689 (34.8%)	18.99 (SD = 1.29), 18–31	Difficulties in Emotion Regulation Scale	Potentially addictive behaviors	
Love et al., (2022), USA	Students	257 (7.9%)	20.18 (SD = 1.04), 18–29	Difficulties in Emotion Regulation Scale	Internet Addiction Test	0.49**
Paschke, Austermann, and Thomasius (2021), Germany	Ordinary People	800 (58.6%)	12.99 (SD = 2.37), 10–17	short form of the Difficulties in Emotion Regulation Scale	DSM-5 the Internet Gaming Disorder Scale parental judgment version (PIGDS)	
Pettorruo et al., (2020), Italy	Ordinary People	428 (64.5%)	22.3 (SD = 3.6), 18–29	Difficulties in Emotion Regulation Scale	Internet Addiction Diagnostic Questionnaire	

(continued)

Table 1. Continued

Author (year), Country	Sample	Total N (% male participants)	Mean age (SD), Age range	Emotion Dysregulation measure	Problematic Technology Use measure	Associations between emotion dysregulation and PTU - r (* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$)
Mancinelli et al., (2021), Italy	Adolescent outpatients	78 (26.9%)	14.24 (SD = 1.56), 14–19	Difficulties in Emotion Regulation Scale	Smartphone Addiction inventory	0.319**
Mo et al. (2018), China	Students	862 (54.4%)	12.53 (SD = 0.84), 12–15	Emotion Regulation Scale	26-item Chen Internet Addiction Scale	0.39**
Müller and Bonnaire (2020), France	Ordinary People and Students	201 (63.18%)	19.02 (SD = 4.20), 12–25	Difficulties in Emotion Regulation Scale	short version of the GAS	
Marchica et al., (2020), Canada	Students	1536 (45.25%)	20.45, 18–27	Difficulties in Emotion Regulation Scale	Internet Gaming Disorder Scale—Short-Form	
Qi (2019), China	Students	870 (57.13%)	13.61 (SD = 0.89), 12–16	Emotional Reactivity subscale of the Differentiation of Self Inventory	Problematic Internet Use Scale	0.36***
Tsai, Lu, Hsiao, Hu, and Yen (2020), China	Students	500 (47.6%)	22.1 (SD = 1.8), 20–30	Difficulties in Emotion Regulation Scale	Chen Internet Addiction Scale	
Starosta et al., (2021), Poland	Students	645 (15%)	20 (SD = 3.04), 18–30	Difficulties in Emotion Regulation Scale	Questionnaire of Excessive Binge-watching	
Sertbaş et al., (2020), Turkey	Students	297 (49%)	20.88 (SD = 1.82), 18–36	Difficulties in Emotional Regulation Scale	Chinese Internet Addiction Scale	0.57**
Uçur & Donmez (2021), Turkey	Ordinary People	1067 (54.3%)	14.7 (SD = 1.8), 12–18	Difficulties in emotion regulation scale	Game addiction scale (short form)	0.234*
Wang and Qi (2017), China	Students	828 (57.61%)	13.58, 11–16	Emotional Reactivity subscale of the Differentiation of Self inventory	Problematic Internet Use Scale	0.37***
Yorulmaz et al. (2020), Turkey	Students	400 (45.5%)	21.24 (SD = 1.73), 18–25	Difficulties in Emotion Regulation Scale	Internet Addiction Test	0.47*
Yu et al. (2013), Australia	Students	525 (70.1%)	15.33 (SD = 0.47), none	Difficulties in Emotion Regulation Scale	The 20-item IAT	
Yıldız (2017), Turkey	Students	262 (49.6%)	16.57 (SD = 1.13), 14–19	Emotion Regulation Scale for Adolescents	Young Internet Addiction Test-Brief Form and Smartphone Addiction Scale – Brief Form	0.53** (EDER and Internet Addiction) 0.37** (EDER and Smartphone addiction) 0.47** (IDER and Internet Addiction) 0.32** (IDER and Smartphone addiction)



strategies (one of the subscales of DERS) were associated with the comorbid presence of gambling disorder and other problematic technology use. And the study by [Chang, Chang, Cheng, and Tzang \(2020\)](#) noted that emotion dysregulation is frequently seen in severely gaming-addicted ADHD (Attention Deficit Hyperactivity Disorder) youth. The longitudinal results of [Donald et al. \(2020\)](#) point out that teaching adolescents general emotion regulation skills may not be as effective in reducing compulsive Internet use as more direct approaches of limiting the use of the internet. [Starosta, Izydorczyk, Sitnik-Warchulska, and Lizinczyk \(2021\)](#) identified a lack of premeditation, impulse control difficulties, and escapist motivation as significant predictors of *problematic binge-watching behaviors*.

Of note, the reviewed studies relied on different instruments to measure adolescent differences in propensities towards emotion dysregulation and problematic technology use. Although measurement tools differ across studies, we can classify PTUs into generalized PTUs (as captured via terms such as Internet, Smartphone, etc.) and content-based PTUs (Video game, Social Network, etc.). This is consistent with generalized problematic Internet use versus specific problematic Internet use in the theoretical model proposed by [Davis \(2001\)](#). It has also been validated in recent empirical studies ([Montag et al., 2015](#)).

The relationship between adolescent ED and generalized PTUs

Among the included articles, there was a significant positive correlation between adolescents' DERS total scores and their severity of *problematic smartphone use* ([Amendola, Spensieri, Guidetti, & Cerutti, 2019](#); [Coco et al., 2020](#); [Domoff, Sutherland, Yokum, & Gearhardt, 2020](#); [Giordano, Coco, Salemo, & Biasi, 2020](#); [Mancinelli, Sharka, Lai, Sgaravatti, & Salcuni, 2021](#)) and *problematic Internet use* ([Amendola et al., 2019](#); [Anita, Andrés, & Bernadette, 2014](#); [Casale et al., 2016](#); [Estévez, Jáuregui, Sánchez-Marcos, López-González, & Griffiths, 2017](#); [Faghani, Akbari, Hasani, & Marino, 2019](#); [Gutiérrez, Fernández, Gonzalvo, & Bilbao, 2014](#); [Günaydin, Arıcı, Kutlu, & Demir, 2021](#); [Kafali et al., 2020](#); [Kim & Chun, 2016](#); [Love, May, Shafer, Fincham, & Cui, 2022](#); [Mo, Chan, Chan, & Lau, 2018](#); [Qi, 2019](#); [Sertbaş et al., 2020](#); [Uçur & Dönmez, 2021](#); [Wang & Qi, 2017](#); [Yorulmaz, Civgin, & Yorulmaz, 2020](#)). The DERS was developed by [Gratz and Roemer \(2004\)](#) to measure emotion dysregulation. When individual differences in ED are assessed via this inventory it includes six subscales: nonacceptance of emotional responses, difficulties engaging in goal-directed behavior, impulse control difficulties, lack of emotional awareness, limited access to emotion regulation strategies, and lack of emotional clarity ([Gratz & Roemer, 2004](#)). [Gül et al. \(2019\)](#) showed that there is a significant positive correlation between adolescent *problematic smartphone use* severity and DERS subscales including clarity, non-acceptance, strategies, impulse, and goals. [Evren et al. \(2018\)](#) argued that adolescent lack of emotional awareness and *problematic Internet use* are closely related. [Yıldız \(2017\)](#) used the Emotion

Regulation Scale for Adolescents (ERSA) ([Phillips & Power, 2007](#)) to measure individual differences in tendencies towards adolescent emotion dysregulation. In this work, it could be observed that adolescent EDER (External-Dysfunctional Emotion Regulation) and IDER (Internal-Dysfunctional Emotion Regulation) were related to higher scores on *problematic Internet use* and *problematic smartphone use*. [Chun \(2016\)](#) points out that although ED did not directly affect *problematic Internet use* alone, it could influence *problematic Internet use* via the self-esteem variable. The results of the [Pettorruso et al. study \(2020\)](#) pointed out that the DERS total score and each subscale score among *problematic Internet users* and high-risk participants were higher than those of non-risk and low-risk individuals.

The relationship between adolescent ED and content-based PTUs

Among the included articles, there was a significant positive correlation between adolescents' DERS total scores and their severity of *Internet Gaming Disorder* ([Amendola et al., 2019](#); [Estévez et al., 2017](#); [Gutiérrez et al., 2014](#); [Paschke et al., 2020](#)) and *problematic social media use* ([Austermann, Thomasius, & Paschke, 2021](#)). [Hormes, Kearns, and Timko \(2014\)](#) found that problematic social media users have a higher degree of emotion dysregulation (lack of awareness and non-acceptance). A study by [Marchica, Mills, Keough, and Derevensky \(2020\)](#) indicated that Internet gaming addicts have higher emotion dysregulation levels (Goals, Impulse, Clarity). A study by [Müller and Bonnaire \(2020\)](#) indicated that Internet gaming addicts have higher emotion dysregulation levels (lack of emotional awareness and clarity). [Karaer and Akdemir \(2019\)](#) found that the total DERS score in the group of "Internet Addicted" individuals was significantly higher than controls. [Evren et al. \(2020\)](#) found that the DERS total scores and subscales of the high risk group of *Internet addiction* were higher than those of the low risk group of Internet addiction (except for awareness). Both studies are again mentioned in the next section.

The role of further variables regarding the association between adolescent ED and PTU

In total, we selected 39 studies for the present systematic review. In these articles, several investigators discussed the role of other variables between emotion dysregulation and problematic technology use. These variables may help to understand the relationship between emotion dysregulation and problematic technology use in adolescents. We therefore briefly describe these studies in this section. We use in this summary always the original wording (regarding the terminology used) from the authors in the original studies.

[Casale et al. \(2016\)](#) indicated that two specific meta-cognitions about Internet use (escapism and controllability) mediate the association between emotion dysregulation and *problematic Internet use*. [Kim and Chun's research \(2016\)](#) showed that both closed communication (a kind of problematic communication) between parents and children and

adolescent depression-anxiety are significantly positively correlated with their emotion dysregulation and problematic Internet use tendencies, and the relationship between closed communication and adolescent *problematic Internet use* severity was partially mediated by both depression-anxiety and emotion dysregulation. Chun's work (2016) indicated that emotion dysregulation was related to *problematic Internet use* severity through low self-esteem as a mediating variable. Wang and Qi (2017) found that child forgiveness of others moderated the indirect relation of harsh parenting to adolescent *problematic Internet use* via child emotion dysregulation. And there has been a moderating role of psychological flexibility in explaining the correlation between difficulties in emotion regulation and problematic internet use (Yorulmaz et al., 2020).

DISCUSSION

The current systematic review of 39 studies including a total of $N = 27,169$ participants supported a clear association between emotion dysregulation and problematic technology use severity in adolescents. This finding suggests that emotion dysregulation and problematic technology use are closely related in adolescents, and against the background of the culturally different groups investigated in the studies, this effect may have some cross-cultural consistency. Moreover, the results of this study are also consistent with those by Gioia, Rega, and Boursier (2021), who carried out a literature review on the relationship between problematic Internet use and emotion dysregulation in all ages. It is important to note that the age range of the participants in the selected literature for the present study was 10–24 (adolescents), and although a few participants in some studies were not in this range, the vast majority of participants were. Please note the age of the participants in the present study (the maximum age was 61 years in the study by Gioia et al. (2021)) and the type of problematic behavior investigated in our study was different than in the study by Gioia et al. (2021). Although our literature review and the one by Gioia et al. (2021) differ to some extent, both works come to the conclusion that the association between emotional dysregulation and problematic technology use is of importance. Compared with the study of Gioia et al. (2021), the current study found that in adolescents, emotion dysregulation is closely related not only to problematic Internet use, but also to specific problematic technology use such as Internet Gaming Disorder, problematic social media use, and problematic smartphone use.

In addition, we also observed that adolescents with emotion dysregulation and problematic technology use often report further behavioral problems or higher levels of negative mood symptoms. Of these, the most closely related variables were higher propensity towards depression and anxiety severity. In the process of literature retrieval, we discovered many studies reporting close relationships between adolescent problematic technology use severity and

emotional disorder symptoms (Bozkurt, Coskun, Ayaydin, Adak, & Zoroglu, 2013; Fabris, Marengo, Longobardi, & Settanni, 2020; Lee, Shin, Cho, & Shin, 2014; Wartberg et al., 2016), as well as many scientific works presenting evidence for meaningful links between adolescent emotion dysregulation and emotional disorders (Berking & Wupperman, 2012; Dvir, Ford, Hill, & Frazier, 2014). Emotion dysregulation is often associated with emotional disorders and other mental health symptoms (Hofmann et al., 2012). A previous study by Sloan et al. (2017) concluded that difficulties in emotion regulation are central to the development and maintenance of psychopathology and that emotion dysregulation is the common feature across depressive, anxiety, substance use, and eating disorders, and also borderline personality disorder. This is consistent with observations from cross-cultural personality, providing evidence for links between higher self-directedness (linked to higher conscientiousness/self-regulation abilities) and lower tendencies towards *problematic Internet use* (Sariyska et al., 2014). In conclusion, the here reviewed studies suggest that the “adolescent emotion dysregulation – problematic technology use” may also be related to other important variables such as personality dispositions or behavioral problems.

The relationship between adolescent ED and PTU: a theoretical perspective

In line with the here observed association patterns, psychological theories suggest that (adolescent) emotion dysregulation plays an important role in problematic technology use (Brand et al., 2016; Kardefelt-Winther, 2014). According to CIUT (Kardefelt-Winther, 2014), people are motivated to use the Internet when they experience adversity and stress. Drawing inspiration from this theory, problematic technology use can be sometimes regarded as an acceptable coping style or a form of self-healing. We are of the opinion, that being in a state of problematic technology use for a longer period can itself have a negative impact on a person's life (Kardefelt-Winther, 2014). In our context, problematic technology use itself can cause harm to those affected. Of interest for the present work: Negative life situations (such as stress) are closely related to emotion dysregulation and emotional disorders (Cavalli & Cservenka, 2021; Schneider, Long, Arch, & Hankin, 2021). This may explain why adolescent emotion dysregulation is closely related to their problematic technology use, and emotion dysregulation may even be a predictor of adolescent problematic technology use, but this hypothesis needs to be supported by longitudinal research.

The I-PACE model proposes that an Interaction of Person-Affect-Cognition-Execution variables is of relevance to understanding problematic technology use (Brand et al., 2016, 2019). In the P- variable, some characteristics of the individual (such as emotional disorders and emotion dysregulation) affect the individual problematic technology use. Specifically, the individual's emotional maladaptation coping styles and cognitive processing, which led to addictive behaviors. Regarding the A- and C- variables the model

indicates that individual Internet-related cognitive biases and coping styles in many instances can be conceptualized as moderating variables, which may affect the relationship between predisposing factors (person variables) and tendencies towards problematic technology use. The model also states that in other cases, individual differences in coping style and cognitive biases can represent a mediating variable. Thus, almost all studies in this review could be therefore seen as supportive of the I-PACE model's hypotheses.

The relationship between adolescent ED and PTU: distress intolerance and impulsivity

To our knowledge, no study directly explored the relationship between adolescent distress intolerance, emotion dysregulation, and problematic technology use in one single design (in particular not in the 39 reviewed studies), but many studies have revealed at least pairwise relationships in adolescents (Akbari, 2017; Juarascio et al., 2020). But it is worth noting that, emotion dysregulation is usually related to individuals' distress intolerance and impulsivity (Naragon-Gainey, McMahan, & Chacko, 2017), which are closely related to individual differences in predisposition to addictive behaviors (Akbari, 2017; Vinayak & Malhotra, 2017). Distress tolerance is defined as the ability to tolerate emotional distress (Leyro, Zvolensky, & Bernstein, 2010), and it consists of several appraisals of experiencing negative emotions: tolerability, perception of acceptability, attentional interference, and regulation of the emotion. Distress tolerance can influence the specific type of emotion regulation (or dysregulation) strategy used (Simons & Gaher, 2005). Future studies could investigate the role of distress (in) tolerance regarding the relationship between adolescent emotion dysregulation and problematic technology use, which may further elucidate the aforementioned relationship between emotion dysregulation and problematic technology use.

As stated at the beginning of this article, during adolescence, people may exhibit more emotional and impulsive behaviors (Cyders & Smith, 2008). Compared to children or adults, adolescents tend to experience greater emotional volatility (Larson & Richards, 1994), including increases in the rates of rash action, especially when experiencing intense emotions (Arnett, 1992; Luna & Sweeney, 2004; Steinberg, 2004). Of note, similar to distress intolerance, the here reviewed studies (see Table 1) did not discuss the role of impulsivity regarding the association between emotion dysregulation and problematic technology use in adolescents. This said emotion dysregulation includes the concept of impulse control difficulties (Yu, Kim, & Hay, 2013). Impulsivity, which can be also considered as a personality trait of relevance in adolescents, may also have an impact on their emotion dysregulation and problematic technology use tendencies (see P- variable in the I-PACE model).

Strengths and limitations of existing research

The existing research mostly could verify the close association between emotion dysregulation and problematic

technology use by adolescents. Beyond the clear evidence, it should be noted that the methodology of the available research is self-reported, which represents a limitation. In the future, the relationship between these two variables (especially causality) should be better explored, by also using longitudinal approaches or by psychological experiments.

The research subjects included in this review were from countries such as Turkey, Italy, China, and USA, etc., in so far results of these studies illustrate the cross-cultural consistency between emotion dysregulation and problematic technology use of adolescents. Despite this, many areas of the world have not been covered so far and this represents a limitation.

Finally, some of the reviewed literature showed that adolescent emotion dysregulation seems to be closely related to impulsivity and distress intolerance, and problematic technology use is also strongly related to the latter two variables. However, the variables of impulsivity and distress tolerance are still understudied in the realm of the present overarching research topic (ED and PTU), which shows that the internal mechanisms between emotion dysregulation and problematic technology use still need to be further explored. In this context we also mention that the construct of ED has many facets and constructs such as alexithymia and interoceptive awareness would be interesting research avenues.

Future research directions

In conducting the literature search for the present systematic review, we also found some studies investigating the relationship between emotion dysregulation and problematic technology use severity in adults and older adults, hence not adolescents (Blasi et al., 2019; Marino et al., 2019). The findings of these studies are consistent with those investigating adolescents only: Emotion dysregulation is positively correlated with problematic technology use severity. Therefore, the studies taken together suggest that the associations between emotion dysregulation and problematic technology use are stable from adolescence onwards, but again this needs to be supported by longitudinal studies. Beyond this, we believe it is also of high importance to investigate the underlying neurobiology regarding emotion dysregulation and problematic technology use (a topic that did not turn up in the papers of the present systematic review).

However, many studies have shown that emotion dysregulation and problematic technology use are related to PFC (prefrontal cortex) function in adolescents (Ball, Ramsawh, Campbell-Sills, Paulus, & Stein, 2012; Beauchaine, 2015b; Chia-Jui, Lin, Tseng, & Gau, 2020; Li et al., 2015). PFC is closely related to individual inhibitory control function. Adolescence is characterized by reduced PFC activity, which may lead to difficulties in inhibiting impulses, weighing the consequences of decisions, prioritizing, and strategizing among adolescents (Luna & Sweeney, 2004). The implication of the incomplete PFC development and incomplete brain integration is that adolescents' ability to engage in affect-guided planning, inhibit impulses, and



consider consequences before acting, is less consistent than that of adults. It appears to be particularly true that adolescents appear less able to consider consequences, to plan, and to inhibit actions in “hot” situations, that is, in states of heightened emotionality (Luna & Sweeney, 2004; Steinberg, 2004). Indeed, it has been reported that 80% of 11.5- to 15-year-olds exhibited one or more reckless behavior(s) during the preceding month (Arnett, 1992; Moffitt, 1993). These studies indicate that the close relationship between adolescent emotion dysregulation and problematic technology use may be due to the still-developing PFC (and its interaction with other brain regions). Interacting brain areas in the still developing brain being also of relevance for the construct of ED logically could be subcortical brain areas, where emotional urges arise when being confronted with rewarding technology use. For instance, Sherman, Payton, Hernandez, Greenfield, and Dapretto (2016) observed that their study participants being confronted with more compared to fewer Likes as a reaction to their photos responded with higher activity of the reward circuitry of the brain, perhaps better labeled as the SEEKING system (see also Pankseppian Affective Neuroscience Theory, Davis & Montag, 2019). Hence emotional dysregulation patterns are likely not only a result by a dysregulated PFC, but can be characterized by the interplay of strong subcortical emotional signal, being insufficiently downregulated by the PFC (see also Becker & Montag, 2019; Montag, Duke, & Reuter, 2017).

It is also worth noting that in our review, problematic technology use can be divided into generalized technology use and content-based technology use, although emotion dysregulation in adolescents is significantly and positively associated with problematic behavior in both categories. However, due to the different mechanisms of different categories of problematic technology use, potential influences of adolescent emotion dysregulation on their problematic technology use may differ (see also that for instance different social media platforms might elicit different addictive potential, Rozgonjuk, Sindermann, Elhai, and Montag (2021), due to different platform design, Montag, Lachmann, Herrlich, and Zweig (2019)). In sum, it might be worthy to systematically re-investigate associations between ED and PTU in different areas of technology use.

CONCLUSION

This systematic review provides evidence for a positive association between adolescent emotion dysregulation and the severity of problematic technology use (including generalized and content-based technology use). The review also showed that the relationship between these two variables in adolescents seems to be robust, regardless of whether sub-clinical or clinical groups were investigated. In the review of the literature it became apparent, that the simple-sounding correlation is influenced by many variables, including diverse metacognitions or psychological flexibility. However, despite the close correlation between ED and PTU, Donald, Ciarrochi, and Sahdra (2020) considered that teaching

adolescents general emotion regulation skills may not be as effective in reducing problematic Internet use as more direct approaches of limiting the use of the internet. Therefore, improving ED alone may not be sufficient to reduce the severity of their problematic technology use. Perhaps the largest problem of the field is that studies investigating causal mechanisms are scarce until now.

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