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# Online-specific fear of missing out and Internet-use expectancies contribute to symptoms of Internet-communication disorder

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ABSTRACT

Some of the most frequently used online applications are Facebook, WhatsApp, and Twitter. These applications allow individuals to communicate with other users, to share information or pictures, and to stay in contact with friends all over the world. However, a growing number of users suffer from negative consequences due to their excessive use of these applications, which can be referred to as Internet-communication disorder. The frequent use and easy access of these applications may also trigger the individual's fear of missing out on content when not accessing these applications. Using a sample of 270 participants, a structural equation model was analyzed to investigate the role of psychopathological symptoms and the fear of missing out on expectancies towards Internet-communication applications in the development of symptoms of an Internet-communication disorder. The results suggest that psychopathological symptoms predict higher fear of missing out on the individual's Internet-communication applications and higher expectancies to use these applications as a helpful tool to escape from negative feelings. These specific cognitions mediate the effect of psychopathological symptoms on Internet-communication disorder. Our results are in line with the theoretical model by Brand et al. (2016) as they show how Internet-related cognitive bias mediates the relationship between a person's core characteristics (e.g., psychopathological symptoms) and Internet-communication disorder. However, further studies should investigate the role of the fear of missing out as a specific predisposition, as well as specific cognition in the online context.

## 1. Introduction

Today, the Internet is used by approximately 3.7 billion people all around the world (InternetWorldStats, 2016). Especially the multitude of Internet-communication applications and social networking sites (SNS) – such as Facebook, WhatsApp, Twitter, and Instagram – as well as the extremely widespread use of smartphones represent opportunities for users. Such applications and platforms allow users to construct an individual profile; to share personal information, photos, and videos; to stay in contact with distant friends; and to stay informed about ongoing events (Amichai-Hamburger & Vinitzky, 2010; Kuss & Griffiths, 2011). Past research indicates different motives and expectancies of Internet-communication users such as meeting social needs, regulating negative emotions, and getting positive feedback from others (Krämer & Winter, 2008; Neubaum & Krämer, 2015). Nadkarni and Hofmann (2012) define the user's need to belong and the need for self-presentation as two basic social needs associated with Facebook use. Other social factors, for example group identification, collective self-esteem, or keeping in touch with friends, seem to be additional motives for participating in SNS (Floros & Siomos, 2013; Kuss & Griffiths, 2011). These socially related motives have a significant effect on repeated Facebook use and could be integrated into the Uses and Gratification Approach by Katz, Blumler, and Gurevich (1974). Furthermore, it has been found that the feeling of being socially isolated, having a higher level of shyness, and having feelings of anxiety in social interactions are positively correlated with spending more time on SNS (Ryan & Xenos, 2011). Accordingly, SNS are frequently used as an environment for shy and/or lonely people to interact with other individuals. In this context, it becomes easier to gratify social needs online than via offline communication (Banjanin, Banjanin, Dimitrijevic, & Pantic, 2015; Bhagat, 2015; Jin, 2013; Steinfield, Ellison, & Lampe, 2008).

Despite the positive opportunities of the above-mentioned services,

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such as SNS or instant messenger, there is a small but significant amount of people who report negative consequences in everyday life, which could be ascribed to their excessive and time-consuming use of the Internet in general or Internet-communication applications in particular (e.g., Griffiths, 2000; Kuss & Griffiths, 2011; Young, Pistner, O'Mara, & Buchanan, 1999). The ubiquity of Internet-based cell phones (smartphones) and other handheld devices is an important factor in this behavior, given that most mobile devices allow people to have permanent access to their online social networks and Internet-communication applications. This constant access makes it possible to communicate/interact with others at any place and any time and can lead to compulsive checking behaviors and excessive engagement (Choi et al., 2015; Montag et al., 2015). Several studies have addressed similarities between substance-use disorders and behavioral addictions, and in particular between substance-use disorder and specific Internet-use disorders, such as Internet-communication disorder (ICD; Brand, Young, & Laier, 2014; Brand, Young, Laier, Wölfling, & Potenza, 2016; Kuss & Griffiths, 2011; Wegmann & Brand, 2016). Similarly to cases of behavioral addiction, individuals suffering from Internet-use disorder show symptoms such as loss of control, relapse, withdrawal, tolerance, preoccupation, neglect of interests and negative consequences in social, academic, and personal life (Griffiths, 2005; Spada, 2014). There is an ongoing debate about the classification of addictive behavior and about the parallels between substance-use disorders and behavioral addictions. Several authors recommend that research about behavioral addictions should be based on theoretical considerations instead of merely investigating the similarities between substance and non-substance-use disorders (Billieux, Schimmenti, Khazaal, Maurage, & Heeren, 2015; Brand et al., 2016). Davis (2001) offered one of the first theoretical models, which differentiates between a generalized and a specific type of Internet-use disorder. He also suggested several predictors of the development and maintenance of Internet-use disorder. Some years later in which new technologies and applications have been delivered, Brand, Young, et al. (2014) and Dong and Potenza (2014) have described two new theoretical models illustrating the mechanisms of Internet-use disorder (Brand, Young, et al., 2014) or Internet-gaming disorder, specifically (Dong & Potenza, 2014). Both models are based on the model by Davis (2001), but integrate several new elements. The recently suggested I-PACE model (I-PACE stands for Interaction of Person-Affect-Cognition-Execution; Brand et al., 2016) is a revision of the model by Brand, Young, et al. (2014) and includes several reflections on the model by Dong and Potenza (2014), as well as recent empirical evidence. The I-PACE model illustrates the different levels of the addiction process and is useful for understanding the development and maintenance of specific Internet-use disorders, including but not limited to Internet-gaming disorder. This model is a process model emphasizing the interaction of several of a person's core characteristics and cognitive, affective, and executive processes. It includes the following key components: The first level of the model describes the person's core characteristics, such as personality factors (e.g., impulsivity and low conscientiousness), social cognitions (e.g., loneliness and perceived lack of social support), psychopathological symptoms (e.g., depression and social anxiety), as well as biopsychological factors. Additionally, specific predispositions and motives for using certain Internet applications play an important role in the onset of the addiction process. The second level of the model includes mediating and moderating variables supporting the user's choice to use a specific Internet application for the purpose of gratification and mood management. These could be coping styles, Internet-related cognitive biases as well as affective and cognitive responses similar to those that have already been reported for other addictive behaviors and substance-related disorders (e.g., cue-reactivity, craving, urge for mood regulation, and attentional bias; Boyer & Dickerson, 2003; Lorenz et al., 2012; Potenza et al., 2003; van Holst, van den Brink, Veltman, & Goudriaan, 2010). The experience of gratification reinforces the individual's mediating and moderating factors and also the user's motives for using the application. Therefore, the individual decides to use the specific application more often, leading to a type of reinforcement circle and resulting in an addictive use of Internet-communication applications (for a more detailed overview of the model and a review of the underlying empirical studies, see Brand et al., 2016).

In the current study, we transferred some of the main hypotheses of the I-PACE model to ICD. A central aspect of this model are Internet-related cognitive biases, such as the expectancies of some users that certain applications are optimal and convenient for gratifying their current needs and desires. Transferring these theoretical ideas to ICD, the repeated and excessive use of SNS and other Internet-communication applications becomes more likely if an individual develops the expectancy that communication applications are the best way to regulate current mood or emotion, to experience pleasure or to distract him or herself from problems in daily life. This has already been shown in previous studies emphasizing that the effect of a person's core characteristics, such as depression and social anxiety, is partially mediated by specific cognitions such as individual's Internet-use expectancies, coping style and self-regulation abilities (Wegmann & Brand, 2016; Wegmann, Stodt, & Brand, 2015). In addition to the effect of specific cognitions, social aspects also play a major role in the development and maintenance of an ICD (Andreassen, 2015; Omar & Subramanian, 2013; Wegmann & Brand, 2016).

Overall, we assume that a person's core characteristics, such as psychopathological symptoms, have an effect on the development and maintenance of an ICD but that this effect is mediated by specific cognitions. This argumentation is directly derived from the I-PACE model. We specify these cognitions as expectancies to experience pleasure or to avoid negative emotions when using Internet-communication applications and as the fear of missing out on something (FoMO; Przybylski, Murayama, DeHaan, & Gladwell, 2013). The current study also discusses FoMO as a bifactorial construct and investigates the role of FoMO in the development and maintenance of an ICD in the light of other variables associated with the I-PACE model by Brand et al. (2016).

## 2. The Fear of Missing Out construct

Fear of Missing Out (FoMO) has been defined as "(…) *a pervasive apprehension that others might be having rewarding experiences from which one is absent* (…)" (Przybylski et al., 2013, p. 1842). The authors presented an operationalized and empirically based picture of the FoMO-phenomenon and developed a self-report questionnaire, which reflects people's fears and worries about being out of touch with experiences across their extended social environment. According to the authors, FoMO was shown to mediate the effects of certain personal characteristics (need deficits, emotional problems) on social media engagement (Przybylski et al., 2013).

The concept of FoMO is relatively new and not yet fully consolidated as a construct, and its role in the development of maladaptive use of Internet-communication applications is not yet fully understood. On an empirical level it has been shown that, on one hand, FoMO mediates the link between psychopathological symptoms and negative consequences of maladaptive use of SNS on mobile devices (Oberst, Wegmann, Stodt, Brand, & Chamarro, 2017), between motivational deficits and social media engagement (Alt, 2015), and between need deficits or emotional problems and social media use (Przybylski et al., 2013). On the other hand, FoMO was also used as a predictor and turned out to predict smartphone addiction (Chotpitayasunondh & Douglas, 2016) and emotional distress (Gil, Del Valle, Oberst, & Chamarro, 2015). On a theoretical level, the construct of FoMO is usually described and assessed in an online context, but neither its definition nor the items of the FoMO scale (except one) refer to online behavior (for example Gil et al., 2015; Przybylski et al., 2013). Therefore, we may assume that FoMO is not a unitary phenomenon, but rather a more complex construct that could reflect a certain personal

predisposition, but also a specific cognition regarding the fear of missing out on something that occurs online. In this sense, FoMO could be considered a dispositional trait in terms of a relatively stable individual characteristic and as the general fear of an individual of missing out on something. However, the possibilities of connecting, sharing, and having rewarding experiences with acquaintances have increased considerably due to the permanent accessibility of social media through mobile devices. Therefore, the frequent use of Internet-communication applications may also trigger or increase an aspect of FoMO that refers specifically to other users' online activities, which develops in the context of Internet communication and is less stable. We therefore use the term state-FoMO – in contrast to the dispositional trait-FoMO – for this type of FoMO considered important in the context of using Internet-communication applications. As these applications provide virtually unlimited possibilities for getting information and making connections, they may increase the possibilities for people subjectively to miss out on others' communications about topics that might be psychologically or practically relevant for them. The constant stream of updates and exchanges in Internet-communication applications makes it more probable for people to miss out on something, which itself increases general trait-FoMO. This, again, may produce more feelings of not being connected online and subsequent engagement to cope with feelings of missing ongoing communications and information about others' activities. In the context of the I-PACE model, state-FoMO represents a specific cognition, which would act as mediator between a person's core characteristics and ICD, whereas trait-FoMO represents one of these predispositions to develop state-FoMO and other Internet-related cognitions.

## 3. Aim of the present study

We aim to contribute to a better understanding of ICD as a specific type of Internet-use disorder. Consistent with the I-PACE model by Brand et al. (2016), we distinguish between predisposing factors and mediating variables. Our assumptions are based on a study by Oberst et al. (2017) that showed FoMO to be a mediator between psychopathological symptoms and negative consequences of mobile device use. Additionally, we argue that FoMO is not a unidimensional but rather a bifactorial construct, one factor measuring general FoMO as a predisposition (trait-FoMO), and another measuring specific online FoMO as a state that is developed during the use of Internet-communication applications (state-FoMO). Likewise, as Internet-use expectancies have shown to be mediators of the relationship between psychopathology and ICD (Brand, Laier, & Young, 2014; Wegmann et al., 2015), such expectancies were also included in the suggested model to illustrate the effect of different specific cognitions.

In the current study we tested the following hypotheses using a structural equation model (see Fig. 1): Based on the theoretical considerations and previous empirical studies with the FoMO construct, psychopathological symptoms and trait-FoMO were hypothesized as predictors of ICD. Psychopathological symptoms were represented on a latent level, and trait-FoMO was represented as a manifest variable. We also assumed that the effect of psychopathological symptoms and trait-FoMO on ICD was mediated by Internet-related cognitive biases, such as Internet-use expectancies and state-FoMO. We hypothesized that state-FoMO would mediate the relationship between the predictors and ICD, as well as between the predictors and Internet-use expectancies.

## 4. Method

### 4.1. Participants and recruitment

A comprehensive online survey in German and Spanish, hosted at University of Duisburg-Essen, was used. Possible respondents were invited to participate via Facebook and local advertisements. After opening the corresponding link, participants were directed either to the German or to the Spanish version. The ads and the first page of the survey stated that participants could take part in a raffle for an Ipad or an Ipad mini tablet. The survey was online March to June 2016, and the final sample consisted of 270 respondents (190 females) from the two countries (153 from Germany and 117 from Spain). The study was approved by the ethics committee of both University of Duisburg-Essen and University Ramon Llull.

The mean age of the participants was 23.43 years ($SD$ = 4.02), and ranged from 17 to 39 years; there was no significant age difference between the two subsamples. All participants were users of Internet-communication applications, with an average use of six to seven days per week and 2.49 h per day. WhatsApp was the most widely used Internet-communication application (97% of all participants), followed by Facebook with 92.3% and Instagram with 51.7%. All other applications (Twitter, Snapchat, etc.) were below 50%. There were neither country nor gender differences with respect to these data.

### 4.2. Instruments

#### 4.2.1. Modified version of the Short Internet Addiction Test for Internet-communication disorder (s-IAT-ICD)

Symptoms of ICD as a specific Internet-use disorder were assessed with the short version of the Internet Addiction Test (s-IAT; Pawlikowski, Altstötter-Gleich, & Brand, 2013), an instrument based on the Internet Addiction Test (Young, 1998). For the purpose of this study, the modified version for ICD was used (Wegmann et al., 2015). This version was also adapted to the Spanish language by two bilingual speakers who reached a consensus. Before beginning, participants were presented a definition of Internet-communication applications, stating that not only social networking sites (e.g., Facebook), but also instant messaging services (e.g., WhatsApp) and microblogs (e.g., Twitter) were subsumed under this category.

The s-IAT-ICD consists of 12 items to be answered on a five-point Likert scale from 1 (= never) to 5 (= very often), arranged in two subscales: loss of control/time management ("How often do you neglect household chores in order to spend more time using online-communication applications?", six items) and craving/social problems ("How often do you intend to spend less time using online-communication applications without success?", six items). Reliabilities were $\alpha$ = 0.832 for loss of control/time management and $\alpha$ = 0.806 for the subscale craving/social problems, both representing the latent dimension of ICD.

#### 4.2.2. Fear of missing out

We assess the bifactorial construct of FoMO on the basis of the original FoMO scale (Przybylski et al., 2013), plus additional items. In a first step, the original ten-item FoMO scale was translated into German. In a second step, six additional items were created in order to assess state-FoMO in the online context (e.g., "I am continuously online in order not to miss out on anything"). All original items were kept or modified for the online context, see for example the original item 5 ("It is important that I understand my friends' 'in jokes'" modified in "It is important that I understand my friends' Internet-slang"), which presented serious translation problems both into German and into Spanish. A five-point Likert scale (1 = totally disagree, 5 = totally agree) was used.

In a preliminary online survey, a total of 155 German-speaking subjects (not included in the present study) replied to this modified 16-item FoMO scale. Using an exploratory factor analysis (EFA) with principal axis factoring, promax rotation, and parallel analysis by Horn (1965) we defined the appropriate number of factors for the 16 items. The procedure resulted in a stable two-factor solution. An EFA with principal axis analysis, promax rotation, and two fixed factors was then conducted to assess the structure of the modified FoMO scale. On the basis of factor loadings, items with insufficient psychometric values were excluded. The EFA concluded with a bifactorial twelve-item version; seven items from the original FoMO scale were kept, five of them

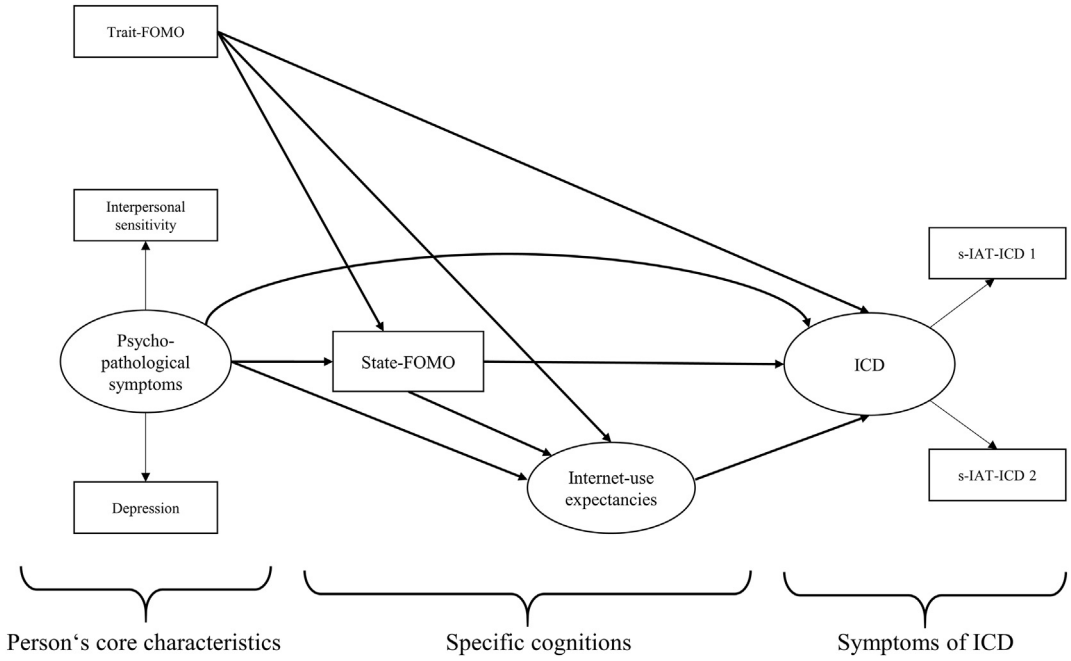



**Fig. 1.** The operationalized model for analyzing the suggested effects including the latent variables of ICD.

**Table 1**
Factor loadings of the two FoMO-factors, means, and standard deviations of the items.

| Item number | Item | Factor | | *M* | *SD* |
|---|---|---|---|---|---|
| | | 1 | 2 | | |
| Factor: trait-FoMO | | | | | |
| O1 | I fear others have more rewarding experiences than me | 0.719 | 0.163 | 2.24 | 1.18 |
| O2 | I fear my friends have more rewarding experiences than me | 0.698 | 0.283 | 2.31 | 1.22 |
| O3 | I get worried when I find out my friends are having fun without me | 0.624 | 0.351 | 2.52 | 1.23 |
| O4 | I get anxious when I don't know what my friends are up to | 0.608 | 0.370 | 1.77 | 1.03 |
| O9 | When I miss out on a planned get-together it bothers me | 0.600 | − 0.023 | 3.30 | 1.23 |
| | Reliability: trait-FoMO $\alpha = 0.749$ | | | | |
| Factor: state-FoMO | | | | | |
| N13 | I am continuously online in order not to miss out on anything | 0.173 | 0.788 | 1.71 | 0.89 |
| N12 | It is important that I have a say about the latest issues in my online social networks (videos, images, posts, etc.) | 0.182 | 0.778 | 1.94 | 1.02 |
| N11 | I fear not to be up-to-date in my social networking sites | 0.268 | 0.717 | 1.70 | 0.88 |
| N14 | I continuously consult my smartphone, in order not to miss out on anything | 0.093 | 0.742 | 2.31 | 1.11 |
| O8 | When I have a good time it is important for me to share the details online (e.g. updating status) | − 0.068 | 0.631 | 1.60 | 0.82 |
| N15 | It is important that I understand the Internet-slang my friends use | 0.232 | 0.508 | 2.23 | 1.22 |
| O10 | When I go on vacations, I continue to keep tabs on what my friends are doing | 0.112 | 0.492 | 2.24 | 1.05 |
| | Reliability: state-FoMO $\alpha = 0.816$ | | | | |

Note: Items in with letter O before the number are original items by Przybylski et al. (2013) in their relative position in the original version. Items with letter N represent items added by us in their relative position in the new (16-item) version.

loading on factor 1, and two loading on factor 2. From the additional six items, five were kept, all loading on factor 2. The items, the factor loadings, and the reliabilities are presented in Table 1. With these two factors, 38.32% of the variance was explained. The items of the first factor represent trait-FoMO. The items of the second factor represent state-FoMO in the online context.

Using the sample of the current study we used confirmatory factor analysis (CFA) to confirm the factorial structure of this newly created twelve-item FoMO scale. The CFA with the current sample was done using MPlus 6 (Muthén & Muthén, 2011). For the evaluation of model fit, standard criteria were applied (Hu & Bentler, 1995, 1999): Standardized root mean square residuals (SRMR) below a value of 0.08 indicate good fit of the data. Comparative fit indices (CFI/TLI) above 0.95 indicate an excellent fit; those above 0.90, a good fit. Root mean square error of approximation (RMSEA) values below 0.08 with significance value below 0.05 indicate acceptable fit. We also used the $\chi^2$-Test to check whether the data differ from the proposed model (Brown, 2006; Weiber & Mühlhaus, 2010).

The CFA confirmed the two-factor solution for the new FoMO scale with good fits (RMSEA = 0.084; CFI = 0.921, TLI = 0.902, SRMR = 0.065, $\chi^2 = 153.91$ with $p < 0.001$). Overall, reliability of both subscales was good (trait-FoMO: $\alpha = 0.821$; state-FoMO: $\alpha = 0.813$).

Finally, a bilingual speaker translated the new scale into Spanish.

#### 4.2.3. *Internet-use expectancies*

The Internet-Use Expectancies Scale (IUES; Brand, Laier, et al., 2014), adapted to the use of Internet-communication applications, was administered (IUES-ICD). The IUES-ICD assesses the expectancies the user has with respect to Internet-communication applications on two scales: One scale reflects positive expectancies (e.g. “I use Internet-communication applications to experience pleasure”; six items). The

other reflects avoidance expectancies (e.g. "I use Internet-communication applications to distract myself from problems", six items). Respondents evaluate all items on a six-point Likert scale ranging from 1 (= completely disagree) to 6 (= totally agree). For the purpose of the current study, a bilingual speaker translated the original German version into Spanish. Before beginning, the participants were given a short description of Internet-communication applications with examples (e.g., Facebook, WhatsApp, Twitter etc.). Reliabilities were $\alpha = 0.825$ for subscale positive expectancies, and $\alpha = 0.675$ for avoidance expectancies. We conclude that the reliability was acceptable given that there are further validation studies including retest reliability (Brand, Laier, et al., 2014; Wegmann et al., 2015).

#### 4.2.4. Psychopathology

To assess psychopathological symptoms, the subscales depression and interpersonal sensitivity of the Brief Symptom Inventory (Boulet & Boss, 1991; Derogatis, 1993) were used in its German and Spanish adaptations, respectively. The depression scale consists of six items assessing depressive symptoms during the last seven days, and the interpersonal sensitivity subscale consists of four items assessing symptoms of social anxiety and interpersonal sensitivity (also within the last seven days). Answers have to be given on a five-point Likert scale ranging from 0 (= not at all) to 4 (= extremely). In our sample, internal consistency of the depression subscale was $\alpha = 0.871$, and of the interpersonal sensitivity subscale was $\alpha = 0.783$. Both subscales represented the latent dimension of psychopathological symptoms as a predictor.

### 4.3. Statistical analyses

Statistical analyses were carried out in SPSS 24.0 for Windows (IBM SPSS statistics). Pearson correlations were calculated by testing the bivariate correlations between the variables. Variance analyses were used to test differences between the groups. The structural equation model analyses were computed with Mplus 6 (Muthén & Muthén, 2011). To evaluate the model fit, the same fit indices as already described in the description of the "Fear of Missing Out" questionnaire were applied.

## 5. Results

### 5.1. Descriptive values and multivariate statistics

The mean scores and standard deviations of all scales for the whole sample as well as for the German and Spanish subsamples separately are shown in Table 2. The comparison of female and male participants is also summarized in Table 2. To control for any gender or language differences between the subgroups, we used a multivariate variance analysis with gender and language-group as independent variables. The results indicate that the Spanish group had higher scores on the s-IAT-ICD, due to higher values on the "loss of control" subscale. They also showed higher scores on the IUES-avoidance subscale. In contrast, Germans scored higher on trait- and state-FoMO. There were neither gender differences, nor interactions of gender and language (see Table 2).

The bivariate correlations between the s-IAT-ICD (sum score) and the scores in the other questionnaires administered are shown in Table 3. As expected, most of the scales and subscales presented intercorrelations with small to moderate effect size.

### 5.2. The structural equation model

The proposed structural equation model did not show an acceptable fit with the data (RMSEA = 0.131 with $p < 0.001$, CFI = 0.920, TLI = 0.828, and SRMR = 0.078; $\chi2 = 73.64$, $p < 0.001$, $\chi2/df = 5.66$). While the latent dimensions of ICD and psychopathological symptoms were well represented, the latent dimension Internet-use expectancies was not optimally represented by the manifest variables positive expectancies ($\beta = 0.558$) and avoidance expectancies ($\beta = 0.973$). Since the subscale positive expectancies of the IUES was also not correlated with all variables and did not fulfill the criteria for mediation analysis (Baron & Kenny, 1986), we excluded this variable from the model and only used the subscale avoidance expectancies of the IUES.

In the next step of model development, we used psychopathological symptoms and trait-FoMO as predictors of ICD, and hypothesized that these relationships were mediated by state-FoMO and avoidance expectancies of the IUES. Again, the proposed structural equation model yielded no sufficient model fit with the data (RMSEA = 0.113 with $p = 0.003$, CFI = 0.956, TLI = 0.886, and SRMR = 0.068; $\chi2 = 35.50$, $p < 0.001$, $\chi2/df = 4.44$). The results indicate that trait-FoMO has to be excluded from the model, because it insufficiently contributes to variance explanation within the structural equation model. It could be assumed that the desire to be socially connected is a basic human need not solely restricted to Internet communication. Therefore, the results emphasize that it might not be a central predictor of ICD, although it correlated with ICD symptoms on a bivariate level. As stated in the introduction of this study, the definition of FoMO and the items of the questionnaire by Przybylski et al. (2013), which are mostly represented in factor 1 of the scale used in this study, do not refer explicitly to Internet-communication applications or online behavior. We argue that the need for having gratifying online experiences and the fear of missing out on something that happens online (state-FoMO) is the more relevant link between the person's core

**Table 2**
Mean scores of the used manifest variables separated for language and gender.

| | | German | | | Spanish | | | Language |
|---|---|---|---|---|---|---|---|---|
| | Total $N = 270$ | Total $n = 153$ | Female $n = 108$ | Male $n = 45$ | Total $n = 117$ | Female $n = 82$ | Male $n = 35$ | |
| s-IAT-ICD (sum) | 25.00 (7.74) | 23.93 (7.06) | 23.92 (6.82) | 23.98 (7.68) | 26.39 (8.37) | 26.41 (7.67) | 26.34 (9.93) | $F(266,1) = 5.54$, $p = 0.019$, $\eta^2 = 0.020$ |
| s-IAT-ICD 1 | 14.80 (4.70) | 13.97 (4.34) | 14.24 (4.24) | 13.33 (4.58) | 15.89 (4.93) | 16.10 (4.67) | 15.40 (5.54) | $F(266,1) = 10.02$, $p = 0.002$, $\eta^2 = 0.036$ |
| s-IAT-ICD 2 | 10.20 (3.82) | 9.96 (3.56) | 9.68 (3.40) | 10.64 (3.86) | 10.50 (4.12) | 10.32 (3.71) | 10.94 (4.98) | $F(266,1) = 0.84$, $p = 0.360$, $\eta^2 = 0.003$ |
| Trait-FoMO | 2.43 (0.90) | 2.78 (0.86) | 2.79 (0.90) | 2.76 (0.77) | 1.97 (0.73) | 1.98 (0.75) | 1.96 (0.69) | $F(266,1) = 54.95$, $p < 0.001$, $\eta^2 = 0.171$ |
| State-FoMO | 1.97 (0.69) | 2.06 (0.72) | 2.01 (0.71) | 2.18 (0.73) | 1.84 (0.64) | 1.87 (0.67) | 1.78 (0.59) | $F(266,1) = 8.51$, $p = 0.004$, $\eta^2 = 0.031$ |
| IUE-ICD pos. reinforcement | 3.61 (1.08) | 3.53 (1.07) | 3.54 (1.10) | 3.51 (1.01) | 3.71 (1.08) | 3.70 (1.08) | 3.74 (1.08) | $F(266,1) = 1.79$, $p = 0.183$, $\eta^2 = 0.007$ |
| IUE-ICD avoid. expectancies | 2.82 (1.07) | 2.62 (1.04) | 2.68 (1.10) | 2.48 (0.89) | 3.08 (1.06) | 3.13 (0.99) | 2.96 (1.23) | $F(266,1) = 10.89$, $p = 0.001$, $\eta^2 = 0.039$ |
| BSI – depression | 0.79 (0.77) | 0.77 (0.78) | 0.74 (0.77) | 0.84 (0.83) | 0.81 (0.76) | 0.84 (0.73) | 0.77 (0.84) | $F(266,1) = 0.01$, $p = 0.928$, $\eta^2 < 0.001$ |
| BSI – interpersonal sensitivity | 0.86 (0.77) | 0.85 (0.80) | 0.91 (0.80) | 0.72 (0.77) | 0.87 (0.74) | 0.94 (0.77) | 0.74 (0.67) | $F(266,1) = 0.07$, $p = 0.799$, $\eta^2 < 0.001$ |

**Table 3**
Bivariate Correlations between the scores of the s-IAT-ICD and the applied scales.

| | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. |
|---|---|---|---|---|---|---|---|---|
| 1. s-IAT-ICD (sum) | 0.927** | 0.887** | 0.205** | 0.459** | 0.369** | 0.530** | 0.175** | 0.223** |
| 2. s-IAT-ICD 1 | | 0.649** | 0.169** | 0.362** | 0.335** | 0.500** | 0.169** | 0.189** |
| 3. s-IAT-ICD 2 | | | 0.208** | 0.485** | 335** | 0.459** | 0.147* | 0.220** |
| 4. Trait-FoMO | | | | 0.424** | 0.083 | 0.164** | 0.174** | 0.290** |
| 5. State-FoMO | | | | | 0.366** | 0.302** | 0.098 | 0.168** |
| 6. IUE-ICD pos. reinforcement | | | | | | 0.546** | − 0.027 | 0.036 |
| 7. IUE-ICD avoid. expectancies | | | | | | | 0.308** | 0.337** |
| 8. BSI – depression | | | | | | | | 0.756** |
| 9. BSI – interpersonal sensitivity | | | | | | | | |

* $p \leq 0.050$.
** $p \leq 0.010$.

characteristics (psychopathological symptoms) and the ICD. The same appears for the link between the expectancies of satisfying one's social needs online and of escaping from real-life problems. Since the assumption with respect to trait-FoMO was not supported by the results of the structural equation model, we again modified the model by excluding trait-FoMO and by using only state-FoMO as a mediator between psychopathological symptoms and avoidance expectancies as well as ICD.

Finally, this structural equation model with psychopathological symptoms as predictor of ICD, and state-FoMO as the first and avoidance expectancies as the second mediator, yielded a good model fit. The RMSEA was 0.071 with $p = 0.211$, CFI was 0.988, TLI was 0.964, and SRMR was 0.020. The $\chi^2$–Test was significant ($\chi^2 = 11.80$, $p = 0.037$, $\chi^2/df = 2.36$). Psychopathological symptoms were a significant predictor of the mediators avoidance expectancies ($\beta = 0.326$, $SE = 0.059$, $p < 0.001$) and state-FoMO (β = 0.166, $SE = 0.063$, $p = 0.009$). There was no direct effect of psychopathological symptoms on ICD (β = 0.033, $SE = 0.062$, $p = 0.590$). State-FoMO significantly predicted avoidance expectancies (β = 0.248, $SE = 0.054$, $p < 0.001$) and ICD (β = 0.392, $SE = 0.055$, $p < 0.001$). There was also a direct effect of avoidance expectancies on ICD (β = 0.455, $SE = 0.059$, $p < 0.001$).

The effect of psychopathological symptoms on ICD was mediated significantly by avoidance expectancies (β = 0.149, $SE = 0.034$, $p < 0.001$) as well as by state-FoMO (β = 0.065, $SE = 0.026$, $p = 0.014$). The relationship between state-FoMO and ICD was also mediated by avoidance expectancies (β = 0.113, $SE = 0.028$, $p < 0.001$). There was a further mediation of the relationship between psychopathological symptoms and ICD by state-FoMO and then mediated by avoidance expectancies (psychopathological symptoms – state-FoMO – avoidance expectancies – ICD; β = 0.019, $SE = 0.008$, $p = 0.025$); however, this mediation showed only a small effect size. Overall, the variables significantly explained 48.6% of the variance of ICD symptoms. The final model with factor loadings, β-weights, and coefficients is shown in Fig. 2.

### 5.3. Additional analyses

As additional analyses, we controlled for age, gender, and language. The correlations between age and the previously used variables were mainly not significant ($r > 0.014$ and $r < -0.182$; Cohen, 1988); therefore the conditions for integrating age into the mediation model were not met (Baron & Kenny, 1986). The first analyses had already indicated that there were no gender differences concerning the variables used. However, to control for possible mediation effects with respect to gender, we analyzed the final structural equation model with gender as a group variable, using mean structure analysis (comparing the model fits for males and females). The model fit indices showed no good fit with the data (RMSEA = 0.132 with $p = 0.001$, CFI = 0.945, TLI = 0.881, and SRMR = 0.042; $\chi2 = 47.14$, $p < 0.001$, $\chi2/df = 3.37$). To control for language, we analyzed structural equation model separated for language, again using mean structure analysis. The model yielded a good fit with the data (RMSEA = 0.072 with $p = 0.211$, CFI = 0.983, TLI = 0.963, and SRMR = 0.031 with $\chi2 = 23.80$, $p = 0.048$, $\chi2/df = 1.70$). The German subsample showed the same effects as the whole sample, but in the case of the Spanish subsample, the path from psychopathological symptoms to state-FoMO was non-significant (β = 0.156, $SE = 0.097$, $p = 0.106$). Overall, the model explained 48.6% of the variance of ICD.

As further additional analyses we controlled our data for divergent validity since researchers emphasize the importance of researching convergent and divergent mechanisms of different specific Internet-use disorders (Brand, Laier, et al., 2014). Internet-gaming disorder as one specific Internet-use disorder has been included in the fifth edition of the Diagnostic and Statistical Manual (DSM-5; APA, 2013), illustrating its clinical relevance and also noting that more research is needed. We tested the modified structural equation model using symptoms of Internet-gaming disorder as dependent variable. Using this additional dependent variable in a second structural equation model, we were able to test the hypothesis that FoMO is particularly involved in ICD, but not in Internet-gaming disorder. In addition, this approach allowed us to check for potential common methods variance in the data and general confirmation bias or social desirability bias. Symptoms of Internet-gaming disorder were measured with a modified version of the Short Internet Addiction Test (Pawlikowski et al., 2013). This version (s-IAT-IGD) consists of four items to be answered on a five-point Likert scale ranging from 1 (= never) to 5 (= very often), two items representing the subscale loss of control/time management, and another two items representing craving/social problems. The sum score of the s-IAT-IGD was $M = 6.90$ ($SD = 3.87$). The variables of the structural equation model correlated with symptoms of Internet-gaming disorder ($r \geq 0.084$ and $r \leq 0.234$, $p \geq 0.169$ and $p < 0.001$), with low effect size. Overall, the structural equation model showed good fit with the data (RMSEA = 0.031 with $p = 0.608$, CFI = 0.998, TLI = 0.993, and SRMR = 0.011; $\chi2 = 6.31$, $p = 0.272$, $\chi2/df = 1.26$) and the effects of the different predictors were comparable with the main model (see Fig. 3). Nevertheless, state-FoMO did not predict Internet-gaming disorder symptoms. Neither did state-FoMO mediate the effect between psychopathological symptoms and Internet-gaming disorder (β = 0.018, $SE = 0.013$, $p = 0.154$). Likewise, the effect of psychopathological symptoms and Internet-gaming disorder was not mediated by FoMO and avoidance expectancies (β = 0.008, $SE = 0.005$, $p = 0.075$), but by avoidance expectancies only (β = 0.066, $SE = 0.026$, $p = 0.012$). The model explained 7.4% of the variance in Internet-gaming disorder. In summary, the details of the structural equation models for ICD and Internet-gaming disorder differ, which emphasizes the specificity of the results concerning the role of FoMO in ICD.

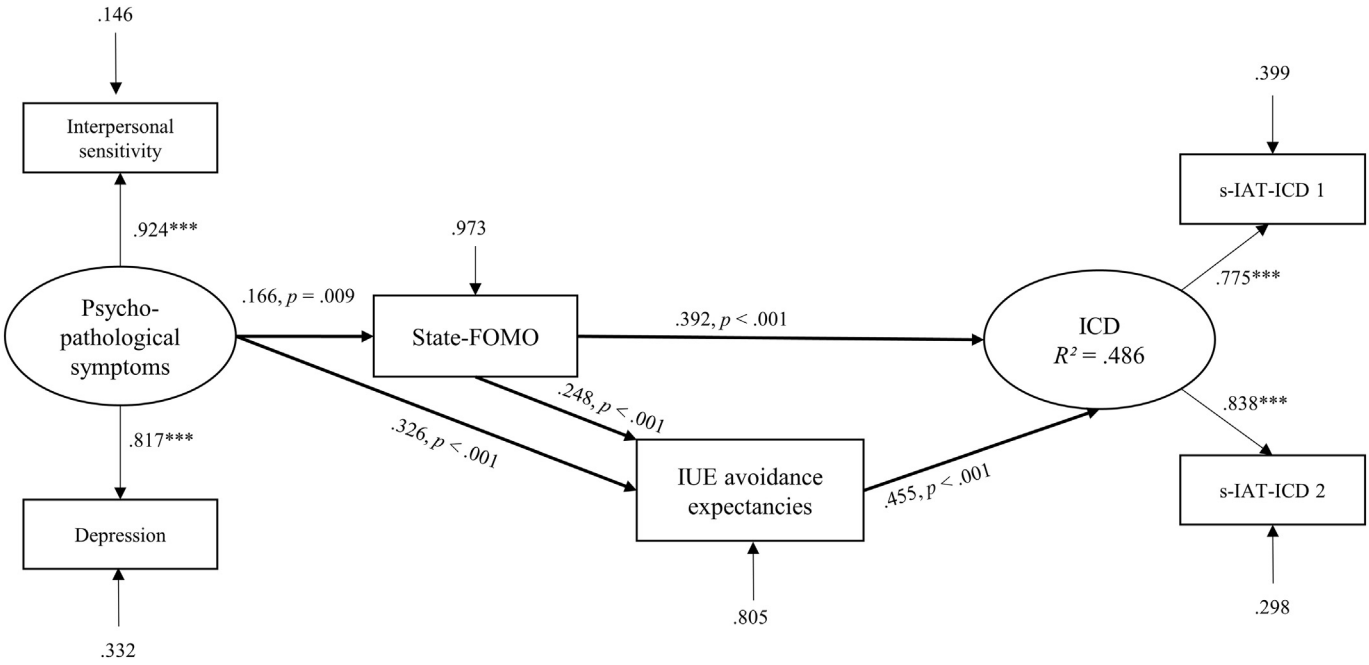
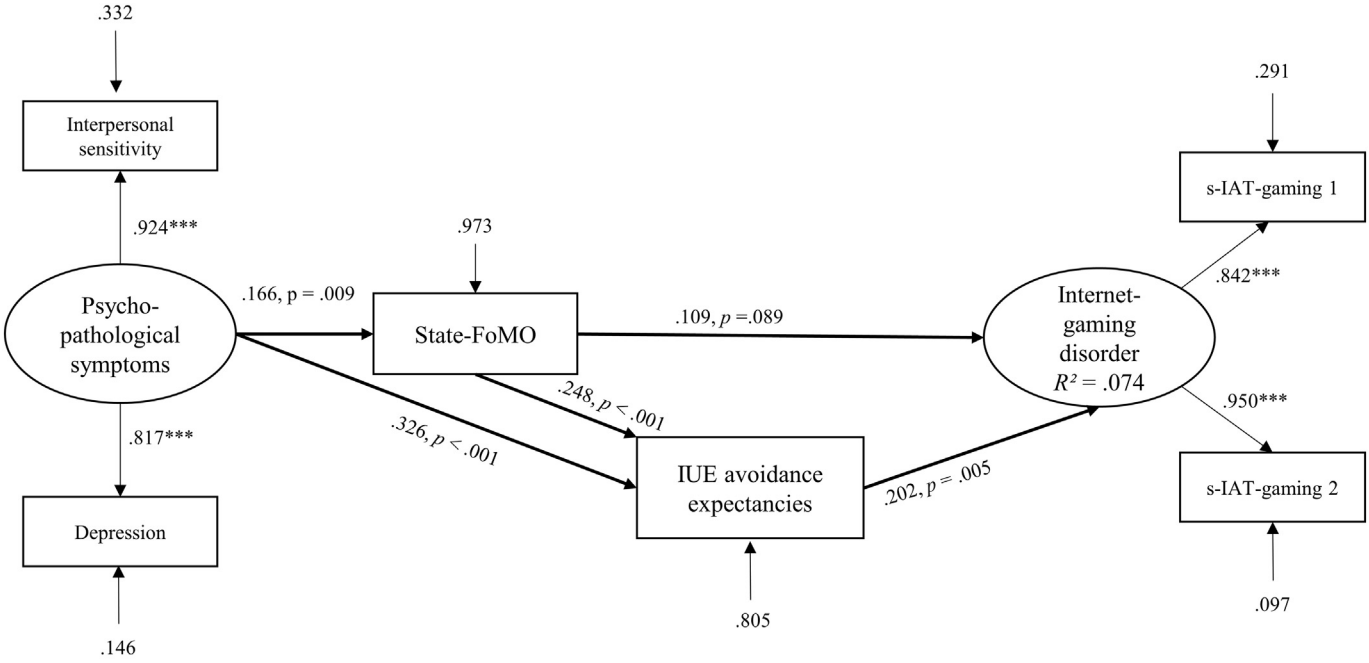



**Fig. 2.** Results of the modified structural equation model with ICD as dependent variable including factor loadings on the described latent variables and the accompanying β-weights, *p*-values, and residuals.




IGD – Psychopathology (direct): (β = .038, *SE* = .072, *p* = .598)
IGD – FoMO (direct): (β = .109, *SE* = .064, *p* = .089)

IGD – IUE – FoMO (indirect): (β = .050, *SE* = .021, *p* = .017)

IGD – FoMO – Psychopathology (indirect): (β = .018, *SE* = .013, *p* = .154)
IGD – IUE – Psychopathology (indirect): (β = .149, *SE* = .034, *p* < .001)

IGD – IUE – FoMO – Psychopathology (indirect): (β = .008, *SE* = .005, *p* = .075)

**Fig. 3.** Results of the modified structural equation model with Internet-gaming disorder (IGD) as dependent variable including factor loadings on the described latent variables and the accompanying β-weights, *p*-values, and residuals.

## 6. Discussion

In the current study, we tested a theoretical model to explain the role of FoMO in developing ICD symptoms. Overall, the first structural equation model did not yield an acceptable fit with the data. Therefore, we modified the model by using state-FoMO as one part of the FoMO construct to explain the possible mechanisms of pathological use. Altogether, 48.6% of the variance in ICD was explained by psychopathological symptoms and the mediation effect of the two variables, state-FoMO and avoidance expectancies. The results emphasize that psychopathological symptoms had no direct effect on the development and maintenance of ICD symptoms. Psychopathological symptoms, however, predict both the expectancies to escape from real-life problems by using Internet-communication applications and the fear of missing out on Internet-communication networks. Both variables enhanced the risk of experiencing ICD symptoms. Moreover, avoidance expectancies and state-FoMO mediated the link between psychopathological symptoms and overall ICD. The variables associated with Internet-related cognitive biases also affected each other, since the mediation of the relationship between psychopathological symptoms and ICD through avoidance expectancies was also mediated by state-FoMO.

The results are in line with the hypothesis that the relationship between a person's core characteristics and impaired control over the use of Internet-communication applications is mediated by Internet-related cognitive biases and other specific cognitions—in our model, Internet-use expectancies and state-FoMO. Such mediation effects are also postulated in the I-PACE model by Brand et al. (2016). The specific cognitions are considered to be influenced by several vulnerability factors, summarized as a person's core characteristics. The specific cognitions are then consolidated by reinforcement processes in the context of using certain applications and by experiencing gratification, and could then enhance the risk of developing and maintaining a specific Internet-use disorder. Empirical evidence for this theoretical process was identified by Wegmann and Brand (2016), whose findings suggest that a person's core characteristics, such as psychopathological symptoms (depression, social anxiety) and personality (stress vulnerability, self-esteem, self-efficacy) predict specific cognitions, such as Internet-use expectancies and a dysfunctional coping style, which then together lead to symptoms of an ICD. The authors also illustrate that social aspects (loneliness, perceived lack social support) play a major role in the addiction process (Wegmann & Brand, 2016). This is also consistent with another study by Wegmann et al. (2015) showing that Internet-use expectancies and self-regulation mediated the effect of depression and social anxiety on the addictive use of Internet-communication applications. The current study illustrates the link between the individual's characteristics and specific cognitions or Internet-related cognitive biases, as outlined in the I-PACE model (Brand et al., 2016); it also expands earlier findings with respect to FoMO, showing that online-specific FoMO is a relevant mediating variable for the addictive use of Internet-communication applications (Oberst et al., 2017).

Furthermore, the relevance of social aspects is a key aspect of using Internet-communication applications. Individuals with depressive symptoms and social anxiety, which may include feelings of loneliness, seem to gratify their social needs online (Wegmann & Brand, 2016). Omar and Subramanian (2013) illustrated the relationship between loneliness, anxiety, and the addictive use of Facebook, while Chak and Leung (2004) showed that shyness predicted Internet addiction. The use of Internet-communication applications seems to be attractive to individuals with a poor subjective quality of social interactions, low social competence, and high loneliness (Bhagat, 2015). It becomes a strategy for connecting with others, especially for lonely users and users with social anxiety (Clayton, Osborne, Miller, & Oberle, 2013), resulting in an uncontrolled use of these preferred applications or the Internet in general. Deficits in social interactions together with the perception of social networking sites as a helpful tool to compensate for real-life deficits could serve as a basis for addictive use (Kim, LaRose, & Peng, 2009). This premise was mentioned by Weinstein et al. (2015), who emphasized that the preference for online over face-to-face interaction is a social compensation strategy and a predictor of Internet-use disorder. Kardefelt-Winther (2014) discussed the use of the Internet as a tool to compensate for real-life deficits as well. The desire to keep in touch with others is one of the strongest reasons for frequent participation and is also part of the compensation theory (Floros & Siomos, 2013; Griffiths, Kuss, & Demetrovics, 2014; Kuss & Griffiths, 2011). However, since loneliness and real-life deficits predict the use of SNS, the users expect the gratification of social needs (Huang, Hsieh, & Wu, 2014; Song et al., 2014), and Internet communication makes interaction easier (Baker & Oswald, 2010). Following this argumentation, the combination of specific predispositions such as loneliness, depression, or social anxiety and the preference for online-communication services for gratifying social needs could lead to a higher online-specific FoMO (state-FoMO). These communication platforms gratify social needs such as the need to belong. Moreover, the fear of missing out on what friends are doing could be part of these social functions and could influence users' motives for participating. An increased online FoMO could result in the desire to check the different Internet-communication applications or one's smartphone more often, which may result in experiencing negative consequences in other areas of life. In particular, the use of smartphones and other handheld devices to satisfy the need for connection may actually increase users' FoMO, in a kind of vicious cycle perpetuated by the virtually unlimited sources of information and connections offered (Oberst et al., 2017). Permanent online activity makes users aware of how many other sources for that information and communication exist and are being used by others. Ultimately, vulnerable individuals, especially younger ones, become “hooked” (Choi et al., 2015; Oberst et al., 2017). Van Deursen, Bolle, Hegner, and Kommers (2015) illustrated that habitual smartphone use contributes to addictive tendencies, especially when using the mobile device for social purposes or if the use is associated with social stress. A vicious circle can ensue: Individuals check their Internet-communication applications more often because they do not want to miss out on something, and they want to be part of the online community. But as a consequence, they experience negative effects due to a compulsive-like or addictive use of communication applications. Overall, these components, such as a preference for Internet communication over face-to-face interaction and mediation by online state-FoMO, could impair users' control over their use of these applications. This seems especially to be the case when individuals additionally have the expectancies to escape from real-life problems or reality in online social networks, or to avoid loneliness or annoying duties, which are also affected by psychopathological symptoms and online state-FoMO. On the theoretical level, this is in line with considerations by Hormes, Kearns, and Timko (2015), who show that individuals remain on Facebook through negative reinforcement. Patterns of an excessive use of Internet-communication applications are associated with physiological arousal, conditioned cues, and reinforcement mechanisms (Kuss & Griffiths, 2011). Also, these persons have limited access to emotion regulation strategies and try to avoid negative emotions, difficult problems, or conflicts (Hormes et al., 2015). The behavior is then reinforced by emerging fears of missing out on something happening online or of no longer being a part of the online community, as well as by the expectancy that by going online they can avoid negative emotions.

These results must be examined in the context of the first proposed model, which did not show an acceptable fit with the data. The data obtained from the trait-FoMO scale and the subscale positive reinforcement of the Internet-Use Expectancies Scale that was modified for Internet-communication applications did not fit with the proposed model. The results emphasize that for psychopathological symptoms, state-FoMO, and avoidance expectancies seem to be relevant variables, which may explain why some individuals prefer online communication and have a higher risk of showing symptoms of ICD. The general fear of

missing out on something seems to be more associated with a need to belong. In earlier studies, FoMO mediated the link between individual differences (needs, emotions, motivations) and social media engagement (Alt, 2015; Przybylski et al., 2013). It is possible that in these earlier studies, where FoMO was analyzed in the context of non-pathological predispositions and (normal) behavior, trait-FoMO served as a mediator, but not in the case of pathological predispositions and addictive behavior. This also indicates that FoMO is a more complex construct. Further studies are needed to shed light on this theoretical and empirical discrimination between trait- and state-FoMO.

Concerning the positive reinforcement effect, it is associated with the use of Internet-communication applications to experience pleasure, to have fun, or to feel good. These hedonistic aspects seem not to be involved in individuals driven by fear or social anxiety.

Age and gender seemed to be unrelated to the variables of the structural equation model, since the effects were equal. This is consistent with research operating under the premise that both male and female users are generally at risk of developing an addictive behavior (Brand, Laier, et al., 2014; Young, Yue, & Ying, 2011). Nevertheless, some studies indicate a higher risk of ICD in female users, which should be addressed in further studies (Choi et al., 2015; De Cock et al., 2013). The model was also valid for the different languages. Although the Spanish group scored higher on symptoms of ICD and avoidance expectancies and the German group higher on the FoMO construct, the main effects of the structural equation model were similar in the two groups. Therefore, it can be assumed that demographic variables such as age, gender, or language are not the most relevant predictors of the development and maintenance of ICD. To control for divergent validity, the modified model was tested with symptoms of Internet-gaming disorder as dependent variable as well. In sum, the model illustrates that the effect of psychopathological symptoms and Internet-gaming disorder was mediated by avoidance expectancies alone. State-FoMO had no effect on Internet-gaming disorder and also was not a mediator of the different relationships. This result emphasizes that Internet-gaming disorder seems not to be associated with a communicative, social exchange and a feeling of belonging to the community and therefore with the FoMO construct. The results also illustrate that specific Internet-use disorders share common mechanisms, such as the mediating effect of Internet-use expectancies, but also have divergent predictive processes, such as FoMO and social aspects; this finding was also shown by Wegmann and Brand (2016). Further research should examine in greater empirical detail the convergent and divergent mechanisms of specific Internet-use disorders and the role of social aspects, such as the need to belong and the FoMO construct.

Finally, there are some limitations. First, an online survey conducted outside of laboratory conditions and with self-selected samples was used. Nonetheless, the data themselves were controlled carefully. Second, a newly developed questionnaire to measure the FoMO construct with the two subscales trait-FoMO and state-FoMO was used. Considering the new construct, further studies are needed to assess the differences between trait- and state-FoMO and to further validate the questionnaire. Third, the latent dimension Internet-use expectancies, which was modified for Internet-communication applications, could not be represented by both subscales (avoidance expectancies and positive expectancies). As already mentioned, it can be assumed that avoidance expectancies better represent the fear of missing out on something or experiencing feelings of loneliness in the suggested theoretical model. The differences between the two subscales of Internet-use expectancies should be researched in future studies.

Overall, the results have implications for education and therapy. The use of online-communication applications allows users to escape from conflicts as well as negative feelings and to compensate for deficits in real-life interactions (Kim et al., 2009; Ryan & Xenos, 2011). These communication and problem-solving strategies could lead to the expectancy of avoiding negative feelings by using Internet-communication applications excessively, which in turn may result in an addictive use. Users should be taught that Internet-communication applications are not the only way to initiate or stay in contact with others and satisfy their social needs. Individuals should be offered alternative strategies and opportunities for connecting with other people without having the feeling of missing out on something.

## Contributors

EW collected the data, conducted the statistical analysis, interpreted the results, and conceptualized and wrote the first draft of the manuscript. UO and BS aided in data collection, data interpretation, and writing the manuscript. MB designed the study and supervised interpreting the data and writing the manuscript. All authors contributed to and have approved the final manuscript.

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## Conflict of interest

The authors declare no conflict of interest.

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