Social Interaction in Major Depressive Disorder, Social Phobia, and Controls: The Importance of Affect

Accepted in Journal of Technology in Behavioral Science

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Abstract

Objective: Social interactions are crucial to human beings. As technology advances, new possibilities of interaction emerge, bringing both opportunities and risks, especially when interpersonal behaviors are impaired (e.g. depression) or associated with strong fear (e.g. social phobia). The authors investigated whether technological social interactions (i.e., phone and internet/chat) are used equally as often as face-to-face social interactions in participants with mental disorders and in controls and whether differences are associated with unpleasant emotions, that is, whether the association between negative affect (NA) or positive affect (PA) differed by type of social interaction.

Methods: The self-chosen social interactions of participants diagnosed with major depressive disorder (MDD) or social phobia (SP) were compared with participants without these diagnoses (control group, CG). Using event sampling methodology (ESM), participants' everyday social behavior was sampled six times per day for one week in their natural environment.

Findings/Results: The CG engaged more often in face-to-face social interactions, while participants diagnosed with MDD or SP engaged more often in phone social interactions. Across all groups, there was a positive relationship between NA and the frequency of technological social interactions, and a positive relationship between PA and the frequency of face-to-face social interactions.

Conclusions: The propensity to experience higher levels of PA during face-to-face social interactions and NA during technological social interactions is important to consider when selecting and planning social interactions. Clinicians may consider exploring the social interaction patterns of their patients in the light of these findings. Likewise, developers of technological interventions and clinicians using them should consider the potential that technological social interactions may increase NA.

Keywords: *social interaction, major depressive disorder, social phobia, affect, technology*

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Introduction

Social interactions are integral to humans (e.g., Darwin, 1859). Sometimes, however, social interactions are distressing, and when social interaction problems become chronic, negative sequelae are likely. Problematic and sometimes absent social interactions are evident in mental disorders, especially in major depressive disorder (MDD) and social phobia (SP). Individuals diagnosed with MDD show impaired interpersonal behaviors (e.g., a reduced desire to communicate and cooperate in economic games, problems in understanding the thoughts or feelings of others) and deficits in performing social roles, possibly leading to stigma and social withdrawal (Kupferberg, Bicks, & Hasler, 2016). Individuals diagnosed with SP avoid and have a strong fear of social situations, which might lead to social withdrawal and impairment in social and other areas of functioning (Rapee & Spence, 2004).

Different types of social interactions

Social interactions lie on a continuum of information availability: While the information available in "real life" face-to-face social interactions is undoubtedly the richest (e.g., hearing/seeing each other, facilitated emotion conveyance, direct information from the immediate environment), other social interactions supported by modern technology ("technological social interactions," such as phone or internet/chat social interactions) provide less information, this being especially true for online communication (Schulz & Hoyer, 2016). While some emotion conveyance is possible in a phone call or video chat, this is more difficult in text messages and emails and can be misunderstood (Madell & Muncer, 2007). This renders the information availability unequal between different types of social interactions, in that phone

and internet/chat social interactions provide less information than face-to-face social interactions.

Patients diagnosed with depression see face-to-face social interactions less positively and as less enjoyable (Nezlek, Hampton, & Shean, 2000), experience more negative affect in social interactions (Baddeley, Pennebaker, & Beevers, 2012), and use negative emotion words more often in their everyday social behavior (Baddeley et al., 2012), which increases negative communication behavior also from the interaction partner (Rehman, Gollan, & Mortimer, 2008). For individuals diagnosed with SP, the fear of negative evaluation by others is ubiquitous (Kashdan & Farmer, 2014; Rapee & Heimberg, 1997); by definition they view most social interactions as stressful and anxiety provoking, especially in social situations with unfamiliar people and/or possible scrutiny (DSM-IV-TR, 4th ed., text rev., American Psychiatric Association [APA], 2000). Patients diagnosed with SP are more likely to interpret social interactions in a negative fashion and to catastrophize even mildly negative or ambiguous social interactions (Stopa & Clark, 2000). This leads to an increasingly negative view of the social world, which in turn can result in safety-seeking behaviors that can affect the response of others to the individual diagnosed with SP (Spence & Rapee, 2016). Hence, non-face-to-face communication might reduce worrying about negative evaluation from others (Ybarra, Alexander, & Mitchell, 2005; Yen et al., 2012), and indeed, people with higher anxiety levels use online interactions or text messaging more often than people with lower anxiety levels (Pierce, 2009).

New technologies such as the internet or chat might facilitate the avoidance or replacement of face-to-face communication (Nie & Erbring, 2002). Anxiety is decreased in online relationships (Ybarra et al., 2005; Yen et al., 2012), which enables participants to meet new people online in a less threatening environment (McKenna & Bargh, 1999), even if they are avoidant of face-to-face interactions. However, in a systematic review based on self-report

assessment scales, 75% of the studies linked pathological internet use – defined as impaired impulse-control which shares characteristics known from behavioral addiction – with depression and 57% with anxiety (Carli et al., 2013). Compulsive internet use – defined as an addiction to certain online activities which lead to compulsive internet use (Meerkerk, Van Den Eijnden, Vermulst, & Garretsen, 2009) – is also associated with mental health problems in adolescents (Ciarrochi et al., 2016). Despite these insights, it remains unknown whether individuals with MDD or SP choose types of social interactions other than face-to-face more often than nonclinical individuals.

Positive and negative affect

Higher levels of negative affect (NA) and lower levels of positive affect (PA) are correlated with both depression and anxiety (e.g., Watson, Clark, & Carey, 1988). PA and some social activities are more strongly related than others: active and informal activities (e.g., eating or drinking with others, parties, etc.) were strongly associated with higher PA, while formal and sedentary social events (e.g., club meetings, lessons, etc.) were unrelated to PA (Clark & Watson, 1988). However, much research has focused on face-to-face social interactions only. Hence, it remains to be investigated whether technological types of social interactions (phone or internet/chat) are associated with differing levels of affect.

Further, the distinction between trait and state affect is important (Levine et al., 2011): trait affect represents broad and stable individual predispositions, while state affect represents momentary fluctuations in mood, which may fluctuate due to daily events, situational characteristics, or other factors (e.g., Brondolo et al., 2008; Watson & Clark, 1984). Research to date has mostly focused on trait affect, while the naturally occurring fluctuations of state affect are poorly understood.

Hypotheses

This paper has two main aims: to understand how participants with MDD, SP, and CG engage in different types of social interactions; and whether state affect (PA and NA) influence the frequencies. It was hypothesized first that participants diagnosed with MDD or SP would show a lower frequency of face-to-face social interactions than participants without these diagnoses (control group, CG), whereas participants diagnosed with MDD or SP would show a higher frequency of technological social interactions, i.e., phone and internet/chat not requiring face-to-face contact (Hypothesis 1). Second, it was hypothesized that emotions impact the frequency of the social interactions across the different types of social interaction. The direction of the relationship was not specified a priori for NA (Hypothesis 2a) or for PA (Hypothesis 2b). Third, it was hypothesized that affect (both PA and NA) would interact with diagnostic group status and impact the frequency of social interactions across the different interaction types for NA (Hypothesis 3a) and PA (Hypothesis 3b).

Methods

Participants

Individuals diagnosed with MDD (N = 118) or SP (N = 47) and individuals without a diagnosis of MDD or SP (CG; N = 119) were included. Participants were recruited from treatment centers (university clinics and cooperating local practitioners) in Switzerland and Germany while recruitment of the CG occurred via local advertising. This was done specifically for this study, which, among other aspects, aimed at investigating characteristics of social interactions (Gloster et al. 2017). All participants completed informed consent procedures. The majority of the participants were female (*n* = 66.5%), with a mean age of 31.75 years (*SD* = 11.52, range: 18 to 63). Consistent with the demographics of this region, the entire sample was Caucasian. The groups were matched for age and sex. On average, 49.30% of the sample was employed (MDD: 52.5%; SP: 38.3%; CG: 57.1%), while 49.26% were unemployed (MDD: 46.6%; SP: 61.7%; CG: 39.5%). Participants also reported on their living

arrangement, namely, whether they lived alone (MDD: 22.9%; SP: 21.3%; CG: 30.3%), with their family or partner (MDD: 60.2%; SP: 55.3%; CG: 49.6%), or in another living arrangement (MDD: 16.9%; SP: 23.4%; CG: 20.2) (Gloster et al., 2017). Inclusion criteria were age (18–65 years), diagnostic groups having a DSM-IV primary diagnosis of MDD or SP, and the CG having no current DSM-IV primary diagnosis of MDD or SP. Exclusion criteria included acute suicidality, current substance dependence, an inability to understand the local language, and physical disabilities preventing participation (e.g., an inability to see text on a smartphone or to hear the smartphone's signal).

Event Sampling Methodology (ESM)

Investigating the everyday affect and social behavior of the participants in a more valid and accurate manner (Husky et al., 2010) and reducing the effect of recall bias (Stone, Shiffman, Schwartz, Broderick, & Hufford, 2003) required following the participants out of the lab and "into the wild." Implementation of the ESM via smartphones was therefore suitable and useful because data collection occurred in real-time in the natural environment wherever the participant chose to go, and it assessed moods, thoughts, symptoms, or behaviors, which change over time (e.g., Trull & Ebner-Priemer, 2009).

Design and Procedure

This was a quasi-experimental, intensive, longitudinal study with a seven-day-ESM phase. During this phase of the study, participants were asked to carry a smartphone, which was, for data security reasons, provided by the research team. For more details on the overall study and exact procedures, please see (Gloster et al., 2017).

Assessment

All participants completed the Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I) (First & Gibbon, 2004; Wittchen, Wunderlich, Gruschwitz, & Zaudig, 1997). At the time of data collection the SCID-I for DSM-V was not available in the local

language, however, there are no major changes in the diagnostic criteria for MDD and SP. Diagnoses were made using the SCID and rated on the Anxiety Disorders Interview Schedule (ADIS) severity rating scale (Brown, DiNardo, & Barlow, 1994). The diagnosis with the highest severity score determined the primary diagnosis and thus group assignment. Data were collected six times a day using a signal-contingent ESM method every three hours (e.g., 8 a.m., 11 a.m., 2 p.m., 5 p.m., 8 p.m., and 11 p.m.), covering the time participants were awake. Questionnaires included disorder-specific and transdiagnostic/supplemental items. Participants reported what percentage of time since the last reminder they had experienced a certain feeling, symptom, or event.

ESM items inquiring about social interactions, PA, and NA were all chosen a priori and adapted to include an indication of the time frame since the last reminder ("Since the last beep, […]"). Items were partly self-developed, partly from previous ESM studies (Brown, Strauman, Barrantes-Vidal, Silvia, & Kwapil, 2011; Kashdan & Steger, 2006; Watson, Clark, & Tellegen, 1988), and partly from the PANAS (Watson, Clark, & Tellegen, 1988), reflecting core components of affect (e.g., Feldman Barrett & Russell, 1998). Three social interaction items were used for the present analysis with the same introduction: "Since the last beep…how many social interactions did you have?" / "…how many of those social interactions were meaningful to you?". The second item was used to determine the number of social interactions. The last social interaction item, "How did the interaction happen?", asked participants to categorize their social interactions into one of four categories: "face-to-face," "phone," "internet/chat," or "other." The category "other" was very heterogeneous and chosen by all groups only up to 6.7% on average and was thus excluded from the analysis. State affect was measured with four NA items ("Since the last beep, what percentage of the time were you… sluggish?" / "sad?" / "anxious?" / "upset?") and five PA items ("Since the last beep, what percentage of the time did you feel… relaxed and rested?" / "enthusiastic?" / "happy?" / "content?" / "grateful?"). Those

items were included to assess core components beyond the PANAS and based on a similar study (Kashdan & Steger, 2006).

Statistical analysis

Data collected from ESM studies are repeated measures with interdependent observations of data nested within individuals. In order to properly address this data structure, and due to the dichotomous outcome (occurrence of social interaction: yes/no), we used generalized linear mixed models (GLMMs). The GLMMs contained a random intercept to account for the dependency among repeated measures.

For the first hypothesis, we compared the frequency of each type of social interaction of the combined diagnostic groups with the CG (i.e., MDD + SP combined vs. the CG), the frequency of each clinical group with the CG (i.e., MDD vs. the CG and SP vs. the CG), and the frequency of the clinical groups with each other (i.e., MDD vs. SP). Second, we compared the frequency of each type of social interaction dependent on state NA (Hypothesis 2a) and state PA (Hypothesis 2b), across all groups. Third, we compared the frequency of each type of social interaction dependent on diagnostic group and state NA (Hypothesis 3a) and state PA (Hypothesis 3b). For this we investigated the interaction between diagnostic group and affect for each type of social interaction. We split NA/PA into state and trait and treated and investigated both separately. Trait NA/PA was measured by calculating the mean level of NA/PA the participants reported across the whole week. State NA/PA were the observed values, centering on the subject specific means (i.e., the trait values). Hence, NA/PA values below 0 referred to values where participants reported lower NA/PA levels than their average (trait level), and values above 0 referred to values where participants reported higher NA/PA levels than their average, across the week. NA and PA were analyzed in separate models. For each analysis, data were excluded if a participant answered fewer than 50% of the smartphone reminders during the ESM week. Effect sizes are reported as odds ratios using Wald statistics

for each variable in each model. Since the focus of this study lies on state affect, only these results are reported. Please see Supplementary Material (Table S2) for the results for trait affect.

Findings/Results

Hypothesis 1: Differences in frequency of different types of social interactions in participants with MDD or SP and the CG

Over the whole ESM week, the CG reported having had *any* meaningful social interaction (regardless of the type of social interaction) 80.4% of the assessment week, while the MDD group reported the same 74.2% of the assessment week, and the SP group reported 72.5%, as calculated by a count of how often participants reported to have had at least one social interaction. An overview of the general absolute and relative frequencies of types of social interactions engaged in for each group are shown in Table S1 of the Supplementary Material. The response rate during the ESM phase amounted to 91.5% across all groups, with no significant differences between the groups. For the summarized results for Hypothesis 1, see Table 1 and Figure 1.

In order to establish the relationship between different types of social interactions and diagnoses, we first ran a GLMM comparing the CG to the combined diagnostic groups (i.e., MDD + SP) to examine general frequency of the different types of social interactions. The results showed that the combined diagnostic groups engaged significantly less often in face-to-face social interactions (CG: 93.3%; MDD: 90.8%; SP: 90.4%) and used their phones more often for social interactions (CG: 8.1%; MDD: 10.9%; SP: 13.0%) across the whole week, while there were no statistically significant differences regarding frequency of internet/chat social interactions (CG: 7.1%; MDD: 7.6%; SP: 9.5%). When we divided the combined diagnostic group into patients diagnosed with MDD and patients diagnosed with SP, both groups and the CG reported the same frequency in face-to-face interactions. However, the

MDD group reported using their phone significantly more often than the CG. There were no differences regarding internet/chat interactions.

[Table 1 here]

[Figure 1 here]

Hypotheses 2a and 2b: Differences in frequency of different types of social interactions depending on state affect.

We investigated the relationship between state affect and types of social interactions, regardless of diagnostic group. Across all three groups, higher NA was associated with less face-to-face social interactions and more social interactions through phone and Internet/Chat. Higher PA was associated with more face-to-face social interactions and less social interactions through phone and Internet/Chat. For the summarized results of all outcomes of Hypothesis 2a (NA) and Hypothesis 2b (PA), see Table 2.

Hypotheses 3a and 3b: Interactions between groups and state affect by type of social interaction.

We investigated the interaction between diagnostic groups and NA/PA for each of type of social interaction. For NA, the interaction between affect and diagnostic groups did not yield any significant results, for any of the types of social interaction. For PA, none of the interactions were significant either, except the interaction between PA and MDD for phone social interactions. This suggests that, for the MDD group, the probability of phone interactions decreased when the PA of the patients increased, however, not as strongly as for the other groups. For the summarized results of all outcomes of Hypothesis 3a (NA) and Hypothesis 3b (PA), see Table 2 and Figure 2.

[Table 2 here]

[Figure 2 here]

Discussion

This study examined patients diagnosed with major depressive disorder (MDD) or social phobia (SP) and a control group (CG) during a one-week intensive longitudinal examination in their natural environment. The results suggest two main findings: First, diagnostic groups (MDD and SP) reported a significantly higher frequency of social interactions via their phones than did the CG. Second, across all groups, when NA was higher, participants engaged in more technological social interactions (i.e., via phone and internet/chat), while they engaged in more face-to-face social interactions when PA was higher.

Frequency of different types of social interactions by patients diagnosed with MDD and SP

In partial contrast to our results, some previous studies found that face-to-face social interactions were associated with higher NA and lower PA in patients diagnosed with MDD (Baddeley et al., 2012; Nezlek, Imbrie, & Shean, 1994) and SP (Kashdan & Farmer, 2014). However, if face-to-face social interactions are indeed associated with higher NA and lower PA, this might, theoretically, give patients less reason to engage in face-to-face social interactions in the future, and indeed our results suggest that participants diagnosed with MDD and SP engage in more phone social interactions. These results are partially consistent with other previous studies: participants with depressive symptoms spend less time with other people (e.g., Brown et al., 2011), while social anxiety patients prefer their phone for contact (Reid & Reid, 2007) and experience social contexts online as more liberating than those offline (Schulz & Hoyer, 2016). Participants with SP also reported the highest frequency of no social interactions since the last reminder relative to participants with MDD or the CG. However, higher levels of loneliness (which are associated with depression [Barger, Messerli-Bürgy, & Barth, 2014] and social anxiety [Maričić & Štambuk, 2015]) were related to reduced engagement in face-to-face and phone social interactions (Jin & Park, 2010). While our results

indeed suggest reduced engagement in face-to-face social interactions, the opposite was found for phone social interactions.

The CG and the diagnostic groups engaged equally in internet/chat social interactions. One possible explanation might be that misunderstandings are still possible via internet/chat (Madell & Muncer, 2007), therefore making a phone social interaction more appealing than the possibly more anonymous internet. Also, a certain communication synchronicity (i.e., speed of information exchange) might be important for participants with MDD or SP. Despite asynchronous information exchange (i.e., slow information exchange, e.g., email), allowing for more time to think than synchronous information exchange (i.e., rapid information exchange, e.g., phone calls, face-to-face) (Madell & Muncer, 2007; Münzer & Borg, 2008), neither the MDD, nor the SP group seemed to have sought this opportunity. Further, a ceiling effect may be possible: many people use the internet or online communication anyway (Schulz & Hoyer, 2016). Eighty-eight percent of the German population used the internet in 2016 ("Daily internet usage rate in Germany in 2016, by age group," 2018), as did 85.6% of the Swiss population in ("Internet usage development in

Switzerland from October 2008 to March 2017, by frequency," 2018). The internet is omnipresent: while earlier it was only available on a computer, today it is also available on phones.

There are clear differences between the types of social interactions investigated that may help to explain these results: some communicative factors (such as body language, mimics, gestures etc.) are conveyed easier in face-to-face social interactions, while it is harder or impossible to convey them through a phone (Madell & Muncer, 2007) or online (Schulz & Hoyer, 2016). This information availability also differs regarding positive reinforcers (e.g., a reassuring smile, an occasional nod, etc. in a face-to-face social interaction). While these reactions are valuable in a face-to-face social interaction, it is also noticed quickly if they are

missing. This might elicit stronger feelings of doubt and insecurity and even confirmation of worries in participants diagnosed with MDD or SP.

Social interactions and affect

Higher state NA was related to fewer face-to-face social interactions and more technological social interactions across all groups. Higher state PA was related to more face-to-face social interactions and fewer technological social interactions across all groups. Earlier research suggests a relation of active or informal social activities to PA (Clark & Watson, 1988); however, merely different situations of face-to-face social interactions were investigated. Thus, the present results extend this research by investigating social interactions beyond face-to-face ones and showing an association between lower PA and technological social interactions. The interaction between PA and the MDD group for phone social interactions suggests that the relation between state PA and the probability of engaging in phone social interactions was less negative for subjects in MDD compared to those in CG. This means that while participants with MDD used their phone less when they experienced higher PA, they still used it more often than when the CG experienced higher PA. This might be a consequence of the mood-brightening effect (individuals with depression exhibit an enhanced mood response to positive daily events (Bylsma, Taylor-Clift, & Rottenberg, 2011). If patients with MDD experienced a phone social interaction as positive, the associated enhanced mood response might lead to them using the phone more often in the future, despite the negative plunge afterwards. This possibly indicates that social interactions precede affect. While this is in line with suggestions by other researchers (e.g., Vranceanu et al., 2009), further studies are necessary to clarify the temporal sequence.

Technological social interactions and NA, and face-to-face social interactions and PA

The association between technological social interactions and NA, and between face-to-face social interactions and PA can be interpreted in two ways: First, the type of social

interaction might elicit different types of affect. If this is the case, it is possible that a type of social interaction might be associated with a certain frustration (e.g., wanting to see a person face-to-face but only being able to stay in touch with them through technological matters), possibly leading to an increase in NA. Second, affect might impact the selection of type of social interaction. In this case, one interpretation might be that participants try to avoid NA (associated with face-to-face social interactions) and therefore engage more in technological social interactions. While claiming causality is not possible, the latter interpretation seems plausible in the light of MDD patients experiencing social interactions less positively and less enjoyably (Nezlek et al., 2000) and experiencing more NA in social interactions (Baddeley et al., 2012), and SP patients having a strong fear of social situations (Rapee & Spence, 2004). A vicious cycle might result in both diagnoses: usage of more negative language, and experiencing more NA (Baddeley et al., 2012), as in depression, and likewise worrying about negative evaluation by others (Kashdan & Farmer, 2014; Rapee & Heimberg, 1997), thus experiencing higher levels of NA and tending to interpret social interactions in a negative fashion (Stopa & Clark, 2000), as in SP might lead to a desire to avoid face-to-face social interactions. Thus, increased engagement in phone social interactions might serve as a safety behavior. A consequence of this might be increased negative communication behavior from the interaction partner (Rehman et al., 2008) and fewer people wanting to interact with the individual. Therefore, there is also less chance of experiencing PA during social interactions, starting the vicious cycle anew. Nevertheless, regardless of which interpretation is correct, putative factors contributing to these relationships need to be established in future research. Developers of interventions, whether technological or not, and clinicians applying interventions may consider these possible interpretations.

This study is also relevant for clinical approaches, which increasingly use technology in therapy, e.g., computerized cognitive behavioral therapy (CCBT) or internet-delivered

cognitive behavioral therapy (iCBT) (Andrews et al., 2018; Kaltenthaler et al., 2006). Considering the present results, technological clinical approaches might want to examine whether patients potentially use technological interventions partly to avoid face-to-face social interactions, in addition to using them as a therapeutic tool. Needless to say, patients should be encouraged to seek treatment, be it through face-to-face or online programs or sessions. However, technological interventions and therapies in general should recognize the importance of helping patients engage in face-to-face social interactions, even if the intervention is based on online programs or sessions. Developers of technological tools must carefully consider the importance of preventing the technological intervention from being used as a safety behavior in future studies.

Additionally, social values tend to be more important to patients compared to other values (e.g., spirituality, recreation, or physical self-care) (Wersebe et al. 2017), and increasing values-related behavior precedes a reduction in suffering (Gloster et al. 2017b). Thus, if patients have strong social values and are encouraged to engage more often in those, for instance through more face-to-face social interactions, not only might more PA be a consequence but also a reduction in suffering. Increasing values-related behavior is also related to flexible responding, which helps buffer the impact of stress on social interactions (Gloster et al. under review).

This study had several limitations: First, participants reported considering the time since the last reminder and not how they felt *during* a social interaction. However, ESM (today's gold standard) provided more close-meshed information, including state affect, which can be valuable in therapy (Scollon, Chu, & Diener, 2009). Second, the categorization of the technological types of social interactions was subjective. Verification via one's smartphone log is technologically possible. However, we chose to maximize data security by issuing participants a study smart phone. Future research that wishes to use participants own phone

would allow such verification. This would require researchers to balance data security issues and participants would need to give researchers access to their personal smartphone. Third, even with this fine-grained data and rich multilevel structure, it is not possible to claim causality, although it is suggested that social experiences are more likely to precede affect than follow it (Vranceanu et al., 2009). Future studies might investigate temporal properties of antecedents and consequences. Fourth, within phone and internet/chat social interactions, there are possibilities of communicating that probably differ in their information availability (e.g., phone calls vs. text messages, anonymous chat rooms vs. Skype calls). However, the focus was on finding potential differences between phone social interactions and internet/chat social interactions generally, as opposed to differences within one type of social interaction. Future studies may include additional items to differentiate text messages and phone calls.

These limitations notwithstanding, this study provides new insights into the social interactions of individuals diagnosed with MDD and SP, also by countering the lack of studies explicitly investigating relationships between clinically relevant social anxiety and online communication (Schulz & Hoyer, 2016). To the best of our knowledge, this is the first study to investigate different types of social interactions, combined with different affect states (PA and NA), across a mood disorder, an anxiety disorder, and a CG, hence testing for specificity while also testing the moderating effect of affect. Therefore, this study has practical implications: lower NA levels and higher PA levels might aid the patient to be more open to experiences and situations, possibly leading to a more fulfilling life. Moreover, it also contributes to theoretical knowledge: the association of different types of social interactions with PA and NA might help uncover mechanisms for the maintenance or alleviation of MDD and SP.

Research to date mainly focused on *whether* a social interaction occurred. However, this study shows that *how* a social interaction occurs is equally important: Participants

diagnosed with MDD or SP engaged more often in phone social interactions and less in face-to-face social interactions. Across all groups, when PA levels were high, more face-to-face social interactions were reported, while when NA levels were high, more technological social interactions were reported. Despite our advancing technology certainly making many things easier or even possible, at least in terms of affect, our phones and the internet cannot replace real-life interactions.

References

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th Ed.). Washington, DC: American Psychological Association.

Andrews, G., Basu, A., Cuijpers, P., Craske, M. G., McEvoy, P., English, C. L., & Newby, J. M. (2018). Computer therapy for the anxiety and depression disorders is effective, acceptable and practical health care: An updated meta-analysis. *Journal of Anxiety Disorders*, *55*(February), 70–78. https://doi.org/10.1016/j.janxdis.2018.01.001

Baddeley, J. L., Pennebaker, J. W., & Beevers, C. G. (2012). Everyday Social Behavior During a Major Depressive Episode. *Social Psychological and Personality Science*, *4*(4), 445–452. https://doi.org/10.1177/1948550612461654

Barger, S. D., Messerli-Bürgy, N., & Barth, J. (2014). Social relationship correlates of major depressive disorder and depressive symptoms in Switzerland: nationally representative cross sectional study. *BMC Public Health*, *14*(1), 14–273. https://doi.org/10.1186/1471-2458-14-273

Brondolo, E., Brady, N., Thompson, S., Tobin, J. N., Cassells, A., Sweeney, M., … Contrada, R. J. (2008). Perceived Racism and Negative Affect: Analyses of Trait and State Measures of Affect in a Community Sample. *Journal of Social and Clinical Psychology*, *27*(2), 150–173. https://doi.org/10.1521/jscp.2008.27.2.150

Brown, L. H., Strauman, T., Barrantes-Vidal, N., Silvia, P. J., & Kwapil, T. R. (2011). An Experience-Sampling Study of Depressive Symptoms and Their Social Context. *The Journal of Nervous and Mental Disease*, *199*(6), 403–409. https://doi.org/10.1097/NMD.0b013e31821cd24b

Brown, T. A., DiNardo, P. A., & Barlow, D. H. (1994). Diagnosis. In *Anxiety Disorders Interview Schedule for DSM-IV: Client Interview Schedule* (Adult Vers, p. 77). Graywind Publications Incorporated.

Bylsma, L. M., Taylor-Clift, A., & Rottenberg, J. (2011). Emotional reactivity to daily events in major and minor depression. *Journal of Abnormal Psychology*, *120*(1), 155–167. https://doi.org/10.1037/a0021662

Carli, V., Durkee, T., Wasserman, D., Hadlaczky, G., Despalins, R., Kramarz, E., … Kaess, M. (2013). The association between pathological internet use and comorbid psychopathology: A systematic review. *Psychopathology*, *46*(1), 1–13. https://doi.org/10.1159/000337971

Ciarrochi, J., Parker, P., Sahdra, B., Marshall, S., Jackson, C., Gloster, A. T., & Heaven, P. (2016). The Development of Compulsive Internet Use and Mental Health: A Four-Year

Study of Adolescence. *Developmental Psychology*, *52*(2), 272–283.

Clark, L. A., & Watson, D. (1988). Mood and the mundane: relations between daily life events and self-reported mood. *Journal of Personality and Social Psychology*, *54*(2), 296–308. https://doi.org/10.1037/0022-3514.54.2.296

Darwin, C. (1859). Chapter IV: Natural Selection. In *On the Origin of Species* (pp. 51–82). Mineola, New York: Dover Publications, Inc.

Feldman Barrett, L., & Russell, J. A. (1998). Independence and Bipolarity in the Structure of Current Affect. *Journal of Personality and Social Psychology*, *74*(4), 967–984. https://doi.org/10.1037/0022-3514.74.4.967

First, M. B., & Gibbon, M. (2004). The Structured Clinical Interview for DSM-IV Axis I Disorders (SCID-I) and the Structured Clinical Interview for DSM-IV Axis II Disorders (SCID-II). In M. J. H. & D. L. Segal (Ed.), *Comprehensive handbook of psychological assessment, Vol. 2. Personality assessment* (pp. 134–143). Hoboken, NJ, US: John Wiley & Sons Inc.

Gloster, A. T.,Miché, M.,Wersebe, H., Mikoteit, T., Hoyer, J., Imboden, C., & Lieb, R. (2017). Daily fluctuation of emotions and memories thereof: Design and methods of an experience sampling study of major depression, social phobia, and controls. *International journal of methods in psychiatric research*, *26*(3), e1578.

Gloster, A. T., Klotsche, J., Ciarrochi, J., Eifert, G., Sonntag, R., Wittchen, H.-U., & Hoyer, J. (2017b). Increasing valued behaviors precedes reduction in suffering: Findings from a randomized controlled trial using ACT. *Behaviour Research and Therapy*, *91*, 64–71. https://doi.org/10.1016/j.brat.2017.01.013.

Gloster, Hoyer, Karekla, Meyer, Bader, Imboden, Mikoteit, Hatzinger, and Lieb (under review). Having my stress and seeing you too: How response styles moderate the relationship between daily stress and social interactions in depression, social phobia, and controls. Manuscript submitted for publication.

Husky, M. M., Gindre, C., Mazure, C. M., Brebant, C., Nolen-Hoeksema, S., Sanacora, G., & Swendsen, J. (2010). Computerized ambulatory monitoring in mood disorders: Feasibility, compliance, and reactivity. *Psychiatry Research*, *178*(2), 440–442. https://doi.org/10.1016/j.psychres.2010.04.045

Jin, B., & Park, N. (2010). In-Person Contact Begets Calling and Texting: Interpersonal Motives for Cell Phone Use, Face-to-Face Interaction, and Loneliness. *Cyberpsychology, Behavior, and Social Networking*, *13*(6), 611–618. https://doi.org/10.1089/cyber.2009.0314

Kaltenthaler, E., Brazier, J., De Nigris, E., Tumur, I., Ferriter, M., Beverley, C., … Sutcliffe, P. (2006). Computerised cognitive behaviour therapy for depression and anxiety update: a systematic review and economic evaluation. *Health Technology Assessment*, *10*(33). https://doi.org/10.3310/hta6220

Kashdan, T. B., & Farmer, A. S. (2014). Differentiating Emotions Across Contexts: Comparing Adults with and without Social Anxiety Disorder Using Random, Social Interaction, and Daily Experience Sampling. *Emotion*, *14*(3), 629–638. https://doi.org/doi:10.1037/a0035796.

Kashdan, Todd B, & Steger, M. F. (2006). Expanding the Topography of Social Anxiety. *Psychological Science*, *17*(2), 120–128. https://doi.org/10.1111/j.1467-9280.2006.01674.x

Kupferberg, A., Bicks, L., & Hasler, G. (2016). Social functioning in major depressive disorder. *Neuroscience and Biobehavioral Reviews*, *69*, 313–332. https://doi.org/10.1016/j.neubiorev.2016.07.002

Levine, E. L., Xu, X., Yang, L.-Q., Ispas, D., Pitariu, H. D., Bian, R., … Musat, S. (2011). Cross-National Explorations of the Impact of Affect at Work Using the State-Trait Emotion Measure: A Coordinated Series of Studies in the United States, China, and Romania. *Human Performance*, *24*(5), 405–442. https://doi.org/10.1080/08959285.2011.614302

Madell, D. E., & Muncer, S. J. (2007). Control over Social Interactions: An Important Reason for Young People's Use of the Internet and Mobile Phones for Communication? *CyberPsychology & Behavior*, *10*(1), 137–140. https://doi.org/10.1089/cpb.2006.9980

Maričić, A., & Štambuk, M. (2015). The Role of Loneliness in the Relationship Between Social Anxiety and Subjective Well-Being: Using the Social Phobia Inventory (SPIN) as a Measure. *Drustvena Istrazivanja*, *24*(3), 407–426. https://doi.org/10.5559/di.24.3.05

McKenna, K., & Bargh, J. A. (2000). Plan 9 From Cyberspace: The Implications of the Internet for Personality and Social Psychology. *Personality and Social Psychology Review*, *4*(1), 57–75. https://doi.org/https://doi.org/10.1207/S15327957PSPR0401_6

McKenna, K. Y. A., & Bargh, J. A. (1999). Causes and Consequences of Social Interaction on the Internet: A Conceptual Framework. *Media Psychology*, *1*(3), 249–269. https://doi.org/10.1207/s1532785xmep0103

Meerkerk, G. J., Van Den Eijnden, R. J. J. M., Vermulst, A. A., & Garretsen, H. F. L. (2009). The Compulsive Internet Use Scale (CIUS): Some psychometric properties. *Cyberpsychology and Behavior*, *12*(1), 1–6. https://doi.org/10.1089/cpb.2008.0181

Münzer, S., & Borg, A. (2008). Computer-Mediated Communication: Synchronicity and Compensatory Effort. *Applied Cognitive Psychology*, *22*(5), 663–683. https://doi.org/10.1002/acp.1387

Nezlek, J. B., Hampton, C. P., & Shean, G. D. (2000). Clinical Depression and Day-to-Day Social Interaction in a Community Sample. *Journal of Abnormal Psychology*, *109*(1), 11–19. https://doi.org/10.1037/0021-843X.109.1.11

Nezlek, J. B., Imbrie, M., & Shean, G. D. (1994). Depression and everyday social interaction. *Journal of Personality and Social Psychology*, *67*(6), 1101–1111. https://doi.org/10.1037/0022-3514.67.6.1101

Nie, N. H., & Erbring, L. (2002). Internet and Society: A Preliminary Report. *IT & Society*, *1*(1), 275–283.

Pierce, T. (2009). Social anxiety and technology: Face-to-face communication versus technological communication among teens. *Computers in Human Behavior*, *25*(6), 1367–1372. https://doi.org/10.1016/j.chb.2009.06.003

Rapee, R. M., & Heimberg, R. G. (1997). A cognitive-behavioral model of anxiety in social phobia. *Behaviour Research and Therapy*, *35*(8), 741–756. https://doi.org/10.1016/S0005-7967(97)00022-3

Rapee, R. M., & Spence, S. H. (2004). The etiology of social phobia: Empirical evidence and an initial model. *Clinical Psychology Review*, *24*(7), 737–767. https://doi.org/10.1016/j.cpr.2004.06.004

Rehman, U. S., Gollan, J., & Mortimer, A. R. (2008). The marital context of depression: Research, limitations, and new directions. *Clinical Psychology Review*, *28*(2), 179–198. https://doi.org/10.1016/j.cpr.2007.04.007

Reid, D. J., & Reid, F. J. M. (2007). Text or talk? Social anxiety, loneliness, and divergent preferences for cell phone use. *Cyberpsychology & Behavior*, *10*(3), 424–435. https://doi.org/10.1089/cpb.2006.9936

Schulz, A., & Hoyer, J. (2016). Onlinekommunikation und soziale Angst. *Klinische Psychologie Und Psychotherapie*, *45*(2), 132–144. https://doi.org/10.1026/1616-3443/a000360

Scollon, C. N., Chu, K.-P., & Diener, E. (2009). Experience Sampling: Promises and Pitfalls, Strengths and Weaknesses. In *Diener E. (eds) Assessing Well-Being. Social Indicators Research Series* (Vol. 39, pp. 5–34). Dordrecht: Springer. https://doi.org/https://doi.org/10.1007/978-90-481-2354-4_8

Spence, S. H., & Rapee, R. M. (2016). The etiology of social anxiety disorder: An evidence-

based model. *Behaviour Research and Therapy*, *86*, 50–67. https://doi.org/10.1016/j.brat.2016.06.007

Stone, A. A., Shiffman, S., Schwartz, J. E., Broderick, J. E., & Hufford, M. R. (2003). Patient compliance with paper and electronic diaries. *Controlled Clinical Trials*, *24*(2), 182–199. https://doi.org/10.1016/S0197-2456(02)00320-3

Stopa, L., & Clark, D. M. (2000). Social phobia and interpretation of social events. *Behaviour Research and Therapy*, *38*(3), 273–283. https://doi.org/10.1016/S0005-7967(99)00043-1

Trull, T., & Ebner-Priemer, U. W. (2009). Using Experience Sampling Methods/Ecological Momentary Assessment (ESM/EMA) in Clinical Assessment and Clinical Research: Introduction to the Special Section. *Psychological Assessment*, *21*(4), 457–462. https://doi.org/10.1037/a0017653

Vranceanu, A. M., Gallo, L. C., & Bogart, L. M. (2009). Depressive symptoms and momentary affect: The role of social interaction variables. *Depression and Anxiety*, *26*(5), 464–470. https://doi.org/10.1002/da.20384

Watson, D, & Clark, L. A. (1984). Negative affectivity: the disposition to experience aversive emotional states. *Psychological Bulletin*, *96*(3), 465–490. https://doi.org/10.1037/0033-2909.96.3.465

Watson, David, Clark, L. A., & Carey, G. (1988). Positive and negative affectivity and their relation to anxiety and depressive disorders. *Journal of Abnormal Psychology*, *97*(3), 346–353. https://doi.org/10.1037/0021-843X.97.3.346

Watson, David, Clark, L. A., & Tellegen, A. (1988). Development and Validation of Brief Measures of Positive and Negative Affect: The PANAS Scales. *Journal of Personality and Social Psychology*, *54*(6), 1063–1070. https://doi.org/10.1037/0022-3514.54.6.1063

Wersebe, H., Lieb, R., Meyer, A. H., Hoyer, J., Wittchen, H. U., & Gloster, A. T. (2017). Changes of valued behaviors and functioning during an Acceptance and Commitment Therapy Intervention. *Journal of Contextual Behavioral Science*, 6(1), 63–70. https://doi.org/10.1016/j.jcbs.2016.11.005.

Wittchen, H.-U., Wunderlich, U., Gruschwitz, S., & Zaudig, M. (1997). *Strukturiertes klinisches Interview für DSM-IV, Achse-I (SKID).* Göttingen, Hogrefe.

Ybarra, M. L., Alexander, C., & Mitchell, K. J. (2005). Depressive symptomatology, youth Internet use, and online interactions: A national survey. *Journal of Adolescent Health*, *36*(1), 9–18. https://doi.org/10.1016/j.jadohealth.2003.10.012

Yen, J.-Y., Yen, C.-F., Chen, C.-S., Wang, P.-W., Chang, Y.-H., & Ko, C.-H. (2012). Social

anxiety in online and real-life interaction and their associated factors. *Cyberpsychology, Behavior and Social Networking*, *15*(1), 7–12. https://doi.org/10.1089/cyber.2011.0015

List of tables and figures

Tables

Table 1.

Frequencies of social interactions by type between patients diagnosed with major depressive disorder or social phobia and the control group.

[Table 1 here]

Table 2.

Frequencies of social interactions by type, depending on diagnosis (major depressive disorder, social phobia) and **negative or positive** affect.

[Table 2 here]

Figures

[Figure 1 here]

Figure 1. Differences in engagement in different types of social interaction, depending on diagnostic group (MDD, SP, CG), based on results of the GLMM. The MDD and SP groups used their phones significantly more often than did the CG. CG: control group; MDD: major depressive disorder; SP: social phobia. *$p < 0.05$

[Figure 2 here]

Figure 2. Differences in engagement in different types of social interaction, depending on diagnostic group (MDD, SP, CG) and state **negative affect and positive affect**, based on results of the GLMM. Panels (a) to (c) correspond to negative affect, panels (d) to (f) correspond to positive affect. The relationships between mean centered state negative/positive affect and the probability of a type of social interaction are depicted on group level (black, medium gray, and light gray lines). The relationships on the group level are all significant ($p < 0.00$). CG: control group; MDD: major depressive disorder; SP: social phobia.