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Technical Challenges of a Mobile Application Supporting Intersession Processes in Psychotherapy

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Abstract

The usage of mobile applications in healthcare is gaining popularity in recent years. The ubiquity of a sophisticated mobile appliance that is applicable to sample ecological patient data in real life by acquiring both mental state and environmental data has enabled new possibilities for researchers and healthcare providers. Collecting data using the mentioned approach is often called Ecological Momentary Assessment (EMA) and is characterized by an unidirectional data flow towards the platform provider. A more challenging approach, in turn, is called Ecological Momentary Intervention (EMI). The latter requires a bidirectional data flow in order to enable the possibility of sending feedback to the patients and controlling their experiences through interventions. Although both approaches are established parts of IT-supported treatments in the field of psychology and psychotherapy until now, the so-called intersession process has not been technically supported appropriately yet. Therefore, the *Intersession-Online* platform was developed in order to (a) assess intersession processes systematically, (b) monitor a patient, and (c) intervene by suppressing negative thoughts concerning the therapy. In this paper, the technical requirements, architecture, and features of the mobile application of the *Intersession-Online* platform are presented. In this context, the development of a patient data sampling mechanism, which consists of a sophisticated, inter-questionnaire dependent sampling schedule and synchronization strategy is particularly illustrated and discussed. Altogether, the technical challenges will show that a mobile application supporting intersession processes in psychotherapy is an endeavor which requires many considerations. However, on the other, such a mobile application may be the basis for new technical as well as psychological insights.

Keywords: Ecological Momentary Intervention; Ecological Momentary Assessment; Mobile Crowdsensing; Intersession Experience; Psychotherapy; Intersession Processes

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1. Introduction

In the field of Mobile Health (mHealth) research, several new paradigms have been introduced throughout the last years that are able to support many questions in medicine and psychology. Especially the paradigms mobile crowdsourcing, mobile crowdsensing, and Ecological Momentary Assessments have garnered a lot of attention [18, 15]. A major idea of these approaches is to utilize the powerful capabilities of smart mobile devices to assess healthcare parameters of patients in daily life without burdening them much (as a particular advantage compared to clinical procedures). As a result, new data sources and insights can be established [17]. However, still one major shortcoming of all these approaches constitutes the way how patients are involved. To be more specific, in the aforementioned approaches, only (or mainly) an unidirectional data flow strategy is applied [2].

In the work at hand, a framework was developed that mainly pursues the accomplishment of two aims that are related to a bidirectional data flow strategy in the mHealth context: First, in the field of psychology and psychotherapy, so-called intersession processes should be supported by a proper technical mHealth solution [5]. Second, with respect to the latter aim, the pursued mHealth solution shall make use of Ecological Momentary Assessments and Ecological Momentary Interventions [5].

Regarding the first aspect, intersession processes [26, 5] characterize the processes happening in the period of time between two sessions of a patient with his/her therapist. From a research perspective, this phase is still rather unexplored as it is complex to monitor patients during this phase properly without burdening them much. Therefore, having the capabilities of modern smart mobile devices in mind, a technical solution was developed to support intersession processes by Ecological Momentary Assessments (EMAs; [15]) and Ecological Momentary Interventions (EMIs; [8]). EMIs shall be the basis of giving feedback and support back to a patient based on the following two aspects. First, the applied EMIs shall consider personal aspects and gathered data of patients while they are being in the intersession phase. Second, applied EMIs shall be applied similarly to EMAs in the daily life of patients in an efficient and unobtrusive manner; again, while patients are being in the intersession phase. To support the intersession processes properly, the mHealth solution *Intersession-Online* was developed. This platform, in turn, comprises the following three distinct components: (1) mobile applications for iOS and Android, (2) a server component providing the business logic, and (3) a feature-rich web application for therapists and researchers to manage patients, data, and EMAs as well as EMIs (see Figure 1). In this work, we focus on the mobile side of the *Intersession-Online* platform. More specifically, based on the example of iOS, we delineate the technical challenges to deal with the two major aspects raised above for the entire platform. As it will be shown, a complex mobile application had to be developed [28] in order to properly cope with the requirements that emerge with respect to the mentioned two aims of the *Intersession-Online* platform.

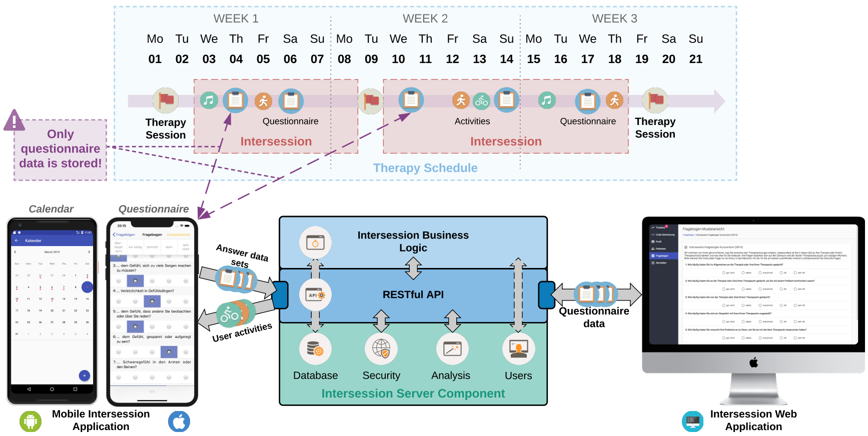

Fig. 1: The *Intersession-Online* Platform at a Glance [5]

The remainder of this work is organized as follows. In Section 2, related works are discussed. As the overall procedure that has to be accomplished by patients when using the developed platform is complex, the procedure and important background information are introduced in Section 3. Based on this, Section 4 discusses a key component of the platform, the mobile application. In Section 5, the current practical use is discussed, while Section 6 summarizes the work and provides an outlook of future work.

2. Related Work

Regarding related approaches that are in the scope of this work, two perspectives are of interest. First, technical approaches that support EMAs and EMIs. Second, technical approaches that directly support intersession processes. Regarding the latter, also approaches that do not utilize mobile technology must be considered separately. **Regarding the first perspective**, many solutions have been introduced in the field of EMAs [17, 25, 10]. These approaches impressively show that daily life data is a very promising source for current healthcare research. By the nature of EMAs, respective work mainly focus on the collection and less on the feedback procedure based on the gathered data. In the field of EMIs, approaches using mobile technology have been already proposed that are related to this work. For example, in the context of remote therapeutic interventions, the time period between the sessions with a therapist has been addressed [23]. Another promising approach is to provide just-in-time interventions on the smartphone between sessions [11]. Also, in clinical trials, intersession interventions were applied [27]. Interestingly, all mentioned approaches have two aspects in common. They are rather recent developments, which shows that EMIs are an emerging topic. Second, they do not systematically focus on the technical challenges of a proper mobile application for intersession processes in this context as done by this work. However, when looking at EMIs as a proper feedback mechanism for patients, other works have impressively shown that promising possibilities are given [14, 19]. Note that if methods from the field of artificial intelligence are combined with EMIs, then they can be particularly powerful instruments [16]. **Regarding the second perspective**, less approaches have been introduced that are directly related to the work at hand. As an exception, [23] and [24] are similar to the work at hand. Although they utilize mobile technology for therapeutic homework in the time period between sessions with a therapist, a mobile application like shown here was not presented. An approach that focuses on the support of intersession processes particularly by the use of web technologies can be found in [12]. Again, a complex mobile application is not a major focus of this work. Altogether, the aims raised in this paper can be partly found in other works as well, a combination of them implemented in a technical solution as shown here, to the best of the authors knowledge, is not pursued so far.

3. *Intersession-Online Procedure*

As already mentioned, the procedure that must be pursued to use the platform is complex. A detailed discussion can be found in [5]. However, the major aspects that are important in the context of this work are briefly introduced. Particularly, the patient participation follows a predefined procedure that is illustrated in Fig. 2. To use the platform, first of all, patients have to download the mobile application from an app store that corresponds to their installed operating system. Note that for Android and iOS apps have been officially released to the Google Play and the Apple App Store. Then, after downloading the app and the creation and validation of an account, the pursued procedure is split into a therapy-dependent and therapy-independent part that can be accomplished in parallel.

In the therapy-independent part, the sub-process shown in Fig. 2 Ⓐ is executed if the patient has a session appointment in the according week. The sub-process is responsible for the provision of a post-session questionnaires and the creation of a system notification according to the following schema: The patient is notified two hours after the completion of the session and is able to submit the questionnaires (see Table 1, Ⓐ) within 12 hours. If the submission period begins after 8pm, then the starting point in time is postponed till the following day at 8am.

In the therapy-dependent part of the *Intersession-Online* procedure, the patient firstly has to pair its user account with the therapist's by creating a therapy instance. The pairing task is necessary to ensure that the patient has an ongoing psychotherapeutic treatment and to prevent an app usage without professional help. For this reason, the therapist provides the patient with an individual code that is used for the pairing task. After starting the therapy, the pre-treatment sub-process (see Fig. 2, (D_1)) is triggered. The latter notifies the patient to fill in several questionnaires (see Table 1, Ⓓ). The therapy-dependent part itself is split into three looping routines: (1) a daily routine, (2) a weekly routine, and (3) a routine that is only accessed in the weekend.

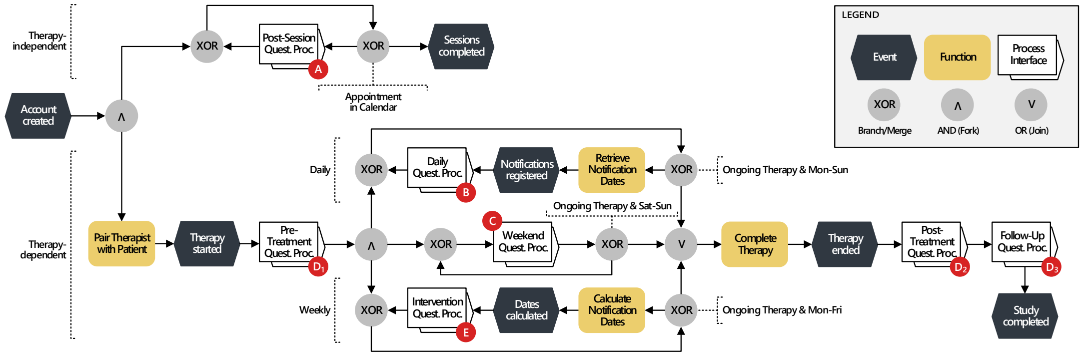

Fig. 2: *Intersession-Online-Procedure*, denoted in an Event-driven Process Chain (EPC) [22]

The daily routine is triggered per day and starts with the retrieval of the notification dates. An algorithm (see Algorithm 1) is responsible for the collision-free determination of three points in time, each in one of three distinct periods of four hours starting at 8am and ending at 8pm. The daily questionnaire procedure (see Fig. 2, (B)) is executed locally on the mobile device and the patient is able to submit the daily questionnaire within 30 minutes after the notification is displayed.

Furthermore, an intervention is triggered once a week. The latter, in turn, can have one of the following three types: commendation, question, or task. For example, a question could be *"What happened in the last therapy session and how did you feel?"*. Further information to interventions can be found in [5]. The intervention sub-process (see Fig. 2, (E)) is responsible for the notification and provision of the intervention. Importantly, the calculation of the notification time for interventions strongly depends on both the existence of an session appointment in the ongoing week and the submission of the weekend questionnaire of the last week. Therefore, it is executed by the *Intersession Server Component*. If the following conditions match, the intervention must be submitted starting at Monday 8am and ending at the day of the session at 8pm: (i) the therapy is not yet completed, (ii) there is a session appointment in the ongoing week and (iii) the questionnaire of the weekend routine was submitted.

If one of the conditions is not matching, the end of the submission period is extended till Friday 8pm. The result of the intervention is only visible for the patient and is therefore only stored locally. The weekend routine consists of the weekend questionnaire sub-process (see Fig. 2, (C)) and is executed every weekend in an ongoing therapy. The questionnaire shall be submitted starting at Saturday 8am and ending at Sunday 4pm, but not between Saturday 8pm and Sunday 8am.

After the completion of the therapy, the post-treatment sub-process (see Fig. 2, (D$_2$)) is executed and the patient is notified to fill out the questionnaires depicted in Table 1 (D). Then, the follow-up sub-process shown in Fig. 2, (D$_3$) is executed, which creates notifications by applying the patterns of three, six, and 12 months. Note that at each notification, all the questionnaires of Table 1 (D) shall be filled out.

Questionnaire	**Post-Session (A)**	**Daily (B)**	**Weekend (C)**	**Pre-Treatment (D$_1$)**	**Post-Treatment (D$_2$)**	**Follow-Up (D$_3$)**
Intersession Daily		×				
Intersession Questionnaire (ISF-K) [6]			×			
Working Alliance Inventory (WAI-SR) [29]	×					
SCL-K-9 [13]	×		×			
Childhood Trauma Questionnaire (CTQ) [30]				×	×	×
List of Pathogenic Beliefs (LPB) [21]				×	×	×
Mentalization Questionnaire (MZQ) [7]				×	×	×
Relationship Questionnaire (RQ) [1]				×	×	×
Inventory of Personality Organization (IPO-57) [3]				×	×	×
Personality Inventory for DSM-5 (PID-5-BF) [31]				×	×	×
Health-49 (Module A-F) [20]				×	×	×

Table 1: Questionnaire Groups (cf. Fig. 2, labeled process interfaces)

3.1. Questionnaire Management

As the number of used questionnaires for the *Intersession-Online* platform is high compared to other related platforms, the used questionnaires are briefly introduced. They are also a key aspect that complex notification (see Section 4.1) and synchronization (see Section 4.2) schemes became necessary. In Table 1, all used questionnaires are listed. It is further distinguished at what point in time they are applied to a patient (see Table 1, Ⓐ-Ⓓ). Importantly, the points in time are denoted in Fig. 2 with the same labels Ⓐ, Ⓑ, Ⓒ and Ⓓ. All questionnaires except the *Intersession-Daily* are generated and dynamically provided by the server component (see Fig. 1). The server also calculates the notification dates for the questionnaire groups shown in Table 1, Ⓐ, Ⓑ, Ⓓ. Further information to the entire questionnaire management can be found in [5, 28, 9].

4. Mobile Application

A crucial component of the *Intersession-Online* platform constitutes the mobile application as it has to provide most of the features on one hand, while supporting the patient in his/her ongoing therapy properly on the other. For this reason, the *Intersession-Online* procedure requires the fulfillment of several technical requirements, which have been elaborated in collaboration with the domain experts from the field of psychology [5]. They are summarized in Table 2. Note that we discuss the mobile application based on the iOS-implementation [28]. Although technically some aspects are different on Android, the basic strategy is the same for both mobile operating systems.

As the *Intersession-Online* platform constitutes a distributed system, the characteristics of such systems [4] have to be carefully considered. For example, a sophisticated synchronization feature that handles the exchange of data between the application modules and the RESTful API of the server component is crucially required. Therefore, a synchronization module was designed as the central application module that handles the bidirectional data flow and ensures full functionality of all application features even if no internet connection is available (see Table 2, No. 1, 2). Due to the importance of a powerful synchronization, one use case, namely the synchronization of intervention meta data (see Table 2, No. 10), is discussed in Section 4.2.

In addition, the mobile application has to meet general requirements when working in a multi-user environment like a general account management or the management of settings for the mobile application itself (see Table 2, No. 3, 4, 15, 16). In order to be able to support the overall study design, the mobile application must provide a feature to inform the patient about the study participation agreement, including the possibility to confirm or revoke the agreement (see Table 2, No. 17-19). To ensure the professional help by a therapist, the application must enforce a pairing procedure (see Table 2, No. 5-6) that is based on a shared individual code between therapist and patient. Furthermore, a reliable data collection mechanism must be supported by guaranteeing the notification of questionnaires to be submitted and the rendering of dynamic content inside the questionnaires (see Table 2, No. 7, 8, 14). Although the intersession process should be interruptible in cases of unforeseen events, a sophisticated intervention module is necessary that ensures both privacy and monitoring. Moreover, the therapy itself must be supported by guaranteeing the creation of system notifications and the synchronization of intervention meta data (see Table 2, No. 9-11). The architecture of the mobile applications follows the Model-View-Controller (MVC) software pattern and separates the graphical user interface from the business logic and the data persistence layer. Each requirement group shown in Table 2 is developed as an independent module that communicates through well-defined interfaces.

4.1. Daily Notifications

Notifications are a key feature for each EMA-based data collection application to ensure a consistent sampling rate. In general, all notifications for questionnaires are calculated by the server except the one for daily questionnaires. The reason to calculate the daily notifications by the mobile application itself was to ensure the best possible offline functionality. The algorithm for the daily notifications has the following characteristics. Within the three time windows, a daily questionnaire notification appears on a random basis within one time period: 8am to 12pm, 12pm to 4pm, and 4pm to 8pm. After the notifications has appeared, the questionnaire can be filled out for 30 minutes. After the 30 minutes, the questionnaire cannot be filled out any longer. Furthermore, if a daily notification appears at the end of one of the three periods and the 30 minutes availability period intersects with the following period, the starting

Requirement Group	No	Title	Description
Synchronization	01	Offline Mode	Ensure all features even without internet connectivity.
	02	Multiple Devices	Synchronize data between different mobile devices.
Account	03	Manage	Create, validate, and authenticate user credentials.
	04	Profile	Show/Update user related information and settings.
Therapy	05	Pairing	Pair patient and therapist.
	06	Information	Show therapist information.
Questionnaires	07	Submission	List and submit questionnaires.
	08	Rendering	Render dynamic input structures of questionnaires.
Interventions	09	Manage	Manage patient interventions.
	10	Meta Data	Synchronize intervention meta data.
	11	Completion	Save completed interventions locally.
Appointments	12	Manage	List, create, edit, and delete appointments.
	13	Calendar View	Show appointments in calendar.
Notifications	14	System Notification	Display custom notifications.
Settings	15	Notification	Edit notification settings.
	16	Profile	Edit profile settings.
Data Privacy & Study Participation	17	Privacy Agreement	Show information and confirm data privacy.
	18	Study Participation	Approve/Withdraw data sharing agreement.
	19	Contact Data	Show contact data of platform provider.

Table 2: Functional Requirements of the Mobile Application

time of the following period is adjusted to the future by the time that intersects with the former period. How these notifications are calculated for the daily questionnaires is illustrated in the listing of Algorithm 1. To ensure that the data of the filled out questionnaires is synchronized with the server, even when submitted in offline mode, a complex synchronization mechanism was developed (see therefore the next section).

4.2. Intervention Synchronization

For the filled out data of the daily questionnaires as well as all other gathered data by the mobile application, two aspects are of utmost importance. First of all, the pursued mechanism should be robust and reliable. Second, and more importantly, it must be ensured that the mobile device can always work in an offline manner. Therefore, a complex synchronization mechanism was developed for the mobile devices. Generally, relevant user inputs are stored locally and, once a data set is completed, synchronized with the server, when reachable. Based on the selected example for interventions, the mechanism is illustrated in Fig. 3. For more information, interested readers are referred to [28].

By using interventions, the intersession processes can be directed in a certain way. Yet, this can be disturbed if patients fear that the outcome of the intervention is shared without their consent. For this reason, the result of an intervention and its derived data is only stored locally on the mobile device and is never being synchronized with the server component. In order to monitor the execution and the awareness of an intervention, the meta data *seen* (i.e., intervention has been displayed) and *submitted* (i.e., intervention has been submitted locally) have to be tracked and synchronized by the application. The platform, and in particular the therapist, must know the current state of an intervention. Hence, possible states that can occur must be analyzed and considered. The developed model for this purpose can be obtained from Fig. 3. After the server-side creation of the intervention, an intervention instance is stored on the server. The synchronization module of the mobile application is from this point on responsible for the synchronization of the intervention data. Being locally persisted, the intervention data may be deleted on the server's side and must be deleted locally as well. The latter is accomplished regardless of whether the patient has noticed and has opened the intervention or not. If an intervention is not deleted and it was noticed or opened by the patient (e.g., after displaying a system notification), its state changes to *locally seen*. The state transition is either synchronized with the server component or stored locally in case of lacking internet connectivity. In either cases, the patient is now able to execute and to complete the intervention's task. Note that the completion is bounded to a time period and cannot be completed by the patient after the time period, whereas locally stored meta data (*seen* and *submitted*) will still be synchronized with the server. For simplification reasons, the latter state transition is not included in Fig. 3. Eventually, the intervention state is either deleted or completed on both the server and the mobile application side.

Algorithm 1: `calcDates`

Input : List l, where each element is a tuple of integers. Integer d, the number of tuples to be created.
Output: List l, where each element is a tuple of integers.
Data:
- List t, where each element is a pair of integers, specifying the start- & endpoint of a time interval (minutes starting from 12am).
- Integer s, submission period (minutes).

if $sizeOf(l) >= d$ **then**
  return l
end if
$|t| = sizeOf(t)$
$q \leftarrow \{\}$
repeat
  $q_i = \lceil \texttt{random}(0..1) * (t_{i,1} - t_{i,0}) + t_{i,0} \rceil$
until $\forall i = 0..|t| - 1,\ \ q_i > (q_{i-1} + s)$;
$l \leftarrow l \cup q$
return `calcDates`(l, d)

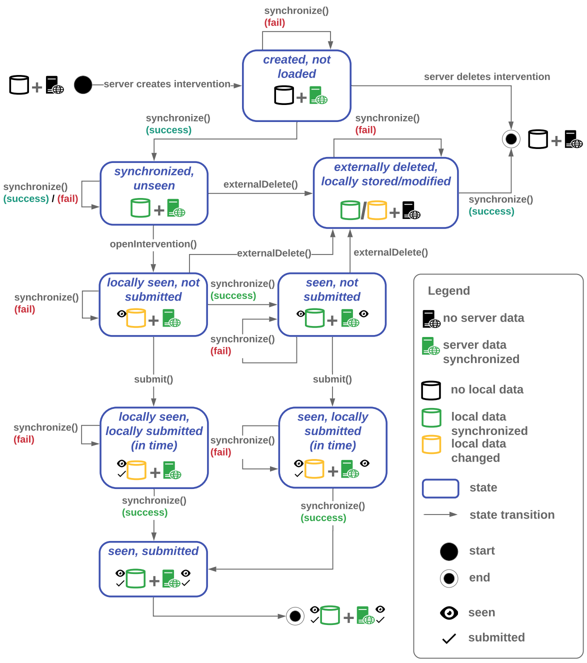

Fig. 3: Intervention Synchronization States

5. *Intersession-Online* in Practice

The components of the *Intersession-Online* platform are all implemented and the deployed platform can be found at the website `www.intersession-online.de`. In addition, the Android and iOS apps can be found in the respective app stores. Currently, the entire platform is tested in an outpatient clinic in Austria. So far, 10 patients are using the platform for a longer period of time. Further results are expected within the next 2-3 months.

6. Summary and Outlook

This work presented the *Intersession-Online* platform. The latter pursues two major goals, namely the proper support of intersession processes by mobile technology and the integration of Ecological Momentary Assessments as well as Ecological Momentary Interventions for the intersession processes. Based on the platform component of the mobile iOS application, this work has shown that a technical complex implementation becomes necessary to address the two goals. In particular, it was shown that the questionnaire, intervention, and notification management – in combination with the technical demand to support an offline mode – are challenging. The elaborated technical requirements were shown and to some of the requirements the technical solutions discussed. The current practical use shows already promising results, but further adjustments are certainly required. In addition, in future work, the integration of sensor measurements like the collection of GPS positions or vital signs (e.g., heart rate) are planned. To conclude, although many technical requirements had to be met, a feasible solution through the combination of different paradigms could be achieved that is able to address the requirements. We consider technical solutions like the one shown in this work as being decisive in the future research of medical questions in the daily life of patients.

References

[1] Bartholomew, K., Horowitz, L.M., 1991. Attachment Styles Among Young Adults: A Test of a Four-Category Model. Journal of personality and social psychology 61, 226.

[2] Beierle, F., et al., 2019. What data are smartphone users willing to share with researchers? Journal of Ambient Intelligence and Humanized Computing , 1–13.

[3] Dammann, G., et al., . IPO-2001/IPO-16: Inventar der Persönlichkeitsorganisation–Kurzversion .

[4] Deutsch, P., 1994. The Eight Fallacies of Distributed Computing.

[5] Gablonski, T., et al., 2019. Intersession-Online: A Smartphone Application for Systematic Recording and Controlling of Intersession Experiences in Psychotherapy. J—Multidisciplinary Scientific Journal 2, 480–495.

[6] Hartmann, A., et al., 2003. Der Inter-Session-Fragebogen (ISF)–Ein Instrument zur Erfassung von psychotherapierelevanten Prozessen zwischen Sitzungen. PPmP-Psychotherapie· Psychosomatik· Medizinische Psychologie 53, T67–T75.

[7] Hausberg, M., et al., 2012. Is a self-rated instrument appropriate to assess mentalization in patients with mental disorders? Development and first validation of the Mentalization Questionnaire (MZQ). Psychotherapy Research 22, 699–709.

[8] Heron, K.E., Smyth, J.M., 2010. Ecological Momentary Interventions: Incorporating Mobile Technology Into Psychosocial and Health Behavior Treatments. British journal of health psychology 15, 1–39. URL: https://pubmed.ncbi.nlm.nih.gov/19646331, doi:10.1348/135910709X466063.

[9] Huber, J., 2019. Conception and realization of a REST-based application programming interface for intersession-management in psychology, in: Bachelor Thesis, Ulm University.

[10] Huckins, J., et al., 2019. Fusing Mobile Phone Sensing and Brain Imaging to Assess Depression in College Students. Frontiers in Neuroscience 13, 248.

[11] Juarascio, A.S., et al., 2018. Just-in-time adaptive interventions: A novel approach for enhancing skill utilization and acquisition in cognitive behavioral therapy for eating disorders. The International journal of eating disorders 51, 826–830. doi:10.1002/eat.22924.

[12] Kaiser, T., Laireiter, A.R., 2017. DynAMo: A Modular Platform for Monitoring Process, Outcome, and Algorithm-Based Treatment Planning in Psychotherapy. JMIR medical informatics 5, e20.

[13] Klaghofer, R., Brähler, E., 2001. Konstruktion und Teststatistische Prüfung einer Kurzform der SCL-90–R. Zeitschrift für Klinische Psychologie, Psychiatrie und Psychotherapie .

[14] Klasnja, P., et al., 2019. Efficacy of Contextually Tailored Suggestions for Physical Activity: A Micro-randomized Optimization Trial of HeartSteps. Annals of Behavioral Medicine 53, 573–582.

[15] Kraft, R., et al., 2020. Combining Mobile Crowdsensing and Ecological Momentary Assessments in the Healthcare Domain. Frontiers in Neuroscience 14, 164.

[16] Menictas, M., et al., 2019. Artificial intelligence decision-making in mobile health. The Biochemist 41, 20–24.

[17] Probst, T., et al., 2016. Emotional states as mediators between tinnitus loudness and tinnitus distress in daily life: Results from the "TrackYourTinnitus" application. Scientific reports 6, 1–8.

[18] Pryss, R., 2019. Mobile Crowdsensing in Healthcare Scenarios: Taxonomy, Conceptual Pillars, Smart Mobile Crowdsensing Services, in: Digital Phenotyping and Mobile Sensing. Springer, pp. 221–234.

[19] Pryss, R., et al., 2018. A Personalized Sensor Support Toolfor the Training of Mindful Walking, in: 15th Int'l Conf on Wearable and Implantable Body Sensor Networks, IEEE. pp. 114–117.

[20] Rabung, S., et al., 2009. Psychometrische Überprüfung einer verkürzten Version der "Hamburger Module zur Erfassung allgemeiner Aspekte psychosozialer Gesundheit für die therapeutische Praxis" (HEALTH-49). Zeitschrift für psychosomatische Medizin und Psychotherapie , 162–179.

[21] Sammet, I., et al., 2007. Self-ratings of pathogenic beliefs: A study based on the psychodynamic control-mastery theory. Psychotherapy Research 17, 494–503.

[22] Scheer, A.W., et al., 2005. Process Modeling Using Event-Driven Process Chains. Process-aware information systems 119.

[23] Schickler, M., et al., 2017a. An IT Platform Enabling Remote Therapeutic Interventions, in: 30th Int'l Symposium on Computer-Based Medical Systems, IEEE. pp. 111–116.

[24] Schickler, M., et al., 2017b. Supporting Remote Therapeutic Interventions with Mobile Processes, in: Int'l Conf on AI & Mobile Services (AIMS), IEEE. pp. 30–37.

[25] Schlee, W., et al., 2016. Measuring the Moment-to-Moment Variability of Tinnitus: The TrackYourTinnitus Smart Phone App. Frontiers in aging neuroscience 8, 294.

[26] Stewart, S., Schröder, T., 2015. Emotional homework: A systematic literature review of patients' intersession experiences. Journal of Psychotherapy Integration 25, 236–252. doi:10.1037/a0039639.

[27] Timm, C., et al., 2018. Mindfulness-Based Attention Training Improves Cognitive and Affective Processes in Daily Life in Remitted Patients with Recurrent Depression: A Randomized Controlled Trial. Psychotherapy and psychosomatics 87.

[28] Vogel, C., 2019. Conception and realization of a mobile data acquisition and assistance application for intersession processes of patients in psychotherapeutic treatments at the example of the iOS platform, in: Master Thesis, Ulm University.

[29] Wilmers, F., et al., 2008. Die deutschsprachige Version des Working Alliance Inventory-short revised (WAI-SR)-Ein schulenübergreifendes, ökonomisches und empirisch validiertes Instrument zur Erfassung der therapeutischen Allianz. Klinische Diagnostik und Evaluation 1, 343–358.

[30] Wingenfeld, K., et al., 2010. Die deutsche Version des Childhood Trauma Questionnaire (CTQ): Erste Befunde zu den psychometrischen Kennwerten. PPmP-Psychotherapie· Psychosomatik· Medizinische Psychologie 60, 442–450.

[31] Zimmermann, J., et al., 2014. The Structure and Correlates of Self-Reported DSM-5 Maladaptive Personality Traits: Findings From Two German-Speaking Samples. Journal of personality disorders 28, 518–540.