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Chapter

Videoconferencing Psychotherapy in an App Environment for Trauma-Related Psychopathology

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Abstract

The theoretical background of the life-span sequelae of exposure to interpersonal psychological trauma (emotional or physical neglect or abuse or sexual abuse) in childhood, particularly when a primary caretaker is involved, and its assessment and treatment possibilities in a 100% online environment are outlined. These sequelae may be understood as a complex variant of PTSD (CPTSD) or a complicated array of overlapping mental and personality disorders or as trans-diagnostic symptoms. However, disorders of extreme stress not otherwise specified (DESNOS) constitute a distinct syndrome of potential clinical utility. In childhood, adolescence, and young adulthood (YA), these symptoms seem encompassed by developmental trauma disorder (DTD). Affect dysregulation, identity alterations, and relational impairment are central features of DESNOS/DTD/CPTSD and can also be understood as trans-diagnostic symptom clusters. More and more people use smartphone apps in daily life. Therefore we started our 100% online treatments in patients' environments and at their convenience (need driven). Our digitally enriched outpatient clinics (DOCs) using smartphone apps for videoconferencing psychotherapy (VCP) and personal data monitoring aim to augment established evidence-based treatment protocols. Also, they facilitate continuously gathering real-time sensor- and self-reported data that improve ecological validity of self-reports and monitoring for course of treatment and relapse prevention.

Keywords: childhood trauma, smartphone, app, videoconferencing psychotherapy, PTSD

1. Introduction

1.1 The life-span sequelae of exposure to interpersonal psychological trauma (emotional or physical neglect or abuse or sexual abuse) in childhood

Caretaker-related traumatic stressors are likely to occur in and contribute to a relational growth-inhibiting early environment, interfere with the development of optimal set points and strive for homeostasis of basic brain functioning, and may therefore adversely impact the development of self- and affect regulation capacities in childhood. Infants of caretakers who are unresponsive or poorly affectively attuned are at risk for developing insecure attachment. Infants who additionally experience an abusive caretaker are at risk for developing post-traumatic states of

enduring negative affect that may become disorganized attachment working models and chronic dysfunctional self- and affect regulation patterns. Such sequelae of early life "neurodevelopmental injuries" have been described as epidemic and understudied [1].

Also, the life-span sequelae of exposure to interpersonal psychological trauma (emotional or physical neglect or abuse or sexual abuse) in childhood, particularly when a primary caretaker is involved, do not seem to be encompassed by any single DSM disorder [2]. Symptoms include and extend symptoms associated with post-traumatic stress disorder (PTSD) with and without dissociative symptoms. Also, it has been argued that these sequelae also include a complex symptom presentation reflecting disturbances in (interpersonal) self-regulatory capacities and mental disorders that may occur comorbidly with or separately from PTSD [3]. Whether these sequelae are best understood as a complex variant of PTSD (CPTSD) or a complicated array of overlapping mental and personality disorders is controversial [4, 5]. However, there is mounting evidence that a disorder of extreme stress not otherwise specified (DESNOS) formulation of CPTSD constitutes a distinct syndrome of potential clinical utility [6, 7]. In childhood, adolescence, and young adulthood (YA), these symptoms seem encompassed by the developmental trauma disorder (DTD) formulation [8].

1.2 Affect dysregulation, identity alterations, and relational impairment

Three core features of the DESNOS formulation of CPTSD symptomatology and DTD were identified based on a comprehensive literature review [8]: affect dys-regulation, identity alterations (dissociation), and relational impairment (insecure attachment) [3, 9–12].

Affect dysregulation is defined as problems in experiencing, managing (keeping emotional arousal within the Window of Tolerance (WoT) [13]), or recovering from extreme states of affect, including both under-regulation of heightened affect states and maladaptive overregulation of affect (e.g., [14]). Under-regulation involves limited access to or capacity for deploying strategies to reduce intense affect states and associated difficulties with impulse control and goal-directed behavior (e.g., anger that escalates into rage or anxiety that becomes an unmanage-able state of terror). Overregulation involves nonacceptance and limited awareness or clarity of emotions (e.g., states of profound emotional emptiness or detachment) [15]. The latter has also been defined as alexithymia [16]. Alexithymia type I is characterized by low emotionality and a poor fantasy life in combination with poorly developed cognitions accompanying the emotions. This type is also referred to as core or full-blown alexithymia and displays both cognitive and affective alexithymia (e.g., [17, 18]). Alexithymia type II only suffers from cognitive alexithymia and is characterized by high emotionality and a rich fantasy life in combination with poorly developed cognitions accompanying the emotions. Alexithymia type II has been associated with childhood sexual abuse and PTSD symptoms (e.g., [19]).

Clinically, Lane differentiated levels of emotional awareness (LEAS; e.g., [20]), a three-dimensional cognitive-developmental framework that LEAS scores plausibly track, including the transition from focusing on external/physical to internal/psychological characteristics, greater conceptual complexity, and self-other differentiation. This concept is closely related to differentiating alexithymia types but highlights the cognitive-developmental character of emotional maturation and also taps into affective agnosia.

Identity alterations involve problems with maintaining a coherent sense of (mental and embodied) self within the WoT, which may take the form of dissociation symptoms including somatoform or embodied dissociative symptoms such

as conversion symptoms, pain, or somatization and psychoform or mentalized dissociative symptoms such as depersonalization, amnesia, or identity alterations that may turn into positive or negative forms of dissociation (e.g., [15, 21]). Trauma-related overwhelming affect and its dysfunctional regulation compromise the integrative capacities associated with cognitive-emotional information processing so that information becomes disassociated, disorganized, or disoriented (e.g., [22]). Janet [23] introduced his model of the mind consisting of two different ways of functioning: (a) activities that preserve and reproduce the past and (b) activities which are directed toward synthesis and creation (i.e., integration). In line with Janet, Van der Hart and colleagues consider dissociation a core feature of trauma: a division of personality into dissociative (biopsychosocial) subsystems that evolve when the individual lacks the capacity to integrate adverse experiences in part or in full, as can be recognized in dissociative identity disorder (DID) patients [23]. Already in Janet's original research (and recently further conceptualized), the existence of dissociative subsystems manifests in positive and negative dissociative symptoms (e.g., dissociative flashback episodes; e.g., in [23]). These positive and negative dissociative symptoms can be further distinguished as psychoform and somatoform dissociative symptoms (e.g., [24]). Negative dissociative symptoms refer to apparent losses of functions, for example, of memory, motor control, skills, and somatosensory awareness. Negative psychoform dissociative symptoms, among others, include loss of memory (amnesia) and loss of affective experiencing (numbness), loss of needs and will (abulia), loss of critical function (a cognitive action) resulting in suggestibility and difficulty thinking things through, loss of previously existing skills, and diminished sense of self. Negative somatoform dissociative symptoms, among others, involve loss of sensory-perceptual or motor functions, e.g., analgesia, paralysis, and aphonia. Positive psychoform dissociative symptoms include traumatic memories and nightmares that have affective, cognitive, and somatosensory components such as dissociative flashbacks and full re-experiencing of traumatizing events, as well as intruding voices, thoughts, and amplified affective experiencing. Positive somatoform dissociative symptoms include intrusions of sensorimotor aspects of traumatic re-experiences, including pain, uncontrolled behaviors such as tics, sensory distortions, and pseudo-epileptic seizures.

Relational impairment in adulthood involves two dimensions [25] that have been shown to have better internal consistency than the prototypical secure, preoccupied, dismissing, and unresolved attachment categories and to provide a good fit in confirmatory factor analyses: avoidance (i.e., fear of closeness) and anxiety (i.e., fear of abandonment) [26]. Attachment-related avoidance and anxiety were selected to represent adult relational impairment rather than the childhood-based categories of insecure attachment because they were shown to be trait-like risk factors for self-reported psychiatric symptoms (i.e., correlated with psychopathology under conditions of both high and low stress), while the insecure attachment categories were associated with psychopathology in adults only under high-stress conditions [27]. When confronted with potential threatening events, the primary attachment strategy (secure attachment) involves proximity seeking: attempting to move closer, physically or emotionally or both, to persons who are perceived as providing relational security that can serve to alleviate distress and build or access resources, remaining within the WoT. When external (real) or internalized (i.e., working model representations of) attachment figures are unavailable, secondary attachment strategies (insecure attachment: hyper-activation or deactivation of the internalized attachment system) are hypothesized to be activated in order to cope with relational insecurity and related distress: failure of remaining within the WoT. Secondary attachment strategies involve a defensive focus either on fear of abandonment (i.e., attempts to restore proximity and reduce anxiety; hence

hyper-activation) or fear of closeness (i.e., attempts to inhibit proximity seeking and reduce awareness of distress; hence deactivation/inhibition). Clinically and phenomenologically, the secondary attachment strategies appear to involve relatively distinct forms of emotion dysregulation, with under-regulation of emotion predominating in fear of abandonment and overregulation of emotion characterizing fear of closeness [25].

Overall, dysfunctional self-regulation is the core of these problems.

1.3 Childhood interpersonal trauma-related disorders

Although the life-span sequelae of exposure to psychological trauma-by-primary-caretaker in childhood do not seem to be encompassed by any single DSM disorder [2], the DESNOS formulation of CPTSD in adulthood and DTD in adolescence-YA has been demonstrated *empirically* to be associated with childhood relational adverse experiences that are potentially traumatic (e.g., maltreatment, family violence) consistently across numerous studies [10–12, 28, 29].

CPTSD as defined by DESNOS is theorized to represent the results of developmental adaptations to exposure to interpersonal trauma in developmentally sensitive periods, including altered emotion processing, dissociative shifts in self-awareness and consciousness, and disruption of secure attachment working models (e.g., see [7]).

Borderline personality disorder (BPD) arguably involves similar forms of dysregulation, and, historically, symptoms of somatic symptom disorders (SSD) have been associated with interpersonal trauma and hysteria [6]. Nevertheless, CPTSD can be distinguished in terms of clinical phenomenology from PTSD, BPD, SSD, anxiety disorders, and depression. CPTSD as defined by DESNOS appears to involve hypervigilance related to being harmed, whereas BPD involves extreme sensitivity to perceiving oneself as being abandoned or rejected/shamed [6, 30].

Moreover, certain features of CPTSD that are conceptually related to PTSD (i.e., arousal-related somatic dysregulation; altered personal schemas) may be largely accounted for by PTSD, but CPTSD features that are more clinically and conceptually distinct from PTSD (i.e., affect dysregulation, dissociation) appear to be empirically distinct from PTSD in adults with severe psychopathology [30].

1.4 Network theory of trauma

As opposed to trying to categorize symptoms within existing classifications/diagnoses (e.g., dissociative subtype of PTSD), or attempting to get new diagnoses accepted (e.g., DESNOS, CPTSD, DTD), the life-span sequelae of exposure to interpersonal psychological trauma (emotional or physical neglect or abuse or sexual abuse) in childhood can also be understood as *trans-diagnostic* phenomenology.

Network theory supports this trans-diagnostic perspective. According to Borsboom (e.g., [31]), the comprehensive theoretical model of (trauma-related) psychopathology follows five principles to encode the backbone of the *network theory* of mental disorders:

Principle 1. Complexity: Mental disorders are best characterized in terms of the interaction between different components in a psychopathology network.
Principle 2. Symptom-component correspondence: The components in the psychopathology network correspond to the problems that have been codified as symptoms in the past century and appear as such in current diagnostic manuals.
Principle 3. Direct causal connections: The network structure is generated by a pattern of direct causal connections between symptoms.
Principle 4. Mental disorders follow network structure: The psychopathology network has a nontrivial topology, in which certain symptoms are more tightly

connected than others. These symptom groupings give rise to the phenomeno-
logical manifestation of mental disorders as groups of symptoms that often
arise together.

These principles imply that the etiology of mental disorders can be thought
of in terms of a process of spreading activation in a symptom network. If a
symptom arises (which may occur for different reasons depending on person,
time, and context), this will increase the probability that a connected symptom
arises as well. Thus, coupled sets of symptoms, which are close in the network
structure, will tend to synchronize. Mental disorders then arise when groups of
tightly coupled symptoms actively maintain each other, leading to a cluster of
psychopathology symptoms that becomes self-sustaining [31].

Principle 5. Hysteresis: Mental disorders arise due to the presence of hysteresis
in strongly connected symptom networks: the network can become self-sus-
taining, which implies that *symptoms continue to activate each other, even after the
triggering cause of the disorder has disappeared*. Although the presence of a trig-
ger can activate a strong network, *the absence/disappearance of that trigger does
not deactivate the strongly connected network*. This may well be the explanation
for PTSD symptoms and attachment trauma-related insecure self-regulation
styles, which develop and endure after the traumatic events have subsided as
observed in attachment-trauma patients (DESNOS/DTD).

1.5 Inhibitory, excitatory, and combined inhibitory and excitatory (IE) regulation

Despite a vast amount of research on the benefits of successfully regulating
affect for our mental well-being, the role of dysfunctional self- and affect regulation
for psychiatric patients remains unclear. However, it has been established that affect
dysregulation is involved in the etiology of psychopathology and that dysfunctional
self-regulation is often described in patients with complex psychopathology and
mental disorders. Dysfunctional affect regulation typically seems to involve an
interpersonal context, and attachment theory has become a prominent conceptual
framework for understanding the process of development of affect regulation and
dysregulation. Whereas some patients react to adversities with inhibited experienc-
ing and social withdrawal, others react hyper-emotionally and tend to cling to a
significant other to alleviate (interpersonal) stress and regulate to baseline and
return within the WoT.

The DESNOS formulation of CPTSD in adulthood and developmental trauma
disorder (DTD) in childhood and adolescence have been demonstrated empirically to
be associated with qualitatively different self-regulation strategies/styles or three dif-
ferent networks: inhibitory, excitatory, and combined inhibitory and excitatory (IE)
regulation (see **Figure 1**; e.g., [7]). Symptoms include disturbances in self-regulation
across several domains of functioning, including affective-, cognitive-, somatic-,
relational-, reflective-, executive-, behavioral-, and psycho-physiological function-
ing. Activation of dysfunctional regulation seems to follow trauma-by-primary-
caretaker associated negatively biased cognitive-emotional information processing.
However, when potentially neutral situations are processed and evaluated as threat-
ening or potentially harmful, dysfunctional regulation is activated false positively.
Consequently, this may result in interpersonal misunderstanding and disappoint-
ments, which in turn condition and uphold the insecure attachment representation/
working models eventually turning into dysfunctional regulation vicious circles.

Mental states associated with *inhibited experiencing* are consistent with over-
regulation of affect and with the negative psychoform and somatoform dissociative
symptoms, including appearing emotionally constricted, expressionless, machine-
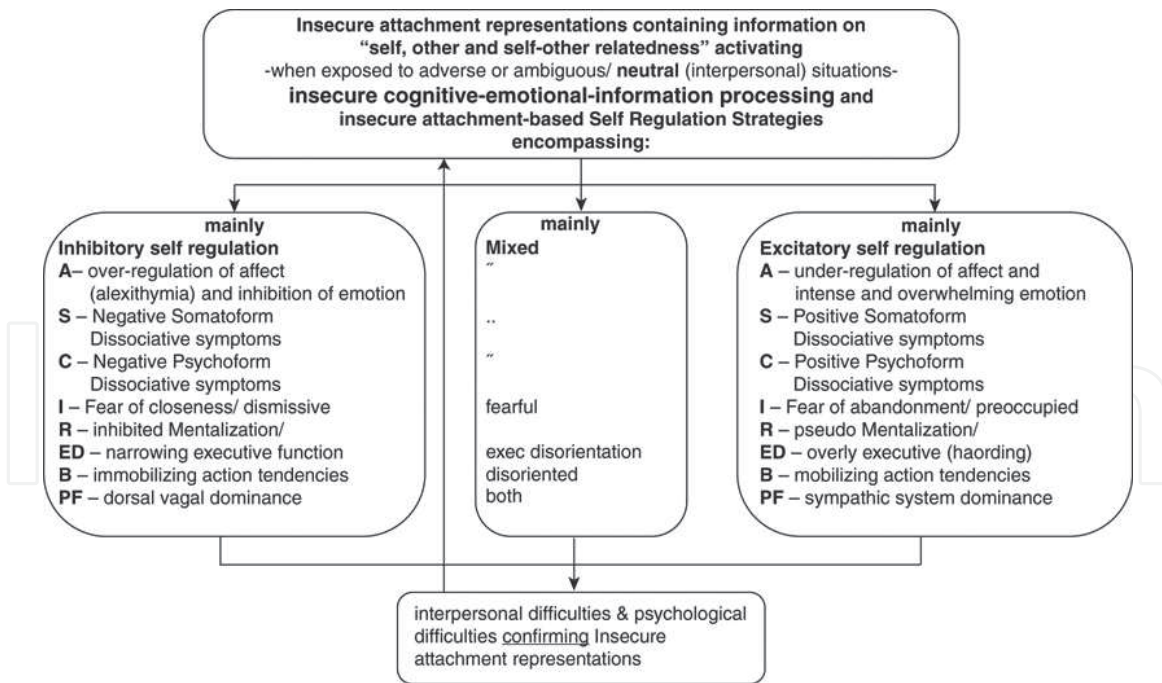like, weak or frozen, social avoidant, rigid mental elaborations or mental blancs,

Figure 1.
Three qualitatively different self-regulation styles or different networks: inhibitory, excitatory, and combined inhibitory and excitatory (IE) regulation operating in self-sustaining, vicious cycles due to the presence of hysteresis in strongly connected childhood trauma-related symptom networks.

diminished reflective functioning, low or cramped nerve, muscle tension, etc. Mental states associated with *excitatory experiencing* are consistent with under-regulation of affect and with the positive psychoform and somatoform dissociative symptoms, including feeling overwhelmed, seizures, hyper-alertness, impulsivity, and difficulty handling intense emotion states. Mental states associated with *combined or altering inhibited and excitatory experiencing* present clinically with mixed features of inhibitory and excitatory (IE) regulation and are associated with more complex psychopathology and DESNOS/DTD (see **Figure 1**; e.g., see [7]).

1.6 Basic affective systems in the brain and trauma

Panksepp and Biven argue that the basic brain functions strive for survival and homeostasis [32]. Seven basic affective-motivational systems are differentiated, located deep in the most ancient, subcortical regions of mammalian brains: SEEKING (expectancy), FEAR (anxiety), RAGE (anger), LUST (sexual excitement), CARE (nurturance), PANIC/GRIEF (sadness), and PLAY (social joy). Affects need no higher cognitive brain function to work appropriately, nor do they need the ability to use words to express themselves. They are the rawest form of emotional experiencing. In fact, these are referred to as the primary-process emotions. The theory of a SEEKING system has been studied for decades. It stems from the research done on the brain reward system, but it attempts to explain behaviors beyond a simple motivation for a reward. It is not just the reward itself that pushes one to learn, but it is the whole process of reinforcement that urges one to learn new things. "This general-purpose SEEKING response not only helps [animals] spontaneously look for and, with luck and skill, find the resources that they need, but also the means of escaping from danger, which they eventually need to learn to avoid. All this entails looking around and exploring the environment" (p. 133). Individuals can experience problems when something is amiss with the SEEKING system. FEAR systems were designed to help anticipate bad things in the future, and through the process of experience, they become capable of anticipating bad

things. FEAR, like every other emotional system, is born essentially "objectless," and, like all other emotional systems of the BrainMind, it becomes connected to the real world through learning. FEAR produces terror and promotes chronic anxiety in response to milder, more sustained arousal. However, this system can also become sensitized and overactive, especially if it has been repeatedly traumatized, as is the case in PTSD and other trauma-related disorders [32]. Overactivation and sensitization of the PANIC/GRIEF (sadness) system can be recognized in our patients reporting disrupted attachment bonds or severe emotional neglect, a different kind of traumatization.

However, conditions arising from an overstimulated FEAR or PANIC/GRIEF system, such as chronic anxiety, can be treated through a process of learning. The mind is capable of reconsolidating memories, a phenomenon useful for psychotherapy. By retrieving memories in a different affective context, it can soften the feelings of negative memories. It is their hope that, "Fearful memories can be erased or overridden by 'therapeutic' maneuvers that cleverly use the consolidation process against itself" (p. 208). The CARE system is intertwined with the SEEKING system. The CARE system is at work in the therapist/patient relationship. "Effective psychotherapists share their ability for CARE, along with the ability to recruit the healing power of positive emotions" (p. 310) [32]. Especially in attachment-trauma cases, we can recognize these seven basic affective systems, with disturbed functioning in complex PTSD. Too much FEAR, RAGE, and PANIC/GRIEF and too little SEEKING, CARE, and PLAY are often recognized in our patients.

The therapist and the therapeutic relationship therefore facilitate and promote learning in a secure and attuned stimulating environment.

1.7 Bad lifestyle, risk behavior, ill health, and physical illness in relation to trauma

Dysfunctional self- and affect regulation, sensitization, and overactivation of FEAR, RAGE, and PANIC/GRIEF systems may result in bad lifestyle, risk behavior, ill health, and physical illness. Bad lifestyle, risk behavior, ill health, and physical illness have also been associated with exposure to interpersonal psychological trauma (emotional or physical neglect or abuse or sexual abuse) in childhood (many publications, e.g., [33, 34]). The ACE studies by Kaiser Permanente revealed the vast prevalence of physical illness and early death in childhood trauma survivors [33]. Others found the presence of ill health as well as health-undermining behavior to be overrepresented in patients reporting childhood traumas [33, 34]. Difficulties with self- and affect regulation are related to bad lifestyle and risk behavior. Also, the overactivation of insecure attachment-based self-dysregulation strategies may burden organs, e.g., the heart, and stress hormone-releasing activity to the extent of function failure and physical illness.

2. Digitally enriched outpatient clinics (DOCs) using smartphone app for videoconferencing psychotherapy (VCP) and personal data monitoring

2.1 Use of smartphones

People are becoming more and more supported by technology, and many people use smartphones with apps. Therefore we initiated digitally enriched outpatient clinics using a smartphone app for videoconferencing psychotherapy and ecological momentary assessment (EMA) in the Netherlands. Our DOCs provide technology-supported, evidence-based treatment (including, but not limited to,

cognitive-behavior therapy) in patients' environments and at their convenience in an app environment. Also, EMA facilitates continuously gathering real-time sensor- and self-reported data that improve ecological validity of the results of self-reports and outcome monitoring.

Symptoms are considered consequences of mutually reinforcing demographic, personal, social, and contextual factors and (interpersonal) life events that differ for each individual and can change over time. Assessment and monitoring happen intuitively and take place in the here and now of their social and personal contexts in an app environment, rather than discretely, retrospectively, or in an isolated static moment outside the patient's personal world, thereby enriching information relevant for course of treatment, recovery, and (relapse) prevention for similar or different illness over a longer period of time.

There is currently an urgent need for psychotherapeutic interventions that use less therapist time, with the same or better outcomes than with traditional face-to-face therapy (e.g., [35, 36]. Anxiety disorders, including PTSD and depression, are among the top 10 most costly medical conditions (e.g., [37]).

2.2 The role of learning in relapse after treatment: transfer failures and erosion of therapy gains in trauma treatment

Major problems regarding the effectiveness of psychological interventions for (trauma-related) treatment are (1) transfer failures of change processes from therapy room to target situation, e.g., home environment, and (2) relapse after intervention termination. Both problems originate mainly from context-dependent learning in psychological change processes, implying that what is learned in one context generalizes insufficiently to other (target) contexts, and that learned behavior is maintained by context-dependent cues and reinforcement.

Failure to generalize/transfer the mental health gains that clients experience in the practitioner's office in treatment to their situation in daily life is a major issue in mental health care. For example, in the treatment of clients with anxiety disorders, repeated exposure to the feared stimuli reliably leads to extinction of the anxiety and the disinhibition of previously learned avoidance behavior. However, confrontation with the feared stimuli in another context than the one in which exposure took place has been found to lead to reinstatement of the problematic fearful apprehension and avoidance behavior in several experimental studies as well as in comparative clinical studies [38–40]. Another major issue in the clinical practice of mental health care is relapse, referring to the recurrence of mental health problems after the termination of psychological interventions [41]. Context-specific learning processes that lead to reinstatement of fearful behavior contribute to relapse after cognitive-behavioral exposure treatment of anxiety disorders [42, 43].

Our DOCs were initiated to accommodate patients' needs with regard to modern therapy modes and overcome problems with effectiveness of psychological interventions and relapse: we aim to augment the effectiveness of existing and evidence-based psychological interventions for prevalent mental disorders, transcending transfer failure, and relapse issues. A set of ecological momentary assessment and intervention (EMAI) tools that help to facilitate transfer of psychological change to target situations helps increase the effectiveness of already existing evidence-based interventions for trauma-related disorders in home and work environments of patients. Moreover, EMAI helps to maintain these gains over time. This is pursued by incorporating the existing knowledge of well-established methods for technology-enhanced learning and contextual and cross-contextual support of learning and adapting these methods for the development of the EMAI tools in trauma-focused and trauma-informed treatment. Our DOCs build on and extend

well-established, trans-diagnostic mechanisms of behavior modification and cognitive and emotional change for trauma-related (mental) health improvement. We carefully investigate the involved mechanisms of change for each patient among different types of trauma-related psychopathology. Videoconferencing technology, which allows audio and video information to be shared, is generally associated with good user satisfaction and is found to have similar clinical outcomes to traditional face-to-face psychotherapy. VCP has become well established as a feasible and acceptable mode of psychological treatment delivery.

Findings from the WHO survey reinforce the importance of (interpersonal) negative life events as a major public health problem and highlight the significance of exposure to (interpersonal) negative life events as a risk factor for mental and physical illness, learning problems, low personal and social well-being, and personal development. Learning from experience seems crucial in treatment success, resilience, and overcoming adversity. Psychotherapy is learning and facilitates learning from experience. The app will monitor the course of symptoms and function as a support tool for exercises, e.g., send reminders, prompt exposure moments, and suggest cognitive elaborations of beliefs for the therapeutic alliance. The focus of the app environment will be on overcoming dysfunctional regulation, including avoidance. Our DOCs with smartphone app environment:

1. Facilitate context-specific learning (deliver evidence-based treatment at home, work, trips, etc.).

2. Enable easy and flexible collection of personalized data (including self-report and sensor data).

3. Enable therapeutic support (VCP, chatting).

4. Enable the use of problem-solving techniques.

5. Allow for automatic, tailored, trans-diagnostic ecological momentary interventions (EMAI), based on ecological momentary assessment (EMA) of the needs and wants of clients.

6. Allow for delivery of interventions that help maintain therapy gains or prevent relapse into previous problem states based on personalized EMA and self-reports.

2.3 Therapeutic alliance

Therapeutic alliance (TA) is an essential factor underlying successful therapy across therapeutic models. A literature review overwhelmingly supported the notion that TA can be developed in psychotherapy by videoconference, with clients rating bond and presence at least equally as strongly as in-person settings across a range of diagnostic groups [44]. Therapists also rated high levels of TA, but often not quite as high as that of their clients early in treatment. The evidence was examined in the context of important aspects of TA, including bond, presence, therapist attitudes and abilities, and client attitudes and beliefs. Also, psychotherapy seems to support and enhance self-reflection. First results support the idea that patients can develop a reflective self in cyberspace [45]. VCP helps facilitate this reflective self, and our app environment embraces and mirrors the personal content using ecological momentary assessment.

Internet-based trauma-focused guided self-help for PTSD seems a promising treatment option that requires far less therapist time than current first-line face-to-face psychological therapy [46]. The Internet-based program includes eight modules that focus on psycho-education, grounding, relaxation, behavioral activation, real-life and imaginal exposure, cognitive therapy, and relapse prevention.

Our DOCs meet and extend these possibilities as our app environment includes VCP options with EMA and EMAI. Our app environment enables us to monitor and study (A) the course and effectivity of our technology-supported assessment and evidence-based treatment and (B) the course (and erosion) of therapy gains after treatment termination over a longer period of time. The premise of this model is that trauma-related symptoms and its mutual interactions differ among patients and may change over time since no one-to-one relation was found for (interpersonal) negative life events, personal characteristics, and any mental or physical illness across the life-span.

Because patients can use the app whenever they need a therapeutic intervention, treatment can be offered more flexibly and be more integrated in patients' daily life (ecological environment). The data will result in personalized information about learning in psychotherapy and potential mediators for recovery/relapse, e.g., risk profiles at treatment onset for poor treatment course/outcome, low self-esteem, interfering (covert) behavior such as risky lifestyle, positive or adverse life events, small chaotic social network, (in)secure attachment behavior, or self-transcendence that help improve assessment- and technology-supported evidence-based treatment.

After initial treatment and during follow-up, the app functions as a support tool monitoring positive and negative life events, lifestyle/somatic well-being, and interpersonal activities to detect early warning signs of potential relapse or crisis (prevention).

3. Digitally enriched therapeutic processes

3.1 Stuck in a "survival state of mind" or "historical time loop"

In our patients with complex trauma histories, we can often recognize dysfunctional self- and affect regulation: too much activity of the FEAR, RAGE, and PANIC/GRIEF systems (excitatory dysregulation; see **Figure 1**) or too little activation of the SEEKING, CARE, and PLAY systems (inhibitory dysregulation; see **Figure 1**) or a combination of both due to the presence of hysteresis.

The strongly connected symptom networks have become self-sustaining, and the absence/disappearance of the trauma-related trigger does not deactivate the network. As a result patients report in the app environment often too much negative emotional experience while undertaking few fun, relaxing, healthy, social-bonding activities. And the patient is often stuck in a "survival or destructive state of mind" or "historical time loop," thereby overruling the "learning state of mind." This may well be why complex trauma/DESNOS/DTD patients have poorer therapy outcome and quick erosion of (little to modest) therapy gains [47].

By monitoring the app content, the app possibilities facilitate the therapist to support patients when help, comfort, or encouragement is needed: hence need-driven interventions. The therapist may choose to chat with the patient or initiate a VCP session or provide the patient with useful information from the library via a link in a chat message. To help overcome the "survival or destructive state of mind" or "historical time loop," a therapist-initiated chat contact referring to a therapy motto or personal one-liner may be helpful, or a "ping" [sound] or buzz [sound + sensation] from the smartphone may help overcome depersonalization and dissociation to help the patient to transit, through realization, into a "learning or productive state of mind"

associated with activation of the SEEKING, CARE, and PLAY systems and decline of excitatory and inhibitory dysregulation symptoms.

3.2 REX

For complex trauma and DESNOS/DTD, often a phase-oriented treatment program (phase 1, stabilization; phase 2, trauma therapy; and phase 3, rehabilitation) is held [48]. In the app, this was translated into the "toolbox" metaphor. During the therapy process, elements from three toolboxes (REX) are held: toolbox **R**, for self- and affect regulation techniques, healthy lifestyle, etc.; toolbox **E**, for trauma work/ exposure therapies; and toolbox **X**, for X-factor activities—fun, social activities, rehabilitation, work, and sports activities that give meaning to life and help over-come, or alleviate, the burden of symptoms temporarily. During therapy, elements from the three boxes are combined *from the start through the ending*. An example would be that from toolbox X, e.g., social participation—in any form—is a topic already from the start of therapy and parallels with elements from toolbox R, self-reg-ulation techniques, and toolbox E, trauma work in any form [49]. One example could be having a cup of tea with a sister that was also abused as a child. Different elements from the toolboxes REX are paralleled with support from the app environment.

3.3 Inside the app environment

In our DOCs, we provide personalized, need-driven treatment. Patients connect with their assigned clinician using the app. After connection, they automatically receive instructions on how to operate the app environment, as well as an invitation to already start filling the app with personal information. First, patients fill out their personal profile. The planner facilitates planning and organizing significant events and therapy sessions. The planner also facilitates typing cognitions and experi-ences before the event is happening. Moreover, it facilitates recording anticipatory emotions for that significant event using swipe techniques for levels of arousal. To enhance success, the option of setting a reminder for this event is given. The planner then shows the events and time during the day and asks if the event, e.g., exposure assignment, was performed. In the case of Yes, one can add text to keep notes of this exposure session, accompanied by recording emotional experiencing, mood, and the option of filling out a cognitive schema. However, in the case of No, when the exposure session was not performed, one is reassured and asked what to do next: perform later today or change/alter session. Even canceling is possible, after which again a reassurance message is given with the invitation to plan something else that day, preferably an X-factor activity to lift one's mood. Next patients start using the tracker for registering mood three times a day and activating the steps tracker. Here, patients can access past event-related information and keep diary for significant events during the week, register mood, registering associated emotional experienc-ing, and (optionally) the first sections of a cognitive schema. Also, they can access notes given by the therapist associated with therapy sessions. Using the support button, the patient can start a chat session with app support or with the therapist. Also, the patient can initiate a VCP session, with and without visual contact, e.g., to team up with the therapist for an online therapist-assisted exposure assignment.

The therapist using the portal side of the app environment is able to connect with the patient upon invitation and access the patient's information filled out in the app. The therapist can overview all patients and their app content in a dashboard in order to reply to need-driven activity and contact requests. Moreover, graphs are presented per patients with regard to mood, emotional experiences, activities, and results from "homework," e.g., exposure exercises, cognitive elaborations, and

social activities. Also, sensor-based information from the smartphone environment, as well as EMA-based information, is presented per patient at the therapist's request. Next therapists are able to initiate VCP, chatting, push messages for encouragement, and planning of next VCP session, activities, and treatment exercises for patients. As part of the treatment via chat messaging, web information is sent on topics of patient's personal relevance, e.g., food, physical exercises, lifestyle, psycho-education on PTSD, and trauma symptoms. Also, vlog or blog information of experiences of trauma therapy of other patients can be shared.

3.4 Treatment

3.4.1 Assessment, self-reported EMA, and predictors of therapy course, effectivity, and erosion

For assessment, the VC option in the app is used for intake purposes, clinical interviewing using MINI 5 for the presence of any mental disorder [50] and CAPS 5 for the presence of PTSD [51], and visual clinical assessment. Initial assessments can help determine possible treatment options using self-report measures, e.g., LEC-5 [52] and post-traumatic stress disorder checklist for DSM-5 (PCL-5 [53]) or the Short PTSD Rating Interview (SPRINT; [54]), or for more complex trauma histories or symptoms, the Structured Interview for DESNOS-revised self-report (SIDES-rev-sr; [47, 55]) is sent. Working alliance is regularly measured with the patient and therapist version of the Working Alliance Inventory (WAI; [56]).

Inhibitory and excitatory forms of self-dysregulation are assessed for:

- Problems in affect regulation involve under-regulation and overregulation of affect [15]. Overregulation of affect is assessed with the Bermond-Vorst Alexithymia Questionnaire (BVAQ; [57]), a Dutch 40-item questionnaire with demonstrated psychometric qualities [57]. Under-regulation is assessed with the "Affect instability scale" from the BPDSI [58]. BPDSI scores range from 0 = never to 10 = daily (Cronbach's alpha = .81).

- Relational impairment and adult relational fears involve "fear of abandonment" and "fear of closeness" (e.g., [25, 26]), which are assessed using the Dutch version of the validated 30-item Relationship Style Questionnaire (RSQ; [59]).

- Dissociation involves positive and negative psychoform and somatoform features [15] and is assessed with the Dissociative Experiences Scale (DES; [60]) for negative (e.g., amnesia) and positive (e.g., intrusions) psychoform features and with the Somatoform Dissociation Questionnaire (SDQ-20; [61]) for negative (e.g., anesthesia, paralysis) and positive (e.g., pain, cramps; [24, 26]) somatoform features.

3.4.2 Evidence-based psychotherapy protocols for trauma-related disorders

Using the videoconferencing psychotherapy (VCP) option, we provide psycho-education about the aftermath of (interpersonal) trauma, PTSD symptoms, and the broader scope of DESNOS/DTD symptoms.

When necessary, psycho-education with regard to dissociation and insecure attachment styles is provided. Since many patients suffering from the aftermath of severe trauma have already tried (and often failed) forms of psychotherapy, motivational interviewing combined with the positive aspects and benefits of our app possibilities is provided.

Evidence-based CBT therapies (many publications, e.g., [62]) like imaginal exposure (IE) aiming at extinction of intrusion symptoms, cognitive therapy (CT) aiming at restructuring trauma-related cognitions and beliefs, and eye movement desensitization and reprocessing (EMDR) protocol using clicks and self-initiated bilateral stimulation aiming at reducing intrusion symptoms and overcoming avoidance, or Imagery Rescripting (ImRs) evidence-based protocols for trauma-related disorders may be provided to patients. Next to these directly trauma-focused therapy forms, interpersonal psychotherapy (IPT; [63]) for PTSD is an option aiming at social and relational rehabilitation while focusing on "role transitions" [63].

Network-oriented interventions are provided with data input from EMA. Self- and affect dysregulation and skill development therapy based on network theory and information from EMA with regard to personalized insecure attachment-based self-regulation symptoms and behaviors will be targeted with EMAI and encompass (i) interventions which "directly change the state of one or more symptoms," (ii) protocols oriented to "inhibition of triggering causes," and (iii) protocols oriented at "inhibiting or modifying symptom-symptom connections." For trauma-related symptoms, aiming at "inhibiting or modifying symptom-symptom connections," the therapeutic environment of our DOCs seems very well suited.

3.4.3 Tracking, app-generated EMA, and predictors of therapy course, effectivity, and erosion

The aim here is building skills to self-regulate [64–67] by monitoring therapy gains and relapse prevention based on EMA data using tracking, self-reports, and clinical observations. Tracking in the app environment taps moment-to-moment tracking of emotions and emotional functioning, mood, movement, behavioral activation and physical exercises, and heart rate information derived from smartphone, combined diary and therapeutic notes, mood before and after events, cognitions and beliefs, cognitive schema, and social network. Also, the planner is used for planning VCP moments, exposure exercises, social events, etc. that can be evaluated with mood charts and cognitive reports before, during, and after the events. Also the therapist can make notes for the patient or send push messages. The built-in sensors synchronizing with Google Fit/Apple Healthkit collect data to reflect physical well-being, activity, and lifestyle. The app facilitates personalized medicine/matched care. Results are combined and discussed in a multidisciplinary team using network theory. Psychotherapy indication is concluded upon, as well as matching a psychotherapist for treatment.

Based on results from assessment, EMA information, predictors (facilitating and disruptive) of therapy course, effectivity, and erosion are drawn. During therapy, these symptoms and behaviors will receive special attention to try to augment treatment effectivity of otherwise evidence-based treatments. Before ending treatment, results will also be integrated in a personalized relapse-prevention plan.

3.4.4 Ending the treatment and the working alliance

Ending of treatment and ending of working alliance—albeit in a 100% online environment—is highly comparable to ending of a regular therapeutic environment. However, next to the VCP session, patients have also developed a relation with the app environment, for some, comparable to the bonding with a personal diary.

Within the app, the integrative and personalized relapse-prevention plan is integrated, accompanied by a "selfideo," a video in which the patient speaks to him/herself in a kind and encouraging manner. The content is an abstract of course

of treatment with the treatment rationale, memorabilia (mental representations of personal victories/highlights of therapy and low points of therapy course with lessons learned), names of significant helpful others, and a forecast of whatever the (fearless/depressedless) future may hold for them.

Next, a traffic light principle is held: green for subclinical symptomatology, red for clinical diagnosis (relapse), and orange for trigger points that may predict transfer to relapse. These triggers can be, e.g., reduced sleep quality, feelings of stress for more than 3 days, over- or under-eating, skipping sports and social activities, etc. The target here is to prevent crossing the border from "orange" to "red."

At the end of therapy, our patients with complex trauma histories have overcome hysteresis effect to some extent (e.g., avoidance and intrusion of trauma triggers), report no or less dysfunctional self- and affect regulation, and report a more balanced activity of the FEAR, RAGE, and PANIC/GRIEF systems with SEEKING, CARE, and PLAY systems as can be concluded from the app content (EMA).

Longitudinal outcome studies and studies of outcome predictors are currently in preparation.

4. Conclusion

The life-span sequelae of exposure to interpersonal psychological trauma (emotional or physical neglect or abuse or sexual abuse) in childhood, particularly when a primary caretaker is involved, do not seem to be encompassed by any single DSM disorder and interfere with the development of self-regulation skills and development and remainder of homeostasis. Although symptoms include and extend symptoms associated with PTSD with and without dissociative symptoms, it has been argued that these sequelae also include a complex symptom presentation reflecting disturbances in (interpersonal) self-regulatory capacities and mental disorders that may occur comorbidly with or separately from PTSD. Whether these sequelae are best understood as a complex variant of PTSD (CPTSD), or a complicated array of overlapping mental and personality disorders, is controversial. However, there is mounting evidence that a disorder of extreme stress not otherwise specified (DESNOS) formulation of CPTSD or in childhood, adolescence, and young adulthood (YA), developmental trauma disorder (DTD) constitutes a distinct syndrome of potential clinical utility. Three core features of DESNOS/DTD are affect dysregulation, identity alterations (dissociation), and relational impairment (insecure attachment) and empirically have been associated with qualitatively different and dysfunctional self-regulation vicious cycles: inhibitory, excitatory, and combined inhibitory and excitatory (IE) dysregulation. These can be also considered as trans-diagnostic symptoms clustered along the lines of the network theory.

Individuals with mental health problems may face barriers to accessing effective psychotherapies, e.g., waiting lists in general mental health institutions or office hours [68]. People are becoming more and more supported by technology, and many people use smartphones with apps. Therefore we initiated DOCs using smartphone app for VCP. Our DOCs provide with technology-supported evidence-based treatment in patients' environments and at their convenience in an app environment. Also, it facilitates continuously gathering real-time sensor- and self-reported data that facilitates assessment, self-reported EMA, and need-driven treatment and helps target predictors of therapy course, effectivity, and erosion. Treatment is successful when patients with complex trauma histories have overcome hysteresis effect to some extent (e.g., avoidance and intrusion of trauma triggers), report no or less dysfunctional self- and affect regulation, and report a more balanced activity

of the FEAR, RAGE, and PANIC/GRIEF systems with SEEKING, CARE, and PLAY systems as can be concluded from the app content (EMA). Also, they have learned that behavior promotes resilience and prevents relapse. The integrative treatment as described aims to encompass the best of both worlds: it combines established evidence-based treatment protocols for PTSD with innovative technology-enriched app environment that captures more complex trauma-related symptoms and behaviors (lifestyle) to augment therapy effect, improve quality of life, and prevent relapse. However, our work remains a "work in progress": a continuous improvement of technology-supported evidence-based treatment.

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