What makes inpatient treatment for PTSD effective? Investigating daily therapy process factors

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Running head: What makes inpatient trauma-focused treatment for PTSD effective?

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Number of Tables: 1

Number of Figures: 1

Keywords: Real-Time Monitoring, Psychotherapy Process, Post-traumatic Stress Disorder, Psychotherapy Research, Treatment Outcome

No Acknowledgements

Abstract

Objective: Therapeutic process factors including alliance and motivation are considered to play a key role in the treatment of post-traumatic stress disorder (PTSD). Yet, our understading of change processes in therapy is mostly based on theoretical considerations with limited empirical evidence. In order to identify process characteristics of successful inpatient treatments of PTSD, we investigated the intraindividual, interindividual, and temporal associations of daily assessments of therapy process factors like motivation, alliance, and insight.

Methods: Therapy Process Questionnaire (TPQ) assessments were collected from 101 inpatients with PTSD over 50 days, resulting in 5050 assessments. Multilevel Vector Autoregressive (mlVAR) modelling was applied to investigate the networks of the TPQ factors in a subgroup with good outcome regarding PTSD symptomatology and a subgroup with less favourable outcome.

Results: The two subgroups differed markedly in their network models, suggesting that therapy processes might be different for those with good and those with poor treatment outcomes.

Conclusions: Our results suggest that good treatment outcome is linked to a specific therapy process dynamic where mindfulness and insight lead to the kind of temporary well-being required to effectively engage with problems and negative emotions, while motivation to change ensures the continuity of confronting negative emotions and problems.

Introduction

Post-traumatic stress disorder is a common, severe, debilitating, and often chronic psychological disorder in the aftermath of traumatic events with a liftetime prevalence of 13.0-20.4% for women and 6.2-8.2% for men (Bryant, 2019). According to the ICD-11, PTSD is characterized by a re-experiencing of traumatic memories in the here and now, avoidance of traumatic reminders, and a persistent sense of current threat.

The Treatment of Post-traumatic Stress Disorder

The treatment of PTSD predominantly involves trauma exposure therapies such as Cognitive Behavioural Therapy (CBT) or Eye Movement Desensitization and Reprocessing (EMDR) (Mavranezouli et al., 2020). However, non-trauma-focused treatments such as present-centered therapy (Belsher et al., 2019) are also being used in clinicial practice. Whereas evidence is mixed regarding whether trauma-focused treatments yield significantly better results than non-trauma-focused treatments, evidence-based treatments of PTSD are generally very efficacious with large and long-lasting effects (Belsher et al., 2019; Coventry et al., 2020; Ehring et al., 2014; Karatzias, Murphy, et al., 2019; Morina et al., 2021; Weber et al., 2021). Evidence is less available regarding inpatient treatment of PTSD, although similar therapeutic principles which involve exposure therapies are normally used. Inpatient treatment is usually offered to those with more severe PTSD and there is evidence for its efficacy in a variety of populations (Bohus et al., 2013; Campbell et al., 2016; Lampe et al., 2014; Sachsse et al., 2006; Voorendonk et al., 2020). Nevertheless, evidence-based treatments of PTSD typically have high dropout rates of above 20% and nonresponse rates up to 50% in many studies (Schottenbauer et al., 2008; Varker et al., 2021). This highlights the need to better understand the therapeutic process of trauma-focused treatments for PTSD to improve engagement and acceptability.

Psychotherapy Process Research and the Treatment of PTSD

Even though it is well established that psychotherapy is efficacous in the treatment of mental disorders, surprisingly little is known about how psychotherapy works (Cuijpers et al., 2019). There is compelling meta-analytical evidence that common factors like empathy, expectations, and alliance account for most of the benefits of psychotherapy whereas the evidence for specific treatment effects is much more limited (Wampold, 2015). This also holds true in the field of PTSD, where effective treatments contain both a variety of specific ingredients as well as common factors (Wampold et al., 2010). For example, the development and monitoring of a safe, trustful, and respectful therapeutic relationship has consistently been found to be linked to a better treatment outcome in those with PTSD (Beierl et al., 2021; Ehlers et al., 2021; Wampold et al., 2010). Expectations about treatment are another very important predictor of treatment outcome of PTSD, although expectations are often compromised due to shattered assumptions about self, the world, and the future (Maier & Straub, 2011; Rief & Anna Glombiewski, 2017). PTSD has also been linked to reduced mindfulness, acceptance, and self-compassion which may hamper patients' ability to engage in self-care, thereby making therapeutic progress more difficult (Karatzias, Hyland, et al., 2019; Kratzer, Heinz, Ehrig, et al., 2019; Martin, 1997; Winders et al., 2020). Furthermore, goal consensus and collaboration are known to be important common factors in psychotherapy (Wampold, 2015). At the same time, traumatic stress is linked to motivational dysfunction and ambivalence to change symptoms and problematic behaviors (Murphy et al., 2004; Simmen-Janevska et al., 2012). Hence, common therapeutic factors play a crucial role in the treatment of PTSD.

The conjecture that it is specific factors like exposure that make treatments of PTSD work has gained less support. In dismantling studies, treatments remained efficacous even when core ingredients of the respective trauma-focused treatments were removed (Bryant et al., 2008; Laska et al., 2014; Resick et al., 2008). The lack of evidence for the relative importance of specific treatment factors (Ahn & Wampold, 2001; Benish et al., 2008) has led some authors to conclude that all evidence-

based psychotherapies will produce equivalent results, irrespective of their specific components like exposure or cognitive restructuring (Rosenzweig, 1936; Wampold & Imel, 2015). This became known as the «Dodo Bird Verdict» (Rosenzweig, 1936). However, previous work has presented with major methodological limitations including the problematic dichotomy of common and specific factors and the resulting neglect of their correlations in statistical analyses which limit the evidence regarding the «Dodo Bird Verdict» (de Felice et al., 2019; McAleavey & Castonguay, 2015). Furthermore, so far, the temporal associations and the interplay of common factors during psychotherapy processes remain unknown and conceptualizations of sequential processes of change or reciprocal interaction processes of common factors are mostly based on theoretical considerations and less on empirical research (Cuijpers et al., 2019; Weinberger, 1995). This might at least partly be due to the fact that it is only recently that methodological developments like real-time monitoring tools are widely available and that network analysis has been extended to model the complex interplay of variables in multivariate time series (Epskamp, Waldorp, et al., 2018; Schiepek et al., 2016).

Network Analysis and Multilevel Vector Autoregressive Modelling

Network analysis can be used to explain complex relationships of variables (Borsboom & Cramer, 2013a). According to the network approach, recently introduced in the field of psychopathology, mental disorders can be conceptualized as complex network systems with symptoms or psychological processes interacting and evolving over time (Borsboom, 2017; Borsboom & Cramer, 2013b; Contreras et al., 2019). A network consists of nodes and edges connecting these nodes. Whereas nodes reflect constructs, the strength of the edges indicates the strength of the association between the constructs and the colour indicates whether the association is positive or negative. Several studies have recently used cross-sectional symptom-level data of PTSD symptoms

and adjacent symptoms like somatic symptoms, sexual symptoms, dissociative symptoms, or Borderline symptoms (Knefel et al., 2016; Kratzer et al., 2021, 2022).

However, there are severe pitfalls in the analysis and interpretation of cross-sectional network analyses. For example, while cross-sectional networks may be helpful to investigate comorbidity, correlations should not be overinterpreted and significant associations in a cross-sectional network may also not be interpreted as indicative of how symptoms or psychological processes trigger each other over time (Bos et al., 2017; Contreras et al., 2020). Yet, network analysis can be extended to model complex interaction processes of multivariate psychological constructs over time (Bringmann et al., 2016). A time-lagged, graphical vector autoregressive (VAR) model allows to analyse temporal relationships between constructs (Epskamp, Waldorp, et al., 2018; Wild et al., 2010). These temporal relationships are depicted in the network using arrows. Self-loops reflect the relation between a variable at time *t* and the very same variable at time *t*-1.

To capture the temporal interplay of variables, intensive time-series data is required, e.g. from a real-time monitoring tool that allows for the high-frequency assessment of symptoms or psychological processes using specific process questionnaires (Schiepek et al., 2016). To investigate the temporal interplay of possibly causal relations between therapy process factors like motivation to change and therapeutic alliance in the inpatient treatment of patients with PTSD, we analyzed for the first time ever clinical routine data of daily assessments of therapy process factors using mlVAR network models. For these analyses, the sample was divided in a subgroup with favourable outcome and a subgroup with less favourable outcome. In so doing, we aimed to identify both important common therapeutic factors as well as specific dynamics amongst these factors that can enhance the effectiveness of exposure-based therapies for PTSD and improve retention and engagement with treatment.

Materials and Methods

Participants

A sample of n = 101 inpatients (female=91; male=10) with an ICD-10 diagnosis of PTSD who were treated in a clinic in Germany were included. Clinical diagnoses were given by attending psychologists and doctors relying on the structured clinical interview for DSM-IV personality disorders (First et al., 1994; Fydrich et al., 1997) and the structured clinical interview for dissociative disorders (Gast et al., 2000; Steinberg, 1993). The mean age of the sample was 47.3 years (*SD* = 9.3). At the time of admission, 68 patients (67.3%) had long-term psychopharmacological medication, the majority for more than 1 year (N = 60; 59.4%); 56 (55.4%) patients received antidepressants, 28 patients (27.7%) received anxiolytics, and 42 patients (41.6%) received antipsychotics. Furthermore, 72 patients (71.3%) received analgesics at the time of admission. 81 patients (80.2%) reported current suicidal ideation and 48 patients (47.5%) reported at least one suicide attempt (min = 0; max = 4). Inclusion criteria were a diagnosis of ICD-10 post-traumatic stress disorder as well as a time series of at least 50 days of Therapy Process Questionnaire ratings with no more than 5% missing data. To enhance ecological validity, there were no exclusion criteria.

Measures

At the time of admission, patients were administered the childhood trauma questionnaire (CTQ; Bernstein & Fink, 1998) to retrospecitvely assess potentially traumatic childhood experiences. The CTQ consists of 28 items, of which 25 correspond to the five subscales sexual abuse, physical abuse, emotional abuse, emotional neglect, and physical neglect. Patients indicate the severity of items like „I got hit so hard by someone in my family that I had to see a doctor or go to the hospital.“ on a 5-point Likert scale. The German version of the CTQ (Wingenfeld et al., 2010) has good psychometric properties.

The German version of the Impact of Event Scale-Revised (Maercker & Schützwohl, 1998) was used to assess PTSD symptoms at the time of admission and discharge. The IES-R consists of 22 items like „I had dreams about it“ that are answered on a 4-point Likert scale with non-equidistant scoring (0-1-3-5) and correspond to three subscales (intrusion, avoidance, hyperarousal). The psychometric properties of the German translation (Maercker & Schützwohl, 1998) are sound.

The TPQ (Schiepek et al., 2019) consists of 43 items corresponding to the seven therapy process factors well-being and positive emotions (WPE), relationship with fellow patients (RFP), therapeutic alliance and clinical setting (TAS), emotional and problem intensity (EPI), insight/confidence/therapeutic progress (ICP), motivation to change (MOT), and mindfulness/self-care (MSC).Items like „I perceive the work with my therapist(s) as helpful (not at all–very much)“ are rated using visual analogue scales (0 to 100). The TPQ offers excellent psychometric properties and can be administered daily to create time series with equidistant measurement points.

Procedure

All patients received intensive multi-component trauma-focused inpatient treatment comprising social skills training, antidissociative skills training, emotion regulation skills training, mindfulness skills training, body and art psychotherapy, and 150 minutes a week of individual psychotherapy comprising of reprocessing of traumatic memories using EMDR (Kratzer, Heinz, Schennach, et al., 2019). Using the web-based monitoring tool Synergetic Navigation System, every patient completed the TPQ every evening during inpatient treatment as part of the routine real-time monitoring of trauma-focused therapy processes (Kratzer, Heinz, Schennach, et al., 2019; Schiepek et al., 2016). Patients could either use their smartphone or were provided with a tablet computer. A wireless network allowed patients to rate the TPQ in their room in a quiet atmosphere (single bed rooms only). The IES-R was conducted at the time of admission and discharge, respectively, and the CTQ was conducted only at the time of admission.

Statistical Analysis

Missing data of the TPQ in the time series was imputed using last observation carried forward (LOCF). 21 of the 101 patients (20.8%) had at least one missing data point in the time series (min = 0; max = 2). In total, 32 (0.6%) of the 5050 measurement points were missing and imputed using LOCF.

The sample was divided in two groups using a diagnostic algorithm with a sensitivity of .70-.76 and a specificity of .88-.89 in the detection of a PTSD diagnosis (Maercker & Schützwohl, 1998). The mlVAR model in R (Epskamp et al., 2019; Epskamp, Waldorp, et al., 2018) was used to analyse the multivariate time series of the factors of the TPQ. The mlVAR model integrates a nomothetic approach with an idiographic one and allows to investigate longitudinal data from three different perspectives (Bringmann et al., 2013; Epskamp, Waldorp, et al., 2018).

The *temporal network* allows to model temporal dynamics across individuals. For this purpose, all variables of a multivariate set of variables at time *t* are regressed by a lagged version of the same multivariate set of variables at time *t*-1. Under strict assumptions, results of the temporal model can be interpreted causally (Aalbers et al., 2019; Granger, 1969). For example, a negative effect of avoidance on well-being in a temporal network with a lag of one day might suggest a causal pathway from avoidance to reduced well-being on the next day.

The *between-subjects network* models demonstrate how the within-person mean levels of a set of variables are related to each other on average over a larger time-scale, thereby reflecting an interindividual perspective (Aalbers et al., 2019). For example, a negative association of avoidance and well-being in the between-subject network might suggest that over a longer period of time, people who tend to avoid more tend to be people who on average experience less well-being.

Finally, the *contemporaneous network* is a multilevel partial correlation network of the set of variables at the same time *t*, thereby reflecting within-measurement associations. It is based on the residuals used to estimate the between-subjects model and the temporal model and reflects the

remaining associations after both all other variables in the network at the same time *t* as well as all temporal associations that have been partialled out (Aalbers et al., 2019; Jordan et al., 2020). The contemporaneous network is an important complement to the temporal model as it reflects possible causal relations between nodes that occur at a faster pace than the time-lag in the temporal model (Jordan et al., 2020). For example, avoidance might have a strong positive association with well-being from the perspective of a contemporaneous network. This might suggest a causal pathway from avoidance to well-being that occurs at a much faster pace (e.g., five minutes) than the time-lag of the model (e.g., one day).

An integration of the three network models described above allows for a complementary and holistic view of the data (Aalbers et al., 2019; Epskamp, van Borkulo, et al., 2018). Combining all three models might help to understand that it is particularly those with reduced well-being who tend to avoid, and that while avoidance may be linked to well-being on the short term, there might be a causal pathway from avoidance to reduced well-being on the next day.

Multilevel VAR models are based on the assumption of multivariate normality (Epskamp, Waldorp, et al., 2018). The R package *MVN* (Korkmaz et al., 2014) was used to assess multivariate normality and univariate normality using Henze-Zirkler tests and Anderson-Darling tests, respectively. While violations of the assumption of normality are common in clinical samples, as of today, it is unclear how robust mlVAR models are to such violations (Aalbers et al., 2019; Terluin et al., 2016; Wigman et al., 2016). Stationarity, i.e. the stability of means and variances of all variables over time, is another basic assumption of temporal network analysis (Jordan et al., 2020). At the same time, time series of clinical self-ratings are known to be highly complex and to often violate this unrealistic assumption (Bringmann et al., 2018; de Vos et al., 2017; Molenaar & Campbell, 2009; Olthof et al., 2020; Schiepek et al., 2020). Therefore, all individual time series were investigated for non-stationarity using the KPSS test (Kwiatkowski et al., 1992) implemented in the R package *tseries* (Trapletti & Hornik, 2020). As detrending may have problematic consequences and limit the exploratory power of models

(Isvoranu et al., 2022; Wu et al., 2007), we followed recommendations to only detrend those time series with a significant linear trend (α=.05) by removing the linear trend component from the time series (Jongeneel et al., 2020).

As temporal models with correlated random-effects are not recommended when more than six variables are analysed (Epskamp et al., 2019), only temporal models with non-correlated random effects and intercept-only random effects were estimated. The mlVARcompare function of the *mlVAR* package was then used to compare these models. As the mlVAR model consists of a combination of univariate models (see above), the random effect models with the highest number of minimal Bayesian Information Criterion (BIC) values were selected for further analysis. Furthermore, the conservative AND-rule was used for the contemporaneous and the between-subjects networks to reduce type I error (Epskamp, Waldorp, et al., 2018). Type I error was furthermore reduced by an alpha level of α = .01 for the network visualization.

Results

Descriptive Statistics and Therapy Outcome

The sample reported severe childhood sexual abuse (*M* = 15.7, *SD* = 6.8), childhood emotional abuse (*M* = 19.45, *SD* = 5.4), childhood emotional neglect (*M* = 20.1, *SD* = 4.6), childhood physical abuse (*M* = 12.6, *SD* = 6.0), and childhood physical neglect (*M* = 12.5, *SD* = 4.5) in the CTQ. A comorbid dissociative disorder was present in 29 patients (28.7%), 5 patients presented with (partial) dissociative identity disorder (5.0%), and 23 patients (22.8%) had a comorbid personality disorder. An affective disorder was present in 96 patients (95.0%), whereas 12 patients (11.9%) had a comorbid anxiety disorder, and 18 patients (17.8%) had a comorbid obsessive-compulsive disorder. Substance abuse disorder with current abstinence was diagnosed in 10 cases (9.9%). Somatoform disorder was present in 29 patients (28.7%) and 26 patients (25.7%) presented with an eating disorder. The decrease of the

IES-R score from admission (*M* = 82.3, *SD* = 12.5) to discharge (*M* = 58.9, *SD* = 23.7) was significant and corresponded to a large effect (*t*(150.9) = 8.73, *p* < .001, *g* = 1.02 [0.84; 1.21]).

Subgroups with favourable and less favourable outcome

The diagnostic algorithm of the IES-R (Maercker & Schützwohl, 1998) was used to divide the sample into two groups; one with a favourable outcome that likely corresponds to patients no longer meeting the requirements of a diagnosis of PTSD at the time of discharge (*N* = 49) and another group with a less favourable outcome that likely corresponds to the persistence of PTSD at the time of discharge (*N* = 52). The decrease of the IES-R score from admission (*M* = 86.0, *SD* = 12.4) to discharge (*M* = 76.6, *SD* = 11.2) was significant yet corresponded only to a moderate effect for the group with poor outcome (*t*(100.9) = 4.10, *p* < .001, *g* = 0.64 [0.34; 0.93]). However, the significant decrease of the IES-R score from admission (*M* = 78.4, *SD* = 11.6) to discharge (*M* = 40.2, *SD* = 18.4) in the group with favourable outcome corresponded to a large effect (*t*(80.9) = 12.3, *p* < .001, *g* = 1.86 [1.51, 2.23]). Medians of the therapy process factors for the respective groups are presented in table 1.

[Please put Table 1 here]

Assumption checks

The results of the Henze-Zirkler tests indicated violations of multivariate normality for both subgroups including the one with poor outcome (HZ_β = 4.44, *p* < .01) as well as the group with good outcome (HZ_β = 4.60, *p* < .01). For both subgroups, results of the Anderson-Darling tests indicated violations of univariate normality for all therapy factors (*p* < .01). Distributions were right-skewed for WPE, ICP, and MSC, and left-skewed for EPI, MOT, RFP, and TAS in the subgroup with bad outcome. In the subgroup with good outcome, WPE and EPI were found to be right-skewed, and ICP, RFP, MOT, MSC, and TAS were found to be left-skewed.

Results from the Kwiatkowski-Phillips-Schmidt-Shin unit root tests suggested non-stationary data for 127 time series (18.0%). 10 WPE time series (9.9%), 11 EPI time series (11.9%), 13 ICP time series (12.9%), 39 TAS time series (38.6%), 15 RFP time series (14.9%), 23 MOT time series (22.8%), and 16 MSC time series (15.8%) had to be detrended. Using Δ BIC, temporal models with random-intercept were found to have better fit than non-correlated random effect models.

Network Estimation and Visualization

The temporal network of the group with less favourable outcome showed both significant self-loops as well as significant associations between therapy process factors (shown in Fig. 1). Significant self-loops were found for WPE (edge weight = .23, $p < .01$), EPI (edge weight = .23 $p < .01$), ICP (edge weight = .28, $p < .01$), TAS (edge weight = .36, $p < .01$), RFP (edge weight = .17, $p < .01$), MOT (edge weight = .28, $p < .01$), and MSC (edge weight = .22, $p < .01$). Significant temporal effects were found from ICP to WPE (edge weight = .08, $p < .01$), ICP to MSC (edge weight = .09, $p < .01$), EPI to MSC (edge weight = .08, $p < .01$), and RFP to TAS (edge weight = .04, $p < .01$). The group with good outcome showed more significant temporal associations (shown in Fig. 1). Significant self-loops were found for WPE (edge weight = .21, $p < .01$), EPI (edge weight = .25 $p < .01$), ICP (edge weight = .34, $p < .01$), TAS (edge weight = .42, $p < .01$), RFP (edge weight = .19, $p < .01$), MOT (edge weight = .20, $p < .01$), and MSC (edge weight = .23, $p < .01$). Positive changes in ICP were found to lead to positive changes in MOT (edge weight = .12, $p < .01$), MSC (edge weight = .17, $p < .01$), and WPE (edge weight = .13, $p < .01$) as well as reductions in EPI (edge weight = -.14, $p < .01$). Furthermore, MOT was found to significantly decrease WPE (edge weight = -.10, $p < .01$) and increase EPI (edge weight = .09, $p < .01$) on the following day. Higher MSC was found to be linked to higher WPE (edge weight = .09, $p < .01$) and ICP (edge weight = .07, $p < .01$) on the following day. WPE was found to lead to reductions in ICP on the following day (edge weight = -.09, $p < .01$).

The between-subjects networks for the groups with good outcome and poor outcome were found to share a significant positive association of MSC and WPE (edge weight = .46, $p < .01$, and edge weight = .56, $p < .01$, respectively), a significant positive association of ICP and WPE (edge weight = .41, $p < .01$, and edge weight = .41, $p < .01$, respectively), as well as a significant negative association of EPI and TAS (edge weight = -.38, $p < .01$, and edge weight = -.51, $p < .01$, respectively). Apart from these common features, networks differed markedly. The between-subjects network of the group with favourable outcome was characterized by positive associations of MOT and MSC (edge weight = .53, $p < .01$), MOT and ICP (edge weight = .36, $p < .01$), and MOT and TAS (edge weight = .41, $p < .01$). The between-subjects network of the group with less favourable outcome, however, showed positive associations of RFP and EPI (edge weight = .50, $p < .01$), and RFP and TAS (edge weight = .58, $p < .01$).

For both the group with good and the group with poor outcome, in the contemporaneous networks, there were positive associations of WPE and MSC (edge weight = .22, $p < .01$, and edge weight = .21, $p < .01$, respectively), WPE and ICP (edge weight = .22, $p < .01$, and edge weight = .22, $p < .01$, respectively), MOT and ICP (edge weight = .58, $p < .01$, and edge weight = .60, $p < .01$, respectively), MOT and WPE (edge weight = .09, $p < .01$, and edge weight = .11, $p < .01$, respectively), ICP and EPI (edge weight = .19, $p < .01$, and edge weight = .20, $p < .01$, respectively), MOT and TAS (edge weight = .13, $p < .01$, and edge weight = .14, $p < .01$, respectively), ICP and TAS (edge weight = .12, $p < .01$, and edge weight = .13, $p < .01$, respectively), MSC and ICP (edge weight = .15, $p < .01$, and edge weight = .15, $p < .01$, respectively), and EPI and RFP (edge weight = .09, $p < .01$, and edge weight = .12 $p < .01$, respectively). Furthermore, both groups shared negative associations of WPE and EPI (edge weight = -.48, $p < .01$, and edge weight = -.44, $p < .01$, respectively). The group with favourable outcome showed an additional positive association of MOT and MSC (edge weight = .11 , $p < .01$) and additional negative associations of MSC and EPI (edge weight = -.09, $p < .01$) and WPE and RFP (edge weight = -.12 , $p < .01$) which were not present in the network of the group with less favourable

outcome. For the latter group, however, a significant negative association of EPI and TAS (edge weight = -.07, $p < .01$) not present in the network of the group with favourable outcome could be observed.

[put figure 1 here]

In summary, the temporal dynamic of the group with poor outcome was characterized by positive effects of insight, confidence, and therapeutic progress on both mindfulness and self-care as well as well-being and positive emotion. Emotional and problem intensity was found to increase mindfulness and self-care and the subjective quality of the relationship with fellow patients helped to increase the subjective quality of the therapeutic alliance and the setting.

The temporal dynamic of the therapy process factors was found to be a lot more sophisticated for the group with favourable treatment outcome. Here, insight, confidence, and therapeutic progress also led to well-being and positive emotions. Yet, not only did insight reduce emotional and problem intensity and increased motivation in this group, but there was also a feedback loop from well-being and positive emotions which *decreased* therapeutic progress. Furthermore, motivation to change decreased well-being and positive emotions on the following day. Insight, confidence, and therapeutic progress increased mindfulness and self-care. These increases then contribute to increases in both well-being and positive emotions and insight, confidence, and therapeutic progress on the next day.

Discrete yet important differences could be observed in the between-subjects networks of the groups with favourable and less favourable treatment outcome. In the group with less favourable outcome, patients with more severe emotional and problem intensity tended to report better relationships to their fellow patients. At the same time, reports of a good relationship to fellow patients were linked to a good therapeutic alliance and setting. In the group with a more favourable outcome, relationship to fellow patients was less important. Here, however, therapeutic progress was better for those patients with more motivation. Also, motivation was found to be linked to mindfulness and self-care as well as to the therapeutic alliance in the group with better outcome.

The contemporaneous networks of the respective groups also showed important differences. Whereas the experience of mindfulness and self-care is linked to both better motivation to change and reduced emotional and problem intensity in the group with more favourable outcome, these associations were missing in the group with less favourable outcome, possibly indicating difficulties in the transition from motivation to engaging in effective self-care in the latter group. Furthermore, the quality of the therapeutic alliance was found to be negatively associated to emotional and problem intensity only in the group with poor outcome.

Discussion/Conclusion

The current study provides preliminary evidence on how therapy process factors fluctuate and interact over time in inpatient trauma-focused psychotherapy for PTSD. The group with favourable outcome was found to be characterized by a temporal network reflecting a variety of systematic associations that can potentially improve outcomes. Furthermore, negative associations and feedback loops reflect a highly complex and dynamic interplay of therapy process factors. In the group with favourable outcome, insight leads to a reduction of negative emotions and problem intensity. Yet, at the same time, insight also increases motivation to change which increases negative emotion and problem intensity, respectively. Hence, while reducing emotional pain on the short-term, insight and therapeutic progress also support a demanding systematic process of confronting one's negative emotions and core problems. Therefore, the role of insight in therapy processes in those with favourable outcome seems to be a dialectical one, as insight both directly reduces and indirectly increases negative emotions and problem intensity at different time points in the process. This continuing process of exposure to negative emotions is complemented by increases in well-being and positive emotions through insight and therapeutic progress, partially mediated by mindfulness and self-care. Yet, increases in well-being and positive emotions attenuate insight and therapeutic progress. This negative feedback effect of well-being on therapeutic progress is counteracted by a negative effect of motivation to change on well-being. Integrating the information from the

388 contemporaneous network, it becomes clear that mindfulness and self-care and positive emotions are
389 important to cope with negative emotions and problems «in the here and now». Insight and the
390 therapeutic alliance form important prerequisites to engage in this process, and it is motivation to
391 change that ensures continuation of the therapeutic process. Taking all these aspects into account, our
392 results suggest a dialectical dynamic where mindfulness and insight lead to the kind of temporary well-
393 being and positive emotions needed to effectively engage with problems and negative emotions, while
394 motivation to change ensures the continuity of confronting negative emotions and problems. The links
395 to the process model of dialectical behavior therapy (DBT) (Linehan, 1993) are obvious, as DBT
396 postulates a therapy process that is characterized by the balancing of mindfulness and acceptance-
397 oriented interventions and change-oriented strategies (Chapman, 2006). Furthermore, our results
398 stress the importance of mindfulness and self-care in the treatment of PTSD (Boughner et al., 2016;
399 Kratzer, Heinz, Ehrig, et al., 2019; Kratzer, Heinz, Pfitzer, Padberg, et al., 2018) and may be seen as
400 evidence that it is worthwile to further investigate self-compassion as a treatment target in PTSD
401 (Karatzias, Hyland, et al., 2019).

402 The temporal network of the group with less favourable outcome was found to be less
403 sophisticated and showed no feedback loops. Also, there were no significant effects on emotional and
404 problem intensity, only on well-being and positive emotions. This may indicate that while patients in
405 this group do acquire mindfulness and self-care skills and promote their well-being in the therapeutic
406 process, they – together with their therapists - fail in systematically engaging with negative emotions
407 and core problems, possibly indicating avoidance, lack of motivation, or a different understanding of
408 self-care of patients in this group. This fact may hint at the presence of self-care patterns that are more
409 directed at acquiring social support or at using social distractions than problem-solving. The
410 contemporaneous network allows to further explore these hypotheses. In the group with good
411 outcome, mindfulness and self-care are linked to reduced emotional and problem intensity. Yet, in the
412 group with poor outcome, it is the therapeutic alliance that is specifically linked to reduced emotional

and problem intensity, adding to the evidence that in the group with less favourable outcomes, helplessness or a lack of self-efficacy might draw patients to their therapists instead of coping through acceptance, mindfulness, and self-care. Furthermore, in the group with less favourable outcome, motivation to change was not associated with self-care, possibly indicating high motivation for therapy, yet reduced motivation for self-care or difficulties in the transition from motivation to acting with self-care. The hypothesis that motivational difficulties and processes of dependence or even malignant regression may play a role in treatments with less favourable outcome is further corroberated by interindividual findings in this group. A good therapeutic alliance is not linked to higher motivation in the group with less favourable outcome. Furthermore, motivation is neither linked to self-care nor therapeutic progress.

Taking all these findings into account, the group with less favourable outcome seems to rely more on the relationship to fellow patients and the therapists and does not systematically engage with negative emotions and problems using helpful coping skills. Apart from problems like lack of self-efficacy, helplessness, and motivational difficulties, this may also hint at problems of malignant regression and the dangers of inpatient treatments for chronically suicidal patients (at the time of admission, 80.2% of our sample reported current suicidal ideation and 47.5% reported at least one suicide attempt) (Paris, 2004; Yager & Feinstein, 2017). A lack of readiness to change, ambivalence, and lack of awareness about the need to change have been linked to poor outcome in the treatment of PTSD before (Murphy et al., 2002).

Future studies should investigate if our results can be used for an early detection of problematic therapy processes. Last but not least, high-frequency monitoring and idiographic analyses of therapy processes should become a standard of practice (Kratzer, Heinz, Pfitzer, Schennach, et al., 2018; Lambert, 2017; Schiepek et al., 2016).

Strengths and limitations

To the best of our knowledge, this work represents the first analysis of the daily interplay of therapy process factors from an interindividual, intraindividual, and temporal perspective. Furthermore, we used a severely traumatized sample of inpatients with PTSD, guaranteeing high ecological validity of our data. Very good compliance to the routine real-time monitoring resulted in a sample size for our analysis that is large when compared to other mlVAR analyses (Contreras et al., 2020; Hoffart et al., 2019; Jongeneel et al., 2020; Rath et al., 2019) and the number of time points analyzed is at the upper end of the interval recommended for mlVAR analyses of 20 to 50 (Jordan et al., 2020).

A major limitation of our analysis is that our data was found to violate assumptions of (multivariate) normality. Violations of this assumption are quite common in clinical samples (Aalbers et al., 2019; Contreras et al., 2020; Molenaar & Campbell, 2009; Terluin et al., 2016; Wigman et al., 2016) and the assumption of normality can even be problematic as it imposes that subjects can only differ on their parameterization, yet not the structure of their networks (Epskamp, Waldorp, et al., 2018). Yet, as of today, even though violations of normality are accepted in mlVAR research, it is unclear how robust mlVAR models are to such violations (Aalbers et al., 2019; Contreras et al., 2020). Furthermore, currently, other than with cross-sectional network analysis, it is impossible to assess the robustness and accuracy of mlVAR models (Aalbers et al., 2019). Last but not least, we did not include symptoms of PTSD in the model. Therefore, it remains unclear how therapy process factors are temporally related to symptom change. Taking all this into account, it is of paramount importance to stress that our results need to be interpreted with caution, particularly regarding causality. Our exploratory results require further investigation. For example, it might be the case that causal relations change during treatment and this should be investigated using multiple mlVAR models (Haken & Schiepek, 2010).

Another limitation is that we investigated contemporaneous networks and temporal networks with a time-lag of one day. Yet, there might be important therapy processes that unfold within shorter

time frames. Furthermore, the 0.6% of missing data was imputed using LOCF which underestimates the complexity of data (Moritz et al., 2015).

Summary, Clinical Implications, and Outlook

Our preliminary results indicate that therapy processes in inpatient trauma-focused treatment may be dramatically different for patients with good outcome and patients with less favourable outcome. Effective trauma-focused psychotherapy for PTSD seems to rely on a specific dialectical dynamic of therapy process factors where mindfulness, well-being, insight, therapeutic alliance and self-care enable engagement with emotional pain and problems. Enhancement of these factors during therapy can lead to a more favourable outcome. Although our results require replication in future research, future modular and personalized treatments of PTSD should encompass therapy monitoring tools that allow for a rapid detection of disadvantageous idiographic therapy processes (Brintzinger et al., 2021; Cloitre et al., 2020; Hoeboer et al., 2021; Karatzias & Cloitre, 2019). Furthermore, our results hint at the existence of a subgroup of patients with motivational, mindfulness, and self-care deficits who profit less from inpatient treatment. Further research into this group is necessary.

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Figure Legends

Fig. 1. The between-subjects networks, contemporaneous networks, and temporal networks of the subgroups with good and poor treatment outcome. W = Well-being and positive emotion; E = Emotional and problem intensity; I = Insight/confidence/therapeutic progress; M = Motivation to change; R = Relationship with fellow patients; T = Therapeutic alliance and clinical setting; S = Mindfulness/self-care

Table 1

Comparison of central tendencies of the therapy process factors of the groups with more favourable and less favourable outcome

Variable (Abbreviation)	Median of the subgroup with poor outcome (N = 52)	Median of the subgroup with good outcome (N = 49)	Mann-Whitney $U(N_{poor} = 52, N_{favourable} = 49)$	p
Well-being and positive emotion (WPE)	Md = 23.4	Md = 40.7	4347952	<.01
Emotional and problem intensity (EPI)	Md = 54.7	Md = 45.4	2349257	<.01
Insight/confidence/therapeutic progress (ICP)	Md = 40.2	Md = 51.8	3975187	<.01
Motivation to change (MOT)	Md = 67.6	Md = 73.5	3693267	<.01
Relationship with fellow patients (RFP)	Md = 52.8	Md = 52.5	3143002	.42
Therapeutic alliance and clinical setting (TAS)	Md = 94.8	Md = 96.7	3610281	<.01
Mindfulness/self-care (MSC)	Md = 42.0	Md = 58.8	4375885	<.01