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Perceived treatment processes and effects of interactive motion-assisted exposure therapy for veterans with treatment-resistant posttraumatic stress disorder: a mixed methods study

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ABSTRACT

Background: A novel intervention, Multi-modular motion-assisted memory desensitization and reconsolidation (3MDR), aims to reduce avoidance and improve engagement for patients with posttraumatic stress disorder (PTSD) who did not sufficiently respond to previous treatments. It has been found to effectively reduce PTSD symptoms for veterans with treatment-resistant PTSD. Symptomatic measures alone might not capture all treatment effects, and addition of qualitative outcomes may provide deeper understanding of treatment processes and treatment-induced changes.

Objective: To study the perspectives of veterans with treatment-resistant PTSD on 3MDR treatment processes and effects and explore the relation of their experiences to PTSD symptom improvement.

Method: A convergent parallel mixed methods design was applied. For the qualitative part, open-ended question interviews were conducted until data saturation was reached (N = 10). Thematic analysis, rooted in grounded theory, was performed. Quantitative data included pre- to posttreatment responder status based on a structured clinical interview for PTSD.

Results: Treatment processes endorsed by the veterans were engaging, regulating distress, feeling supported, facing traumatic memories, allowing emotions, associating, and disengaging from trauma. In terms of effects, veterans reported positive changes following 3MDR, including openness, new learning, self-understanding, closure, and reintegration. High comparability across themes was observed for responders and non-responders, except for the themes closure and reintegration, which were reported more often or more in depth by responders.

Conclusions: Veterans indicated 3MDR treatment processes that complied with its aims of breaking through avoidance and increasing engagement, thereby facilitating traumatic memory retrieval and processing. However, this did not necessarily translate into PTSD symptom improvement for all veterans. Walking towards trauma-related pictures was highlighted as unique component of 3MDR and connected to specific treatment processes and effects. Positive changes following 3MDR were experienced outside the domain of PTSD symptom improvement, implicating that 3MDR may beneficially impact veterans beyond symptom changes alone.

Procesos y efectos de tratamiento percibidos de la Terapia de Exposición Interactiva Asistida por Movimiento para veteranos con trastorno de estrés postraumático resistente al tratamiento: un estudio de métodos mixtos

Antecedentes: Una nueva intervención, la reconsolidación y desensibilización de la memoria asistida por movimiento multimodular (3MDR), tiene como objetivo reducir la evitación y mejorar la adherencia de los pacientes con trastorno de estrés postraumático (TEPT) que no respondieron lo suficiente a tratamientos anteriores. Se ha descubierto que reduce eficazmente los síntomas de TEPT en los veteranos con TEPT resistente al tratamiento. Las medidas sintomáticas por sí solas pueden no capturar todos los efectos del tratamiento, y la adición de resultados cualitativos puede proporcionar una comprensión más profunda de los procesos de tratamiento y los cambios inducidos por el tratamiento.

Objetivo: Estudiar las perspectivas de los veteranos con TEPT resistente al tratamiento sobre los procesos y efectos del tratamiento 3MDR y explorar la relación de sus experiencias con la mejoría de los síntomas de TEPT.

Método: Se aplicó un diseño de métodos mixtos paralelos convergentes. Para la parte cualitativa, se realizaron entrevistas con preguntas abiertas hasta que se alcanzó la saturación de datos

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PALABRAS CLAVE
Veteranos; TEPT; 3MDR; resistente al tratamiento; resultado de tratamiento; realidad virtual; movimiento; desensibilización y reprocesamiento del movimiento ocular; investigación cualitativa

关键词
退伍军人; PTSD; 3MDR; 难治型; 治疗结果; 虚拟现实; 运动; 眼球脱敏和再加工; 定性研究

HIGHLIGHTS
- Veterans with PTSD indicated high engagement in 3MDR leading to processing of traumatic memories.
- Following 3MDR, increased openness, self-understanding, new learning, closure and reintegration were reported.
- Similar experiences were reported by responders and non-responders.

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(N = 10). Se realizó un análisis temático, basado en la Teoría Fundamentada. Los datos cuantitativos incluyeron el estado del participante antes y después del tratamiento basado en una entrevista clínica estructurada para el TEPT.
Resultados: Los procesos de tratamiento respaldados por los veteranos fueron los de involucramiento, regular la angustia, sentirse apoyados, enfrentar recuerdos traumáticos, permitir emociones, asociar, y desligarse del trauma. En términos de efectos, los veteranos informaron cambios positivos después de 3MDR, incluida la apertura, nuevo aprendizaje, la autocomprensión, el cierre y la reintegración. Se observó una alta comparabilidad entre los temas de los que respondieron y los que no respondieron, excepto para los temas cierre y reintegración, que fueron informados con más frecuencia o con mayor profundidad por los que respondieron.
Conclusiones: Los veteranos indicaron que los procesos de tratamiento 3MDR cumplieron con sus objetivos de romper con la evitación y aumentar la adherencia, facilitando así la recuperación y el procesamiento de la memoria traumática. Sin embargo, esto no se tradujo necesariamente en una mejoría de los síntomas de TEPT para todos los veteranos. Caminar hacia imágenes relacionadas con el trauma se destacó como un componente único de 3MDR y conectado con procesos y efectos de tratamiento específicos. Los cambios positivos después de 3MDR se experimentaron fuera del dominio de la mejora de los síntomas del TEPT, lo que implica que 3MDR puede tener un impacto beneficioso en los veteranos más allá de los cambios en los síntomas por sí solos.

患有难治型创伤后应激障碍退伍军人感知到的交互运动辅助暴露疗法的治疗过程和效果:一项混合方法研究

背景: 一种新型干预措施, 即多模块运动辅助记忆脱敏和再巩固 (3MDR), 旨在减少对先前治疗反应不足的创伤后应激障碍 (PTSD) 患者的回避, 提高其参与度。已经发现这种治疗可有效减轻患有难治型PTSD退伍军人的PTSD症状。仅仅对症措施可能无法捕捉到所有治疗效果, 定性结果的补充也许可以提供对治疗过程和治疗引起的变化更深入的了解。
目的: 考查患有难治型PTSD的退伍军人对3MDR治疗过程和效果的观点, 并探讨其体验与PTSD症状改善之间的关系。
方法: 采用收敛性平行混合方法设计。对于定性部分, 进行开放式问题访谈, 直到达到数据饱和 (N = 10) 。基于扎根理论进行主题分析。定量数据包括根据PTSD结构化临床访谈得出的治疗前至治疗后的应答者状态。
结果: 退伍军人认可的治疗过程包括参与, 调节痛苦, 感到支持, 面对创伤性记忆, 允许情绪, 联想和脱离创伤。在效果方面, 退伍军人报告了3MDR后的积极变化, 包括开放性, 新学习, 自我理解, 闭合和重新整合。应答者和未应答者在各个主题之间都具有高度相似性, 除了在闭合和重新整合上, 响应者更经常或更深入地报告了这些主题。
结论: 退伍军人指出3MDR治疗过程符合其突破回避和增加参与度的目标, 从而促进了创伤性记忆的再提取和处理。但是, 这未必在所有退伍军人处都转为PTSD症状的改善。走向创伤相关图片被强调为3MDR的独特组成部分, 并与特定的治疗过程和效果相关。3MDR带来的PTSD症状改善范围之外的积极改变也有所体验, 表明3MDR对于退伍军人可能有除症状变化之外的有利影响。

1. Introduction

Veterans with posttraumatic stress disorder (PTSD) tend to benefit less from treatment than civilians with PTSD (Haagen, Smid, Knipscheer, & Kleber, 2015; Kitchiner, Lewis, Roberts, & Bisson, 2019). A recent meta-analysis found trauma-focused cognitive behavioural therapy to be the only treatment with sufficient evidence for veterans at the moment, and even for this intervention effects were considerably smaller than those for the general population (Kitchiner et al., 2019; Lewis, Roberts, Andrew, Starling, & Bisson, 2020). The causes of lower treatment outcomes in veterans are likely to be multi-factorial, but high drop-out has been identified as a central issue (Hoge et al., 2014; Kitchiner et al., 2019; Steenkamp, Litz, Hoge, & Marmar, 2015). Several qualitative investigations have consistently found veterans to attribute avoidance behaviours and avoidance of trauma-related feelings and memories as main causes for withholding and withdrawing themselves from treatment (Hundt et al., 2018; Sayer et al., 2009). Our group developed a novel intervention, called 3MDR, which aims to break through persistent avoidance and optimize engagement in treatment for veterans who did not respond to prior PTSD treatment (van Gelderen, Nijdam, & Vermetten, 2018).

In 3MDR a virtual environment has been personalized with trauma-related pictures and music and within this context, patients walk towards their trauma-related pictures, reiterate their traumatic narratives, and perform a dual-attention task. Therapeutic techniques from Virtual Reality Exposure Therapy (VRET) and Eye Movement Desensitization and Reprocessing (EMDR) have been integrated with walking and trauma-related stimuli. The rationale for this has been based on preliminary evidence for exercise and virtual reality (VR) components as adjuncts to exposure-based treatments (for an extensive description of the theoretical rationale see van Gelderen et al. (2018)). Walking towards trauma-related stimuli was expected to decrease avoidance of the traumatic memory (Wolitzky & Telch, 2009). VR was used to enhance in-session attention and immersion in

the trauma-related pictures and music (Rizzo, Reger, Gahm, Difede, & Rothbaum, 2009). Together, these elements were hypothesized to overcome avoidance and improve (emotional) engagement in treatment, thereby enhancing activation of the traumatic memory network, including associated difficult emotions and cognitions (van Gelderen et al., 2018). Processing of the traumatic memories was expected to be enhanced with a dual-attention task. Such tasks have been found to facilitate traumatic memory processing through reconsolidation and addition of new information to the memory network (James et al., 2015).

Evidence on the efficacy of 3MDR is emerging. Two trials investigated 3MDR as compared to either a non-trauma focused treatment (Van Gelderen, Nijdam, Haagen, & Vermetten, 2020) or a waitlist control group (Bisson et al., 2020) for veterans with treatment-resistant PTSD (TR-PTSD). PTSD symptoms improved significantly more for those receiving 3MDR, with moderate (Cohen's d = 0.65 (Bisson et al., 2020)) to large effect sizes (Cohen's d = 0.83; (Van Gelderen et al., 2020)). These studies demonstrated that 3MDR can effectively reduce PTSD symptoms for veterans with TR-PTSD. However, quantitative symptomatic measures alone cannot fully capture all treatment outcomes, treatment processes, or putative mechanisms of change (Gallegos, 2005). Moreover, bias can be present by selecting certain outcome domains, but not others. Clinicians and researchers, therefore, emphasized the need to use qualitative methods in therapy outcome research (Klein & Elliott, 2006). However, only a few studies have applied such approaches to evidence-based treatments. These studies have shown that benefits went beyond symptom changes and included a wide array of effects, such as greater self-understanding, increased self-esteem, improved relationships, and changes in thoughts and beliefs (Barone, Beck, Mitsunaga-Whitten, & Perl, 2019; Hundt, Barrera, Arney, & Stanley, 2017; Price, MacDonald, Adair, Koerner, & Monson, 2016). A process-nested qualitative evaluation of the 3MDR trial by Bisson et al. (2020), included qualitative interviews with veterans who had received 3MDR. The intervention was described as powerful and complex, and the importance of support by others and resolving practical barriers to care were emphasized. Previous case reports of veterans have provided some support for perceived mechanisms of action of 3MDR, with participants reporting that walking, VR and the trauma-related stimuli increased engagement in treatment and recollection of their traumatic memories (Nijdam & Vermetten, 2018; van Gelderen et al., 2018). However, these studies did not investigate veterans' own perception of effects of this treatment.

The primary objective of this investigation was to study veterans' perspectives on treatment processes and effects in 3MDR treatment. Open-ended question interviews were conducted with veterans with TR-PTSD who received 3MDR, and qualitative analysis was performed. A second aim was to explore how these processes and effects were related to PTSD symptom change as assessed by a structured clinical interview reported previously (Van Gelderen et al., 2020). Data from both were integrated in a convergent parallel mixed methods design (Creswell & Plano Clark, 2017). With this study we aimed to expand and deepen our knowledge on treatment processes and effects of 3MDR.

2. Methods

2.1. Design, participants and procedure

This study was part of a larger single-blind randomized controlled trial (RCT) (Van Gelderen et al., 2020), conducted at two tertiary mental health care institutes in the Netherlands: ARQ Centrum'45 and Mental Health Centre Beilen. It utilized a convergent parallel mixed methods design as described by Creswell and Plano Clark (2017) (Figure 1).

Participants had to be (a) veterans, (b) diagnosed with PTSD as according to DSM-5 criteria, (c) 18–70 years old, and (d) treatment-resistant for trauma-focused treatment (TFT) prior to 3MDR treatment, defined as persisting PTSD diagnosis and lack of improvement in PTSD symptom severity following a full course of individual TFT or repeated failed trials of individual TFT and treatment for at least six months. They had to have received at least one 3MDR session. Exclusion criteria were (a) acute suicidality, (b) severe walking difficulties, (c) current severe alcohol and/or substance dependence according to DSM-IV, and (d) acute psychosis.

Patients were referred by their therapist and a baseline assessment was conducted, including a structured interview for PTSD symptom severity. If randomized to the 3MDR group, participants received six weekly 3MDR sessions followed by 10 weeks treatment as usual. After this, the structured interview was repeated (post-treatment assessment). Assessors were junior psychologists that were blinded to treatment condition. More details on the procedure for the quantitative data collection have been described elsewhere (Van Gelderen et al., 2020).

The qualitative interviews were optional when participating in the RCT. For the qualitative data collection, purposeful random sampling was applied. This allowed for the recruitment of a population of interest, but was not based on prior knowledge of outcomes as to increase credibility of the results (Palinkas et al., 2015). Thus, no criterion for treatment outcome was applied. The order in which participants were approached was balanced over the two

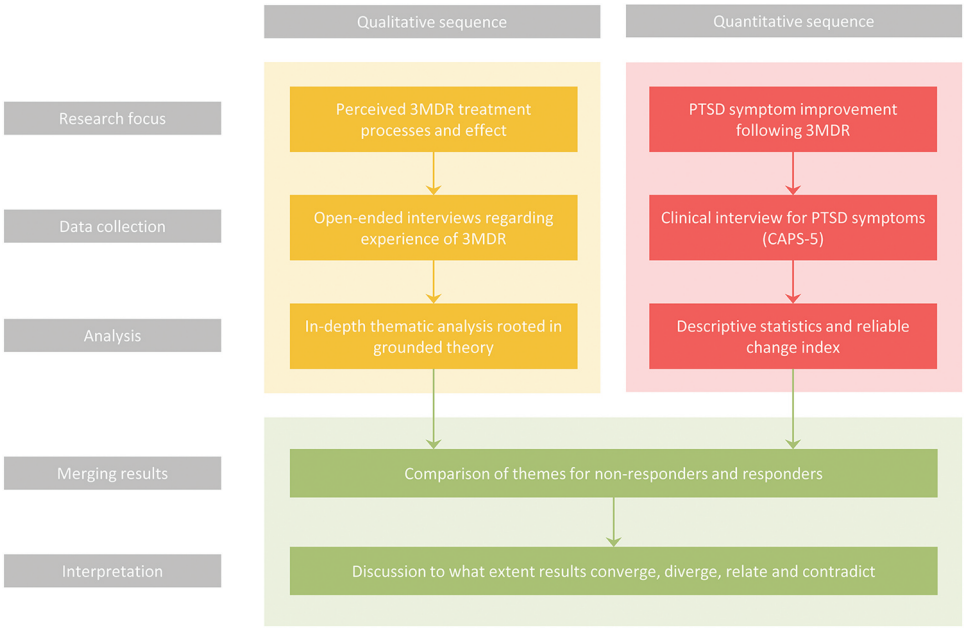

Figure 1. Flow chart of the convergent parallel mixed methods design: two strands of complementary qualitative and quantitative data were collected and analyzed independently and then interpreted together to examine conformity, contradictions and relationships between the two sources of data.

treatment centres. Participants who had received 3MDR were approached for the qualitative interviews after the quantitative post-treatment assessments. If they wanted to participate, a face-to-face appointment was made. Interviews were conducted and coded by the first and third author (MG and ED), who were blind to treatment outcome. Each interview (approximately 60 minutes) was audio-recorded and transcribed. Names, locations and other privacy sensitive information were substituted with functional codes to ensure confidentiality. Interviews were conducted until data saturation was reached, which was after 10 interviews.

Written informed consent was obtained for all participants for both the quantitative and qualitative data collection. All procedures were approved by the Medical-Ethical Review Committee of Leiden University Medical Centre (approval number: P14.325) and comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

2.2. Treatment

3MDR is a manualized TFT. An extensive description of the theoretical framework and treatment protocol has been published (Van Gelderen et al., 2020; van Gelderen et al., 2018), and a summary description is provided here. A schematic overview of the 3MDR set-up is given in Figure 2. Patients selected pictures that strongly reminded them of their traumatic events. During 3MDR, patients walked on the treadmill

Figure 2. Image of the 3MDR set-up. The hardware included a dual-belt treadmill, a 180° projection on 3 screens by 3 projectors, and a surround sound system. The software consisted of a purpose-built virtual environment to walk in, personalized for each patient with images and music selected by patients. Participants wore a harness whilst on the treadmill for safety reasons. The therapist was standing alongside the veterans. A junior psychologist operated hardware and software.

in a virtual environment. Starting with a warm-up, self-selected deployment-related music was played. Next, patients entered a virtual tunnel at the end of which the first picture was displayed. Upon approaching each picture, a description of the picture was asked, followed by recall of the related traumatic memory, and associated bodily sensations, feelings, cognitions, and meanings. These associations were projected in real-time over the picture. Whilst focusing on the picture and associations, patients were asked to track a ball moving over the screen and call aloud the numbers appearing in the ball at the far end (dual-attention task). After completion of the task, the picture faded

and the next virtual tunnel appeared. This sequence was repeated for seven times in total, after which patients walked in a neutral environment while listening to their selected contemporary music. Off the platform, each session ended with a therapist-led discussion about experiences the patient had during the session.

2.3. Materials

2.3.1. Interview

A topic list with sub-questions was formulated by the research team, including experienced 3MDR therapists and a researcher with ample experience in qualitative research (MS) (Table 1). Data collection and data analysis were conducted in parallel (Boeije, 2009) and as such the topic list was evaluated after each interview and adjusted when topics were no longer relevant or when new topics emerged.

2.3.2. Structured PTSD symptom interview

The Clinician Administered PTSD Scale for DSM-5 (CAPS-5) was used to assess PTSD symptom severity (Weathers et al., 2018). The CAPS-5 consists of 20 items measuring PTSD symptoms in 4 symptom clusters (intrusions, avoidance, alterations in mood/cognitions and hyperarousal). Questions are rated on a 5-point scale, with the total symptom severity score ranging from 0–80. Higher scores reflect more severe PTSD.

Table 1. Questions included in interview guide.

How did you experience the preparation for the 3MDR?
How did you select the images?
How did you select the music?
What information did you receive about the 3MDR?
Looking back, did you miss any information?
What was your expectation of treatment?
What effect has the preparation had on you?
How did you experience the 3MDR sessions?
What happened when the music was playing?
What was it like to walk?
What was it like to be in the virtual environment?
What did you experience while walking towards the image?
How did recalling the memory go?
What happened when naming your emotions?
How was it that your emotions were displayed on the screen?
How did you experience the ball moving across the screen?
What was it like to have the practitioner standing next to you?
What did you experience during neutral music?
What did you talk about in the therapist-led discussion?
(follow-up for all questions) What was/was not helpful?
What effect has the 3MDR had on you?
What did you notice in the week after a 3MDR session?
Which positive effects did you experience after the treatment was completed?
Which negative effects did you experienced after the treatment was completed?
To what do you contribute these effects?
What about 3MDR contributed to these effects?
When did you notice positive or negative effects of 3MDR?
Which effects are most important to you?
How are you now?
Which complaints or symptoms do you still have?
Which reactions have you received from your environment?
What do you think of the 3MDR treatment?
Why would you recommend or not recommend the treatment to others?
What would you like to change about the 3MDR?
What is the difference between 3MDR and other treatments you have received before?

2.4. Data analysis

Qualitative data analysis was conducted in a three-step process as described by Boeije (2009), rooted in Grounded Theory and recommended for use in qualitative psychology research (Ponterotto, 2005). First, open coding was applied to the transcripts in order to explore the data. Next, axial coding reduced the number of codes and more abstract concepts were assigned to (groups of) codes. Finally, during selective coding, the relations between these concepts were explored and verified. Open coding was conducted in parallel (MG and ED). The coding was discussed among these raters and consensus was reached. Axial and selective coding were conducted (MG) while keeping an ongoing discussion with the rest of the team. After 10 interviews, there was sufficient depth of information and redundancy of data because no new main themes emerged in the interviews. Qualitative analyses were conducted with MAXQDA.

The quantitative analysis were conducted with SPSS IBM Statistics V.23. A reliable change index (RCI) was calculated and used as a clinically relevant margin [22]. Using the pooled variance at baseline (SD = 7.26) and test-retest reliability (r = 0.78), a change of 10 or more points on the CAPS-5 was deemed clinically relevant. Based on individual change in CAPS-5 score from baseline to posttreatment, participants were defined as either responder (improved: ≥10 points decrease), or non-responder (remained stable: <10 points change, or deteriorated: >10 points increase).

To integrate the quantitative and qualitative data, themes were evaluated with respect to the number of responders and non-responders that endorsed a theme (Figure 1). The content of the themes was compared between groups and differences described.

3. Results

3.1. Sample characteristics

Fourteen veterans were approached for this study. Two veterans were unreachable, and two veterans declined to participated because they did not want to revive their traumatic experiences and therapy. This corresponds to a response rate of 71.4%. Participant characteristics are displayed in Table 2. Participants were all male, had an average age of 43.10 (SD = 7.53) upon entering the study, and on average were deployed 1.5 times (SD = .85). Before entering this study, participants received an average amount of 4.1 (SD = 2.08) different types of psychological treatments for PTSD, and 4.3 (SD = 2.63) different types of pharmacological

Table 2. Description of individual participant characteristics.

Participant	Age	Marital status	Education level	Prior psychological treatments for PTSD	Benzodiazepine use
1	32	Married	Low	3	Yes
2	25	Co-habiting	Low	2	Yes
3	47	Married	Low	3	No
4	56	Relationship	Low	6	No
5	53	Married	Low	1	No
6	59	Divorced	Middle	4	Yes
7	59	Married	Middle	6	Yes
8	36	Married	Middle	8	No
9	37	Co-habiting	Middle	4	No
10	42	Married	Middle	4	Yes

treatments for PTSD. All participants had received EMDR prior to entering the trial. Except for participant five, all participants used psychotropic medication during the trial. All participants received the full treatment course of six 3MDR sessions. During the 10 weeks following 3MDR, nine participants received treatment as usual. The mean number of weeks with a treatment session was 4.67 (SD = 2.06; range 2–7). The most frequently used intervention strategies during treatment as usual were case management (n = 8), optimizing coping skills (n = 5), evaluation of treatment (n = 5), and medication consults (n = 3). None of the participants in the current study received additional trauma-focused treatment. On average, the interviews were conducted 53 weeks after the final 3MDR session (range 12–118 weeks).

3.2. Quantitative outcome

The average CAPS-5 score was 43.10 (SD = 7.53) at baseline and 36.20 (SD = 9.56) at post-assessment (Table 3). Based on the margin for clinical relevance (RCI), three participants improved and were categorized as responders (30%). One participant deteriorated and six remained at the same level (non-responders: 70%). In the RCT as a whole, 45% of the participants were categorized as responders and 55% as non-responders (Van Gelderen et al., 2020).

Table 3. Reliable change index based on PTSD symptom pre- and post- 3MDR treatment.

Participant	CAPS pre-treatment	CAPS post-treatment	Reliable Change Index
Non-responders			
1	41	48	1.45
2	51	43	−1.66
3	45	39	−1.25
5	29	30	0.21
6	34	44	2.08
8	41	35	−1.25
9	45	38	−1.45
Responders			
4	55	41	−2.91
7	46	29	−3.53
10	44	15	−6.02

CAPS: Clinician Administered PTSD Scale for DSM-5 (CAPS-5). A reliable change index of ±2.08 was clinically significant.

3.3. Qualitative outcomes

The key themes that emerged from the transcripts were categorized as either representing treatment processes or treatment effects (Figure 3). Within the 'treatment processes' category, three themes could be regarded as preconditions for the therapeutic process and four themes described working through the traumatic memories, which has been subdivided into memory retrieval and memory processing. The treatment processes occurred sequentially and repeatedly throughout a treatment session and ultimately resulted in the treatment effects.

3.3.1. Treatment processes

3.3.1.1. Engaging. A key theme that emerged from the transcripts was the experience of being highly focused during treatment and being unable to avoid the traumatic memory. These experiences can be considered as two sides of the same coin and were described by all participants (N = 10). Most participants (n = 8) explicitly stated that 3MDR made it impossible for them to apply avoidance strategies in order to prevent being confronted with the traumatic memory. Instead, a strong focus on the trauma-related picture and the associated memory and emotions was experienced. This heightened engagement was discussed as an essential condition which made it possible to fully work through their traumatic memories and, therefore, deemed a prominent factor of 3MDR. High engagement in 3MDR was also discussed as a crucial difference from EMDR, with participants having been able to avoid during previously received EMDR while they felt this was not possible during 3MDR (n = 8).

> So if I compare it to EMDR, during EMDR you could sometimes pretend a bit as if you weren't there, you know? And that is not possible with 3MDR. You have to walk, so you can't stop or just lean back and relax for a bit, in a sense. (P7)

Walking was described as the most important facilitator for high engagement (n = 7). It activated participants, improved focus, and decreased dissociation. In addition, the trauma-related pictures were discussed as an explanation for lowered avoidance, and a few participants talked about VR in this respect as well.

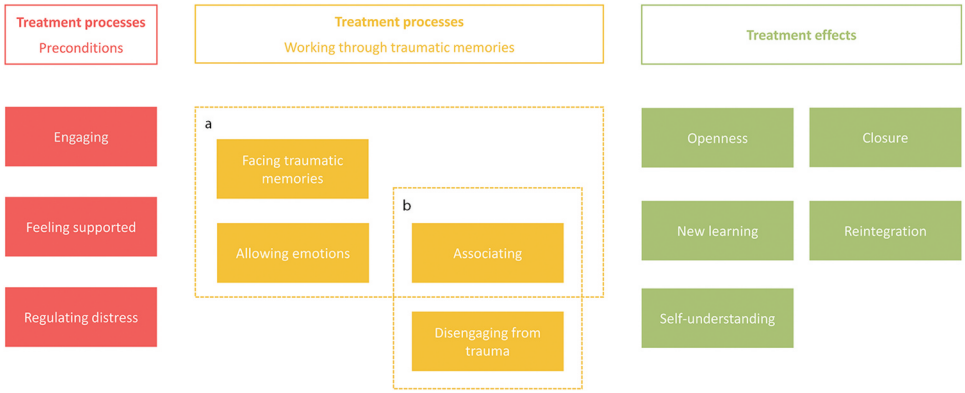

Figure 3. A schematic representation of key themes that emerged from the qualitative interviews. Themes represented either treatment processes or treatment effects. Treatment processes that were experienced could be divided into 'preconditions' and 'working through traumatic memories', with the latter subdivided into memory retrieval (panel A) and processing (panel B). The theme 'associating' could be regarded as both part of memory retrieval and processing.

> It's very hard to, like, step out of the picture, because you are walking straight towards it. And when you're walking, you always look straight ahead and not … You wouldn't really walk sideways, because you'd head in the wrong direction. […] I actually really enjoyed the walking, but it was also tough because I was not able to look for ways to distract myself. That is what I basically do all the time: finding distractions to avoid thinking about it. I wasn't able to do that because of [the walking]. (P8)

3.3.1.2. Regulating distress. Another theme that emerged concerned the regulation of levels of distress during 3MDR (n = 9). Participants described how the pictures and the warmup music elevated levels of distress, whereas walking, interaction with the therapist, and the cooling down music supported down-regulation of distress. This theme seems to reflect that 3MDR supported arousal within the window of tolerance: some participants experienced how walking helped them to maintain aroused (instead of dissociating), whereas others discussed how walking supported release of tension and prevented anxiety attacks.

> And one time I had a … well, I usually would have had a panic attack. But because you're walking, that is just not possible, because you have to keep walking. Otherwise, I really would have just, like, had a serious breakdown. (P7)

3.3.1.3. Facing traumatic memories. A common theme across transcripts was that of participants confronting their traumatic memories (N = 10). This theme is about rising up to the challenge of recalling the traumatic memories, mentally reliving them, and facing the most feared aspects of it. Most participants explicitly stated that they were able to fully confront their traumatic memories (n = 6), which was a new experience as compared to previous therapies. For some this resulted in a feeling of empowerment (n = 3). The confrontation was, again, facilitated by walking (n = 5):

> V: I still enjoyed walking. I: What did you enjoy about the walking? V: [Silence, crying]. I had said yes to that confrontation, and I'm not going to walk away from that. Bring it. (P3)

Most participants explicitly discussed being back in the place and time of the traumatic experience in their mind. This sensation was considerably stronger than simply thinking about the events and participants related this to the trauma-related pictures (n = 7), music (n = 5), walking towards trauma-related pictures (n = 3), questions by the therapist (n = 3), and VR (n = 2). Recalling traumatic memories thus seemed to be facilitated by the combination of these components and different components may have mattered most for different individuals who underwent the treatment. A more in-depth recollection of the traumatic events during 3MDR as compared to during EMDR was described (n = 6) and directly related to the use of trauma-related pictures (n = 5).

> V: With the 3MDR, it really felt like you were moving forward. […] That you really step into [the memory]. Yes. That you step into it. Like you're actually there. (P2)

3.3.1.4. Allowing emotions. A key theme across transcripts was the experience of strong emotions during 3MDR when confronted with their traumatic memories (n = 9). A wide array of emotional responses was reported, including anxiety, anger, powerlessness, sadness, disgust and disappointment. In general, it was challenging for the participants to experience these intense emotions, with several explicitly stating that it was highly confronting for them (n = 4). However, it was also regarded as necessary for the therapeutic effect to occur:

> Because you really tap into your emotions and feelings, you go deeper in there, that makes you feel vulnerable. They could see sadness in me, they could see anger in me. […] On the one hand it really felt horrible, but on the other hand you know that you have to be in [the memory]. It feels very conflicted. I: And why do you have to be in there? V: Well, because otherwise it won't work at all, I guess. (P8)

Often, feelings had been pushed away for a long time and were now newly recognized (n = 6). As such, it was challenging to find words to describe these emotions (n = 4):

> As far as emotions that were suppressed for years, and what word was associated with that, I always suppressed that feeling. So that feeling, I wasn't familiar with it. (P3)

Participants highlighted the profound experience of emotions as different from what they experienced during other TFT (n = 4). The most mentioned facilitator for allowing emotions were the questions asked by the therapist (n = 5).

> I: And how did that compare to other treatments? V: It did hit something occasionally, but I was always able to cover it up again. […] Or, well, cover it up … . Like, occasionally it would touch on something, like a certain emotion or feeling, but then we wouldn't get any deeper than that. And now you're, like, scraping out everything inside your head. And that didn't happen with other therapies. (P10)

Two participants discussed that they were surprised to learn that they were able to feel as much as they did. These veterans were also the only ones to report that they did not fully express their feelings. Participant 5 reported that he was scared to feel anger and participant 9 spoke about how his anger was in the way of other emotions.

> [Experiencing the emotions was] Confronting. Like, do I have so much emotion inside of me? I'm always told: you are just emotionless. I: Who tells you that? V: Well, the people around me. They say, you are simply cold as stone sometimes. You don't show any emotion, nothing at all. I can't tell just by looking at you whether you're laughing or crying. I: Yes, and during one of these sessions, then … V: Yeah, then you feel it stirring, but only to a certain extent. You can name it, but that is as far as it goes. I never really did break. (P9)

3.3.1.5. *Associating.*

This theme encompasses the effortless emerging of memories and feelings, which participants were unaware of until then (n = 6). It is about how 'new' memories, fragments of those memories or details of existing memories, were again remembered. It seems to refer to the reorganization of the traumatic narrative. Remembering increased over sessions and participants were surprised by these unexpected associations. Of note is the recollection of positive memories for some (n = 2). The trauma-related pictures were most consistently mentioned as triggers for novel associations (n = 5).

> That went a little deeper with every session. And with every trauma, actually … At some point, I could recall things that I had never … That I had never thought about again, that never crossed my mind. (P9)

3.3.1.6. *Disengaging from trauma.*

A prominent theme that emerged from the transcripts was disengaging from the traumatic memory and returning to the present moment. All participants (N = 10) described that they were distracted by the dual-attention task and as such experienced a fading of the traumatic memory and associated emotions.

> Yes, I was very distracted. Because of course you're inside an emotion that is not particularly pleasant. After the balls and reciting numbers out loud, which you had really concentrate on and follow them. So you are really focused on that, so the other thing actually fades into the background. (P1)

The demanding nature of 3MDR on the working memory was explicitly described by several participants. Not just the dual-attention task, but the combination of modalities was experienced as taxing the working memory (n = 3). In addition, participants discussed how the dual-attention task and the music at the end of a session brought them back to the present moment and provided closure (n = 6).

3.3.1.7. *Feeling supported.*

A recurrent theme was that of feeling supported by the therapist (n = 8). This was reported to be an important factor in facilitating all treatment processes described. In particular, support was experienced through the position of the therapist (next to the patient) and hearing the voice of the therapist. As such, the therapist provided familiarity and safety, reassurance, and a link to the present moment.

> Sometimes it was almost as if she was, like, walking with me. I: How did that feel to you? V: Well, that she was close to me, a kind of support and calmness. (P10)

3.3.2. Treatment effects

All participants discussed enduring positive treatment effects and no enduring negative effects. Positive effects included decreased PTSD symptoms, but current PTSD symptoms were a common theme across transcripts as well. Some participants (n = 3) had hoped to have gained more PTSD symptom improvement following 3MDR. Negative short-term effects that were common across transcripts were feelings of tiredness and increased symptoms during the six weeks receiving 3MDR. Positive effects

entailed more than PTSD symptom reduction. Themes that emerged from the data were increased openness, changes in cognitions related to traumatic events (new learning), a deeper self-understanding, closure, and reintegration. Participants (n = 6) highlighted that the positive effects they experienced occurred 2–6 weeks after 3MDR.

> And actually, about four or five weeks afterwards, I started to notice that I was sleeping better. And the overall stress was getting less, which made me think, that's strange. Because I was so used to it. (P2)

3.3.2.1. Openness. A key theme was the ability to more easily think and talk to others about past traumatic events (n = 6). This increased openness was perceived as directly related to having discussed the traumatic events during 3MDR treatment and remembering in more detail what happened. Some valued this as the most important effect: being able to discuss the traumatic events without feeling overwhelmed.

3.3.2.2. New learning. A common theme was that of a new learning experience during which thoughts and emotions related to a traumatic event changed (n = 4). For instance, no longer feeling guilty about their role in a traumatic event, no longer feeling angry, and having learned that they are safe now:

> Yes, it was an incident involving a roadside bomb. A colleague of mine who was searching my area, and I felt guilty about that. He wasn't actually supposed to do it anymore, but he did anyway, and the roadside bomb exploded. And I felt guilty about that for a very long time. He wasn't going to do it, but there was still enough light out. And essentially, with 3MDR, it's like: why do you feel guilty then? And talking through it. But overlaying the talk it was like: it doesn't make sense. It was his job, and it was just bad luck. […] And the advantage of 3MDR is, [compared to previous treatments,] you are so intensely focused on it, that my feelings of guilt from that one incident are less intense. None of those other things had managed that. (P8)

3.3.2.3. Self-understanding. A prevalent theme regarded a deeper understanding of triggers and symptoms (n = 4). Participants described having gained insight into why certain persons or situations were triggering for them, which resulted in greater control over symptoms and experiencing less distress. They discussed being able to handle triggering situations better, but also avoiding situations known to be triggering. For one participant, the latter was experienced as a negative consequence of increased self-understanding:

> Avoiding the tensions. At some point you know what yields tension or not. And you will have to learn to cope with that at some point. […] Yes, if you don't feel comfortable at a full market, just don't go there. (P6)

3.3.2.4. Closure. Participants also spoke about how they appreciated feeling more at peace with what had happened, like things had fallen into place (n = 4). Participants described how this resulted in fewer flashbacks, less fixation on war-related news, and less vivid nightmares. This theme seemed to reflect mindfulness and no longer being consumed by traumatic memories. Participants related this experience to the full recollection of their traumatic events and having spent ample time reviewing and talking about those events.

> No, it's really … there are more things that fell into place. And some things that you're kind of, like, somewhat at peace. You've managed to leave it behind you a bit. (P7)

One veteran explicitly stated that he expected this effect, but it did not occur for him:

> Yes, a team of specialists, it's all being pulled out again. The old wounds are being opened again. And the idea is that you can start putting everything into perspective again somewhat. But that wasn't really entirely a success. (P5)

3.3.2.5. Reintegration. A common theme across transcripts can be captured as 'moving on', from being in treatment and returning to normal life (n = 10). Some participants talked about undertaking and enjoying normal life activities, such as going out to dinner or going to the marketplace. Many veterans were trying to participate in such activities, but still found it difficult. Increased social contacts, trust in others, and self-confidence was highlighted by three participants.

> I had lost faith in everyone, and I regained a little bit of that, but also that bit of confidence in myself. I rediscovered that here. (P3)

For some being able to reintegrate was directly related to their improved psychological state following treatment. In addition, two participants described reaching a turning point in life, as with 3MDR they felt like 'having tried everything', and they were now accepting the remaining symptoms:

> Well, it's … You explored your traumas a little deeper, so you opened it up a bit more for yourself. In the sense that I am processing a little more now. But it's also just done now. I'm in a learning process now, working on acceptance. So maybe it's a combination of both, you know. The 3MDR for the processing, but besides that, I am also in the process of learning: okay, it is done, finished. Or at least, trying to come to terms with it. Trying to pick your life up again somewhat, as much as you can. So yes, 3MDR did contribute to that. Yes, it did. (P9)

Table 4. Thematic overview and differences of themes endorsed by responders and non-responders.

Theme	Endorsed by: Responders (*n* = 3) n (%)	Endorsed by: Non-responders (*n* = 7) n (%)
Treatment processes		
Engaging	3 (100.0)	7 (100.0)
Regulating distress	2 (66.7)	7 (100.0)
Facing traumatic memories	3 (100.0)	7 (100.0)
Allowing emotions	3 (100.0)	6 (85.7)
Associating	2 (66.7)	4 (57.1)
Disengaging from trauma	3 (100.0)	7 (100.0)
Feeling supported	2 (66.7)	6 (85.7)
Treatment effect		
Openness	2 (66.7)	4 (57.1)
New learning	1 (33.3)	3 (42.9)
Self-understanding	2 (66.7)	2 (28.6)
Closure*	3 (100.0)	1 (14.3)
Reintegration	3 (100.0)	7 (100.0)

3.4. Mixed outcomes

The amount of responders and non-responders that endorsed themes were compared (Table 4). A visual analysis of the data indicated no differences between groups, apart from substantially more responders reporting 'closure', which was discussed by all responders and only by one non-responder with less depth. In addition, although non-responders endorsed 'reintegration', they provided fewer specific examples of activities. High comparability was present across the other descriptions of treatment processes and effects.

Of particular interest was participant six who showed a significant worsening of PTSD symptoms on the quantitative outcome. He had lost a significant other before the post-assessment, to which he attributed his PTSD symptom exacerbation. At the time of the qualitative interview, he still suffered from flashbacks and being overly alert, but he also experienced decreased feelings of guilt, depressive symptoms, and arousal symptoms, and his confidence and self-understanding had increased.

4. Discussion

This study examined 10 veterans' perspectives on 3MDR to help understand treatment processes and effects of this novel intervention. Veterans experienced the most essential treatment processes to be engaging, regulating distress, facing traumatic memories, allowing emotions, associating, disengaging from the traumatic memory and feeling supported. The combination of treatment components in 3MDR was reported to facilitate these processes, and walking towards trauma-related pictures was highlighted as the critical component among these. Veterans compared 3MDR favourably to other trauma-focused therapies they had experienced. To our surprise, all participants in this sub-study experienced positive changes following 3MDR, also in the absence of PTSD symptom improvement. These included increased openness, self-understanding, new learning, closure and reintegration. None of the veterans described a long-term worsening of symptoms at the time of the qualitative interview. A few veterans had hoped for more PTSD symptom improvement. However, the fact that they had worked through their trauma narratives and allowed strong emotional processing to occur was very meaningful for them and seemed to be the overall most valued outcome. Responders and non-responders reported similar treatment processes and effects, with the exception of 'closure' and 'reintegration', which were described more often and more elaborately by responders. The similarity in experiences of responders and non-responders makes it difficult to tie specific processes to treatment outcomes based on the current results.

3MDR was developed to counteract avoidance in exposure-based treatment, as this has been found to hinder positive treatment outcomes (Hundt et al., 2018; Sayer et al., 2009). Based on the veterans' appraisals, 3MDR seems to comply with this aim, both in terms of heightened engagement and stronger trauma memory network activation, including difficult emotions and cognitions associated with the trauma memory (van Gelderen et al., 2018). This is in line with previous case reports of 3MDR (van Gelderen et al., 2018) and may reflect an appropriate fit for the studied population of veterans with the therapy rationale and environment. Compliance with the therapy rationale has been deemed important for initiation and retention in treatment (Hundt et al., 2018), which may explain the low drop out rate in the larger RCT (Van Gelderen et al., 2020). The qualitative evaluation of 3MDR in the Bisson et al. (2020) trial highlighted several similar themes as the current study. These included experiencing 3MDR as an immersive and intensive intervention, highlighting walking as important component, and retrieving new (aspects of) memories. A difference may have been that veterans in the Bisson et al. (2020) study emphasized challenges in selecting images and music, and the importance of practical support. These issues were not explicitly reported in the current study, although our clinical experience underlines that guidance during the earliest stage of picture and music selection seems to be important.

3MDR has also been theorized to allow for traumatic memory processing through reconsolidation (van Gelderen et al., 2018). During this process a memory trace is stored with additional embedded information, which can allow for adapted or new meanings to the traumatic event and its aftermath, and ultimately result in PTSD symptom improvement (Lane, Ryan, Nadel, & Greenberg, 2015). Participants reported disengaging from the traumatic memory by the dual-attention task, new learning, and

being able to more easily talk and think about their traumatic events. Taken together, these themes may point to traumatic memory processing through reconsolidation. Based on the current results, however, it is not possible to determine whether reconsolidation actually occurred and whether this resulted in PTSD symptom improvement. A salient finding in this respect is that non-responders reported new learning as well. Future (biological) studies could provide more insight into the learning processes that result in changes during 3MDR.

In line with the hypothesized mechanisms of change in 3MDR, the participants attributed the high engagement, low avoidance, and subsequent trauma memory network activation to the combination of walking, VR, trauma-related pictures, and music (van Gelderen et al., 2018). Walking stood out as a main mechanism of action for heightened engagement while remaining within a window of tolerance. This is in line with activating and stress-releasing qualities of walking (Jin, 1992). Veterans described how walking towards their trauma-related pictures encouraged them to face their traumatic memories. This may be indicative of a more open state of mind as a result of walking, as walking has been found to increase divergent thinking (Kuo & Yeh, 2016; Oppezzo & Schwartz, 2014). Moreover, it could reflect the benefit of approach behaviour in therapy. Such approach behaviours have been found to augment anxiety-related exposure treatment (Wolitzky & Telch, 2009), but to the best of our knowledge have not yet been applied in PTSD treatment. Our results provide preliminary support for such a paradigm.

Despite a relatively large percentage of participants without significant PTSD symptom change in the current sample as compared to the larger clinical trial (70% vs 55%), all participants experienced a range of positive changes due to 3MDR. The few qualitative evaluations of TFT reported similar effects, including greater self-understanding, changing thoughts/beliefs, and engagement in new activities (Barone et al., 2019; Hundt et al., 2017; Price et al., 2016). These and the current findings highlight gains from treatment beyond PTSD symptom improvement and emphasize the importance of including qualitative outcomes to assess a wide array of potential changes. However, it is important to consider the potential influence of other factors that are not specific to 3MDR and which may account for the positive effects reported in this study. First, demand characteristics refer to participants being aware of what the researchers are investigating, and being inclined to provide answers that fit with that aim (McCambridge, de Bruin, & Witton, 2012). This, and the willingness to show appreciation to the research team, could have resulted in participants being inclined to report desired therapeutic processes and effects. Second, most veterans received treatment as usual following 3MDR, which may have influenced the experiences and effects that were reported by the veterans. However, as the qualitative interviews focused explicitly on the 3MDR sessions, the contribution of treatment as usual is unclear. Third, for many veterans, 3MDR was the final treatment they were willing to try. The feeling of 'having tried everything' could have led to a positive perception of the treatment even in the absence of adequate symptom decrease.

Responders experienced closure more often and described reintegration in more detail. This is in line with existing literature that showed that veterans suffering from fewer PTSD symptoms following treatment also experienced greater improvements in other aspects of life (NICE, 2018). It is notable that responders described fewer flashbacks and nightmares as part of the theme 'closure', whereas non-responders did not. Re-experiencing symptoms have been demonstrated to precede changes in other PTSD symptoms (Maples-Keller, Price, Rauch, Gerardi, & Rothbaum, 2017). Possibly, for some participants, 3MDR may have insufficiently decreased their sense of threat, and subsequently re-experiencing symptoms, which could account for limited improvements in PTSD symptoms. Potentially, a higher number of sessions and additional suggestions for therapists on how to incorporate threat disconfirming information could enhance treatment outcomes for patients that did not respond to 3MDR in terms of PTSD symptom reduction. In addition, some veterans attributed limited symptom change to the chronicity of their disorder and expected their PTSD symptoms to have improved more if they would have received 3MDR during an earlier stage. Patient or extra-therapeutic factors, which were not the focus of the current study, could have been of influence as well (e.g. readiness to change or life events (Cuijpers, Reijnders, & Huibers, 2019)). Unexpectedly, none of the other themes were specific to response status. This might have been a result of the underrepresentation of responders in this study and the fact that the study was not a priori set up to compare responders and non-responders. Furthermore, 3MDR is a multi-component treatment from which it may be challenging for patients to deduct effects of components separately. Because of these factors, it is difficult to link symptom improvement to specific findings of the current study.

Several limitations to this study should be noted. Categorizing participants into non-responders and responders based on PTSD symptom change may have been an oversimplification of the reality. Although based on a frequently used cut-off point, a different cut-off or associations with continuous outcomes could have resulted in different outcomes. Moreover, the percentages of responders (45%) and non-responders (55%) in the RCT as a whole,

differed from the percentages of responders (30%) and non-responders (70%) in the current study. This was the result of the random component in our sampling strategy, which may have led to a degree of bias. The quantitative post-assessment and the qualitative interview were conducted at different time points and the time between these assessments differed for participants. Moreover, the time between 3MDR and the qualitative interview varied among participants with a range of 12 to 118 weeks. Veterans are likely to have remembered less of 3MDR, its processes, and direct effects if this gap was larger (Rubin & Wenzel, 1996). However, more uncommon events are better remembered and it is likely that 3MDR will have been a unique experience (Tourangeau, 2000). The cues about components of 3MDR in the qualitative interview questions may have also supported long-term memory recall. Nonetheless, a methodology with consistent time periods would have been preferential. Future studies may want to conduct interviews in the direct aftermath of a treatment when investigating therapeutic processes, whereas for treatment effects both short-term and long-term interview data could be relevant.

This mixed methods evaluation of 3MDR for veterans with TR-PTSD demonstrated that veterans experienced positive changes in response to 3MDR that reach beyond PTSD symptom improvement. Few studies have investigated these effects of PTSD treatment. The current results emphasize the importance of such research, especially when considering treatment outcome in a chronically ill population for whom symptom improvement might be difficult. Veterans' perceptions in this study emphasized strong engagement, ease of emotional memory retrieval and possibly reconsolidation of their traumatic memories in this new intervention. In spite of this, not all veterans reported PTSD symptom improvement, suggesting that other factors may be important in the persistence of symptoms in this population. Walking towards trauma-related pictures stood out as unique component of 3MDR as compared to other trauma-focused treatments and was highly appreciated by the veterans. Surprisingly, differences in treatment effects and processes between the responders and non-responders group were small and as such conclusions that can be drawn on specific treatment factors related to PTSD symptom improvement were limited. Future dismantling studies could give more insight into the active components of 3MDR and on what works for whom. This study showed that veterans appreciated 3MDR to be an appropriate fit, which allowed for high engagement in treatment and deepened memory retrieval. This novel intervention is, therefore, an important candidate treatment for further evaluation in veterans and other traumatized populations with TR-PTSD, to hopefully provide them with improved treatment options in the near future.

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Data availability statement

Due to the nature of this research, participants of this study did not agree for their data to be shared publicly, so supporting data is not available.

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