EMDR Therapy for Bilinguals: Utilizing Linguistic Diversity for Improved Therapeutic Success

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EMDR protocols, theories, and guides tend to presume or prescribe a monolinguistic approach. However, there are many bilinguals whose knowledge of a second language (L2) is sufficiently advanced to allow them to interact with EMDR therapists, but who might also possess memories encoded in a first language (L1), which is strategically useful in EMDR. The objectives of this clinical practice study were to (a) describe the real-world use of EMDR therapy in which the L1 of an EMDR recipient is selectively integrated into processing by a therapist who need not know the recipient's L1 and (b) demonstrate an adaptation of the standard EMDR therapy protocol to support full resolution of memory material among clients with exposure to more than one language.

Keywords: EMDR therapy; bilingualism; bilingual EMDR; trauma

hapiro defined EMDR therapy as "the adaptive processing of disturbing memories" (Shapiro, 2018, p. 13) as facilitated by a trained practitioner. EMDR is built on three prongs (processing of past events, targeting of current distressing circumstances, and creating adaptive future templates) and eight phases (client history and treatment planning, preparation, assessment, desensitization, installation, body scan, closure, and reevaluation) (Shapiro, 2018; Solomon et al., 2021). As such, EMDR is rooted in information processing theory as applied to mental and behavioral health. EMDR recalls one of the basic claims of humanistic psychology, which is that humans are biased towards mental health (Moss, 2014). However, departing from psychodynamic and older models of psychology in this regard, EMDR discusses this bias in terms of memory networks and the overall apparatus of information processing. In the third edition of Francine Shapiro's Eye Movement Desensitization and Reprocessing: Basic Principles, Protocols, and Procedures, she identified so-called adaptive resolution-that is, a process whereby "negative emotions are relieved ... learning takes place, is appropriately integrated, and is available for future use" (Shapiro, 2018, p. 15)-as a default state that can be hindered by trauma. In this

context, EMDR can be understood as a means of (a) desensitizing anxiety, (b) generating new insights, (c) restructuring the brain's networks and structures, and (d) re-orienting to a more resourceful and positive state. These objectives are pursued through EMDR protocols that rely on performing horizontal eye movements while processing memories in a free-associational state designed to facilitate adaptive resolution (Shapiro, 2018).

Introduction to Language, Memory, and Trauma

In the Construction-Integration (CI) model, the meaning of words and sentences is inseparable from our experience of them (Kintsch & Mangalath, 2011), and such experience includes emotional contexts (Dylman & Bjärtå, 2018). Thus, experiences and words enter memory together, and, when experiences are subsequently retrieved from memory, they are inseparable from the language initially associated with them. This general model of experience, memory, and meaning has clear therapeutic relevance in treating individuals whose memories are stored in more than one language—perhaps not the language in which these individuals seek therapy.

Schwanberg (2010) found that, among bilinguals, there is "unique access to traumatic memories through the first language" (p. 44). For Schwanberg, this experimental finding justified a therapeutic approach in which second languages (L2s) were used instead of first languages (L1s) in order to achieve a distancing effect from traumatic memories. However, not all therapeutic modalities rely on such distancing. Shapiro (2018) noted that one of the foundations of eye movement desensitization and reprocessing (EMDR) therapy is the ability to "elicit information from [a] targeted memory network" (p. 51). She added that trauma blocks the brain's ability to access positive memories, with negative information dominating the memory network forming around the trauma. Thus, the success of EMDR depends on accessing and subsequently reprocessing and integrating negative memories. For bilingual subjects, such memories might be encoded in an L1 rather than in the L2 in which the EMDR practitioner engages them. As a fifth of Americans (Ardila et al., 2019) and perhaps half of all people worldwide (Mathews, 2019) are bilingual, EMDR practitioners are highly likely to encounter bilinguals in practice settings, but little theoretical work or practical guidance focuses on how to apply L1 and L2 differentially in EMDR settings. The purposes of this article are to (a) describe the real-world use of EMDR therapy, in which the L1 of an EMDR recipient is selectively integrated into reprocessing by a therapist who need not know the recipient's L1 and (b) demonstrate an adaptation of the standard EMDR therapy protocol to support full resolution of memory material among clients with exposure to more than one language.

Nature of the Problem

Following the general practice in the greater world of psychotherapy, EMDR protocols, theories, and guides presume or prescribe a monolinguistic approach, that is, an approach in which a single language is used. This approach is necessary in the treatment of both monolinguals and bilinguals whose command of an L2 is weak. An EMDR therapy study in the Netherlands reported a 7% dropout rate among recipients whose command of Dutch was insufficient for engagement with EMDR practitioners working in that language (De Roos et al., 2011). For this reason, EMDR practitioners working with recipients who might be bilingual have preferred to operate in the L1 of the bilinguals, often through the use of interpreters (Acarturk et al., 2015). However, there are many bilinguals whose knowledge of an L2 is sufficiently advanced to allow them to interact with EMDR therapists, but who might also possess memories encoded in an L1.

In a study by Caldwell-Harris et al. (2011) focused on Mandarin Chinese-English bilinguals living in the United States, study participants were reported to prefer English (their L2) to discuss their emotions while associating greater emotionality with their L1. For these bilinguals, the L1 of Mandarin Chinese elicited and was associated with greater emotion, but the L2 of English was preferred to actually discuss emotion with others because of "more relaxed social constraints in English-speaking environments" (Caldwell-Harris et al., 2011, p. 329). If these kinds of bilingual clients receive EMDR, the question is not one of mere understanding. Rather, the issue is that strategic use of an L1-by the client, if not also by the practitionermight be necessary to obtain fuller access to the emotional content of memories in the manner required by EMDR. However, the existing EMDR research base does not appear to offer such guidance in terms of a protocol, case studies, or a theoretical framework.

Current Approaches

EMDR was first defined by Shapiro (1995, 2001, 2018), and a review of a cross-section of the recent EMDR therapy literature indicates that most of the existing protocols are still in English, prompting ongoing adaptation of such protocols into other languages (Naseh et al., 2019; Urdaneta & Triana, 2020). There is also evidence of EMDR protocols being successfully translated into other languages (Acarturk et al., 2015; De Roos et al., 2011; Molero et al., 2019). However, there does not appear to be evidence of EMDR protocols or procedures, in which the EMDR practitioner manages treatment in a single language-the L1 or L2 of the practitioner, and the L2 of the recipient—while strategically invoking the use of the L1 of a recipient. In this sense, current approaches to EMDR are likely to fall short when applied to bilinguals whose relevant memories might be encoded in their L1, not their L2.

In conceptual definitions, as well as in some recent confirmatory empirical studies, there is an emerging recognition of language, experience, memory, information, and retelling as part of a single model, much in the manner of the CI model (Barcelos, 2015; Kintsch & Mangalath, 2011; Moate & Ruohotie-Lyhty, 2017). Barcelos (2015) described emotions in terms of information theory, that is, as "processes in which information generates emotional responses, which, in turn, generate new information" (p. 314). In a study of native Finnish speakers who acquired English as an L2, Moate and Ruohotie-Lyhty emphasized that language, emotion, experience, and memory are closely interconnected. While these interconnections have been recognized in some studies of bilinguals and bilingualism, they do not appear to have informed EMDR therapy research (Barcelos, 2015; Moate & Ruohotie-Lyhty, 2017).

Current approaches in psychotherapy are often flexible and interdisciplinary, reflecting researchers' and theorists' ambition of integrating insights, findings, and paradigms from neuroscience, information theory, linguistics, and other fields to better understand real-world phenomena, such as trauma, emotion, meaning, and healing. These current approaches can inspire EMDR practitioners and researchers, especially given that EMDR is itself a nexus for theories emerging from many different fields.

Discussion of Relevant Literature

There is limited existing EMDR literature on the topic of emotional intensity and the encoding of memory in L1 vs. L2 contexts. Some trauma-informed therapists have noted the importance of integrating L1 and L2 in different ways, depending on the context of therapy. In a case study, Rodriguez, a bilingual (Spanish and English) therapist who is trained in EMDR, noted a dedication to making the bilingual visible and manifest in trauma-informed therapy:

Throughout treatment, I will refer to their language of origin with curiosity. I may inquire "How do you say that in (client's language of origin)?" "If you were to say that in (client's language of origin), how would it feel different to you?" "Can you say the same thing in (client's language of origin) and notice what is different this time?" (Rodriguez, 2018, p. 133)

In this case study, Rodriguez discussed the interplay of L1 and L2 in trauma-focused work in general, but did not tie these observations to a specific EMDR protocol. Nonetheless, Rodriguez's suggestion of asking clients to repeat phrases in an L1 and noticing the difference aligns well with the EMDR practitioner's objective (Shapiro, 2018) of asking EMDR recipients to continue introspecting under different conditions and as new memory material comes to the fore.

EMDR research, training, and practice has rather focused on developing translations of the standard protocol that can be applied to recipients in their L1 (directly by the therapist or with the assistance of an interpreter), regardless of the number of languages they speak (Aldahadha et al., 2012; De Roos et al., 2011; Schubert et al., 2016). Nonetheless, what Shapiro (2018) emphasized as EMDR's intrinsic sensitivity to the difference between now and then, here and there, negative and positive, and adaptive and maladaptive offers rich theoretical and practical support for integrating linguistic differences into EMDR therapy when administered to bilingual clients. In this context, insights from research in related psychotherapeutic and psychological fields may guide the evolution of EMDR therapy with bilingual populations. From a trauma-informed perspective, the key insight is that the greater emotionality of L1, at least in some contexts, can be a boon for any therapy that relies on memory reprocessing and emotion (Brase & Mani, 2017; Dylman & Bjärtå, 2018; Szoke et al., 2020).

Language-and even non-linguistic vocalizationis an important part of polyvagal theory (Porges, 2018), which is relevant to understanding the importance of L1 for bilinguals who communicate with their EMDR therapist in an L2. Porges noted the existence, in mammals, of a second vagal pathway, that is, a "social engagement system" going beyond fight-orflight or immobilization responses to danger. This second vagal pathway is, according to Porges, based on conveying "cues of safety and danger-via vocalizations, head gestures, and facial expressions" (Porges, 2018, p. 63). Such vocalizations, while theoretically belonging to all mammals and existing within a fairly narrow bioacoustic range (Porges et al., 2021), might vary slightly from language to language. For instance, Chinese is a tonal language (Ling & Liang, 2017), rendering Chinese speakers more sensitive to tone-even in nonsensical sentences-than speakers of non-tonal languages (Wu, 2019). Thus, for Chinese L1 speakers or others who have Chinese in their developmental history, meaning and emotional content might be accessible through slightly different vocalizations that vibrate differently in the middle ear. There might, in other words, be a layer of human linguistic difference atop the universal vocalizations expressed through the second vagal pathway, linguistic difference that justifies sensitivity to strategically toggling between L1 and L2 in EMDR treatment contexts. Furthermore, Lauzon (2017) has argued that even silence is structured by a native language, which dominates the auditory imagination (even when it is pre- or non-linguistic).

Therefore, while differences between L1 and L2 may not be formally recognized in polyvagal theory or in forms of psychotherapy that are sensitive to non-linguistic vocalization (e.g., Somatic Experiencing; Payne et al., 2015), they may none-theless hold resonance in therapeutic settings. There appear to be language-specific considerations relevant to differential forms of cognition—for instance, to the negative and positive self-referencing cognitions

identified by EMDR recipients. Alssiefy (2016, p. 378) noted that, in Egyptian Arabic, the sentence "I want to cut my hair" actually means "I want to have my hair cut." Thus, Egyptian Arabic places less emphasis on causative structures and cognitions than English. Many such examples of the connections between language and cognition exist. For instance, Mongolian speakers differentiate between shades of blue more reliably than Chinese speakers, possibly because the Mongolian language distinguishes between lighter and darker blues in a manner that Chinese does not (He et al., 2019). Such a difference raises interesting questions about possible differences in sense-data and their interpretation that can arise for bilinguals whose two languages do not encode experiential data similarly.

More generally, there is some evidence (Rhode et al., 2016) that speakers of East Asian languages (including Chinese, Japanese, and Korean) have a holistic bias-meaning that, in comparison to speakers of Western languages, such as English, they are more systems-oriented in thought and perception. Rhode and colleagues suggested that, for speakers of Western languages, "the attentional focus is on some salient object, which is detached from its context, assessed in terms of its attributes and assigned to a category in order to find out the rules that govern its behavior;" speakers of East Asian languages, on the other hand, "focus on relationships between objects and the field" (Rhode et al., 2016, p. 2). Such differences in attentional focus inform both the present (in the form of representation and description) and the past (in the form of autobiographical memory) (Wang, 2003).

Overall, the research suggests that, for bilinguals, differences in language inform differences in perception, memory, emotion, and, simply put, mental life itself. Insofar as cognition, emotion, sensation, and memory are the raw material with which EMDR works, the influence of linguistic differences on these phenomena is surely worth considering—especially in the context of bilinguals, for whom competence in two or more languages is implicated in the kinds of now/then, here/there, positive/negative, child/adult dichotomies that are of concern to EMDR practitioners.

Clinical Examples and Practice Tips

Three case illustrations have been presented below. Each case contains examples of how the selective integration of an L1 other than English was useful in EMDR therapy. The EMDR provider in these cases is bilingual in Turkish (L1) and English (L2). The three clients whose experiences are discussed below are bilinguals whose L2 is English.

Client History and Treatment Planning

To begin with, all EMDR history-taking sessions should include questions about language. Regardless of a client's accent, grammar, lexical command, etc., the EMDR clinician should ask questions such as:

- What are all of the languages you spoke growing up?
- If you speak, or have ever spoken, more than one language, can you describe where and how you learned each language (home, school, etc.)?
- If you are monolingual now, when did you begin to speak exclusively or almost exclusively in your current language?

In the course of an intake or history-taking session, being oriented to clients' language use as well as trauma history can naturally lead the Englishspeaking EMDR practitioner to conclude that at least one trauma memory may be encoded in a language other than English. However, because of the importance of learning more about the interaction of language, memory, and trauma, general questions such as the ones below might be advantageously supplemented by more specific questions that could take the following form:

- In reference to [a specific perpetrator], do you remember what language they spoke in?
- In reference to [the client at a specific period in time], do you remember what language you spoke in then?
- When you think of [a specific memory], does it unfold in English or another language for you?

The likelihood is that questions oriented to language will indicate how much of an emphasis the EMDR practitioner should place on the integration of an L1 other than English. In terms of Clients A and B in the case illustrations presented below, the EMDR therapist was aware of a non-English linguistic background that overlapped with time periods in which the clients experienced formative traumas.

For instance, Client A speaks English as a native language but is a legacy speaker of Chinese. She was exposed to Chinese more extensively in her youth than at present. In one of the formative memories of this client, at the age of four, she had wet herself at an indoor water fountain in a library, and she remembered being in the bathroom with her mother and with the librarian. The client's mother had warned her about playing with the fountain; nevertheless, Client A ended up getting wet. Now, in the bathroom, Client A remembered her own mother being angry while the librarian (who did not speak Chinese) was also looking on. This moment stood out for this client in its capacity to impose on her feelings of helplessness and of being cornered, and, as discussed subsequently, differences between L1 and L2 ended up being pivotal for this client's success in reprocessing.

Client B speaks Arabic as an L1 and was introduced to English as an L2 in childhood. Thereafter, Client B moved to the United States and used English far more extensively, in both school settings and the context of her relationships. Increasingly, Arabic was Client B's language of communication with her family of origin, which remained geographically separated from her. Client B disclosed a memory, at age seven, in which her brother frightened her. In this memory, the client had stayed up past her bedtime; she was under the covers and felt that her heart was beating so loudly that her brother would hear it, would know that she wasn't asleep, and become angry at her. Client B indicated that this memory remained powerful years later; even in relating the memory, she felt her heart beating as fast as it did then. Among the client's negative cognitions was the saddening and self-diminishing experience-expressed in English, the L2-that "My heart needs to stop beating for me to be acceptable." As with Client A, the difference between L1 and L2 ended up being highly relevant to therapy, but special attention was paid-in the first phase of EMDR-to understanding the roles of L1 and L2 in memory formation and expression.

Client C is a native speaker of German for whom English became an L2 after school exposure and moving to the United States. This client was sexually abused at a very young age at the home of a caretaker. During her memory reprocessing, it became obvious that the moments of sensing that what was happening to her wasn't right—but not being able to say or do anything created substantial turmoil in her. This resulted in years of emotional flooding and dissociation in her adult years, making her question her sanity. For this client, liberating her child self from shame and engaging the perpetrator from her adult place felt impossible. The very necessary dialogue that needed to take place between her younger self and her adult self, as well as the one between her and the perpetrator, was enabled by mindful use of both her languages. As with Clients A and B, phase one sensitivity to the role of languages in Client C's life history and memories proved to be of subsequent therapeutic use.

Initially, Client A—the legacy Chinese speaker reported a SUD [subjective units of distress] score of 3, which went up to 7–8 over the course of reprocessing. She then reported a SUD of 0.25, which was stable; two weeks after the SUD of 0.25, Client A reported a SUD of 0.30. SUD was not, however, reaching 0. When engaged, the client stated that she wasn't sure why this picture still felt disturbing, but that it still did. At this point, emphasis shifted to the somatic signatures of the disturbance as she expressed, "I'm feeling discomfort in my throat." Further exploration revealed that the sentiment she wanted to express, as the child in the memory, was: "Let me out."

At this point, remembering that Client A was a legacy speaker of Chinese, the therapist asked her what "Let me out" would be in Chinese. Eliciting the client's L1 was related to the therapist's conceptualization of the client's somatic discomfort as somehow related to the gap in languages. This gap was between the Chinese-speaking world of Client A's childhood and her current reality as a bilingual. In the moment of the memory, it seemed that proper emotional activation and processing would require connecting to something authentic, which would, given the circumstances, be in Chinese.

When Client A was asked about saying "Let me out" in Chinese, she was taken aback. In similar situations, the therapist's experience is that this moment of surprise is universal in such situations, when clients realize the boundaries of their L1s in terms of opening or not opening space for certain kinds of expressions. Client A first noted that she wouldn't say something that abrupt in Chinese, at which point the therapist encouraged her to make an exclamation sound in Chinese. She made an exclamation sound that a Chinese speaker would make, and, subsequently, she was able to come up with a colloquial and self-authentic rendition of "Let me out" in Chinese.

In EMDR reprocessing, Client B experienced lower SUDS levels, but there was an abiding blockage. The client would express sentiments related to "He shouldn't have done that" and "This shouldn't have happened" (in English). However, the nature of her advocacy for herself seemed theoretical and bookish when compared to the richness of her felt-sense advocacy for things that mattered to her. She simply lacked affect in her advocacy. This lack of affect could be ascribed to inadequate activation, which might be related to the difference between how the client thought and spoke at the time of her memory and her current bilingual reality. Client B was therefore asked how she would express "He shouldn't have done that" in Arabic. Like Client A, Client B was immediately struck by the difference in the cultural capabilities of language; her response was that "You don't say such things in Arabic." As an adult, Client B did not lack fluency and proficiency in her native tongue, so this was not due to the linguistic limitations, but, rather to a cultural attitude given the context of the moment: A young person facing an older person, a girl facing a boy, a little sister facing an older brother. She was asked to revert to Arabic during bilateral stimulation, and, before long, she was talking back to her brother within the memory. Client B's child self had both a limited control of Arabic and an obligation to a cultural and familial script, in which she could not assert herself against her brother. However, Client B's adult self had both high articulacy and a vision of her own empowerment and dignity that enabled her to talk back to her brother within the EMDR setting. As the client's adult self reached back to her child self, in Arabic, there was powerful emotional activation, a change in body language, and the unmistakable imprint of self-assertion.

Through the course of the EMDR therapy experience, many people feel critical of their child selves and positive cognitions often involve the insight that children have clear limits to their autonomy-limits whose acknowledgement can prevent or overcome harsh self-judgments. Indeed, it wasn't only the case that Client B was speaking for her child self. It was also that, by having realized the inadequacy of her child self's language, the client understood the scope of her helplessness. She felt, rather than merely knew, that she could not have said anything at all. As Client B spoke to her child self in Arabic, she was able to extend greater compassion to the child, while she felt ownership of that moment from a more adult place as she enacted talking back to her brother, confronting him with the fallacies that entitled him destructively towards her. Consequently, the memory resolved quickly and the SUD was a solid zero. The client's newfound understanding of self-assertion continued to grow throughout the therapeutic process and subsequent reprocessing of other memories.

English was used exclusively in the early sessions of reprocessing with Client C, the child abuse victim, as it provided a safe distance and allowed her to tap into her universal compassion for children. It was easier to feel and speak adaptively in English, even though it didn't really give her any felt sense of relief. However, the safe distance provided by the use of English allowed her an immense amount of practice of self-expression and self-assertion. She was able to play with the full spectrum of her affect safely, albeit at arm's length. When she built that confidence around a wider range of affect in the face of what happened to her, it was possible to activate moments in her memory with the full use of German. It was necessary for Client C to be able to tell off her perpetrator; however, in the memory, the client remained stuck. In essence, the client had to be able to say both "I want out" and "You're a creep," but, in English, saying these phrases didn't get her unstuck. In her memory, Client C was sitting at a chair that was right up against a wall; liberation clearly took the form of pushing herself away from the table and confronting the perpetrator. However, this liberation was not forthcoming in English.

The client had vocalized "F*** off" in English as a means of accosting the perpetrator. She was asked to do it in German. At first, she could not-not because German lacked the facility for expressing this simple phrase or because she herself was unaware of it, but because, even in the act of reimagining, she was operating from her child self's framework. Client C's child self found it easier to be quiet and inoffensive. However, after a while, she was able to be profane in German in replaying her memory. As soon as Client C used German, she was, in the memory, able to push herself away from the table and leave the room. As was the case with Clients A and B, Client C was more highly activated in her L1 than in English. Client C cried and vocalized loudly when she reverted to German, indicating an improved access to the memory and a stronger ability to apply an adaptive framework.

Installation

Sensitivity to the languages in which memories are replayed appears to assist the strength of installation automatically, because the strength of positive beliefs is aided by the appropriate use of language. For instance, the eliciting of Chinese resulted in a breakthrough for Client A. Client A was able to replay the memory in a manner that expanded adaptive information about her mother. Thinking about Chinese sounds and words made Client A think about her mother singing. The client thus reprocessed her mother's anger and disapproval in the bathroom memory in terms of her mother not having access to something-singing-that she did well. The memory was replayed with the client's mother singing to calm the client down in the bathroom, since her mother's words in Chinese had also limited her to discipline rather than comfort. This resulted in a flow of compassion and camaraderie from Client A towards herself and her mother. The client felt relieved; subsequently, she herself began wanting to sing and to play the piano right at the end of the session as well as in the weeks following the session.

After a client reports a VOC of 7, it is appropriate to ask 'How true does that sound in [your other language]?' Initially, clients do not assign a VOC of 7 in both of their languages. Inevitably, one language has a VOC lower than 7. The good news is that, because of the adaptive bias of information processing that serves as the very basis for EMDR, the language in which VOC is 7 will exercise positive effects on the language in which VOC is not yet 7. Bilingual clients should be asked to toggle between positive cognitions in two languages in order to benefit from the adaptive bias of information processing and memory integration.

The emergence of a positive cognition in phase 3 typically changes by phase 5, installation, when the evolution of the positive cognition is itself enriched by the interplay between languages. For Client B, who had been raised within a cultural-linguistic tradition that highly prized honesty and consistency, the Arabic-language positive cognition phrased during installation was "I deserve honesty and consistency," whereas the English-language positive cognition was the more general "I matter." In this case, the interplay between the general and specific positive cognitions during installation, as a result of the selective use of L1 and L2 in therapy, represented two complementary and mutually enriching pathways to desensitization.

Discussion

In the context of trauma, the formative experiences of bilinguals are likely to have been encoded naturalistically and closely linked to an L1 as a language in which the memory is represented. If so, then the therapeutic processing of such emotions in an L2 rather than in an L1 suggests that EMDR recipients might be distanced from the content of their emotions. Considering that the success of EMDR relies partly on appropriate engagement with the emotional content of experiences (Shapiro, 2018), it is clear that EMDR practitioners who work with bilingual populations need to consider the importance of L1 vs. L2 in the context of EMDR treatment.

Previous EMDR research (Aldahadha et al., 2012; Schubert et al., 2016) acknowledges the importance of providing EMDR in the L1 of special populations, such as migrants, but such a concern does not address the strategic use of language with bilinguals. For bilinguals, the key questions are how, when, and in what kinds of contexts to selectively integrate an L1 into processing in order to obtain general therapeutic benefits. The key contribution of this clinical instruction article and its case illustrations was to provide a modified EMDR therapy practice guide based on the selective use of an L1 in settings with EMDR recipients whose L2 command (of English, in the cases described), while otherwise sufficient to sustain the therapeutic process, requires supplementation with the earlier language for adequately adaptive reprocessing.

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