Imagery rescripting of emotional memories
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Summary and general discussion
Imagery Rescripting (IR) is a promising transdiagnostic psychotherapeutic technique that focuses on the modification of dysfunctional emotional memories. IR has proven to be an effective treatment in a variety of disorders ranging from anxiety and trauma-related disorders (Morina et al., 2017) to depression (e.g., Brewin et al., 2009; Wheatley et al., 2007) and personality disorders (Jacob & Arntz, 2013). Despite its widespread use, research on the underlying working mechanisms of IR is still in its infancy. Improving our understanding of how and why IR leads to clinically significant change may ultimately enhance treatment effectiveness (Kazdin, 2007, 2009). The present thesis aimed to investigate the working mechanisms of IR. For this purpose, we systematically studied the effects of IR on artificially induced and clinically persistent emotional memories in a series of studies. In this final chapter, the main findings from previous chapters are summarized, their implications are considered, and directions for future research are outlined.

**SUMMARY OF FINDINGS**

This thesis first presented a series of fear-conditioning experiments that aimed to examine the effects of rescripting-versus exposure-based interventions on emotional (fear) memory (chapter 2 and 3). Next, a randomized wait-list controlled trial that focused on mediators of the treatment effects of IR and imaginal exposure (IE) was described (chapters 4 – 6). The following paragraphs recapitulate the main results of the previous chapters.

**Effects of IR on induced emotional memory in a laboratory setting**

The science of clinical psychopathology aims to thoroughly understand dysfunctional processes in patient populations. However, studying processes of change in clinical populations usually involves a number of complications, which limit the conclusions that can be derived from such research. For instance, although clinical studies can help to better describe a certain phenomenon by providing information about the variables involved, causal relationships between the variables cannot be established from cross-sectional research. Experimental psychopathology (EPP) offers a means to circumvent these problems (for reviews, see van den Hout et al., 2017; Zvolensky, Lejuez, Stuart, & Curtin, 2001) by using models of behavior to examine the psychological processes that underlie abnormal behavior (Vervliet & Raes, 2013). For this purpose, time-limited dysfunctional processes are often induced in healthy participants. In order to allow for inferences about their causal relationship, EPP models of psychopathology and therapeutic processes aim to isolate and manipulate variables of interest under constrained and artificial conditions (van den Hout et al., 2017). EPP has therefore been proven a suitable means to investigate the processes that underlie psychological treatments such as IR.
Pavlovian fear conditioning is an invaluable EPP model for research on mechanisms of change involved in associative fear learning and memory (Beckers et al., 2013; Kindt, 2014; LeDoux, 2014; Lonsdorf et al., 2017). In a typical fear-conditioning experiment, the development of fear (i.e., fear learning) is usually provoked during an acquisition phase, where a neutral stimulus such as a picture (conditioned stimulus, CS) is systematically paired with an aversive stimulus such as an electric shock (unconditioned stimulus, UCS). The treatment of fear (i.e., exposure therapy) is typically modeled by extinction learning, where the CS is repeatedly presented without being paired with the UCS. As a consequence, the CS loses its predictive value (with regard to the UCS) and the previously induced conditioned response (CR) decreases. Such traditional fear-conditioning models mainly manipulate associative fear memories by influencing CS-UCS contingencies (i.e., the experience that the CS will or will not be followed by the UCS; see Figure 1.1). Extinction learning provides a very informative and helpful behavioral model for the working of exposure therapy (Vervliet et al., 2013). Specifically, during exposure a new, inhibitory memory trace is induced (CS-noUCS association) that counteracts the original, excitatory memory trace (CS-UCS association) at retrieval (Bouton, 1993; Bouton & Swartzentruber, 1991). More innovative treatment approaches for emotional memories including IR, however, necessarily rely on the manipulation of CS-UCS contingencies (e.g., Amtz, 2012). Rather, it is proposed that IR may influence the evaluation of the UCS directly, by altering subjective interpretations, attributions, and beliefs about the UCS, a process called UCS-revaluation (see also chapter 1 and 3). Because the stimuli used in traditional fear-conditioning paradigms typically fail to mimic the complexity of multifaceted emotional memories such as their subjective evaluations, other experimental paradigms can be used to model more analogous clinical symptoms. With regard to emotional memories, the trauma film paradigm has recently received much attention in the literature (Holmes & Bourne, 2008; James et al., 2016), as it offers a means for studying analogue symptoms of emotional disorders such as intrusive memories. However, the trauma film paradigm alone does not allow for the investigation of UCS-revaluation processes. In conditioning terms, the trauma film serves as a UCS but the paradigm does not mimic associative learning processes responsible for the induction of CS-UCS associations that are thought to be crucial in the maintenance of trauma-related emotional disorders (Ehlers & Clark, 2000; Ehlers, Hackmann, & Michael, 2004). As a consequence, the effects of UCS-revaluation on CR towards the CS cannot reliably be measured using merely the trauma film paradigm.

The need for experimental procedures that allow for the systematic investigation of more complex learning processes and non-exposure based therapeutic procedures such as IR is evident. Adapted approaches to traditional Pavlovian fear conditioning and the trauma film paradigm have been presented by several research groups. For example, Wegerer and colleagues (2013; see also Streb et al., 2017) integrated the trauma film paradigm with fear-
conditioning methodology to enable the investigation of associative learning processes in intrusion development. In their procedure, neutral sounds (CS) are presented during an aversive film clip (UCS). When participants are subsequently presented with the CS, the memory of the UCS is triggered and symptomatic reactions such as intrusions are evoked. Even though such efforts provide a very elegant way to study the role of associative learning in intrusion development (and possibly treatment), its usefulness for the investigation of UCS-revaluation is still limited, since conditioned reactions such as fear-potentiated startle (FPS) responses toward the CS cannot be assessed directly within this paradigm. In fear-conditioning experiments, FPS is often used to assess the emotional expression of fear learning (Sevenster, Beckers, & Kindt, 2014a) towards the CS, which is typically elicited by a loud burst of white noise during presentation of the CS. Hence, using sounds as CS (e.g., Streb et al., 2017; Wegerer et al., 2013) during UCS presentation does not allow for the investigation of CR by means of FPS. Yet, FPS may provide invaluable information about the role of UCS-devaluation in IR, as it reflects the emotional components of fear memory (i.e., valence), while acting relatively independent from knowledge about CS-UCS contingencies (Sevenster, Beckers, & Kindt, 2012a, 2014b). Therefore, in chapter 2, we developed a fear-conditioning procedure aimed at inducing more complex and meaningful associative emotional fear memories that could later be manipulated by potentially non-exposure based therapeutic interventions such as IR. In line with the hypothesis, we observed that watching an aversive film clip, which placed the CS and UCS into a meaningful context during fear conditioning, induced a more complex fear memory than watching an unrelated neutral film clip. The findings indicate that the trauma film inflated the aversiveness of the UCS (i.e., UCS-revaluation; Davey, 1997), which led to increased and more persistent subjective and physiological CR towards the reinforced CS. We concluded that the adapted procedure was not only suited to induce more complex emotional memories, but that those memories could also be susceptible to UCS-revaluation processes.

The next logical step was to use the newly developed procedure for critically testing two contrasting hypotheses about the underlying mechanisms of IR. As stated in the introduction, it has been postulated that (a) IR may either facilitate the generation of a new, positively valenced memory trace (CS-noUCS association) that competes with the old, negatively valenced memory at retrieval (retrieval competition theory; e.g., Çili et al., 2017; Holmes & Mathews, 2010), or that (b) IR may directly change the dysfunctional meaning of the original memory representation by generating and integrating additional, corrective information about the UCS into the original memory representation (UCS-devaluation; e.g., Amtz, 2012). Chapter 3 presented three consecutive studies aimed to examine these two competing hypotheses with the newly developed fear-conditioning procedure. Despite several methodological challenges that limit the interpretation of the results with regard to the proposed hypotheses, the three studies consistently showed that IR (i.e., imagery
rescripting of an aversive film clip) produced differential effects on memory encoding and/or consolidation compared to an exposure-based intervention (i.e., imaginal rehearsal of an aversive film clip). Importantly, in experiment 2, we showed that IR decreased subjective valence ratings and CR towards the CS, demonstrating successful UCS-devaluation. Although the findings did not allow for any definite conclusions about the underlying memory processes of IR, the results tentatively indicate that rescripting- and exposure-based treatments may work through different processes.

Though very promising, the adapted fear-conditioning procedure is still compromised in some ways, clearly indicating room for improvement. For example, while the memories induced by the new paradigm were found to be more complex, they lacked personal relevance for participants. Personally relevant memories are particularly important with regard to IR, given that the intervention does not only aim to create more benign images of aversive events, but also more positive images of the self (Holmes et al., 2007; Stopa, 2009). Thus, the new fear learning procedure could be improved by explicitly involving participants in the aversive event. This could either be achieved by mental imagery (Dibbets et al., 2012), or by the use of virtual reality (VR) techniques, where participants are no longer passive observers of aversive events. Instead, they actively partake in the event and interact in a virtual environment (Dibbets & Schulte-Ostermann, 2015). For example, Cuperus and colleagues (2016) showed that the emotionality of VR induced emotional memories can be reduced by an analogue eye movement desensitization and reprocessing (EMDR) intervention (but see Cuperus, Klaassen, Hagaenaars, & Engelhard, 2017). EMDR (Shapiro, 1989) is an evidence-based psychological treatment for PTSD. Among other theories (see van den Hout & Engelhard, 2012), EMDR has also been proposed to work via UCS-devaluation (Leer, Engelhard, Dibbets, & van den Hout, 2013; Leer, Engelhard, Altink, & van den Hout, 2013). Though its underlying working mechanisms are not yet fully uncovered, research on the technique is currently more advanced compared to IR and a multitude of laboratory experiments have improved our understanding of EMDR (e.g., Leer, Engelhard, & van den Hout, 2014; van Schie, van Veen, Engelhard, Klugkist, & van den Hout, 2016; van Veen et al., 2015). The line of research on EMDR demonstrates that clinically effective treatments, which possibly work through UCS-devaluation processes, can successfully be studied in experimental paradigms. With respect to IR, we suppose that an asymmetry between learning and unlearning currently limits the usefulness of the new procedure: Even though the procedure facilitates the induction of more complex emotional memories, we are not yet able to imitate the compelling clinical effects of IR in a laboratory setting. Thus, we argue that in addition to improving the fear learning procedure, the efficacy of the analogue IR intervention should be enhanced in order to more reliably investigate the memory mechanisms underlying IR. One possibility to optimize the experimental intervention is to gather additional knowledge about the variables involved in IR. The next part of this thesis
therefore focused on advancing our understanding of IR.

**Effects of IR on clinically persistent emotional memory**

To further our knowledge about the therapeutic processes of IR, we aimed to identify variables that mediate its treatment efficacy (Kazdin, 2007, 2009). For this purpose, we conducted a randomized controlled trial in a sample of nightmare sufferers, as IR is an established technique in the treatment of nightmare disorder (Aurora et al., 2010). Given that imaginal exposure (IE) has also been shown to effectively reduce nightmare symptoms (Hansen et al., 2013), patients suffering from nightmares offered a useful and accessible clinical population to examine the similarities and differences between exposure- and rescripting-based psychological treatments.

Nightmare treatment protocols usually comprise a variety of treatment elements including IR and/or IE, nightmare diaries, relaxation training, and other imagery exercises. To systematically investigate the working of IR and IE only, we developed stripped-down treatment protocols that minimized the influence of potentially confounding factors or variables (chapter 4), by discarding the other treatment components. Doing so, we were able to extract the isolated efficacy of the supposedly active treatment components of nightmare treatments (i.e., IR and IE; chapter 5), and to investigate mediators of the treatment effects of both IR and IE for nightmares (chapter 6).

In chapter 5, we showed that three weekly individual treatment sessions of IR and IE both effectively reduced nightmare frequency and nightmare distress from pre- to posttest when compared to a wait-list control group. Moreover, the effects on nightmare frequency remained stable at 3- and 6-months follow-up, while nightmare distress was even further reduced over the course of follow-up assessments in both treatment groups. On the grounds that stripped-down IR and IE proved to be beneficial treatments, we set out to examine the working mechanisms of the treatment effects of IR and IE observed in chapter 6. Based on the hypothesis that IR may work through UCS-devaluation, we theorized nightmare valence to be a potential mediator of the treatment effect of IR. Contrary to the expectation, nightmare valence did not predict or mediate the efficacy of IR. The results may contradict the UCS-devaluation theory at first glance. Yet, we found increased mastery of the nightmare content to be a significant mediator of the treatment effect of IR, which may be indicative of UCS-devaluation. Specifically, by facilitating feelings of mastery (versus powerlessness or helplessness), IR changes the evaluation of the nightmare content (i.e., UCS) to being perceived as more positive and generally less threatening. In consonance with several sources that have emphasized the role of self-efficacy or feelings of mastery in IR (e.g., Germain et al., 2004; Grunert et al., 2003, 2007; Hagenaars & Arntz, 2012; Harb et al., 2012; Long, Davis, et al., 2011; Long, Hammons, et al., 2011; Pajak & Kamboj, 2014; Rusch et al., 2000; Seebauer, Froß, Dubaschny, Schönberger, & Jacob, 2014; Smucker et al.,
1995; Smucker & Niederee, 1995; Watson et al., 2016; Whitaker, Brewin, & Watson, 2010), this finding indicates that the efficacy of IR could be improved by encouraging patients to express their inhibited action tendencies, feelings, or needs in the rescripted storyline (Arntz, 2012; Arntz et al., 2007; Prasko, Grambal, Kamaradova, & Jelenova, 2012; Seebauer et al., 2014).

Remarkably, mastery was not a mediator of the treatment effect of IE. In line with contemporary theories of exposure therapy (e.g., Craske et al., 2008; Craske et al., 2012), the efficacy of IE was mediated by increased tolerability of emotions associated with the nightmare. This suggests that rather than changing the evaluation of the nightmare (i.e., UCS-memory representation) directly, exposure therapy works by increasing the patients’ ability to tolerate negative emotions associated with nightmares. In terms of expectancy violation, this possibly induces a mismatch between experience (e.g., “I can tolerate the emotions associated with my nightmares”) and expectation (e.g. “I cannot tolerate the emotions associated with my nightmares”), which may facilitate the development of new, inhibitory expectancies (Craske et al., 2014). Together with the findings presented in chapter 3, these results further support the notion that IR and IE tap into different underlying processes.

Even though the work described in this thesis does not allow for final conclusions with regard to the memory processes involved in IR, it offers a starting point to systematically investigate the underlying working mechanisms of IR. Identifying treatments that do not leave the original memory trace intact (i.e., exposure) but instead might directly modify the UCS-memory representation (e.g., IR) may advance psychological treatment for emotional disorders, for example, by reducing relapse rates. Therefore, it is relevant to further examine the differences between rescripting- and exposure-based therapies.

OPTIMIZING IMAGERY RESCRIPTING

Research on the underlying working mechanisms of IR is still in its infancy and many questions regarding this topic ask for further investigation. The following section outlines a number of issues that are worthwhile to examine in order to advance our understanding of the underlying mechanisms of IR and to augment its effectiveness.

Memory processes involved in IR

In line with previous studies on the working mechanisms of IR (Dibbets & Arntz, 2016; Dibbets et al., 2012; Haginaars & Arntz, 2012), chapter 3 investigated the effects of IR on memory consolidation. Though these studies provide a first step towards the understanding of the underlying processes of IR on artificially induced fear memories, they do not concentrate on the clinically more relevant aspect of memory reconsolidation. As explained in chapter 1,
memory reconsolidation can be initiated by reactivating a previously consolidated memory (Nader et al., 2000; Sara, 2000) if the environment requires an updating of the fear memory (Sevenster et al., 2012b). While research about reconsolidation of artificially induced fear memories is currently thriving (for reviews, see Beckers & Kindt, 2017; Elsey & Kindt, 2017), only a limited number of studies have investigated reconsolidation processes of episodic memories, a type of emotional memory that involves fundamentally different underlying neural mechanisms than fear memory as induced by fear conditioning (Lonergan, Olivers-Figueroa, Pitman, & Brunet, 2013; Sevenster et al., 2012a, 2014b). However, investigating the effects of reconsolidation processes on different kinds of memory is particularly important with respect to emotional memory in disorders such as PTSD, where physiological hyperarousal in reactions to trauma reminders (i.e., conditioned fear responses) and intrusive memories of past events (i.e., episodic memory) are core symptoms of the disorder. Even though the results are still inconclusive with regard to their direction of change (i.e., impairment, strengthening, or update of the memory), the available data indicate that episodic memory can indeed be influenced during its reconsolidation (Kessler, Blackwell, & Kehyayan, 2017). In line with previous findings which showed that imagined events can undergo reconsolidation (Soeter & Kindt, 2012a), and the proposition that memory reconsolidation may be central to the changes brought about by psychotherapy in general (Lane, Ryan, Nadel, & Greenberg, 2015), the current evidence indicates that IR may tap into processes of memory reconsolidation. Future studies should examine under which conditions and in what way IR interferes with the reconsolidation of emotional memories.

Insights from reconsolidation research imply that the effectiveness of IR might depend on the time point of its implementation in the re-exposure process. It is suggested that prolonged exposure to an aversive memory could prevent reconsolidation from occurring (Lee, Milton, & Everitt, 2006; Merlo, Milton, Goozee, Theobald, & Everitt, 2014; Sevenster et al., 2014a). Instead, prolonged (imaginal) exposure to the traumatic event may trigger the formation of a competing memory trace (Suzuki et al., 2004), while exposure to only the incipient parts of the trauma memory might trigger reconsolidation. The timing of IR (or the duration of exposure) could determine whether new information generated by IR can alter the original memory trace during its reconsolidation, or whether a new memory trace is being formed (Eisenberg, Kobilo, Berman, & Dudai, 2003; Suzuki et al., 2004). In order to optimize the effectiveness of IR it seems crucial to examine the boundary conditions that may prevent memory reconsolidation from occurring. For example, it has long been debated at what moment the sequence of events is best changed during IR. Dibbets and Arntz (2016) proposed to start the rescripting process before the hotspot of the reactivated memory, where a mismatch between the original memory (e.g., the expectation that the most aversive part will now follow) and its state during retrieval (e.g., the most aversive part does not follow) may destabilize the memory (Beckers & Kindt, 2017). This could be in line with
research on the boundary conditions of reconsolidation, which suggests that expectancy violation during memory retrieval is necessary in order to induce memory destabilization (Sevenster et al., 2013; Sevenster et al., 2014b). However, according to emotional processing theory (Foa & Kozak, 1986; Rauch & Foa, 2006), it may be necessary to reactive the hotspot of the memory in order to involve the entire associated fear network of the memory. Though not conclusive, preliminary results of an experimental study suggested that IR is more effective when the hotspot of the memory was reactivated (Dibbets & Arntz, 2016). In contrast, IR can also be beneficial even if the most aversive scenes of the memory are deliberately not included (e.g., Krakow & Zadra, 2006). In light of the fact that reactivation of the trauma memory including the hotspot may negatively influence treatment compliance, additional research is needed to identify the circumstances under which IR works best.

Another issue that arises with regard to the memory processes involved in IR refers to the type of memory that IR may target. The present thesis focused on the effects of IR on subjectively (e.g., online distress, nightmare symptoms) and objectively (e.g., FPS) measured emotional reactions, but it did not address the effects of IR on declarative, more explicit memory of aversive events. If IR induces a new memory trace, which competes with the original memory at retrieval, the new memory should include the rescripted, more benign storyline associated with less negative emotions than the original memory. In contrast, if IR changes the memory representation of the UCS directly, it is currently unclear whether these changes are only reflected in the emotional part of the memory (i.e., the emotional response), or whether the rescripted storyline is (at least partly) integrated into the original memory. Previous studies showed that disrupting reconsolidation of fear memory by means of pharmacological agents such as propranolol leads to a long-term reduction of the emotional response, whereas the declarative aspect of the memory remained fully intact (e.g., Sevenster et al., 2012a; Soeter & Kindt, 2010). Research aimed to examine the effects of propranolol on episodic memories yielded mixed results. For example, propranolol did not seem to have an effect on the explicit recall of previously learned words (Tolenaar, Elzinga, Spinhoven, & Everaerd, 2009) and pictures (Schwabe, Nader, Wolf, Beaudry, & Pruessner, 2012), whereas Kroes and colleagues (2010) observed impaired recall of negatively valenced words. Even though the effects of disrupted reconsolidation of episodic memories are still inconclusive, an important difference remains between pharmacological agents aimed to disrupt the reconsolidation process of emotional memories and IR: In contrast to pharmacological substances, IR purposely aims to change the original storyline of the reactivated memory in order to reduce emotional responding. Thus, whereas pharmacological interventions may specifically target the emotional aspect of the memory (Elsey & Kindt, 2016), it could be argued that IR focuses more directly on the declarative aspect of the memory. Indeed, Chan and LaPaglia (2013) showed that reactivated memories induced by a trauma film were susceptible to interference that specifically targeted the existing memory (i.e., an audio
narrative of the film where several details were replaced by incorrect information), but not to nonspecific interference. Likewise, preliminary evidence from an experimental study revealed that compared to a trauma-irrelevant positive imagery task, IR even enhanced cued recall of the induced memory (Hagenaars & Arntz, 2012). Importantly, the authors did not observe any differences between IR and exposure-based memory rehearsal. This demonstrates that changing mental images via IR does not necessarily lead to forgetting of the original memory, but that it may even improve recall of factual details of the memory. Similarly, evidence from research on consolidated episodic memories showed that self-reports of traumatic events in borderline personality disorder patients remained consistent after schema therapy (Kremers, Giezen, Does, Dyck, & Spinhoven, 2007), a psychological treatment that includes IR. In sum, although preliminary results suggest that IR does not change the declarative knowledge of aversive events, this topic evidently warrants further investigation.

**Fine-tuning IR interventions**

Understanding how IR leads to clinically significant change may enable us to optimize its treatment efficacy. To the best of our knowledge, chapter 6 describes one of the first studies that systematically investigated mediators of the treatment efficacy of IR. One of the main findings was that mastery significantly mediated the effects of IR, which implies that clinicians and researchers ought to take a closer look at the circumstances under which mastery can have potential additional effects on treatment outcome. For instance, we propose that intervention protocols should specifically focus on increasing patients' feelings of mastery (or self-efficacy) during treatment in order to enhance the effectiveness of IR in clinical and laboratory settings. Though often interchangeably used in the nightmare literature, mastery and self-efficacy traditionally refer to different theoretical concepts. Whereas mastery can be conceptualized as a competence or skill, self-efficacy traditionally refers to perceived behavior control (Bandura, 1996; Bandura, 1977). This distinction could have important consequences, because it may point to whether IR protocols should focus on skill building (e.g., patients imagine that they can actively overpower a perpetrator), or confidence building (e.g., patients learn to identify their needs and how to fulfill them). Likewise, such indications could improve the therapeutic effects of IR interventions used in laboratory settings. On this note, we are currently conducting an experiment that aims to examine the efficacy of an active vs. passive IR intervention (Siegesleitner, Strohm, Wittekind, Ehring, & Kunze, in prep). Based on the results obtained from chapter 6 and following the EPP philosophy, we aim to establish a causal relationship between mastery and treatment outcome in an analog IR intervention. For this purpose, we manipulate mastery by implementing different types of rescripting. In an active IR condition, participants are instructed to imagine themselves actively intervening and mastering an aversive situation.
they previously watched. In the passive IR condition, participants are instructed to imagine how someone else enters the situation who masters it in any way the participant wishes. According to the hypothesis, active IR should lead to increased mastery and better treatment outcome than passive IR. Alternatively, it may be possible that both treatments lead to similar therapeutic outcomes, given that perceiving other people in control of the situation has also been shown to reduce distress (Brewin & Bradley, 1982) and behavioral modeling may promote observational learning.

Another unknown factor in IR concerns its optimal approach. For instance, researchers and clinicians ponder upon the question whether acting out rage or aggressive behavior towards a perpetrator in IR may have adverse effects by promoting the disinhibition of aggression. Seebauer and colleagues (2014) found neither harmful nor beneficial effects of IR with or without revenge, while Watson et al. (2016) showed that IR including revenge fantasies of bullying incidents was less beneficial when compared to avoidance imagery or forgiveness imagery. In light of the fact that mastery seems to be critical in IR treatments, it seems worthwhile to revisit this topic, as acting out rage or aggressive behavior in IR may directly lead to enhanced feelings of mastery and/or self-efficacy of the situation, thereby increasing treatment efficacy.

In addition, it is undetermined whether IR is most effective when it contains realistic images, or whether unrealistic scenarios (e.g., having superpowers) can also lead to a beneficial therapeutic outcome. This may depend on numerous aspects like the type of memory in question. Having superpowers might be helpful in IR for nightmares, which often depict unrealistic and fictional situations. However, it may not be satisfactory for a sexual abuse victim, who imagines that Superman helps him/her to flee from an aversive situation rather than resolve the situation in a more realistic way (e.g., the police or other helpers enter the situation and rescue the victim). Moreover, seemingly realistic images (e.g., mother helps child) may not be credible for patients (e.g., mother has never helped the child before). In such cases, patients are generally able to indicate if the rescripting does not lead to a satisfying outcome and typically revert to other, more helpful strategies (e.g., other helpers enter the situation). Whether the effectiveness of IR depends on the explicit content presented during rescripting remains an empirical question. However, it is rather apparent that the content of IR strongly varies with regard to the individual patients’ needs, abilities, and memories, which implies that individualized IR strategies may be more effective than a one-fits-all solution.

In sum, it currently remains elusive whether variations in IR produce differential therapeutic effects. In order to advance our general understanding of IR and eventually optimize its therapeutic effectiveness, it is crucial to address these topics in future studies. Moreover, the findings from chapter 3 suggest that fine-tuning and improving the IR intervention in laboratory settings is one of the next critical steps towards investigating the memory processes underlying IR by means of experimental paradigms.
Active treatment components of IR protocols

Studying the underlying working mechanisms of therapeutic interventions may improve the generality of therapeutic effects in clinical practice. Instead of providing practitioners with congested treatment protocols, we need to know what works in order to isolate and implement active treatment components. In case of nightmares for instance, there is an ongoing debate about the active treatment ingredients of nightmare therapies (Hansen et al., 2013). Though effective (Augedal et al., 2013; Aurora et al., 2010; Lancee et al., 2008), most treatment protocols focus on different treatment components (e.g., rescripting, exposure, and/or relaxation). To date, it remains unknown which treatment ingredients are responsible for producing therapeutic change in people suffering from nightmares.

In chapter 5 we presented an effective approach to disentangle the different treatment components of nightmare therapies and investigate their discrete efficacy. In line with previous findings (Hansen et al., 2013), we showed that stripped-down, stand-alone IR and IE are indeed both effective in the treatment of nightmares when compared to a wait-list control group. Interestingly, the effects of stripped-down IR and IE were even similar in size to those observed with the full protocols even though we excluded all non-specific treatment components. Conversely, a recent study by Pruiksma and colleagues (2016) found that nightmare therapy with rescripting and exposure did not significantly differ from treatment without rescripting and exposure (i.e., relaxation skills, sleep habit modification, and psychoeducation about nightmares). Obviously, these results not necessarily imply that exposure and rescripting do not contribute to treatment outcome. Yet, they indicate that further dismantling of treatment protocols is warranted in order to identify active treatment components and their incremental role on treatment outcome.

Similar ignorance of the active treatment components can be observed in other IR manuals, including those for childhood abuse. For example, the protocol proposed by Smucker and colleagues (1995) comprises IE in order to activate traumatic memories and to reduce fear, as well as IR to decrease other emotions and cognitions often observed in PTSD (e.g., guilt, shame, little self-efficacy). Thus, IR was added to enhance the efficacy of IE (Arntz et al., 2007), by offering a means to generate and integrate corrective information into the trauma memory. In contrast, Arntz and Weertman (1999) place much less emphasis on the exposure part of the treatment and they proposed that prolonged exposure to the traumatic memory may not be necessary in order to observe therapeutic change. While both treatments produce promising therapeutic effects (Grunert et al., 2007 and Raabe, Ehring, Marquenie, Olff, & Kindt, 2015, respectively), it is currently unclear whether prolonged exposure may up- or downgrade the therapeutic efficacy of IR.

In a similar vein, it is discussed whether cognitive restructuring of dysfunctional beliefs linked to negative mental images before image modification (e.g., Jung & Steil, 2013; Wild & Clark, 2011) may be conductive to treatment outcome. In line with the proposition that
cognitive restructuring specifically addresses patients’ negative beliefs about themselves, others, and the world (Müller-Engelmann & Steil, 2017). Norton and Abbott (2016) recently showed that cognitive restructuring did indeed yield larger effects on cognitive measures such as maladaptive self-beliefs and fear of negative evaluation compared to IR. In contrast, IR led to stronger reductions in experienced distress and negative imagery when compared to cognitive restructuring. However, deliberate cognitive restructuring does not seem necessary for cognitive reappraisal to occur (Nilsson et al., 2012). Whether cognitive restructuring benefits the efficacy of IR remains an empirical question and is yet to be examined by dismantling studies.

The issues mentioned here are exemplary for many other psychological therapies. With the trial presented in chapter 4, we illustrated how therapeutic techniques can systematically be studied in order to eventually increase their clinical effectiveness, and we hope to have inspired further research efforts towards a better understanding of psychological treatments in general.

**Moderators of the treatment effect of IR**

Investigating treatment mechanisms might help to identify variables that possibly influence the effectiveness of IR. Such potential moderators of the treatment effect refer to patient or therapist variables (e.g., gender or personality) and other relevant factors that may influence the direction or strength of the relationship between an intervention and its outcome (Kazdin, 2007, 2009). Whereas we did not directly aim to uncover relevant moderators in any of the studies presented in this thesis, we unexpectedly recruited a rather homogeneous sample of idiopathic nightmare sufferers (chapter 5). Idiopathic nightmares are usually distinguished from posttraumatic nightmares, and they refer to nightmares that are unrelated to a traumatic event (Germain & Nielsen, 2003). Both types of nightmare sufferers were eligible for participation in the study and we can only speculate about the cause of the unexpected homogeneous composition of the sample. Supposedly, patients suffering from posttraumatic nightmares did not apply for treatment for yet unknown reasons that may include potential moderator variables like patient motivation, symptom severity, or social economic status. Nevertheless, these findings highlight the fact that there are currently unknown variables that may influence whether or not patients seek treatment (within a research context). A better understanding of these variables may lead to increased treatment effectiveness and enhanced dissemination of IR.
CONCLUDING REMARKS

This thesis presented a translational research approach to studying the underlying mechanisms of Imagery Rescripting (IR), a promising transdiagnostic psychological treatment of maladaptive emotional memory. Combining experimental psychopathology with more applied research methodology, the work featured in this thesis adds to the general understanding of IR. Both laboratory and clinical studies seem to support the hypothesis that IR taps into different processes when compared to exposure-based treatments, which may have critical implications for the treatment of emotional memories. Traditional exposure-based therapies induce new, inhibitory memories, thereby leaving the original distressing memory unchanged and vulnerable for retrieval. In contrast, IR may provide a means to directly change the original memory through UCS-devaluation, which might lead to more generalizable and sustainable treatment effects. Although the present findings do not yet allow for any definite conclusions concerning the memory processes underlying IR, they advocate that the technique constitutes a valuable alternative therapeutic approach in the treatment of emotional memory. Further research on how and why IR leads to clinically significant change may enhance its effectiveness and advance the psychological treatment of emotional disorders.