Avoidance: From threat encounter to action execution
Arnaudova, I.B.

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Chapter 7

General discussion

This doctoral dissertation aimed at elucidating factors that play a role in the selection of avoidance responses in the face of threat. To achieve this goal, we presented a novel evidence-based framework (the TeARS model), which traces the process of avoidance response selection from threat encounter to action execution. Based on this model, we made a number of novel predictions about the factors that affect the response selection process. Some of the resulting hypotheses were tested empirically; the results of those experiments are reported in this dissertation as well.

In the present chapter, we summarize the TeARS model and revisit its predictions in light of the empirical findings. We also identify limitations of the research presented here and propose directions for future research. Then, we discuss how the TeARS model can help us understand maladaptive avoidance in anxiety pathology. We examine current treatment protocols for clinically severe anxiety through the lens of the TeARS model and propose potential improvements to clinical interventions.

7.1 The Threat Avoidance and Response Selection (TeARS) model revisited

In Chapter 2, we presented the Threat Avoidance Response Selection and Execution model (TeARS), which was based on empirical findings regarding avoidance from a variety of fields (e.g., social psychology, clinical psychology, ethology). Here, we first briefly summarize the model. We then focus on the empirical findings presented in the other chapters and how they relate to the ideas of the TeARS model.

According to TeARS, the process of selecting one avoidance response from a number of available alternatives (response selection) begins when a threat is encountered, regardless of whether this threat is imagined or real, conscious or unconscious. We suggest that any threat can activate a defensive motivational network, which organizes all responses of the organism (i.e., verbal, physiological and behavioral) in order to increase survival chances (Dickinson & Dearing, 1979;
Lang, 1995). We view avoidance as the main behavioral output of this defensive motivational network (in accordance with Bolles, 1970; Lang, 1995).

We propose that whenever the defensive motivational network is activated, avoidance action tendencies will be present. Action tendencies refer to the priming of distance regulation (e.g., Frijda, 1986) with avoidance tendencies reflecting the priming of distance-increasing responses rather than a distance-reducing responses (approach). These avoidance tendencies are seen as automatic and, thus, as a part of a wider reflexive system that guides all automatic responses (see Strack & Deutsch, 2004, for more detail). The strength of the avoidance tendencies is proposed to be influenced by individual differences. Action tendencies are said to not always result in overt action (e.g., Frijda, 1986) and we maintain a similar position in the TeARS model. We suggest that reflexive avoidance in the form of withdrawal or flight, guided primarily by these avoidance tendencies, takes place only under certain circumstances.

The reason for this is that a slower, more controlled reflective system can inhibit the output of the reflexive system. According to the TeARS model, the success of this inhibition is variable, with individual differences playing a modulating role. Also, whether the reflective system is activated, depends on the characteristics of the threat, most notably its imminence.

Threat imminence refers to the physical (e.g., spatial and temporal) and psychological (e.g., subjective intensity) distance between the threat and the organism (Fanselow & Lester, 1988). Individual differences (e.g., previous experience with a given threat; general tendencies to react to negative stimulation) are assumed to affect the appraisal of threat imminence. We suggest in the TeARS model that the reflective system will be switched off when threat imminence is high, in order to assure quick (reflexive) responding and increase survival chances. Thus, threat imminence appraisal serves as a crucial gatekeeper between the two systems (reflective and reflexive) and has to be updated constantly.

According to the TeARS model, when the reflective system is activated, a process of avoidance evaluation will take place. Thus, the primed avoidance response of (reflexive) withdrawal or flight enters consciousness and other available responses (e.g., calling for help, hiding) are considered and compared against it. Which behavioral alternatives will be considered depends on the individual’s current behavioral repertoire (what actions have been successful in the past), situational affordances (what actions are supported by the objects present in the environment) and social demands (whether a certain action is socially accepted for the individual for the current threat imminence). Appetitive motives (e.g., food or sex attainment) will also affect response selection, because appetitive goals might be present as well at the moment of threat encounter. Thus, actions will be evaluated also in terms of how much they interfere with current appetitive goals and the ones that are least disruptive will be evaluated more favorably. However, conflicts between the defensive and appetitive motivational networks will be resolved in an avoidant way. The TeARS model further posits that once avoidance evaluation has been completed, a behavioral decision is made and an action is executed that may resemble reflexive avoidance (e.g., flight, but possibly executed with less urgency) or not (e.g., calling the police or endurance).

The response selection process is concluded with situational feedback. Such feedback should confirm whether distance regulation has been successfully achieved
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and no other threat is present in the environment. Otherwise, avoidance response selection will start anew.

The TeARS model is based on findings from classical studies of avoidance in human and non-human animals (e.g., Schneirla, 1959) as well as very recent research (e.g., Åhs et al., 2015). As a result, it makes a number of novel predictions that are in need for empirical validation. Chapters 3 to 6 of this doctoral dissertation address a number of these predictions. In the next section, we summarize the empirical findings and revisit some of the central tenets of the TeARS model.

7.1.1 Conscious awareness of threat

According to the TeARS model, threat should instigate a response selection process regardless of whether the threat is processed consciously. It has been previously shown that threat stimuli presented (subliminally) for very short durations (17 to 33 ms) can be processed pre-attentively (without awareness) and activate the defensive motivational network and associated automatic responses (e.g., skin conductance; Ohman & Soares, 1993). Thus, it is assumed that avoidance tendencies might be activated even when threat is only pre-attentively processed (also in Öhman, 2013).

In Chapter 3, we examined whether pre-attentive threat processing results in the priming of automatic avoidance tendencies. Participants first underwent classical conditioning, in which one neutral stimulus (a face; conditioned stimulus, CS+) was always followed by an aversive electric stimulation (unconditioned stimulus, US), while another neutral stimulus (CS-) was not. Following this procedure, avoidance tendencies were measured in a symbolic approach/avoidance task (AAT; Krypotos et al., 2014) with subliminally presented CSs. In this task, following the subliminal presentation of the CS, a neutral mask (scrambled picture) replaced the stimulus. Individuals then made a small manikin move either towards (approach) or away (avoid) from the mask, depending on the orientation of the mask’s white frame (horizontal or vertical). Our findings showed that subliminally presented CSs were indeed pre-attentively processed and yielded the priming of action tendencies. Surprisingly, approach rather than avoidance tendencies were obtained on CS+ trials, which is in contradiction to what has been observed for consciously processed CSs (Krypotos et al., 2014).

The findings of the experiments reported in Chapter 3 confirm the idea put forth in the TeARS model that conscious awareness of threat is not needed for the activation of the reflexive system and the generation of action tendencies. However, approach rather than avoidance tendencies were found on trials with classically conditioned threat stimuli, which at first glance seems at odds with the propositions of the model. In Chapter 3, we argue that these surprising findings might represent responses to the threat value of the mask on a given trial, which might have been modulated by the pre-attentive processing of the threat value of the stimulus it replaces on that trial. Namely, on trials where the mask replaces a conditioned threat stimulus (CS+), the mask could have been perceived as a signal for safety, due to the removal of threat. On the other hand, when the mask replaces a conditioned safety stimulus (CS-), it could be considered a signal for danger, due to its removing safety. Thus, the threat value of the mask would be higher on CS- trials than on CS+ trials. If so, preferential approach would be
expected on CS+ trials and preferential avoidance might have been expected on CS- trials, as observed in the experiment reported in Chapter 3.

A theoretical competitor to the TeARS model is the two-dimensional neuropsychological account of defense, proposed by McNaughton and Corr (2004), which is heavily based on findings from research on the effect of anxiolytic drugs on behavior. In it, the authors suggest that certain threats activate a distinct set of neural structures and can produce defensive approach rather than avoidance, when the emotional reaction to these threats is anxiety rather than fear (for more detail, see McNaughton and Corr, 2004). Using their model, another speculative explanation for the results presented in Chapter 3 is that the subliminally presented threats elicited anxiety rather than fear and we have observed the automatic tendencies underlying defensive approach.

The TeARS model, however, does not distinguish between the emotions of anxiety and fear and suggests that threat avoidance should be observed regardless of emotional experience in a given situation. This is based on the observation that there is little evidence outside of the realm of facial expressions (e.g., Ekman, 1992; Izard, 1994) that specific emotions are linked to specific behavior output.

### 7.1.2 Threat imminence captures attention

Threat imminence appraisal plays a central role in the TeARS model. The level of threat imminence is assumed to optimize the response selection process by deactivating the slow reflective system when threat imminence is high. Thus, it is important that threat imminence appraisal is constantly updated while response selection takes places. In order for this updating mechanism to function properly, close attention needs to be paid to slight changes in threat imminence.

In Chapter 3, we investigated whether increases in threat imminence capture attention. Threat imminence was manipulated by changing the perceived physical distance between the conditioned stimuli, presented on a computer screen, and the participant, by either increasing the CSs’ size (creating a perception of approach) or decreasing it (creating a perception of withdrawal). Participants, then, had to identify the location of a small probe (an arrow) that replaced one of the stimuli as quick as possible, as in other dot-probe tasks (e.g., Koster, Crombez, Van Damme, Verschueren, & De Houwer, 2005). The results showed that increases in threat imminence (both approach of the CS+ and withdrawal of the CS-) were preferentially attended to.

These results confirm the prediction of the TeARS model of an attentional bias towards increases in threat imminence and contribute to the literature on threat imminence as a whole. Even though threat imminence has been widely researched in non-human animals (e.g., rats, see Fanselow & Lester, 1988), empirical research in humans is much more limited. Notable exceptions are the studies by Mobbs and colleagues (2009; 2007), who have investigated the neural activation associated with different threat imminence levels, and a recent study by Åhs et al. (2015), which showed that spatial distance affects not only physiological fear responses, but also amplifies the strength of both appetitive and defensive motivational network activation. The study presented in Chapter 3 provides further evidence of the importance of threat imminence for humans.

It is crucial to note that in Chapter 3, we investigated only changes in spa-
tial distance, without modifying other aspects of threat imminence (e.g., gaze direction) that might be equally important. For example, in non-human animals (Fanselow & Lester, 1988), threat imminence has often been modulated by reinforcing CSs with a different number of aversive USs (e.g., 50% reinforcement rate vs. 100% reinforcement rate). Previous research has shown that CSs that are consistently reinforced with an aversive US attract more attention than stimuli reinforced only partially (Austin & Duka, 2012). What other threat characteristics might determine threat imminence level and capture attention remains a question for future research.

### 7.1.3 Individual differences in threat imminence appraisal

According to the TeARS model, threat imminence appraisal is affected not only by specific characteristics of the threat, but also by individual differences. In **Chapter 4** and **Chapter 5**, we examined whether specific trait characteristics increase perceived threat imminence (perceived likelihood of threat occurrence). Even though this topic has been widely researched before (for a more detailed review, see **Chapter 4** and **Chapter 5**), and associative learning studies comparing anxiety patients to healthy controls show increased threat imminence appraisal to safety cues in pathology (Duits et al., 2015; Lissek et al., 2005), evidence remains inconclusive for individuals at risk (see **Chapter 5**). Beckers et al. (2013), as well as Lissek, Pine and Grillon (2006), have suggested that the paradigms used in the studies with individuals at risk are too simplistic and do not provide much room for individual differences. Thus, in **Chapter 4** and **Chapter 5**, we have used more ambiguous associative learning paradigms in order to increase the understanding of the role of individual differences in threat imminence appraisal.

In **Chapter 5**, we used a blocking procedure, where one stimulus previously reinforced with a US (CS$_A$) is presented conjointly with another stimulus (CS$_B$) to form a compound stimulus (CS$_A$CS$_B$). The compound stimulus is then reinforced with the same US. As a result, the blocked CS$_B$ stimulus remains ambiguous, because it has never been presented alone and its association with the US can only be deduced from its association with CS$_A$. We compared responding to this blocked stimulus to another stimulus: a protected-from-overshadowing CS$_D$. This protected-from-overshadowing CS$_D$ had been previously presented within a compound (CS$_C$CS$_D$), which was reinforced with the US. Crucially, the other conditioned stimulus of that compound (CS$_C$) had been previously presented without US reinforcement. Thus, before test, the CS$_D$ had also never been presented alone and its association with the US could only be deduced from its presence in a reinforced compound and association with the CS$_C$. As a whole, it would be expected that participants would report higher US expectancies for this protected-from-overshadowing CS$_D$ than for the blocked CS$_B$ (Beckers et al., 2013). Individuals high on self-reported tension-stress were found to have a deficit in discriminatory learning, as measured by the difference in US expectancies between CS$_D$ and CS$_B$.

In **Chapter 4**, however, no individual differences in self-reported US expectancies towards another type of ambiguous stimuli were found. In the two experiments reported in **Chapter 4**, individuals responded to generalization stimuli (GS; circles with different shades of gray) that were situated on a perceptual con-
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tinuum between the CS+ (e.g., a black circle) and the CS- (e.g., a white circle). Thus, all GSs had different degrees of perceptual similarity to the CS+ versus the CS-. Generalization of US expectancies was clearly modulated by the degree of similarity to the CS+ versus the CS-. Therefore, higher US expectancies are traditionally observed to GSs more similar to the CS+ than GSs more similar to the CS- (Lissek et al., 2008). However, no individual differences in US expectancies to generalization stimuli were observed. Experiment 2 extended that observation to physiological responding (skin conductance; fear-potentiated eye-blink startle response) to the GSs.

Thus, we observed individual differences in self-reported US expectancies in Chapter 5 but not in Chapter 4. This suggests that specific experimental paradigms can either obstruct or promote the emergence of individual differences. It needs to be established which of the available paradigms better serves the goal of uncovering individual differences in threat imminence appraisal. At present, the uncovering of individual differences in threat imminence appraisal and the boundary conditions for their emergence remains a challenge for future research.

While the findings of Chapter 5 offer evidence for individual variability in threat imminence appraisal as proposed by the TeARS model, the data from Chapter 4 do not. Importantly, generalization has been proposed to be an adaptive phenomenon that should occur across individuals (Torrents-Rodas et al., 2013). Deviations in generalization might be extremely rare. Larger sample sizes with a more diverse population might be needed to uncover such individual variability. An important limitation of the research presented in Chapter 4 is exactly its small sample size and the fact that most participants were young educated adults (university students).

7.1.4 Individual differences in avoidance tendencies and avoidance actions

In the TeARS model, individual differences modulate not just the appraisal of threat imminence but also the strength of the resulting avoidance tendencies and whether avoidance tendencies are eventually translated in overt avoidance behavior. Those two ideas were examined in Chapter 4 and Chapter 5 as well.

Individual differences in conditioned avoidance tendencies were evaluated in both experiments of Chapter 4. We found some indication for the modulation of avoidance tendencies in Experiment 1, with only individuals high on neuroticism, a known vulnerability factor for anxiety (e.g., D. Watson & Clark, 1984), exhibiting conditioned avoidance tendencies. In Experiment 2, we found avoidance tendencies to GSs in certain individuals only (those low and high on neuroticism, but not those in the moderate group). In this experiment, all participants showed avoidance tendencies towards the CSs. These findings, however, need to be interpreted with caution since the effects were not very strong and a replication in a larger sample is warranted.

Considering the mixed findings regarding the effect of individual difference factors on the generalization of fear in Chapter 4, it seems possible that neuroticism does not affect every measure of conditioned fear to the same extent. Fear responding has been theoretically divided into three distinct categories: verbal (e.g., self-reported US expectancies), physiological (e.g., skin conductance) and 136
behavioral responses (e.g., avoidance tendencies and overt avoidance behavior) (Lang, 1995). Orthogonally, these responses can also be separated in two categories: automatic versus controlled responses. Previous research has shown that, in general, measures of controlled behavior (e.g., self-report and overt actions) tend to correlate more strongly with each other than with measures of automatic responding (e.g., physiological responses and avoidance tendencies; Evers et al., 2014; Huijding & de Jong, 2006; Klein et al., 2011; Mauss et al., 2005).

Beckers et al. (2013) have proposed that increased discordance between fear response systems might act as a pathogenic marker and others have also encouraged research into the desynchrony of fear responses (Hodgson & Rachman, 1974). Discordance of fear response systems has been well documented in fear conditioning research (Balderston & Helmstetter, 2010; Knight, Nguyen, & Bandettini, 2003; Manns, Clark, & Squire, 2001; Perruchet, 1985; Schultz & Helmstetter, 2010; Sevenster, Beckers, & Kindt, 2014; Soeter & Kindt, 2010; Weidemann, Broderick, Lovibond, & Mitchell, 2012; Weidemann, Tangen, Lovibond, & Mitchell, 2009), where differences between verbal and physiological responding have been observed. The extent of generalization also has been shown to differ between response systems SCR vs. threat ratings, Holt et al., 2014; FPS vs. threat expectancy, Soeter & Kindt, 2012). It seems entirely possible that individual differences will modulate this discordance. Future research needs to address this question.

Tentative indication for such discordance can be found in Experiment 2 of Chapter 4, where we did not find any significant differences between individuals with different levels of neuroticism in the execution of safety behaviors (button-press variants of avoidance behavior). Thus, in Chapter 4, we have observed that while neuroticism might have an effect on avoidance tendencies, it does not always modulate the rate of overt avoidance responding.

7.1.5 Effects of aversive stimuli on appetitive behavior

Another important idea of the TeARS model is that when both the appetitive and defensive motivational networks are activated, the conflict between the two should be resolved in an avoidant way, i.e., with avoidance of the threat. Nico Frijda in his classic book on emotion proposed a similar control precedence of aversively motivated behavior (Frijda, 1986). Indeed, it has been shown that avoidance responses are emitted when threat is present, regardless of whether they are associated with a loss of reward (Pittig, Brand, et al., 2014; Pittig, Schulz, et al., 2014; van Meurs et al., 2014). In the TeARS model, we further maintain that individual differences should affect the success of inhibition of such avoidance behavior.

In Chapter 5, we found that low-imminent threat cues (pictures of conditioned stimuli on a wrapper) affect appetitively-motivated behavior (choice of chocolate bar) only in individuals high on self-reported stress. Specifically, individuals high on stress were more likely to choose a chocolate bar on which a conditioned ambiguous safety cue (the blocked CS\textsubscript{B}) was depicted than a chocolate bar bearing the picture of a conditioned ambiguous danger cue (the protected-from-overshadowing CS\textsubscript{D}). Importantly, in this experiment, no cost was associated with either choice, but individuals still responded in an avoidant way. This provides some evidence for the TeARS model proposition that individual differences
exist in how successfully people can inhibit their avoidance tendencies, assuming they were activated by the CS\(_D\). It has been shown that non-ambiguous conditioned threats do activate such avoidance tendencies (Krypotos et al., 2014) and CS\(_D\) might similarly evoke them. Future research can examine whether such ambiguous conditioned cues (blocked or protected-from-overshadowing CSs) result in conditioned action tendencies.

Lastly, in Chapter 6, we examined the effect of negative mood on appetitive responses directly. Negative mood can be seen as a direct internal cue (e.g., Baker et al., 2004) threatening the individual’s well-being, even though the experience of negative mood might be more diffuse than the experience of danger or negative emotions (Macht, 2008). According to TeARS and other theories (e.g., the associative network theory of affect; Bower, 1981), negative mood might obstruct the learning and expression of appetitive responses. However, in the two experiments presented in Chapter 6, we found exactly the opposite. Under negative mood, approach tendencies to stimuli conditioned with an appetitive US (e.g., chocolate or alcohol) were enhanced.

These findings are interpreted in light of contemporary theories of addiction where motives to cope with negative mood increase drug use (e.g., Baker et al., 2004; see Chapter 6 for more detail). Both chocolate and alcohol consumption are known to have mood-repairing abilities (e.g., Cooper, 1994; Macht & Mueller, 2007) and individuals report using substances with psychoactive ingredients to reduce negative moods (e.g., Kassel et al., 2003).

According to Baker et al. (2004), negative mood can act as an internal cue and responses can be directly influenced by it. The experience of negative mood can also be threatening to the subjective well-being of the individual, making negative mood an internal threat. Thus, use of mood-repairing substances might serve to increase the psychological distance of the individual from the internal threat of negative mood. The intake of the mood-repairing substances might therefore be rewarding due to the removal of the negative experience (Baker et al., 2004). From the perspective of the TeARS model we might conceptualize approach to cues related to appetitive USs as safety behaviors.

The interpretation of approach to drug-predicting cues as safety behaviors based on this data might however be problematic. According to the TeARS model, safety behaviors should be guided by the reflective system and represent a controlled form of avoidance, while in Chapter 6 we have observed automatic approach tendencies. Future research needs to further examine how goal-oriented behavior is affected by negative mood. Some recent studies have shown that smokers in negative mood are more likely to choose cigarette puffs over chocolate even after being previously satiated with tobacco consumption (Hogarth et al., 2015). Preliminary data from our lab also show a preferential increase in choice for mood repairing substances (beer rather than water, Arnaudova et al., unpublished manuscript) under negative mood. Seeking of mood-repairing substances can also be habitual and thus operate on an automatic level (Stacy & Wiers, 2010). Taken together, this might suggest that drug consumption indeed serves as a safety behavior that can be prompted even on an automatic level.
7.1.6 Summary

This doctoral dissertation presented a novel comprehensive framework for avoidance response selection and execution and reported empirical studies addressing main tenets of the model. The findings mostly support the propositions of TeARS (e.g., that threat imminence guides the allocation of attention), but some results require replication (e.g., individual differences in avoidance action tendencies) and extension (e.g., whether drug use can act as safety behavior). Future research should address the questions raised by the research presented here and guide subsequent reformulation of the TeARS model as needed.

7.2 Application of TeARS to anxiety pathology

The TeARS model represents a framework that can be used to understand the occurrence and form of adaptive avoidance behavior based on the nature of the threat and other situational and personal factors. However, the contribution of this theoretical work is not limited to the understanding of adaptive, healthy behavior. The TeARS model can also apply to maladaptive avoidance in clinically severe anxiety. In the dual-process model of Strack and Deutsch (2004), pathology results when either the reflexive or the reflective system takes excessive control precedence. Based on this notion and empirical evidence to date, we proposed pathways through which avoidance can become maladaptive in clinically severe anxiety Chapter 2. Here, we briefly summarize these pathways.

Recent evidence has shown that individuals with clinically severe anxiety have stronger avoidance tendencies to objects related to their anxiety (e.g., pictures of spiders in spider fear; Rinck & Becker, 2007). Overly strong action tendencies might be difficult to inhibit (e.g., Wiers & Stacy, 2006) and this might be especially true in clinically severe anxiety. Thus, one pathway through which avoidance might become maladaptive is through this enhancement of avoidance tendencies (1). Failure to inhibit reflexive avoidance responding might also contribute to the proliferation of avoidance. Regulatory failure might occur either when the reflective system is incapable of modulating responding (2) or when its resources are weakened (3). Increases in threat imminence appraisal (4) might further lead to higher rate of avoidance responding. Also, with repeated avoidance responding, individuals might develop avoidance habits (5) that are executed in the absence of any response selection process (thus, automatically). One limitation of this doctoral dissertation is that we have not been able to examine these hypothesized pathways for the proliferation of avoidance in a patient population.

In Chapter 2, one form of avoidance, namely experiential avoidance, was largely overlooked. However, it is possible to understand the occurrence of such avoidance through the TeARS framework. Below, we take a closer look into this widespread form of avoidance.

7.2.1 A special case: worry and experiential avoidance

Thus far, we have discussed behavioral avoidance of external threat cues, such as objects or situations. Another type of threat cue is internal, such as aversive thoughts, images or memories. Internal cues can provoke experiential avoidance
(Hayes, Wilson, Gifford, Follette, & Strosahl, 1996). Experiential avoidance is defined as “the phenomenon that occurs when a person is unwilling to remain in contact with particular private experiences (e.g., bodily sensations, emotions, thoughts, memories, behavioral predispositions) and takes steps to alter the form or frequency of these events and the contexts that occasion them” and is characteristic of individuals with a wide range of psychopathology (Hayes et al., 1996), including individuals who worry excessively (Lee, Orsillo, Roemer, & Allen, 2010).

Worry is a thought process predominated by verbalization of problems and their potential negative consequences (Borkovec & Inz, 1990). Borkovec and Inz (1990) propose that the verbalization component of worry serves to suppress anxiety-provoking imagery, which typically leads to stronger autonomic arousal than verbal descriptions of threat-relevant situations (Vrana, Cuthbert, & Lang, 1986). Thus, Borkovec and Inz (1990) proposed that worry is an attempt to avoid and suppress fear arousal (also Borkovec, Ray, Stöber, & Stober, 1998; Roemer, Salters, Raffa, & Orsillo, 2005). Given that physiological arousal is often elevated during worry (e.g., Laguna, Ham, Hope, & Bell, 2004; Stapinski, Abbott, & Rapee, 2010; for a complete review, see Brosschot, 2010), others have suggested that worry serves the function of avoiding extreme negative affect shifts or the steep increase of negative affect (affective contrast theory; Newman & Llera, 2011) rather than arousal as a whole. In either conceptual approach, however, worry is viewed as a form of avoidance to internal threats.

Internal threat could be understood in a similar manner as any other threat, even though it lacks specific physical properties. It can be appraised in terms of threat imminence and can activate the defensive motivational network and associated avoidance tendencies. Physical distancing is not an available option for internal threat cues, and thus an alternative behavior needs to be chosen, i.e., a type of safety behavior that can increase psychological distance. According to the TeARS model, the reflective system should be in charge of searching for an appropriate safety response. Worriers are convinced their behavior helps them avoid or prepare for possible future negative consequences (Borkovec & Inz, 1990; Borkovec & Roemer, 1995). During a worry episode, they often think about possible behaviors they could perform in order to avoid the potential harmful impact of a certain threat (e.g., financial problems following unemployment). As such, worry might be closely related to the avoidance evaluation process proposed in TeARS, during which individuals examine behavioral alternatives to the reflexive withdrawal/flight.

Worry is linked to information seeking and monitoring (Davey, Hampton, Farrell, & Davidson, 1992), which can lead to attending to multiple novel threats during the process of worry. It has indeed been shown that for worriers, engaging in experiential avoidance often results in an increased number of internal threats (Hayes et al., 1996). According to TeARS, every discrete internal threat should activate the defensive motivational network and a new response selection process would begin. Consequently, a new worry episode would begin. With the presence of multiple, internal and non-specific threats, the reflective system can become overwhelmed, which would further hinder making a behavioral decision. As a result, the response selection process might never be completed and this might severely impair functioning. This might be specific to pathological worriers, since a recent study showed that worry is an adaptive strategy for healthy controls and
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can lead to favorable outcomes (e.g., in terms of regulating heart rate; Ottaviani et al., 2014).

After engaging in this avoidance evaluation process, taking further behavioral decisions might be obstructed also by the internal nature of the threat. The internal threat is in reality unavoidable, since it remains in the individual’s mind (Borkovec et al., 1998) or is unsolvable (Davey et al., 1992). Healthy controls might be better at accepting their inability to avoid this threat and stop repetitively worrying about it earlier. For individuals with pathological worry this might not be the case.

In addition, people who engage in pathological worry also often fail to define the feared outcomes they are trying to avoid in concrete terms and stay on a very abstract level (Stöber, 1998; Stöber & Borkovec, 2002; Stöber, Tepperwien, & Staak, 2000). They might similarly have difficulty in making concrete behavioral decisions (Stöber, 1998). Indeed, worry correlates highly with measures of cognitive avoidance, but not with behavioral avoidance (Dickson, Ciesla, & Reilly, 2012). Therefore, these individuals might remain in a constant process of looking for an appropriate response and worrying about feared outcomes, because they cannot make a behavioral decision and complete the response evaluation process.

Individuals with pathological worry and anxiety are also not confident in their problem-solving skills (Davey et al., 1992), and lack of confidence interferes with execution of responses, even when individuals have chosen a particular course of action. Even though worriers have shown good knowledge of problem solving skills (Ladouceur, Blais, Freeston, & Dugas, 1998), this does not mean that the quality of the solutions they generate is sufficient for them to remove the internal threat and stop worrying (Stöber et al., 2000). Worriers have shown poor problem orientation (Ladouceur et al., 1998) and have a predominantly avoidant coping style (Davey, 1993). Thus, the thought process of worry is also maintained by individuals’ lack of desire to initiate any concrete behavioral responses (Berenbaum, 2010). Yet a behavioral decision is what is needed to end avoidance evaluation.

If the threat imminence is extremely high and physical distancing is not an option, dissociation might occur as an extreme form of experiential avoidance (Hayes et al., 1996). Dissociation involves “disruptions in and fragmentation of the usually integrated functions of consciousness, memory, identity, body awareness, and perception of the self and the environment” (Lanius et al., 2010). It has proven difficult, however, to find a clear link between experiential avoidance and dissociation (Marx & Sloan, 2005), thus more research is needed to elucidate the similarities and differences between the two.

7.3 Evaluating treatment protocols for maladaptive avoidance through the lens of the TeARS model

Excessive avoidance can have a deleterious effect on individual functioning. First, individuals who engage in maladaptive avoidance often experience distress about their avoidance and are faced with multiple approach-avoidance conflicts on any given day (Dymond & Roche, 2009). For example, an individual with social anxiety might know that giving a presentation about his team’s achievements
to his boss would result in a promotion, but his avoidance might prevent him from doing so nonetheless. Such approach-avoidance conflicts and reduction of attained rewards (Pittig, Brand, et al., 2014; Pittig, Schulz, et al., 2014; van Meurs et al., 2014) often motivate individuals to seek therapy (Dymond & Roche, 2009). Second, maladaptive avoidance prevents exposure to information that the perceived threat can occur without an aversive consequence, thereby maintaining severe anxiety in the long term (Cornwell et al., 2013; Ehlers & Clark, 2000; Foa & Kozak, 1986; Lovibond et al., 2009, e.g.,) as well as obstructing the learning of more adaptive behaviors (Hayes & Wilson, 1994). Third, avoidance behavior might be used as a source of information for the individual about his or her emotions (Frijda, 1996) and reduce overall confidence in coping abilities, which will render the individual more susceptible to other pathology. In support of this idea, excessive avoiders have been found to be at risk for developing additional anxiety (Craske et al., 1990). Taken together, excessive avoidance could be a major threat to general functioning (for a detailed discussion of negative consequences, see Salters-Pedneault, Tull, & Roemer, 2004). Thus, it is not surprising that many treatment protocols for anxiety focus on reducing avoidance behavior (Rachman et al., 1986).

Behavior change, though, has been shown to be difficult to achieve and maintain (Bouton, 2014). Regardless of how a specific behavior has been learned, the fear behavior can be temporarily inhibited, but often returns (Bouton, 2014; Bouton et al., 2012). Treatment protocols for clinically severe anxiety aim at making this change more permanent and patients are encouraged to inhibit all forms of avoidance behavior as early as possible (Craske, Treanor, Conway, Zbozinek, & Vervliet, 2014). Even though some results suggest terminating avoidance behavior might not be needed for therapeutic gains to occur during treatment (Rachman et al., 1986), it remains the treatment convention (Craske et al., 2014). Reductions in avoidance patterns are proposed to help the progress of anxiety treatment (Aderka, McLean, Huppert, Davidson, & Foa, 2013). We now review some treatment options currently available for individuals suffering from clinically severe anxiety and analyze their effects on avoidance from the perspective of the TeARS model. Then, we discuss potential improvements.

### 7.3.1 Exposure to threats

The primary treatment for clinically severe anxiety is exposure therapy, in which individuals are repeatedly exposed to the threat at the core of their anxiety (e.g., spiders for arachnophobia, heights for acrophobia) without experiencing the feared aversive consequence (e.g., Craske et al., 2008). This treatment can be modeled in the laboratory through a procedure called extinction, where a conditioned fear stimulus (CS+) is repeatedly presented without its associated unconditioned stimulus (e.g., shock). Different explanations for how exposure therapy achieves behavioral change have been proposed. They use evidence from both clinical outcome studies and experimental work with analogue samples to elucidate the processes underlying therapeutic change in exposure therapy. Below, we summarize their key ideas.

Foa and Kozak (1986) suggested that the primary process through which reduction of pathological anxiety is achieved in exposure therapy is habituation.
In habituation, fear subsides both in session and between sessions as a result of the prolonged activation of a “fear structure” (in the TeARS model, the defensive motivational network). This would suggest that the defensive motivational network becomes exhausted and is deactivated, which might result in abolishing the automatic avoidance tendency and the response selection process as a whole.

Recent evidence, however, suggests that exposure therapy might actually achieve reduction of fear through inhibitory learning of the fear response (Craske et al., 2008, 2014), rather than habituation. This means that individuals learn to not react in a fearful way while facing feared objects or situations. The current view is that treatment protocols should optimize further this learning during treatment, so that changes occur on both automatic and propositional/controlled levels (Craske et al., 2008). A number of specific strategies have been proposed to enhance this inhibitory learning. An in-depth discussion of all strategies used to enhance inhibitory learning during exposure is beyond the scope of the current chapter (see Craske et al., 2014). However, here, we briefly summarize the most important ones and suggest at which points of the response selection process, as proposed in the TeARS model, these strategies intervene.

During exposure, threat expectancies can be violated and as a result, the threat imminence of the feared object could be reduced (Craske et al., 2014). According to the TeARS model, reducing threat imminence appraisal should allow for the activation of the reflective system and subsequent regulation of behavior even during exposure to objects that individuals previously avoided. The ability of the reflective system to regulate responding is further strengthened by practice in deepened extinction, where individuals are exposed to multiple danger signals at the same time, and through creating variability in the exposure sessions by changing tasks or contexts. Another strategy used during exposure sessions to strengthen their effect is affect labeling or linguistic processing of current affective states, which again should activate the reflective system and by enhancing the involvement of the reflective system. Affect labeling also focuses the attention on verbal information exchanges (Craske et al., 2008, 2014) rather than the threat and its imminence. These strategies thus work though increasing the control of the reflective system over the reflexive ones.

Safety behaviors and other avoidance responses are also obstructed during exposure sessions (Craske et al., 2014). The motivation for removing safety behaviors is that they might form an association with the non-occurrence of the negative consequence (US) and therefore hinder the progress of extinction (Lovibond et al., 2009). As a result, individuals might fail to learn the association between the feared object (e.g., spider) and the non-occurrence of the US. Thus, during exposure sessions, habitual responding might be reversed, because previously habitually executed avoidance responses are no longer being performed.

There is also some evidence that exposure has also an effect on implicit evaluations, which are central to avoidance (Teachman & Woody, 2003) and that extinction also abolishes classically conditioned avoidance tendencies (Krypotos et al., 2014). It is unclear what are the mechanisms underlying this change. It is possible that initial threat appraisal of the feared stimulus is changed, it is no longer considered a threat and the defensive motivational system is no longer activated in its presence. This would mean that exposure affects avoidance tendencies only indirectly.
7.3.2 Avoidance Response Prevention and Social Mishap Exposure

Avoidance can also occur in the form of habits, as in the case of individuals who respond to threatening obsessions with avoidant compulsions. Such individuals, for example, might habitually and compulsively execute the safety behavior of checking whether the gas stove has been switched off. For them, ritual prevention (RP) or the absolute removal of compulsions during therapy is often added to exposure in treatment. This results in significant improvements in symptomatology (e.g., Franklin, Abramowitz, Kozak, Levitt, & Foa, 2000). This RP technique prevents engagement in avoidance responding, thus reducing habits and strengthening the ability of the reflective system to inhibit the reflexive system within the TeARS model. Alternative functional behaviors (e.g., checking the stove only once) are introduced as well during this treatment.

Another strategy for preventing habitual avoidance responding is through devaluating its expected consequence (C. D. Adams & Dickinson, 1981). Social mishap therapy might do exactly that for individuals whose pathological anxiety centers around social concerns. In this approach, individuals behave in ways that could cause the feared social embarrassment (e.g., walk backwards in a crowded street) and learn that such experiences would not have long-lasting consequences on their social standing or achievement of other goals (Fang, Sawyer, Asnaani, & Hofmann, 2013). Thus, the functionality of avoidance responding is challenged.

7.3.3 Summary

In summary, exposure treatment seems to focus on different aspects of the avoidance response selection process in order to reduce avoidance responding. Exposure-based techniques change threat (imminence) appraisals and increase the ability of the reflective system to inhibit avoidance responding. On the other hand, ritual prevention and social mishap therapy also target habitual avoidance responding.

7.4 Potential improvements to treatment protocols from the perspective of the TeARS model

As already mentioned, behavioral change is difficult to attain and maladaptive behavior often returns (Bouton, 2014). Indeed, many individuals relapse after treatment, with relapse rates reaching 64% for pathological panic in females (Yonkers, Bruce, Dyck, & Keller, 2003). This suggests that despite the significant success that current treatments have in achieving short-term remission, they do not succeed in bringing long-lasting behavioral change. One reason might be that exposure treatment, as described above, targets only one or two of the processes which turn adaptive avoidance into maladaptive. A comprehensive treatment protocol might be better suited in addressing maladaptive avoidance. After examining the effects of exposure treatment and additional therapies such as ritual prevention and social mishap therapy, it appears that one of the pathways proposed within the TeARS model is not specifically addressed. Namely, these treatments do not
target the increased avoidance tendencies of individuals with severe anxiety. In this final section, we discuss how avoidance tendencies can be changed directly.

The application of comprehensive treatment protocols might be challenging, however, because patients can get overwhelmed by information and tasks. Personalized treatment might be a better option. Such treatment would target the problematic behavior, considering the specific characteristics of the individual (Ozomaro, Wahlstedt, & Nemeroff, 2013) and might achieve behavioral change quicker. The formulation of a personalized treatment plan should benefit from an evaluation of the processes that promote the proliferation of excessive avoidance of a particular individual. Applying the TeARS model during treatment case formulation could help in creating such personalized treatment. Thus, finally in this chapter, we make a case for personalizing the treatment of excessive avoidance.

7.4.1 Targeting avoidance tendencies directly

It is important to focus directly and specifically on reducing avoidance tendencies in treatment. This would assure that when individuals with pathological anxiety are faced with a threat stimulus, the avoidance tendency would not be too strong to be inhibited by the reflective system. Changing automatic responses in therapy has been a challenge, recognized for a long time (McNally, 1995), but recent technological improvements and new scientific insights might help to uncover fruitful strategies.

Wiers and Stacy (2006) first proposed that retraining action tendencies might be a useful addition to therapy (also supported by Eder & Rothermund, 2008). Support for this idea comes from experimental research. Cacioppo et al. (1993) first showed that activating flexor/extensor muscles (linked to approach or avoidance movements) could change evaluations of novel stimuli. Approach/avoidance movements also affect speed of valence categorization (Neumann & Strack, 2000). Later, Huijding et al. (2009) showed that children who are trained to repeatedly push or pull pictures of novel animals, evaluated more positively the approached (pulled) animals and more negatively the avoided (pushed) animals. However, these findings were only present on explicit measures of attitudes, fear and avoidance, and not on implicit ones. A second study with children who underwent the training with another approach/avoidance task showed similar results (Huijding, Muris, Lester, Field, & Joosse, 2011). This was further replicated and extended to an adult population by Woud, Maas, Becker, and Rinck (2013), who found an effect of training also on implicit measures. Taken together, these studies suggest that an approach-avoidance tendency can be trained and its effect can extend to other measures of attitudes. This is important, since implicit attitudes drive phobic avoidance (Teachman & Woody, 2003) and if they remain intact after treatment, relapse is more likely (Rinck & Becker, 2007). Initial attitudes towards stimuli can moderate the effect of approach-avoidance training (Gawronski, Deutsch, & Strack, 2005), thus it is important to look at pre-clinical and clinical studies, before raising hopes that such a training could be a useful addition to existing treatments.

This area of research is new and as a result, there is a paucity of evidence about how training affects attitudes and behaviors in pre-clinical and clinical populations. Wiers and colleagues have shown that training has a positive effect
on implicit attitudes and drinking behaviors in hazardous drinkers (Wiers et al., 2010), who show increased approach tendencies are present for stimuli associated with alcohol consumption. Training has been also show to change attitudes and improve treatment outcome in patients with alcohol addictions (Wiers, Eberl, Rinck, Becker, & Lindenmeyer, 2011). Further, training seems to have an indirect effect on alcohol consumption, mediated through change in action tendency (Sharbanee et al., 2014). Thus, these studies suggest that a strong approach tendency towards alcohol can be reduced using computerized trainings and this reduction can potentially aid treatment. However, Centerbar and Clore (2006) found that the effects of training on positive and negative stimuli can diverge. Thus, the findings on approach tendencies in drug addiction might not be easily generalizable to automatic avoidance tendencies in the presence of threat.

Some studies have addressed the question of whether avoidance tendencies can be changed through training. C. T. Taylor and Amir (2012) showed that a computerized training paradigm can improve social approach behaviors during social interactions and improve conversation partner’s evaluations of individuals with social anxiety. However, a weeklong training with an approach-avoidance task with social anxiety patients yielded only short-term effects and no overt behavioral modification in a recent study (Asnaani, Rinck, Becker, & Hofmann, 2014). Amir, Kuckertz, and Najmi (2013) also showed that training with an approach/avoidance reaction time task (AAT; see above) can diminish avoidance tendencies and increase approach behavior towards threatening stimuli of individuals with contamination concerns. In our lab, we have recently compared the effects of such training as an add-on to traditional extinction. Even though the training was successful in reducing avoidance tendencies during the session, it generalized only weakly to other measures of avoidance tendencies, with no effect on other automatic fear responses (Krypotos, Arnaudova, Efting, Kindt, & Beckers, 2015). In sum, research so far does not convincingly indicate that approach training would be a useful addition to the treatment of anxiety pathology. Further research needs to elucidate the boundary conditions for its effectiveness.

Another possible pathway for reducing the increased avoidance tendencies in individuals with anxiety pathology is through the use of pharmaceuticals (Wiers & Stacy, 2006). This line of research is very new and to our knowledge and so far only one study has looked at the effect of drugs on avoidance tendencies. It was found that a single dosage of testosterone diminished avoidance tendencies towards threatening stimuli in female volunteers (Enter, Spinhoven, & Roelofs, 2014). There is a wide variety of drugs being used in the treatment of anxiety (Fitzgerald, Seemann, & Maren, 2014) and further research might help to clarify which of these are most effective for the reduction of automatic avoidance tendencies in anxiety pathology.

In our lab we have repeatedly demonstrated that the administration of the beta-blocker propranolol before or after fear memory retrieval can reduce later threat responding on the implicit level without affecting propositional knowledge of threat (e.g., Kindt & Soeter, 2011; Kindt, Soeter, & Vervliet, 2009; Sevenster, Beckers, & Kindt, 2012, 2013; Sevenster et al., 2014; Soeter & Kindt, 2010, 2012, 2015). One recent study has even showed that the fear-reducing effects of propranolol within a memory reconsolidation based intervention can also be found for the avoidance behavior of spider fearful individuals (Soeter & Kindt, 2015).
It is possible that this treatment also has a direct effect on the reflexive avoidance tendencies and can reduce avoidance behavior without engaging the reflective system.

### 7.4.2 Personalized protocols for excessive avoidance

Currently, personalized medicine is gaining momentum in the treatment of medical illness (e.g., for rheumatoid arthritis; Tak, 2012). The underlying idea is that through identifying specific genes and processes that contribute to the development of certain diseases and by improving the specificity of diagnosis, pharmaceutical treatment or medical interventions can be tailored to the individual (Hamburg & Collins, 2010). Large institutional bodies such as the National Institute of Health (NIH) and the Food and Drug Administration (FDA) in the United States are devoting major research efforts to supporting the development and application of personalized medicine (Hamburg & Collins, 2010).

The idea of personalized medicine is also finding its way in psychiatry, with some recent studies laying the foundations for its application to disorders such as depression, bipolar disorder and schizophrenia (Ozomaro et al., 2013). Nevertheless, in mental health, it might be extremely challenging to match individuals to specific treatments. For example, in depression, response to treatment, both pharmaceutical and therapeutic, seems to be highly variable and unpredictable (Simon & Perlis, 2010). In anxiety, it also remains challenging to identify what factors play a role in determining the individual response to treatment (Schneider et al., 2015). Research in clinical psychology has focused so far on identifying either non-specific predictors (e.g., demographics) of treatment success, regardless of treatment type, or moderating factors, which could clarify what treatment best fits a particular patient (Wolitzky-Taylor, Arch, Rosenfield, & Craske, 2012).

In studies of moderation, usually outcomes from traditional therapies are compared and individual differences, measured by self-report questionnaires, are tested as moderating factors (Wolitzky-Taylor et al., 2012). It has been previously proposed that behavior elicited by specific emotions is more stable across cultures and individuals than the self-report of emotional experiences (Mosquera et al., 2000; Soto et al., 2005). Thus, it might be useful to take a more behavioral approach and examine the specific pathways (as proposed to TeARS) through which avoidance has become maladaptive for particular individuals, rather than personality factors as moderator for treatment success. Further, we have shown that individual characteristics do not necessarily predict all anxiety responses in a similar way and avoidance behavior specifically (see Section 7.1.3 and 7.1.4). Consequently, certain personality characteristics might not reliably predict treatment outcome across different studies.

In this doctoral dissertation, we have proposed that it is possible to identify specific pathways through which adaptive avoidance has become maladaptive for particular individuals (see Chapter 2). Thus, after evaluating a patient’s avoidance behavior from the perspective of the TeARS framework, it might be possible to identify at which points of the response selection process pathological anxiety is interfering. Using such a functional behavioristic case formulation, it might be possible that specific therapeutic strategies within a treatment protocol can be selected to address specifically the most prominent pathological processes first.
This might make the treatment more personalized and easier for the patient to follow. Such approach might also achieve faster and more durable therapeutic change for patients.

### 7.5 Conclusion

This doctoral dissertation presented a novel iterative evidence-based framework for avoidance response selection and execution (the TeARS model) based on disjointed literature from a variety of fields (e.g., psychology, ethology). The TeARS framework allows for the prediction and examination of both adaptive and maladaptive avoidance behavior and its specific form. Empirical investigations validated a number of its novel ideas. Through the lens of this framework, the common treatment protocol of exposure was re-examined and suggestions for its improvement were proposed.

Avoidance response selection has been until recently largely overlooked in research on threat processing and anxiety. It is our hope that the work presented here will instigate more attention to the process and spur further research.