EMHFC

10th European Meeting on Human Fear Conditioning
Wales, 16-18 Apr 2018

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Welcome

Shmae, Croeso i Gymru!

Welcome to the 10th anniversary meeting of the European Meeting on Human Fear Conditioning (EMHFC). It is our pleasure to welcome you all to Wales and the splendid surrounds of Hensol Castle and the Vale Resort. We are delighted to be joined at this anniversary meeting by our keynote speakers, Joe LeDoux and Joey Dunsmoor.

The conference location for the 10th EMHFC is Hensol Castle, which was first mentioned in the year 1419 and exists in its current form since 1735. From 1931 until 2003, the castle was used as the Hensol Hospital for people with learning disabilities before becoming a renowned venue for weddings and conferences.

We have compiled a conference programme celebrating the range of excellent work conducted on human fear conditioning from labs all across Europe. This year, 95 delegates have registered for the conference and will present 25 talks and 47 posters. Delegates will travel to Wales from Australia, Austria, Belgium, Germany, Ireland, Israel, the Netherlands, Spain, Sweden, and the United Kingdom.

On behalf of the organising team, we hope you enjoy the 10th anniversary meeting,
Simon Dymond & Lars Marstaller

Organising team: Simon Dymond, Lars Marstaller, Daniel Zuj, Weike Xia

Program Overview

Day 1 - 16th April 2018

from 11:30	Lunch & Arrival at Hensol Castle
13:00	Principal Investigators & Early Career Researchers Meetings
14:00	Welcome
14:15	Session 1: Fear Learning & Extinction
15:30	Coffee Break
16:00	Keynote 1: Joseph LeDoux - *Have we misunderstood fear?*
17:30	Shuttle to Hotel
18:00	Check-in
19:00	Dinner
20:30	Posters & Drinks

Day 2 - 17th April 2018

until 09:00	Breakfast
09:00	Shuttle to Hensol castle
09:30	Session 2: Avoidance
10:45	Coffee Break
11:15	Session 3: Generalization
12:45	Lunch
13:45	Session 4: Clinical & Individual Differences
15:00	Coffee Break
15:30	Keynote 2: Joseph Dunsmoor - *Multiple systems for generalization of learning and memory in human Pavlovian conditioning*
17:00	Shuttle to Hotel
17:30	Break
19:00	Dinner
20:30	Posters & Drinks

Day 3 - 18th April 2018

until 09:00	Breakfast & Check-out
09:00	Shuttle to Hensol Castle (with luggage)
09:30	Session 5: Applications & Extensions
10:30	Coffee Break
11:00	Plenary Discussion
12:00	Poster Prizes & Farewell
12:45	Lunch packets
13:00	Workshops
15:00	End of Conference

Workshops

This year, participants are offered two methods workshops following the main conference. Both workshops will take place on Apr 18th, 13:00 - 15:00 at Hensol Castle.

1 - Hands-on introduction to Representational Similarity Analysis

Anna Gerlicher (Johannes Gutenberg University Medical Center Mainz)

In the first - theoretical - part of this workshop, I will give an overview of the basic concepts in RSA. The second part will consist of bringing a practical approach. Participants will work on real data and go through a complete analysis pipeline.

2 - Introduction to Bayesian analysis

Angelos Krypotos (Utrecht University), Manuel Kuhn (University Medical Center Hamburg Eppendorf)

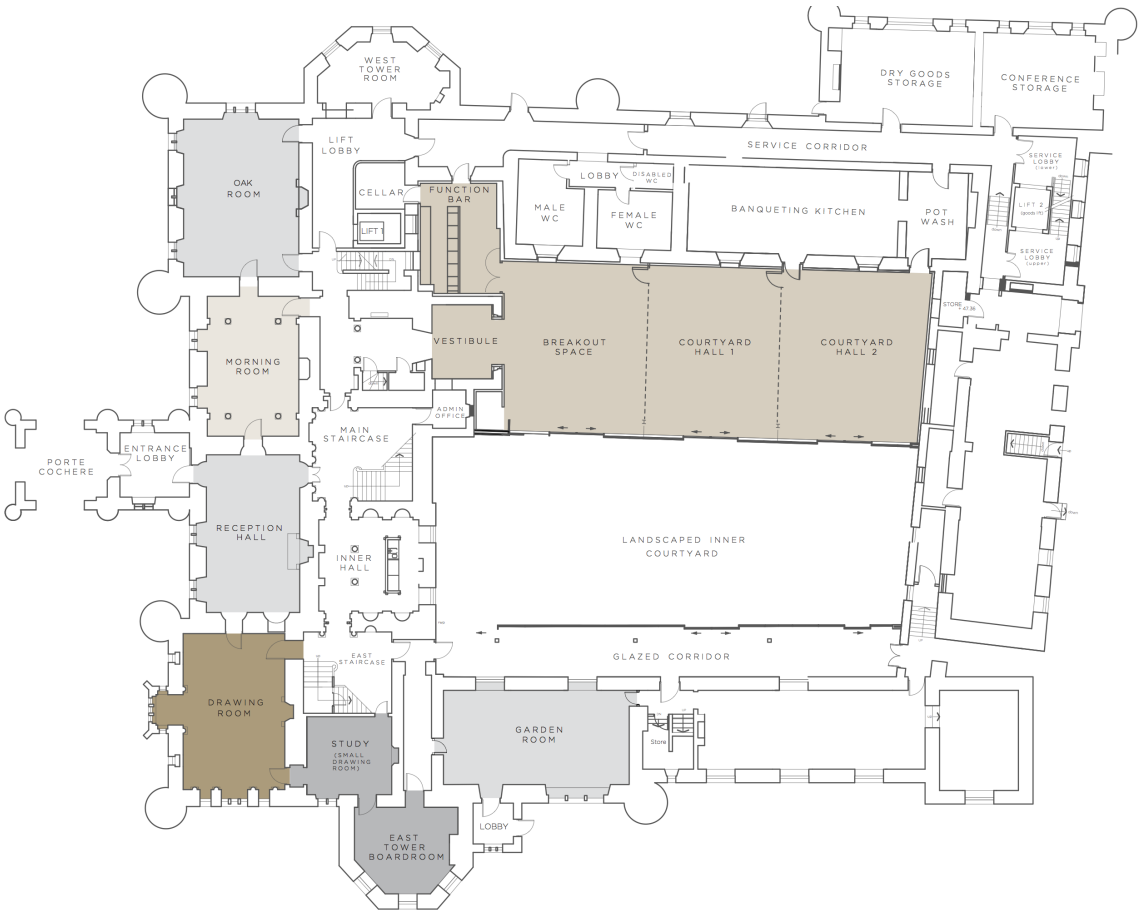
This workshop will introduce participants to Bayesian statistics for the fear conditioning field, and demonstrate how to perform Bayesian hypothesis testing using click-based software (i.e., JASP).

Information

Presentations & Posters

All talks and keynotes will take place at the Courtyard Hall at Hensol castle. Oral presentations are 12 minutes each with a group Q&A at the end of each session. A projector and a presentation computer (Mac) running Microsoft Powerpoint as well as a laser pointer will be available on the day. Please make sure your presentations are in the 4:3 format.

Poster sessions will be at the Castle Suite/Bar (1st floor of the Vale Resort Hotel marked blue in the figure below). Poster boards are 2m wide and 1m tall. Adhesives to hang posters will be available. Poster numbers are marked in the poster abstracts section.



Hensol Castle

Arrival & Departure

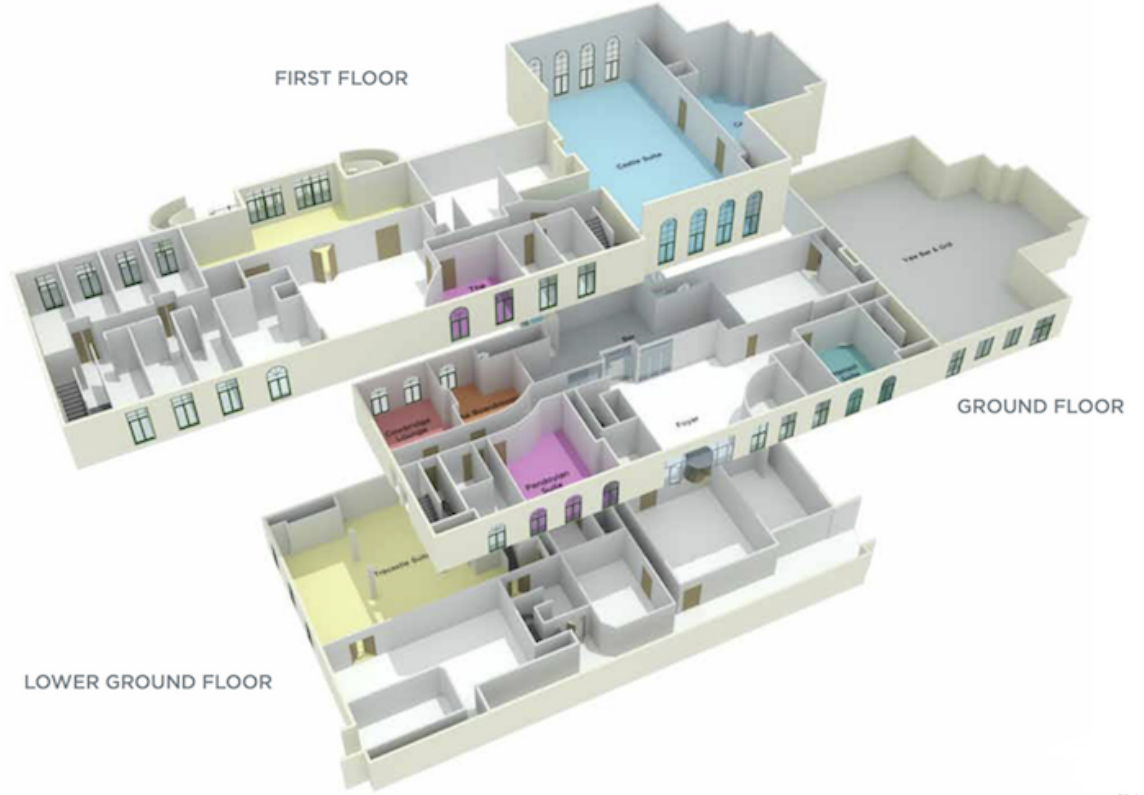
Arrival on Monday and departure on Wednesday are both from Hensol castle. On Wednesday, please make sure to bring your luggage to the castle after checking out from the hotel!

We will pre-order taxis to transport people from Hensol castle to Cardiff station or Cardiff airport.

Food & Shuttle between Hotel & Castle

Breakfast and dinner will be served at the Vale Bar and Grill (ground floor of the Vale Resort Hotel). During coffee breaks, cakes and fresh fruit will be available.

Two shuttle buses will transfer delegates in the mornings and afternoons between the hotel and the castle. It is possible to walk and takes 10-15 minutes.



Vale Resort Hotel

Keynote Speakers

Joseph E. LeDoux

Joseph LeDoux is the Henry and Lucy Moses Professor of Science at NYU in the Center for Neural Science, and he directs the Emotional Brain Institute of NYU and the Nathan Kline Institute. He also a Professor of Psychiatry and Child and Adolescent Psychiatry at NYU Langone Medical School. His work is focused on the brain mechanisms of memory and emotion and he is the author of The Emotional Brain, Synaptic Self, and Anxious. LeDoux has received a number of awards, including William James Award from the Association for Psychological Science, the Karl Spencer Lashley Award from the American Philosophical Society, the Fyssen International Prize in Cognitive Science, Jean Louis Signoret Prize of the IPSEN Foundation, the Santiago Grisolia Prize, the American Psychological Association Distinguished Scientific Contributions Award, and the American Psychological Association Donald O. Hebb Award. His book *Anxious* received the 2016 William James Book Award from the American Psychological Association. LeDoux is a Fellow of the American Academy of Arts and Sciences, the New York Academy of Sciences, and the American Association for the Advancement of Science, and a member of the National Academy of Sciences. He is also the lead singer and songwriter in the rock band, *The Amygdaloids* and performs with Colin Dempsey as the acoustic duo *So We Are*.

Joseph Dunsmoor

Dr. Joseph Dunsmoor received his PhD in Psychology & Neuroscience from Duke University in 2012 and completed a postdoc at New York University in 2017. Research in Dr. Dunsmoor's lab centers on how emotion and cognition interact to determine how we learn about and remember important events. This research integrates a number of psychological and neuroscience disciplines, including Pavlovian conditioning, categorization, decision making, and episodic memory and incorporates fMRI, psychophysiology, and immersive virtual reality tools. Some research questions include (1) on what basis do we generalize from emotional experiences; (2) how do emotional experiences shape our memory; and (3) how do we overcome (or regulate) the unwanted psychological and physiological effects of negative experiences? Dr. Dunsmoor's lab seeks to bridge research from healthy adults to patients characterized by the inability to regulate fear and anxiety using translational cognitive neuroscience approaches.

Abstracts

Keynotes

Joseph E. LeDoux: Have we misunderstood fear?
Center for Neural Science, NYU, Emotional Brain Institute, NYU and Nathan Kline Institute

Fear is a fundamental part of human life, and plays a central role in psychiatric disorders. One of the main ways that fear has been related to brain mechanisms is through studies of defensive behavior in animals. This research has been very successful in revealing the brain's so-called "fear" system. The field has now matured to the point where a sharper conceptualization of what is being studied could be very useful as we go forward. Terms like "fear system" blur the distinction between processes that give rise to conscious feelings of fear and non-conscious processes that control defense responses elicited by threats. While mechanisms that detect and respond to threats contribute indirectly to conscious feelings of fear, they are not the same as those that give rise to conscious fear. This is an important distinction since symptoms based on conscious and non-conscious processes may be vulnerable to different predisposing factors and may also be treatable with different therapeutic approaches in people who suffer from uncontrolled fear or anxiety. A conception of aversive conditioning in terms of circuits that detect and respond to threats non-consciously, but that also indirectly contribute to conscious fear, is proposed as way forward. Key to this conception is a new set of terms that avoid the implication that the circuits are responsible for conscious feelings of fear. Thus, circuits that detect and respond to threats are conceived as defensive survival circuits that work non-consciously in humans and other animals. Activation of defensive survival circuits results in the expression of defensive responses in the body, and a host of changes in the brain. Within the brain, the collective consequence of activating a defensive survival circuit is the establishment of a defensive motivational state. This global state organizes future brain functions, including actions, but also functions non-consciously. In species with the cognitive where-with-all to be able to monitor brain activities in relation to the self, a conscious feeling of fear can arise from the coalescence in awareness of (a) sensory information about an external stimulus; (b) long-term semantic, schematic, and episodic memories that identify the present stimulus as a threat to one?s self, and (c) cognitive monitoring of defensive motivational state information within the brain and in external behavior. The nervous systems of many organisms create such global motivational states that are part of the quest to survive danger. Only organisms that can be conscious of their own brain's activities in relation to a sense of self can consciously experience fear when a defensive motivational state is helping it to stay alive.

Joseph Dunsmoor: Multiple systems for generalization of learning and memory in human Pavlovian conditioning.
Department of Psychiatry, Dell Medical School, University of Texas Austin

Advances in Pavlovian conditioning research in humans can be sourced almost entirely to mechanistic insights made in animal models. Yet there are cognitive processes that humans are especially adept at deploying in the course of learning for which precise animal models are less satisfactory. For instance, humans automatically derive seemingly abstract conceptual regularities from our experience that guides memory formation and future behavior. In this talk, I will discuss research on how an evolutionarily conserved system of associative learning integrates with higher order conceptual processes in humans to determine what we learn and remember from emotional experiences.

Session 1: Fear Learning & Extinction

16 Apr, 14:15 - 15:30, Chair: Tina Lonsdorf

Jan Haaker[1,2]**, Lorenzo Diaz-Mataix**[3,4]**, Sara A. Stark**[3]**, Lea Kern**[2]**, Joseph E. LeDoux**[3,4]**, Andreas Olsson**[2]: Observation of others reinstates threat memories in rats and humans

[1]*University Medical Center Hamburg-Eppendorf, Germany* | [2]*Karolinska Institutet, Sweden* | [3]*New York University, USA* | [4]*Nathan Kline Institute for Psychiatric Research, USA*

Threat memories are persistent and prone to reinstatement induced by directly experienced aversive events even after successful extinction. Yet, it is unclear if social information can reinstate threat memories formed by direct experiences. We addressed this by investigating threat memories shaped by Pavlovian Threat conditioning in rats (Exp 1) and humans (Exp 2 and 3), in which individuals learned to associate a conditioned stimulus (CS) with a directly experienced unconditioned stimulus (US). After extinction, reinstatement of threat memories was tested following merely observed responses of a conspecific to the US. Post-reinstatement threat memory in rats returned (Exp 1, measured as freezing behavior) similar to reinstatement after direct experiences of the US. Translating these results to humans (Exp 2), we found that observing of an unrelated conspecific presented with the US reinstated conditioned threat responses (measured as SCRs). Reinstatement was furthermore specific to the context in which the other?s experience of the US was observed (Exp 3). Our findings demonstrate that threat memories, shaped by direct experiences, can be recovered by social information.

Björn Lindström[1]**, Armita Golkar, Andreas Olsson, Pyungwon Kang, Philippe N. Tobler**: Social fear learning biases decision-making via neural and computational Pavlovian mechanisms

[1]*University of Zürich, Switzerland*

Social fear learning is a common cause of human fears and phobias. To date, studies have almost exclusively examined socially acquired fear responses that are passively expressed. Yet, in real-life, social observations are likely to influence one's decisions. Building on our previous work, we investigated the neural mechanisms underpinning the influence of social fear learning on decision-making using fMRI (n = 44). Participants underwent social fear learning (observing another individual receiving shocks to one, but not the other, cue), and decision-making (involving the same cues, and probabilistic shocks). Replicating our previous work, social fear learning resulted in maladaptive decision-making if the shock contingencies had changed between the two phases. Activity in the perigenual anterior cingulate cortex, during both observational fear learning and decision-making, predicted the maladaptive social bias. Computational modeling indicated that this bias resulted from the competition between two valuation system. Our results shed light on the neural and computational mechanisms underlying the influence others' expressions of fear can have on one's own behavior.

Laura Leuchs[1]**, Max Schneider**[1]**, Victor I. Spoormaker**[1]: A comparison of pupillometry, skin conductance and startle electromyography during fear learning

[1]*Max Planck Institute of Psychiatry Munich, Germany*

Skin conductance responses (SCR), the startle reflex and pupil responses are used interchangeably as outcome measures of human fear learning. However, there are indications that these measures display different temporal dynamics throughout fear learning and possibly reflect diverging cognitive-affective processes. We recorded SCR, pupil diameter and startle responses during fear acquisition, extinction and extinction recall in 47 healthy subjects on two consecutive days. The three measures differed most strongly during fear acquisition, with SCR and startle responses displaying habituation, whereas pupil responses most closely followed US expectancy. Overall response magnitude and habituation slopes were individually stable across test days for each of the three measures, however, trial-wise response magnitudes correlated only weakly among measures. We conclude that slow pupil dilations most likely reflect cognitive processes such as US expectancy, whereas startle responses and SCR at stimulus onset display properties of orienting responses. Our findings suggest, that these three outcome measures reflect substantially different cognitive-affective processes during fear learning.

Anna Gerlicher[1]**, Oliver Tüscher**[1]**, Raffael Kalisch**[1]: Making extinction last: dopamine-dependent spontaneous prefrontal activity after learning explains long-term benefit of fear extinction

[1]*Johannes Gutenberg University Medical Center Mainz, Germany*

Extinction learning protects against the development of pathological fear. However, the success of extinction learning does not predict its long-term expression, pointing to a critical role for memory consolidation processes in determining the long-term reduction of fear. We hypothesized that spontaneous reactivations of neural activity patterns established during extinction in the ventromedial prefrontal cortex (vmPFC) contribute to extinction consolidation and depend on dopamine levels, as has been shown for other types of memories. We tested these hypotheses in N=40 healthy, male adults in a functional magnetic resonance imaging experiment, with fear conditioning on day 1, extinction followed by the administration of placebo or 150/37,5 mg levodopa/benserazide on day 2, and test on day 3. We show that neural activity patterns evoked in the vmPFC upon unexpected US omission at CS+ offset in the beginning of extinction spontaneously reappear in post-extinction rest. The number of spontaneous reactivations predicts conditioned fear and vmPFC recruitment at test. Enhancing dopaminergic activity during rest amplifies vmPFC reactivations and correspondingly reduces the return of fear.

Migual Fullana[1]**, Tina Lonsdorf**[2]: What is wrong with fear extinction?

[1]*Universitat Autonoma Barcelona, Spain* | [2]*University Medical Center Hamburg-Eppendorf, Germany*

"Fear extinction" has gained momentum. In the past 10-15 years, basic and applied researchers have become extremely interested in fear extinction as a process, as a result, or as a technique. However, despite this great deal of research, there are many unresolved issues. These involve conceptual, methodological, and applied (e.g. clinical) aspects. In the presentation, I will focus on methodological and applied aspects and try to engage the audience in a discussion on the following topics: are our measures of fear extinction reliable and/or valid?; what can we predict with fear extinction? I will revisit some old data from our lab (Torrents-Rodas et al., 2015, Psychophysiology) on reliability and validity of fear learning measures as well as present some data from a recent treatment analog study (Forcadell et al., 2018, Int. J. Psychophysiology) to illustrate these issues. The goal of the presentation is to engage the attendants on a fruitful discussion on "what is wrong" with fear extinction and "how to fix it".

Session 2: Avoidance & Extinction

17 Apr, 9:30 - 10:45, Chair: Frank Wilhelm

Bram Vervliet[1]: Reward Processing in Avoidance

[1]*Katholieke Universiteit Leuven, Belgium*

Avoidance refers to any behavior that prevents or minimizes confrontations with aversive events. This is clearly adaptive, but excessive avoidance behaviors in the absence of real threat can be disabling and may contribute to pathological forms of anxiety. However, the learning principles underlying adaptive and maladaptive avoidance are not fully understood. One approach holds that avoidance is reinforced by the successful omission of the aversive event, which may be captured by the subjective feeling of relief and the theoretical signal of reward prediction error. Although relief and safety have long been implicated as rewarding consequences in behavioral theories of avoidance, they have received little empirical scrutiny. I will review the available behavioral and neural evidence that support a role for reward processing in avoidance, and I will present new data on subjective reports of relief pleasantness in humans as an index of reward processing. I will develop the tentative argument that maladaptive avoidance is best understood as a consequence of dysregulated reward processing, rather than dysregulated fear.

Weike Xia[1], **Keith Lloyd**[1], **Bram Vervliet**[2], **Simon Dymond**[1,3]: Partial reinforcement and extinction of avoidance

[1]*Swansea University, UK* | [2]*Katholieke Universiteit Leuven, Belgium* | [3]*Reykjavik University, Iceland*

Considerable research success has been made in augmenting exposure therapy for anxiety, yet little is known about factors influencing the acquisition and extinction of active avoidance. We investigated the clinical relevance of reinforcement rate, or the effectiveness of avoidance responding at preventing shock, on subsequent resistance to extinction. Healthy participants were exposed to different reinforcement rates where avoidance cancelled scheduled shock on 100%, 75%, 50%, 25% or 0% of trials, respectively. During extinction, all shocks were withheld. Higher reinforcement rate groups made significantly more avoidance responses than lower reinforcement groups in both acquisition and extinction, and shock expectancy decreased proportionally with reinforcement rate. Follow-up studies investigated response prevention during extinction and a form of operant extinction where shock was non-eliminable. Findings from all studies will be presented and discussed in the light of different procedures for the extinction of avoidance.

Miriam J. J. Lommen[1]: Individual differences in fear and avoidance learning as predictors of posttraumatic stress disorder in a prospective study among fire fighters

[1]*University of Groningen, The Netherlands*

Although many aspects of fear conditioning and more recently avoidance learning have been associated with posttraumatic stress disorder (PTSD), evidence for causal relationships are lacking due to the scarcity of prospective studies including a pre-trauma assessment. The aim of this study is to replicate the few existing prospective findings and provide first evidence for a potential causal relationship for factors that have not been prospectively tested before. In this study, 530 fire fighters were tested during the summer of 2017 who will be followed for 5 years with assessments every six months. Three conditioning tasks were included at baseline assessment as potential pre-trauma predictors of PTSD. First, a fear conditioning task tested delayed fear extinction learning (Guthrie & Bryant, 2006; Lommen *et al.*, 2013). Second, a fear generalization task tested the level of fear generalization (Lenaert *et al.*, 2014). Third, an avoidance learning task tested the acquisition and extinction of avoidance (Vervliet, Lange & Milad, 2017). The study design and preliminary results of the first post-assessment that is currently taking place will be presented and discussed at the conference.

Andre Pittig[1]**, Stefan Scherbaum**[1]: Temporal dynamics of threat avoidance in approach-avoidance conflicts in anxious individuals

[1]*Technical University of Dresden, Germany*

The mechanisms of elevated avoidance in anxious individuals are poorly understood. Moreover, most research focused on the final behavior (avoid vs. not), neglecting the dynamic process of action selection. This study investigated the temporal dynamics of threat and reward information during approach-avoidance behavior in high and low trait anxious individuals (N=74). In a modified discounting task, a conflict option was linked to high rewards and a varying probability of an aversive US. A safe option was linked to a low reward and US absence. Mouse movements were recorded as temporal measure to test initial action tendencies and the temporal impact of threat and reward. Results indicated that anxious individuals more frequently avoided the conflict option. Elevated avoidance was not linked to a stronger action tendency towards safety. Temporal impact of threat did not differ between anxious and non-anxious individuals. However, rewards showed less impact on behaviour in anxious individuals during late action selection. These results suggest that high levels of trait anxiety are associated with a deficit in inhibiting avoidance tendencies in the light of competing positive outcomes

Andreas Burger[1]**, Ilse Van Diest**[2]: The effects of transcutaneous vagus nerve stimulation on fear extinction: an overview of results in humans

[1]*Leiden University, The Netherlands* | [2]*Katholieke Universiteit Leuven, Belgium*

Stimulation of the vagus nerve has been proposed to facilitate learning. The proposed mechanism is that vagus nerve stimulation increases activity in the locus coeruleus-noradrenergic system. In a series of four studies (total sample size = 214), we assessed whether non-invasive transcutaneous VNS (tVNS) facilitates the extinction of fear in healthy humans, compared to sham stimulation. TVNS did not affect physiological indices of fear extinction in any of the studies. In contrast, declarative US expectancy ratings decreased more rapidly during the extinction phase in participants who received tVNS compared to sham stimulation. No effects of tVNS on the consolidation of extinction memories were found 24h after extinction learning. These results provide preliminary evidence for the role of the vagus nerve in declarative learning. The results also suggest that tVNS could potentially augment extinction-based treatments. However, research on tVNS is still in its infancy, and additional studies are needed to test if - and with which stimulation parameters - clinically relevant effects of tVNS can be obtained.

Session 3: Generalisation

17 Apr, 11:15 - 12:45, Chair: Yannick Boddez

Marta Andreatta[1], **Paul Pauli**[1]: Generalization processes of appetitive conditioned responses

[1]*University of Würzburg, Germany*

When associated to an appetitive unconditioned stimulus (US), a stimulus (conditioned stimulus, CS) acquires positive properties and elicits appetitive conditioned responses (CR). This associative learning has been proposed as model for substance-related disorders. It remains unclear, whether appetitive CR can be generalized to other stimuli. Thirty-four participants underwent an appetitive conditioning during which a circle (CS+) was associated with an appetitive US (chocolate or salty brezel), while a circle with a different diameter (CS-) was never associated to the US. During generalization, the two CSs were presented again as well as four additional circles (generalization stimuli, GS) with gradual diameters from CS- to CS+. We found successful appetitive conditioning as appetitive ratings (positive valence, higher contingency) and physiological responses (startle attenuation and larger skin conductance responses) to CS+ vs. CS- indicate. A generalization gradient was visible in ratings as well as startle responses as they become gradually more positive from CS- to CS+. In sum, appetitive CRs show parallel generalization processes as aversive CRs.

Jonas Zaman[1], **Dieter Struyf**[1], **Tom Beckers**[1], **Bram Vervliet**[1]: Behind the gradient: Probing perceptual mechanisms of fear generalization

[1]*Katholieke Universiteit Leuven, Belgium*

Behavior in novel situations is guided by similarities to previous experiences, a phenomenon known as generalization. Despite the widespread influence of generalization on healthy and pathological behavior, insight into the underling mechanisms is lacking. It remains unclear whether generalization reflects a failure to notice situational changes or an active decision to act based on observed similarities. We combined a fear conditioning and generalization procedure with a perceptual decision task in humans and found that fear generalization to novel stimuli is largely due not to a perceived similarity gradient but to a failure to perceive a novel stimulus as different from the initial fear-evoking stimulus. These findings question the tenets of existing models of fear generalization. They demonstrate the potential of a perception-centered approach to better understand (pathological) behavior and its underlying mechanism and are a promising avenue for the development of refined generalization protocols.

Kati Keuper[1], **Thomas Straube**[1], **Markus Junghöfer**[1]: Temporal Dynamics of Ventromedial Prefrontal Cortex Activity during Fear Generalization in Spider Phobics and Healthy Controls - a MEG study

[1] *University of Münster, Germany*

Imaging studies on fear generalization have yielded evidence for increasing activity in the vmPFC to stimuli approximating the safety-signaling CS- with shallower generalization gradients - indexing overgeneralization - in anxiety patients. If fear (over)generalization is rooted in bottom-up hypo-discrimination, neural gradients should emerge at earliest processing stages (<100ms). By contrast, if vmPFC activity reflects top-down mechanisms in form of a "better safe than sorry" strategy, generalization gradients should be evident in later components. In an ongoing parametric MEG-study (N=30 healthy controls, 22 patients with spider phobia), we recorded event-related fields and fear ratings to a continuum of 9 differently tilted Gabor gratings ranging from CS+ to CS-. Estimates of neural activity reveal stable generalization functions in vmPFC regions at early (∼30-150ms) and later processing stages (∼260-350ms). Group differences were found in behavioral and late vmPFC gradients, but not in early components. We tentatively suggest that the vmPFC supports both basic bottom-up stimulus generalization but also individual top-down risk-avoidance.

Sean Boyle[1], **Bryan Roche**[1]: The semantic generalization of fear: Examining the boundary conditions within an experimental setting

[1]*Maynooth University, Ireland*

The spread of an appreciated threat between conditioned cue words to their formally dissimilar synonyms has been previously demonstrated using skin conductance and behavioral avoidance as indices of fear. This experiment sought to examine the boundary conditions of this semantic generalization effect by including antonyms of the CS as well as novel word stimuli. A number of studies have previously shown that laboratory trained arbitrary stimulus antonyms of a conditioned CS for threat do not produce fear and avoidance responses. It was hypothesised, however, that using natural language categories, the antonym of a safety CS may be threatening for some individuals and that this effect may be related to trait characteristics. Results showed that for those participants who showed transfer of conditioned fear and avoidance to synonyms of the CS, fear also transferred to antonyms of the CS and to unrelated novel cues. In contrast, those participants who did not show generalization of fear and avoidance to synonyms of the CS, also failed to show evidence of threat for the CS antonyms and the novel stimuli. Degree of transfer was not predicted by scores on any of the trait measures.

Ann Meulders[1], **Mathijs Franssen**[1], **Johan W.S. Vlaeyen**[1]: The generalization of pain-related avoidance behavior to novel contexts

[1]*Katholieke Universiteit Leuven, Belgium*

Fear-avoidance models posit that pain-related fear and avoidance contribute to the transition from acute to chronic pain. When avoidance behavior serves to reduce/eliminate genuine bodily threat, it is adaptive. Yet, in the absence of actual danger, avoidance behavior may become maladaptive and lead to functional disability. We investigated the spreading of avoidance behavior to novel contexts in a within-subjects design; participants performed a robotic arm reaching task in two contexts: a pain-avoidance context (e.g. black background) and a yoked context (e.g. white background). In the pain-avoidance context, pain could be partly or completely prevented by performing the more effortful (in terms of distance and exerted force) trajectories T2 and T3; in the yoked context, the same number of pain stimuli was delivered irrespective of the chosen trajectories. Next, we tested a series of generalization contexts (e.g. tints of grey backgrounds). We hypothesize that 1) avoidance spreads to novel contexts resembling the original pain-avoidance context but not to those that resemble the yoked context, and 2) a similar generalization gradient exists for pain-related fear and expectancy.

Tomer Shechner[1], **Rivkah Ginat-Frolich**[1], **Zohar Klein**[1]: Reducing fear overgeneralization using a perceptual discrimination training task

[1]*University of Haifa, Israel*

Anxious individuals tend to overgeneralize fear of dangerous stimuli onto neutral stimuli based on perceptual similarity. To reduce fear overgeneralization, we developed a perceptual discrimination training task consisting of pre-designated geometrically shaped pairs, differing in either shape or size. In each trial, a target shape is presented followed by two shapes. Participants are asked to select the shape that differs from the target. In a placebo task, only one shape appears and participants are asked to identify its location on the screen. Two studies will be reviewed. In the first, discrimination training was examined with typically-developing children (n=73). Results indicate lower levels of fear in the training than the placebo group during threat/safety discrimination task. The second study tested discrimination training among spider phobic adults (n=50). The training group was better able to distinguish between spider/flower morphed pictures and exhibited less fear than the placebo group when exposed to a live tarantula. These findings suggest the effectiveness of the perceptual discrimination task in reducing overgeneralization and, subsequently, fear and anxiety.

Session 4: Clinical & Individual Differences

17 Apr, 13:45 - 15:00, Chair: Jan Haaker

Julina Rattel[1], **Melanie Wegerer**[1], **Lisa M. Grünberger**[1], **Stephan Miedl**[1], **Jens Blechert**[1], **Michelle G. Craske**[2], **Frank H. Wilhelm**[1]: Sex Differences in Peri-Traumatic Conditionability Mediate Elevated Intrusions after Analogue Trauma in Women

[1]*University of Salzburg, Austria* | [2]*University of California Los Angeles, USA*

Re-experiencing trauma is common in PTSD, with intrusions being understood as conditioned responses to trauma cues. Women display higher PTSD rates than men. This sex difference may in part be caused by elevated peri-traumatic conditionability in women. Our "conditioned-intrusion paradigm" employs trauma-films as UCS and neutral sounds as CS during differential fear conditioning and assesses analog-intrusions during a memory triggering task and ambulatorily on subsequent days. Bayes mediation analyses revealed that women reported more intrusions and associated distress than men. This relationship was mediated by higher fear conditionability (differential CS+ vs. CS- valence ratings) in women than men, both during acquisition and extinction. Conditionability stayed significant when state anxiety, unconditioned trauma-film responses, and various trait variables were added to the model. The conditionability sex effect was explained by women's increased responding to CS+ but not CS-, suggesting that it was not due to elevated fear generalization. Elevated conditionability in women compared to men is proposed as a prime mechanism explaining sex differences in PTSD.

Thomas Agren[1], **Andreas Frick**[1]: Imaginal extinction - a meaningful way of bringing verbal instructions and mental imagery into fear conditioning?

[1]*Uppsala Universitet, Sweden*

Exposure therapy can be performed using either in vivo exposure, during which the patient is directly exposed to the feared object or events, or imaginal exposure, during which these are revisited internally using mental imagery. Fear extinction is an experimental model for in vivo exposure, but a model for imaginal exposure has hitherto been missing. We have proposed a procedure, called imaginal extinction, which replaces the in vivo exposures of fear extinction with a recording that instructs subjects to produce mental imagery of the CS. No direct instructions are given about CS-UCS contingency. Subjects must discover that their expectations are erroneous, making the procedure dependent on prediction error, unlike instructed extinction, a previous attempt at studying verbal fear reduction. We hope that imaginal extinction will be a clinically meaningful procedure that enables the study of the impact of verbal instructions on emotional memory processes, using existing methodology. This talk will discuss imaginal extinction by exploring skin conductance and fMRI data that compares in vivo and imaginal extinction, and preliminary data from an fMRI-study on imaginal exposure.

Christian Panitz[1], **Erik M. Mueller**[1]: Differential Effects of Fearfulness and Neuroticism/Anxiety in Short-Term and Long-Term Fear Conditioning

[1]*University of Marburg, Germany*

Neuroticism/anxiety (N/Anx) is one of the most commonly studied personality traits in fear conditioning research. There is, however, mixed evidence regarding the robustness of its associations with fear responses and its relevance for different learning phases (i.e., acquisition, extinction, and recall). Meanwhile, the theoretically highly relevant trait fearfulness has received little attention in fear conditioning research. Here, N = 87 male participants underwent differential fear acquisition and extinction on one day as well as a recall test one day later. Subjective ratings and fear bradycardia were measured during all phases. N/Anx and fearfulness were assessed with multiple questionnaires. As hypothesized, higher levels of fearfulness - but not N/Anx - predicted stronger CS discrimination in ratings and fear bradycardia during fear acquisition. Moreover, exploratory analyses showed that high N/Anx levels predicted decreased Day-1-Day-2 stability of extinguished fear bradycardia. The results suggest fearfulness as a better predictor of initial fear acquisition than N/Anx. In contrast, N/Anx might be primarily associated with the long-term stability of extinguished fear.

Joke Baas[1], **Febe van der Flier**[1], **Nadia van Leen**[1], **Puck Duits**[2]: Individual differences in fear conditioning: A data driven trajectory approach

[1]*Utrecht University, The Netherlands* | [2]*Altrecht Academic Anxiety Center Utrecht, The Netherlands*

Studies on individual differences in anxiety mostly focus on the comparison of predefined groups or correlation with trait factors. A different approach is to use data-driven analyses to form groups with distinct profiles. We aimed to further validate the different trajectories in conditioning and extinction observed in a previous study in anxiety patients. In this study, a short fear conditioning task with subjective fear and expectancy ratings was performed by healthy subjects (N=340). As in our previous study, the task included uninstructed as well as instructed acquisition and extinction phases with faces as CSs and a loud scream as US. Data were analysed with latent class growth modelling. Return of fear and intrusions were assessed at one and six weeks follow-up. Latent trajectories largely replicated earlier findings. Poor extinction of subjective fear to the CS+ predicted intrusions at one but not six weeks follow-up. STAI trait was higher in individuals who show patterns associated with anxiety disorders (poor extinction, generalisation). Next step is to test predictive validity with respect to exposure treatment outcome in patients with anxiety disorders.

Thalia Eley[1], **Kirstin L Purves**[1], **Thomas McGregor**[1], **Elena Constantinou**[1], **Tom Barry**[2], **Kathryn J. Lester**[1], **Michelle Craske**[3]: The Fear Learning and Anxiety Response (FLARe) Study: Developing a Fear Conditioning App to Examine Genetic Influences on Fear Learning and Extinction

[1]*King's College London, UK* | [2]*Hong Kong University, China* | [3]*University of California Los Angeles, USA*

Despite considerable heritability and being a primary cause of lifelong disability, little is known about the molecular basis of anxiety. However, experimental psychology has developed exceptionally robust paradigms that model in both animals and humans how anxiety (fear) is developed (or learned) and how it is treated (or extinguished). No study has attempted to combine modern genetic approaches with the use of these experimental paradigms at scale, with sufficient power to allow transformative science. We have developed a mobile phone App which reliably delivers a standard fear conditioning paradigm. To date we have piloted, validated and undertaken test retest analyses on data produced from the App, and results from these studies will be shared along with our plans for establishing the genetic basis of fear learning and extinction. We have also undertaken the largest genome-wide analysis of anxiety to date, and have created a polygenic score reflecting genetic risk for anxiety. Using this App we will conduct the largest genetic study of an experimental psychology paradigm, and will test the extent to which fear conditioning data reflects genetic risk for anxiety.

Session 5: Applications & Extensions

18 Apr, 9:30 - 10:15, Chair: Miriam Lommen

Anke Lemmens[1], **Pauline Dibbets**[1], **Marisol Voncken**[1]: Turning negative memories around: contingency versus devaluation techniques

[1]*Maastricht University, The Netherlands*

It is assumed that fear responses can be altered by changing the contingency between a conditioned stimulus (CS) and an unconditioned stimulus (US), or by devaluing the mental representation of the US. The aim of the present study was to compare the efficacy of contingency- and devaluation-based intervention techniques on the diminishment in - and return of fear. We hypothesized that extinction (EXT, contingency-based) would outperform devaluation-based techniques (imagery rescripting, ImRs; eye movement desensitization and reprocessing, EMDR) regarding contingency measures, but that devaluation-based techniques would be most effective in reducing the mental US representation and would result in less reinstatement of US averseness. Healthy participants received a fear conditioning paradigm followed by either EXT, ImRs, or EMDR. EXT was most successful in diminishing US expectancies and skin conductance responses (SCRs), but all interventions were equally successful in reducing the averseness of the mental US representation. After reinstatement EXT showed lowest expectancies and SCRs; no differences were observed between conditions concerning the mental US representation.

Gaëtan Mertens[1], **Arne Leer**[1], **Angelos-Miltiadis Krypotos**[1], **Elze Landkroon**[1], **Dieuwke Sevenster**[1], **Iris M. Engelhard**[1]: The role of memory representations and mental imagery in fear conditioning

[1]*Utrecht University, The Netherlands*

Research on fear conditioning is often focused on the relationship between the conditioned stimulus (CS) and the unconditioned stimulus (US). Nevertheless, fear reactions to the CS are not only a function of the expectation of the US, but also of the mental representation of the US (*e.g.*, its intensity, averseness, controllability; Davey, 1992). Though some studies have focused on manipulating the US representation in fear conditioning, empirical research is relatively scarce and the used methodology is quite diverse (*e.g.*, habituation, deflation, revaluation). In this talk, I will focus on one specific method for changing US memory representations, namely mental imagery. Specifically, I will present ongoing projects of our lab to investigate the effects of mental imagery on the acquisition, reduction, and generalization of conditioned fear. I will present preliminary findings, as well as the conceptual and methodological challenges we have encountered.

Diana S. Ferreira de Sá[1], **Danja Michael**[1], **Sonja Römer**[1]: Effects of intranasal insulin as adjuvant on fear extinction in healthy humans: a randomized, double-blind, placebo-controlled experimental study

[1]*Saarland University, Germany*

Exposure therapy is by far the most effective method of treating anxiety disorders. However, many of the patients show impairments in the unlearning of fear, which can hinder therapy and contribute to relapse. There has been a growing interest on the potential of cognitive enhancers as adjuvants to fear extinction. Central insulin is known not only to play a critical role in stress processes, but also to act as a memory enhancer. Thus, we aimed to study the effect of intranasal insulin (IN) application on fear extinction in 121 healthy participants (63 females) using a differential fear conditioning procedure with face pictures as conditioned stimuli (CS) and electrical shocks as unconditioned stimuli (UCS), divided in 3 phases: acquisition (day 1), extinction (day 2), reinstatement (day 3). A single dose of IN (160 IU) or placebo was applied before fear extinction. In the extinction phase, startle potentiation to the CS+ was significantly decreased by IN. Furthermore, women in the IN group also showed a significant decrease of SCR to the CS+ in early extinction. Our results show first evidence that intranasal insulin might be a promising adjuvant to extinction-based therapies.

Daniel Zuj[1], **Matthew A. Palmer**[2], **Kim L. Felmingham**[3]: Sleep disturbances and sleep latency moderate fear reinstatement in PTSD

[1]*Swansea University, UK* | [2]*University of Tasmania, Australia* | [3]*University of Melbourne, Australia*

Fear reinstatement refers to the return of fear following unsignaled encounters with an aversive stimulus, and in a clinical setting can be understood as the return of fear-related symptoms following spontaneous panic attacks. Poor sleep quality is an important symptom of Posttraumatic Stress Disorder, and is shown to impair the learning of conditioned fear contingencies. Here, participants with PTSD, trauma-exposed controls, and non-trauma-exposed controls underwent a standardized fear conditioning, extinction, and reinstatement paradigm, and reported subjective sleep quality. We found that greater PTSD symptom severity was associated with increased reinstatement of fear and greater sleep disturbances, and that greater PTSD symptoms were also significantly associated with increased fear reinstatement and longer sleep latency. These results suggest that subjective sleep quality, in particular disturbances to sleep and the amount of time taken to achieve sleep, are important boundary conditions of the potential for greater fear return in PTSD, and may present as risk factors for symptom relapse in clinical settings.

Poster Session 1: Fear learning, extinction, and return of fear

[16th Apr, 20:30 - 22:00]

1. **Ann-Kathrin Zenses**[1], **Tom Beckers**[1,2], **Yannick Boddez**[2,3]: A novel fear-conditioning procedure to model intrusive thinking

   [1]*Katholieke Universiteit Leuven, Belgium* | [2] *University of Amsterdam, The Netherlands* | [3] *University of Groningen, The Netherlands*

   Intrusive thoughts are characteristic of anxiety-related disorders. However, they are typically not taken into consideration as an outcome measure in fear-conditioning paradigms. With the ultimate aim of reducing intrusive thoughts, we developed a novel fear-conditioning procedure in which we included 'thinking of the unconditioned stimulus (US)' as an outcome variable. Based on theoretical considerations, we expected extinction to be less effective in reducing such thinking of the US than in reducing more traditional outcome variables (*e.g.*, US expectancies). We therefore tested in an additional condition whether an association splitting intervention (*i.e.*, the CS was followed by a compound of the original US and two novel USs) would be successful in reducing thinking of the original US. As expected, extinction left thinking of the US intact while successfully reducing US expectancies. The association splitting intervention, however, did not lead to a reduction in thinking of the US. Our findings stress the clinical and theoretical importance of including 'thinking of the US' as an additional outcome variable and searching for an intervention that can successfully target it.

2. **Katharina Schmidt**[1], **Katarina Forkmann**[1], **Ulrike Bingel**[1]: Enhanced acquisition and decreased extinction of facial compared to hand pain: a fear conditioning study

   [1]*University Hospital Essen, Germany*

   Enhanced associative learning and a failure to extinguish cue-pain associations might contribute to the development and maintenance of chronic pain. This study investigated the differences in acquisition, extinction and reinstatement of cue-pain associations and pain-related fear induced by face and hand pain. A differential 2-day fear-conditioning paradigm was used. In the acquisition phase (day 1), two CS+ were paired with face or hand pain (UCS). Acquisition was followed by extinction. Reextinction and reinstatement took part on day 2. Fear, valence, contingency and pain intensity ratings, and SCR data was acquired in 39 healthy subjects. Face pain led to increased acquisition (steeper increase in valence ratings) compared to hand pain, which was influenced by differences in pain-related fear. Extinction was decreased for face pain CS in terms of contingency ratings. There were no differences in reinstatement. Our results indicate stronger acquisition and impaired extinction for face pain. This effect is in part driven by pain-related fear. Differences in learning and extinction might play an important role in the chronification and high prevalence of facial pain diseases.

3. **Hannah Genheimer**[1], **Marta Andreatta**[1], **Paul Pauli**[1]: How does mood influence extinction processes?

   [1]*University of Würzburg, Germany*

   Extinction memory is influenced by external or internal contextual factors, e.g. the mood in which a fear memory is acquired and retrieved. We investigated whether positive mood could facilitate fear extinction. Fifty-seven participants underwent fear conditioning. During acquisition, a geometric shape (conditioned stimulus, CS+) was paired with an electric shock (unconditioned stimulus, US), but never another shape (CS-). Extinction was identical to acquisition, without US delivery. Prior to extinction, participants watched a short emotional movie clip (fearful, neutral or erotic). Negative mood, but not positive mood, was induced as participants, who watched the fearful clip, reported higher negative affect compared to the other groups. Successful conditioning was indicated by more negative valence, higher arousal, fear and contingency ratings as well as startle potentiation for CS+ compared to CS- for acquisition, while such discriminative responses disappeared during extinction. Mood induction did not affect extinction. In sum, negative mood did not impair extinction. However, a proper induction of positive mood is still necessary to investigate facilitation of extinction.

4. **Valerie L. Kinner**[1], **Oliver T. Wolf**[1], **Christian J. Merz**[1]: The temporal dynamics of conditioned skin conductance and pupillary responses in the context of fear acquisition and extinction

   [1]*Ruhr-University Bochum, Germany*

   Fear acquisition manifests in the development of conditioned fear responses (CR), whereas a decrement in CRs is referred to as extinction learning. Time windows for CR scoring are subject to discussion, especially in terms of skin conductance responses (SCRs), where a subdivision into a first- (FIR) and second-interval response (SIR) is often suggested. In this study, 40 participants underwent a differential fear conditioning paradigm with fear acquisition and immediate extinction. Differential responding as measured by the FIR declined during fear acquisition, while it increased for the SIR. A similar temporal shift from early to late CR patterns was observed for pupillary responses. During extinction, a significant decrement of CRs was found for the late but not for the early pupillary response component. For SCRs, only the FIR indicated successful extinction, while the SIR still revealed a significant CS differentiation at the end of extinction. These distinct learning curves indicate that conditioned SCRs and pupillary responses follow a dynamic temporal pattern that may be differently related to either an early orienting or a somewhat later anticipatory fear response.

5. **Isabell Tapia León**[1], **Onno Kruse**[1], **Rudolf Stark**[2], **Tim Klucken**[1]: Below the optimal level of stimulation - neural correlates of appetitive conditioning and sensation seeking

[1]*University of Siegen, Germany* | [2]*Justus Liebig University Giessen, Germany*

In conditioning research, there is an increasing focus on inter-individual differences. Examining these differences and their role in conditioning processes is central to fully understand the development and maintenance of psychological disorders. Sensation seeking has been assumed to moderate appetitive conditioning. It is partly based on the optimal level of stimulation theory and it is assumed that situations low sensation seekers experience as pleasantly stimulating, might be not stimulating enough for high sensation seekers. This would be reflected by reduced acquisition of conditioning while using standard appetitive stimuli like small amounts of money. After filling out the SSS-V, 38 participants took part in an instructed differential appetitive acquisition procedure while in the MRI (3T). A monetary reward of 50 Cents was used as UCS and a reinforcement rate of 50% was employed. Results show significant negative correlations between sensation seeking and BOLD responses in the CS+ $>$ CS- contrast in the insula, amygdala, NAcc (early phase) and the dACC (late phase). The results highlight the importance of the subjective level of optimal stimulation for emotional learning.

6. **Marie K. Neudert**[1], **Christian J. Merz**[2], **Raphaela I. Zehtner**[1], **Rudolf Stark**[1], **Andrea Hermann**[1]: Cognitive reappraisal and neural correlates of extinction recall

[1]*Justus Liebig University Giessen, Germany* | [2]*Ruhr-University Bochum, Germany*

During cognitive behavioral therapy, patients with anxiety disorders overcome their fear by means of cognitive restructuring and extinction-based interventions. A common emotion regulation strategy is cognitive reappraisal, which involves reinterpreting the meaning of a stimulus. In order to investigate the association between extinction recall and cognitive reappraisal, 44 men participated in a 2-day functional magnetic resonance imaging study consisting of a contextual fear conditioning paradigm with fear acquisition in context A, extinction training in context B (day 1) and an extinction recall (day 2) in context A, B and C (novel context). Habitual cognitive reappraisal was assessed with the Emotion Regulation Questionnaire. First results show that a stronger habitual use of cognitive reappraisal was significantly associated with reduced activation of amygdala and hippocampus during extinction recall in context B. These results are in line with other findings indicating that cognitive reappraisal can enhance fear extinction during exposure. Thus, cognitive reappraisal could be a protective factor for the development and/ or maintenance of anxiety disorders.

7. **Onno Kruse**[1], **Isabell Tapia León**[1], **Rudolf Stark**[2], **Tim Klucken**[1]: Differential association of chronic hair cortisol levels and neural correlates of appetitive conditioning depends on acute stress

[1]*University of Siegen, Germany* | [2]*Justus Liebig University Giessen, Germany*

Acute and chronic stress are thought to play an important role in modulating emotional learning processes like appetitive conditioning. Assessment of hair cortisol concentrations (HCC) of the last two months might provide a possibility to investigate how chronic stress interacts with acute stress in influencing emotional learning. One group (n=27) of healthy male participants was subjected to the Trier Social Stress Test (TSST), while a control group (n=29) was subjected to a Placebo version. Afterwards, participants took part in an appetitive conditioning paradigm, while fMRI and SCR was recorded. For analysis the acquisition phase was split in the first and second half of trials. The stress group showed significantly greater positive correlations of HCC with conditioned SCRs and increased differential activation of dorsal and ventral ACC. In the control group, however, the correlation of HCC and differential conditioned responding were negative. The results indicate better acquisition of conditioning in subjects with high HCC under acute stress, while subjects with low HCC show better acquisition of conditioning under comparably low acute stress.

8. **Marieke van der Schaaf**[1], **Katharina Schmidt**[1], **Katarina Forkmann**[1], **Ulrike Bingel**[1,2]: Learning and extinction of pain predictions: comparing pain exacerbation with pain relief

[1]*University Hospital Essen, Germany* | [2]*Hahn Institute Essen, Germany*

Alterations in learning and "forgetting" of pain predictions are suggested to contribute to maladaptive chronic pain behaviors. However, learning and extinction of pain-relief are also likely to contribute to chronic pain behaviors. As most studies to date have solely focused on aversive pain conditioning, little is known about the commonalities and differences of aversive and appetitive learning processes within the pain modality. We aim to compare acquisition, extinction and reinstatement of cues predicting pain exacerbation and pain relief. Tonic pain will be induced by pre-treating an area of the forearm with capsaicin solution. Pain exacerbation and relief will be induced by increasing and decreasing the temperature of a thermal device placed on the same skin area (Seymour *et al.*, 2005). We hypothesize that cues predicting pain exacerbation compared to cues predicting pain relief will be associated with enhanced acquisition, slower extinction and increased reinstatement, as indicated by subjective valence ratings and skin conductance responses. Preliminary behavioural results will be presented to validate the paradigm for future neuroimaging and patient studies.

9. **Elze Landkroon**[1], **Gaëtan Mertens**[1], **Dieuwke Sevenster**[1], **Iris M. Engelhard**[1]: Devaluation of Threat Memory to Reduce Return of Fear after a Context Switch

[1]*Utrecht University, The Netherlands*

Learned fear to a conditioned stimulus (CS) may be caused by the perceived probability and intensity of a threatening unconditioned stimulus (US; Davey, 1997; see Vervliet, Craske, & Hermans, 2013). Exposure therapy focuses on reducing the probability aspect by disconfirming the CS-US relationship, leaving the original fear memory intact. A context switch after exposure therapy may reactivate the original fear memory, leading to renewal (Bouton, 2002). One way to perhaps more permanently diminish fear is by devaluing the intensity of the threat memory itself, using mental imagery-based methods (van den Hout & Engelhard, 2012). However, it is unclear whether this effect prevents renewal. To test this hypothesis, healthy participants were conditioned with an aversive film clip in context A on Day 1. On Day 2, participants did one of the following tasks: participants either recalled the US memory while making simultaneous eye movements, they only recalled the US memory or they did nothing. Afterwards, extinction took place in context B for all participants. Then, renewal was tested in the original acquisition context. Results and implications will be discussed.

10. **Frank H. Wilhelm**[1], **Julina A. Rattel**[1], **Stephan Miedl**[1], **Esther Seidl**[1], **Jens Blechert**[1]: The effect of excitatory transcranial direct current stimulation over the right dorsolateral prefrontal cortex on avoidance behavior and fear extinction

[1]*University of Salzburg, Austria*

Conditioned fear responses are maintained by repeated avoidance behavior, preventing fear extinction. Previous studies demonstrated altered decision making during approach-avoidance conflict after anodal transcranial direct current stimulation (tDCS) over right dorsolateral prefrontal cortex. Here, we investigated if such stimulation can decrease avoidance decisions and increase fear extinction. Using our previously developed gamified fear conditioning and avoidance computer task, time-delay during a detour represented avoidance costs, inducing an approach-avoidance conflict. After differential fear conditioning with electric shock as US, 170 participants were randomized to either 10 min tDCS or sham stimulation. articipants then underwent extinction where they could either take a risky shortcut (threat of US, signaled by a CS+), or choose the detour. Continuous avoidance decisions resulted in heightened fear post-extinction. Despite adequate statistical power, these findings do not confirm altered avoidance decisions and fear extinction following tDCS. Possible limitations of tDCS in avoidance research are discussed, as well as adaptions for future tDCS designs.

11. **Rachel Sjouwerman**[1], **Alexander MacRae-Korobkov**[1,2], **Tina B. Lonsdorf**[1]: Latency of skin conductance responses during differential fear conditioning with state of the art equipment

[1]*University Medical Center Hamburg-Eppendorf, Germany* | [2]*University of Alberta Edmonton, Canada*

In 1977 Kotses and Glaus described key characteristics of skin conductance responses (SCRs) to conditioned stimuli. They report shorter response latencies for stimuli unpaired with an unconditioned stimulus (CS-) than for stimuli paired with an unconditioned stimulus (CS+). Their equipment however acquired data with a paper speed of 25mm/sec. Anno 2018 data acquisition tools have improved substantially and allow for acquisition of 100.000 samples/sec. Hence, in light of and with the urge for methodological guidelines (*i.e.*, replicability debate), it is timely to re-approach and validate the previously reported, likely outdated, characteristics of SCRs. We confirm shorter mean response latencies towards the CS- than to the CS+ in a large sample (N=260), and identify even shorter latencies to the unconditioned stimulus (US). Importantly, latencies significantly change over the time course of fear acquisition training depending on stimulus type (CS+,CS-,US). This is most likely driven by an increase in latency over time towards the CS- as compared to the US. SCR latency might thus carry fruitful information that can be incorporated as outcome measure in fear conditioning experiments.

12. **Yannik Stegmann**[1], **Philipp Reicherts**[1], **Marta Andreatta**[1], **Paul Pauli**[1], **Matthias J. Wieser**[2]: Attentional mechanisms in combined context and cue extinction learning using the NPU-threat test

[1]*University of Würzburg, Germany* | [2]*Erasmus University Rotterdam, The Netherlands*

Previously, we used an adapted version of the NPU paradigm and recorded steady-state visual evoked potentials (ssVEPs) to quantify attention allocation during threat cue vs. context conditioning. Three different context cues indicate safety (N), predictable (P) or unpredictable threat (U) while foreground cues reliably signal an upcoming shock in the P condition only. In the present study, we followed up on these findings and investigated the temporal dynamics of extinction-learning in high (HA) vs. low anxious (LA) individuals. To this end 60 participants completed a modified NPU-paradigm followed by an extinction phase. Results showed that HA and LA differed only in responses to contextual cues: HA showed higher threat- and contingency-ratings in acquisition and a slower decrease of threat and contingency ratings during extinction. ssVEP-analysis revealed that HA showed lower electrocortical responses to threatening context cues in acquisition compared to LA while there is no difference during extinction. The results might indicate that HA are worse at discriminating contextual threat stimuli and accordingly overestimate the impact of unpredictable threat.

13. **Roland Esser**[1], **Johannes Fuss**[1], **Jan Haaker**[1]: Impact of the GABAergic and Noradrenaline System on social threat learning

    [1]*University Medical Center Hamburg-Eppendorf, Germany*

    Threat responses are often shaped by social information via observation of aversive outcomes in others. Yet, the neurochemistry regulating social learning of threats is largely unknown. We examined if noradrenergic and GABAergic neurotransmitter systems play a role in observational threat learning in humans. To this end 55 participants received double-blind and placebo (N=22) controlled either Lorazepam (N=18) or Yohimbine (N=15) prior to observational threat conditioning. Thereby, participants acquire conditioned threat responses through observation of another individual that is presented with a conditioned stimulus (CS) and an aversive unconditioned stimulus. Participants' threat responses were tested by direct CS exposure immediately after learning and two days later (drug free). Immediate test results indicate lower subjective fear to socially learned CSs (p = .02) through enhanced noradrenergic and GABAergic transmission as compared to controls. We found no differences in psychophysiological responses (SCR) or long-term persistence of conditioned responses. Our results suggest an impact of the two neurochemical systems on the mechanisms underlying social acquisition of threats.

14. **Emma Biggs**[1], **Ann Meulders**[1,2], **Johan Vlaeyen**[1,2], **Rainer Goebel**[2], **Amanda Kaas**[2]: The neural networks of cued and contextual fear of painful touch

    [1]*Katholieke Universiteit Leuven, Belgium* | [2]*Maastricht University, The Netherlands*

    Research on fear of pain related to touch is scarce, despite being a common symptom among many chronic pain conditions. Therefore, we used tactile fear conditioning to evoke cued fear of touch, pairing vibrotactile stimulation (CS+) with pain, in a predictable pain context. In an unpredictable pain context, vibrotactile stimuli (CS1 & 2) were presented unpaired from pain, resulting in contextual fear responses. During both cued and contextual fear of touch there was activity in frontoparietal networks, which are typically related to shifts in attention. In the predictable context this network also had directed influence over SMA, which could be related to the encoding of the sequence of events. Furthermore, the CS+ was associated with greater activity in LO, which may be part of the formation of a higher-order representation of the CS, whilst the CS1 and CS2 were associated with activity in the medial parieto-occipital sulcus, perhaps being encoded as a feature of the context. Further research would be needed to explore these hypotheses, however, our preliminary conclusion is that cued and contextual fear of touch is the result of different neural networks and processes.

15. **Francesco Saldarini**[1], **Jayne Morriss**[1], **Megan James**[1], **Carien M. van Reekum**[1]: Knowledge is power: Contingency instruction promotes threat extinction in high intolerance of uncertainty individuals

    [1]*University of Reading, UK*

    Extinction-resistant threat is considered to be a central feature of pathological anxiety. Reduced threat extinction has been associated with individual differences in intolerance of uncertainty (IU). Here we sought to determine whether contingency instructions could alter the course threat extinction in individuals prone to IU. We tested this hypothesis by recording electrodermal activity in 59 healthy participants during threat acquisition and extinction. Participants were split into groups based on extinction instructions (instructed, uninstructed) and IU score (low, high). All groups displayed larger skin conductance responses to learned threat versus safety cues during threat acquisition, indicative of threat conditioning. Only the uninstructed high IU group displayed larger skin conductance responses to the learned threat versus safety cue during threat extinction. These findings suggest a critical interaction between contingency information and uncertainty in the maintenance of learned threat during extinction contexts.

16. **Fredrik Ahs**[1]: Amygdala activations to innate and conditioned threats

    [1]*Uppsala University, Sweden*

    Responding to threats in the environment is crucial for survival. Some threat responses are innate and do not necessitate learning, whereas others are learned through Pavlovian conditioning. One type of innate threat is produced by objects suddenly appearing near the body (proximal threat). It is not known how the human amygdala orchestrates innate and learned threat responses. We here used functional magnetic resonance imaging (fMRI) and skin conductance response (SCR) to study the effect of proximal and conditioned threat on amygdala function in 45 participants. Skin conductance responses were facilitated to a similar extent by both proximal and conditioned threats, whereas amygdala activations were more pronounced to proximal than conditioned threat. An exploratory whole brain analysis showed that the patterns of fMRI responses to proximal threat involved visual cortical pathways. In contrast, Pavlovian conditioning activations predominantly involved temporal and prefrontal areas. We conclude that the amygdala may be preferentially involved in innate threat processing and that autonomic responses to innate and conditioned threat may be supported by separate brain systems.

17. **Tina Lonsdorf**[1], **Miguel A. Fullana**[2]: Let's talk about the Extinction Recall Index

[1]*University Medical Center Hamburg-Eppendorf, Germany* | [2]*Universitat Autonoma Barcelona, Spain*

The replicability crisis has highlighted many problematic practices in research - among them substantial researcher's degrees of freedom in data processing and analysis. An important step towards more comparability in research and a reduction of researcher's degrees of freedom can be achieved through committing to standardized quantification of effects of interest - without restricting justified flexibility. In the field of fear conditioning research, the "Extinction Recall Index (ERI)" seems to represent such a standardization: Thereby, the ERI is intended to normalize each individual's SCR during extinction recall to that exhibited during fear acquisition. A systematic literature review on the ERI in human research identified seventeen different ways to calculate the ERI across 31 publications. We observed heterogeneity both within and across labs with calculations differing in various ways (*e.g.*, number of trials, based on differential responding or CS+ only responding, correcting for differential responding, CS+ only responding or maximum responding). We discuss potential implications of this heterogeneity and present considerations with respect to potential solutions.

18. **Anastasia Chalkia**[1], **Jeroen Weermeijer**[1]**), Lukas Van Oudenhove**[1], **Tom Beckers**[1]: Reconsolidation blockade vs memory integration: Does state dependency account for the amnestic effect of propranolol on reactivated memories in humans?

[1]*Katholieke Universiteit Leuven, Belgium*

The reconsolidation hypothesis holds that a memory trace can become labile upon reactivation. Disrupting protein synthesis can then prevent the trace from being retained in LTM. Recently, this hypothesis has been challenged by the memory integration account, which proposes that post-reactivation treatments result in the induction of an internal state that becomes integrated with the original memory trace. Apparent amnesia at the time of testing then results not from disrupted reconsolidation of memory, but from retrieval failure due to the absence of the same internal state at test. We report the results of a study investigating whether state-dependent retrieval can be observed upon propranolol-induced post-reactivation amnesia in humans.

19. **Christopher M. Klinke**[1], **Dominik Fiedler**[2], **Maren D. Lange**[2], **Marta Andreatta**[1]: Impaired extinction learning after predating stress induction

[1]*University of Würzburg, Germany* | [2]*University of Münster, Germany*

Previous studies demonstrated stress effects on fear conditioning. An animal study found impaired extinction after stress induction 10 days before fear acquisition. The aim of the study was to translate these findings into humans. Sixty-nine participants underwent fear acquisition and extinction on two consecutive days. During acquisition, one geometrical shape (conditioned stimulus, CS+), but not the other one (CS-), was paired with an electric stimulus (unconditioned stimulus, US). Extinction was identical, but without US-delivery. Ten days before acquisition, participants were randomly divided into three groups: A stress group A (socially evaluated cold-pressor test; SECPT), a sham procedure group in the same context as acquisition or a stress group B in a different context. Successful fear acquisition was evident in startle potentiation, larger skin conductance responses and aversive ratings for CS+ vs. CS-. Decreasing discriminative responses indicated extinction. Notably, the stress group A showed impaired extinction in the ratings. In sum, predating stress may facilitate fear memories and thereby impairing extinction in humans. Importantly, the context boosted such effects.

20. **Frederik Schlitt**[1], **Katharina Schmidt**[1], **Katarina Forkmann**[1], **Ulrike Bingel**[1,2]: Effects of pharmacologically induced stress on the extinction and reinstatement of pain-related fear in health and chronic pain

[1]*University Hospital Essen, Germany* | [2]*University Duisburg-Essen, Germany*

Alterations in learning and 'forgetting' about pain might contribute to the development and maintenance of chronic pain. Moreover, stress hormones are known to modulate fear extinction in rodents and healthy humans. This project investigates the clinically relevant effects of acute stress on extinction recall and reinstatement of extinguished fear of pain. We will examine chronic back pain patients (n=60) and healthy participants (n=60) in a placebo-controlled, double-blind study using a 2-day differential fear conditioning paradigm. Participants will be randomized to either receive a single dose of hydrocortisone or an inert substance (placebo) before extinction recall. Geometrical figures predict the presence (CS+) or absence (CS-) of aversive stimulations (heat pain) as visual cues. We assume that administration of hydrocortisone impairs extinction recall and enhances reinstatement of previously extinguished fear of pain. We also expect these effects to be augmented in chronic pain patients compared to healthy controls and to be related to individual trait variables. Data acquisition will start now. Hence, I will show preliminary data at the meeting.

21. **Laila Franke**[1], **Julina A. Rattel**[1], **Stephan F. Miedl**[1], **Jens Blechert**[1], **Victor I. Spoormaker**[2], **Frank H. Wilhelm**[1]: Are intrusive memories conditioned responses to trauma cues? An experimental study

[1]*University of Salzburg, Austria* | [2]*Max Planck Institute of Psychiatry Munich, Germany*

Intrusive memories in posttraumatic stress disorder are clinically conceptualized as conditioned responses to stimuli associated with the trauma. However, evidence for this is scant. Here we used our conditioned-intrusion paradigm (Wegerer *et al.*, 2013, 2014) to provide further evidence for this relationship. Subjects (N=56) were conditioned with neutral faces as CSs and aversive film clips as US. About half of the subjects were randomized to subsequent extinction training. Intrusive memories were then sampled for three consecutive days. Subjects reported stimuli resembling the CSs or the laboratory context as intrusion triggers. CSs were also reported as intrusive memories. Subjects who underwent extinction had fewer intrusive memories than acquisition-only participants. Conditionability (differential SCR and US-expectancy / valence ratings, at end of acquisition) correlated positively with intrusions in the acquisition-only group, but not in the extinction group. These analog findings provide strong experimental evidence for the assumption that intrusions are a result of fear conditioning during trauma and that their re-experiencing may be triggered by cues present during trauma.

22. **Laura Koenen**[1], **Adriane Icenhour**[1], **Nina Theysohn**[1], **Jost Langhorst**[2], **Ulrike Bingel**[1], **Sigrid Elsenbruch**[1]: Facial Feedback: Adaptation of facial motor responses in interactive dyads as a function of punishment

[1]*University Hospital Essen, Germany* | [2]*Clinic for Internal and Integrative Medicine, Kliniken Essen-Mitte*

Conditioned pain-related fear is a highly adaptive response aimed at self-protection and the recovery of the body's homeostasis impaired by pain. Compared to exteroceptive somatic pain, visceral pain is characterized by its interoceptive nature and unique biological salience, which may distinctly shape associative learning processes. In this fMRI-study, we therefore aimed to examine the specificity of visceral compared to somatic pain in pain-related fear learning. In 34 healthy females, blood-oxygen-level-dependent responses were obtained during differential delay fear conditioning with visceral and somatic pain as two concomitant US, matched for perceived pain intensity. Three counterbalanced visual symbols in pseudorandomized order were presented to participants either paired with visceral US (CS+VIS), somatic US (CS+SOM) or without US (CS-), while CS valence and CS-US contingency were assessed on visual analogue scales. At comparable CS-US contingencies, CS+VIS were rated as more unpleasant compared to CS- ($p < .001$) as well as to CS+SOM ($p = .002$), even after few trials during conditioning, while CS+SOM and CS- were rated as comparably neutral. On a neural level, CS+VIS induced enhanced deactivation compared to CS+SOM in S1, posterior and anterior insula and cingulate regions, and additional thalamus deactivation when compared to CS- (all p FWE $< .05$). No significant differences between CS+SOM and CS- were detectable. An exploratory analysis substantiated these findings by showing a significant correlation between posterior insula deactivation to CS+VIS compared to CS+SOM and enhanced anterior insula activation to visceral compared to somatic pain. In sum, our findings suggest a specific role of visceral pain in pain-related fear

learning in healthy females. This is shown by enhanced pain-related fear responses for the visceral modality, while learning appeared to be blocked for the somatic modality. A distinctive involvement of insular and cingulate regions during anticipation of visceral pain suggests a greater engagement of the salience network during conditioning of visceral compared to somatic pain-related fear.

23. **Lars Marstaller**[1]: Is the default-mode network involved in fear and safety learning?

[1]*Swansea University, UK*

Recent studies have suggested that the default-mode network (DMN) modulates fear and safety learning. fMRI results contrasting activity in relation to CS- with CS+, show activity in DMN regions (Fullana *et al.*, 2016, Mol Psychiatry). Additional studies have demonstrated a relationship between DMN activity with safety learning (Marstaller *et al.*, 2016, HBM), context conditioning (Zidda *et al.*, 2018, NI), and BNST responses to safety stimuli (Torrisi *et al.*, 2018, Transl Psychiatry). In contrast, others have argued that the ventromedial prefrontal node of the DMN but not the DMN as a whole is responsible for inhibition of the fear response associated with safety learning (Harrison *et al.*, 2017, NI). This poster will frame and summarize this emerging debate and explore possible ways, in which the DMN could possible influence fear and safety learning.

Poster Session 2: Clinical, avoidance, and generalisation

[17 Apr, 20:30 - 22:00]

1. **Stephan Miedl**[1]: Neural correlates of intrusive memory formation after analogue trauma: the role of individual fear conditionability and extinction memory

   [1]*University of Salzburg, Austria*

   The present study refined the conditioned intrusion paradigm (Wegerer *et al.*, 2013, 2014) to induce analogues of intrusive memories within the fMRI environment. We focused on individual differences in fear conditionability as predictor for subsequent intrusive memories. After fear conditioning using faces as CS and highly aversive 20-sec films depicting interpersonal violence as US, we assessed intrusive memories event-based for three consecutive days via smartphone application. Based on our previous results we expected that intrusive memory formation will be predicted by deficient fear extinction as indexed by exaggerated fear network responses to CS+ vs. CS-. Results demonstrated successful fear acquisition, reflected by differential fear network activity and US expectancy ratings. Moreover, enhanced differential insula activation during extinction was linked to subsequent intrusive memories. Results suggest that reduced extinction memory may play a prominent role in intrusive memory formation, representing a potential marker of individual PTSD vulnerability after trauma.

2. **Julia Reinhard**[1], **Miriam A. Schiele**[1,2], **Susanne Neufang**[1], **Andreas Reif**[3], **Katharina Domschke**[1,2], **Jürgen Deckert**[1], **Paul Pauli**[1], **Marcel Romanos**[1]: Developmental aspects of fear learning and fear generalization

   [1]*University Hospital of Würzburg, Germany* | [2]*University Hospital of Freiburg, Germany* | [3]*University Hospital of Frankfurt, Germany*

   Alterations in fear learning are considered to play an important role in the pathogenesis of anxiety disorders (AD). Most research on human fear learning has focused on adults, whereas little is known about these processes in children. To address this knowledge gap, we compared 267 healthy children (aged 8-10 years) with 285 adults and in a second step 396 children aged 8 to 12 years with each other in a differential fear conditioning and generalization paradigm. Results indicated overgeneralization of conditioned fear as a developmental correlate of fear learning. Furthermore, we investigated the impact of trait anxiety on fear generalization in 394 children (aged 8 to 12 years), hypothesizing that the developmental trajectory from increased trait anxiety in childhood to manifest AD may be mediated by abnormal fear generalization processes. Results indicated that children with heightened trait anxiety had gradients similar to that of adult patients with AD. In sum, studies suggest that investigating developmental aspects of (maladaptive) overgeneralization may lead to better understanding of the mechanisms of AD, which could result in the development of prevention strategies.

3. **Tom Smeets**[1]: Overgeneralisation of fear and avoidance following acute stress

   [1]*Maastricht University, The Netherlands*

   Characteristic of many stress- and anxiety-related disorders is the spreading of fear for the fear- evoking stimuli to related, but initially innocuous cues (*i.e.*, fear overgeneralization). Exposure to stress affects learning and memory in various ways, including the acquisition and extinction of fear, our ability to discriminate between cues, and memory generalization. In the current study, we will examine whether participants who are exposed to acute stress will display greater overgeneralisation of fear and increased reliance on avoidant safety behaviours compared to non-stressed controls. A standard human fear conditioning protocol will be used, with fear acquisition on Day 1. Twenty-four hours later on Day 2, participants are exposed to the Maastricht Acute Stress Test or a no-stress control procedure, after which avoidant safety behaviour and fear generalisation are measured. This poster will primarily detail the methods of the project, and potentially include preliminary results.

4. **Pauline Dibbets**[1], **Arne Leer**[2], **Lisbeth Evers**[1], **Tom Smeets**[1]: Can you escape the virtual room?

   [1]*Maastricht University, The Netherlands* | [2]*Utrecht University, The Netherlands*

   Background. Even though fear and anxiety play a major role in the misery of anxiety patients, avoidance might even have a more profound effect on their daily lives. Despite its debilitating effects, avoidance has only recently regained attention. The current study explores a novel paradigm that enables measuring avoidance behaviour and, at the same time, assesses generalization of fear. Method. A virtual escape room is created. The instruction is to find three (hidden) codes and to open the (virtual) door. Fear will be induced by presenting an aversive film clip on a television screen in the virtual room. Subsequent avoidance of the screen and related devices (generalization, e.g., tablet, laptop, smart phone) in the same or other environments are measured. Results. Testing will start in February, the pilot results will be presented at the EMHFC.

5. **Anna Slyschak**[1], **Julia Reinhard**[1], **Jürgen Deckert**[1], **Paul Pauli**[1], **Katharina Domschke**[1,2], **Marcel Romanos**[1]: Fear generalization in children and adolescents: a cross-sectional study across ages

   [1]*University Hospital of Würzburg, Germany* | [2]*University Hospital of Freiburg, Germany*

   Anxiety disorders (AD) are common mental diseases with a typical onset in childhood and adolescence. A pronounced fear generalization is a characteristic feature in adult patients with AD compared to healthy controls, while studies on fear generalization in minors are scarce. Our previous investigation indicate that in healthy children aged 8 to 10 years fear generalization is stronger compared to adults possibly reflecting the overall increased risk to develop AD in childhood. However, the developmental time trajectories of generalization gradients from childhood via adolescence into adulthood remain unclear. We investigated 100 healthy children (8-10) with 100 healthy adolescents (12-14) by means of a fear generalization paradigm. The extent of it was assessed subjectively (arousal, valence) and objectively (SCR). We hypothesized that generalization gradients were attenuated in adolescents compared to children. Given our hypothesis will prove true, our data would support the assumption that the age category of the late childhood (8-11) may be regarded as a particularly vulnerable stage for the development of AD being reflected by pronounced fear generalization.

6. **Kirstin L Purves**[1], **Thomas McGregor**[1], **Elena Constantinou**[1], **Tom Barry**[2], **Kathryn J. Lester**[3], **Michelle Craske**[4]: Validating the Use of a Mobile Phone App for Use in Large Scale Fear Conditioning Studies

   [1]*King's College London, UK* | [2]*Hong Kong University, China* | [3]*University of Sussex, UK* | [4]*University of California Los Angeles, USA*

   Fear conditioning is a robust model for exploring at a group level processes related to the development of and recovery from anxiety and fear in human populations. There has been increasing interest in using fear conditioning paradigms to investigate individual difference factors underlying these processes. It is likely that there are many factors, each with small effect, that underlie population level variance in fear conditioning. In order to identify what these factors may be much larger samples than are currently possible will be needed. To address this issue the present study presents the validation of a fear conditioning experiment delivered by a mobile phone app against an in-person version of the same experiment. Eighty-eight participants completed a two day fear conditioning experiment at two time points, a week apart. On one occasion they completed the task at home using their mobile phones. On the other occasion they completed the task in a controlled research environment. Results indicate that fear conditioning administered via mobile phone app is comparable to administration in a typical lab setting, and is sensitive to individual variation in anxiety.

7. **Santiago Garcia-Guerrero**[1], **Denis O'Hora**[1], **Arkady Zgonnikov**[2]: Tracing fear: Hand and eye movement during approach-avoidance

   [1]*National University of Ireland, Galway* | [2]*University of Aizu, Japan*

   Avoidance paradigms have traditionally relied on the analysis of discrete responses to threats (to avoid or not). However, the brain constantly manages incoming sensory information to control efferent motor pulses. Therefore, fine-grained behavioural responses can provide an insight into how decisions are updated "on the fly", capturing the complex interplay between ongoing inputs and outputs. Situations in which people feel both attracted and repelled by the same goal are termed approach-avoidance conflicts (AAC), and are generally expressed in movements away from or towards stimuli. Since computer-mouse trajectories provide a continuous measurement of a participant?s responses, mouse-tracking allows us to investigate the characteristics of decision movements during avoidance, highlighting the effects of ongoing neural evaluation processes: easy choices (low AAC) induce fast, direct movements; difficult ones (high AAC) induce slower movement and changes in direction. We present an AAC mouse-tracking task as a measure of "fear", in which participants decide between greater points plus threat vs. lower points without threat. The strengths and weaknesses of the task are discussed.

8. **Yannick Boddez**[1], **Dieter Struyf**[2]: Small differences make a difference: The effect of discrimination instructions on fear generalization

   [1]*University of Groningen, The Netherlands* | [2]*Katholieke Universiteit Leuven, Belgium*

   More and more evidence is stacking up that generalization is crucially involved in clinical anxiety. Researchers have therefore set their sights on the next goal: How to reduce generalization? In this light, some innovative studies have shown that training people to spot small differences between stimuli reduces generalization. Succes of this discrimination training is typically attributed to an enhanced ability to perceive such small differences. In this experiment, we assess the alternative hypothesis that such training simply serves to indirectly instruct people that small differences matter in the context of the experiment. To test this, participants in the experimental group were subjected to a fear generalization task after receiving the instruction "focussing on differences - even very small ones - between pictures can help you to do this task". Participants in the control group received no such instruction. In line with our hypothesis, participants in the experimental group gave lower shock-expectancy ratings to generalization stimuli than participants in the control group. However, this effect did not reach statistical significance. Follow-up studies are proposed.

9. **Zohar Klein**[1], **Tomer Shechner**[1], **Rivkah Ginat-Frolich**[1]: Reducing fear overgeneralization using a novel perceptual discrimination task among highly spider-phobic adults

   [1]*University Of Haifa, Israel*

   Fear overgeneralization is a central mechanism in anxiety. To reduce symptoms related to overgeneralization, a novel training task was developed. In a previous study, we showed that improvement in basic perceptual learning enhanced discrimination between threat and safety cues. The current study assessed the effects of this training among highly spider-phobic adults with the goal of reducing their avoidant behavior toward spider-related stimuli. Participants were randomized into training or placebo conditions. Following the task, participants completed a behavioral-approach task, consisting 5 unique spider stimuli, ranging from a paper spider to a live tarantula. Participants were asked to move the stimulus as close to themselves as possible, while distances were measured. Next, participants completed a threat-safety discrimination task using schematic morphs ranging from a flower to a spider. Finally, participants were shown a task consisting of paired spider and neutral images, while eye-tracking data was recorded. Results of 51 participants showed the efficacy of the training task on the discrimination test as well as decreased avoidance behavior in the training group.

10. **Andrea Hermann**[1], **Marie Neudert**[1], **Raphaela I. Zehtner**[1], **Onno Kruse**[1], **Rudolf Stark**[1]: Reduced hippocampus activation during long-term extinction recall in social anxiety disorder

    [1]*Justus Liebig University Giessen, Germany*

    Aversive social events might be related to the etiology of social anxiety disorder (SAD) by means of fear conditioning. Relatively less is known about the neural correlates underlying disorder-relevant fear acquistion, extinction and return of fear. In this functional magnetic resonance imaging study we investigated 36 patients with SAD and 39 matched healthy control participants (HC) in a 4-day fear conditioning paradigm comprising fear acquisition, extinction training (+1 day), short-term extinction recall (+1 week), and long-term extinction recall (+4 months; half of the sample). Neutral facial stimuli were used as CS and film clips with insulting comments of the same persons as UCS. SAD patients compared with HC show diminished ventromedial prefrontal cortex activation during fear acquisition, stronger dorsal anterior cingulate cortex activation decrease during extinction learning, enhanced amygdala activation during short-term, and reduced hippocampus activation during long-term extinction recall. These findings emphasize the relevance of aversive social conditioning experiences in the etiology and/or maintenance of SAD.

11. **Katharina Herzog**[1], **Marta Andreatta**[1], **Katharina Domschke**[2],**Paul Pauli**[1]: Reversibility of generalized fear: comparison of a discrimination training with and without feedback

[1]*University of Würzburg, Germany* | [2]*University Hospital of Freiburg, Germany*

Anxiety patients tend to generalize conditioned fear, possibly because of an incapacity to perceive differences between stimuli. We examined the reversibility of fear generalization by a discrimination training. Eighty participants underwent a differential conditioning during which one face stimulus (CS+), but not another face stimulus (CS-), became associated with an aversive scream (US). During generalization, CS+ and CS- as well as four morphs (GS1-4) were presented. Then, two groups underwent a de-generalization training teaching to discriminate the CS+ from the other faces. Importantly, one group received feedback on their performance, but not the other group. Two additional groups (one with feedback, one without) underwent a control discrimination task. Successful acquisition of fear was indicated by discriminative ratings between CS+ and CS-. The Linear Deviation Score revealed better face discrimination (less generalization) in contingency and arousal ratings after training, especially for those who received feedback. In conclusion, a de-generalization task with feedback facilitates stimulus discrimination, *i.e.*, reduces generalization of fear.

12. **Eveliina Glogan**[1], **Christine van Vliet**[1,2], **Rani Roelandt**[2], **Ann Meulders**[1,2]: Generalization and extinction of concept-based pain-related fear

[1]*Maastricht University, The Netherlands* | [2]*Katholieke Universiteit Leuven, Belgium*

Chronic pain patients overgeneralize fear and expectancy to safe stimuli, which may lead to excessive avoidance and disability. Evidence shows that pain-related fear can also be acquired and generalize based on conceptual knowledge. The current study examines the extinction of concept-based pain-related fear. During acquisition, exemplars of one "action category" (CS+; *e.g.*, opening boxes) were followed by pain, whereas exemplars of another "action category" (CS-; *e.g.*, closing boxes) were not. Participants reported more pain-related fear and expectancy in response to exemplars of the CS+ category compared with those of the CS- category. During generalization, fear and expectancy spread to novel exemplars of the CS+ category (GS+), but not to those of the CS- category (GS-). During extinction, acquisition exemplars of both categories were presented in the absence of pain. At the end of extinction, participants no longer reported elevated fear or expectancy in response to CS+ exemplars compared to CS- exemplars. The startle eyeblink measures did not corroborate this data pattern. To conclude, this is the first study to demonstrate the extinction of concept-based pain-related fear.

13. **Rivkah Ginat-Frolich**[1], **Tamar Gendler**[1], **Dan Marzan**[1], **Yuval Tsuk**[1], **Tomer Shechner**[1]: Perceptual discrimination training: Reducing fear generalization among children

[1]*University Of Haifa, Israel*

Fear-overgeneralization is a core feature in anxiety disorders. As a deficit in perceptual discrimination is thought to contribute to fear-overgeneralization, a perceptual discrimination training task was designed. This study assesses the task's effectiveness among 73 children (9-14 yrs). Following a fear-conditioning task participants were randomized into 3 groups: perceptual training, placebo and nothing. In the training task, a target shape appeared on the screen, followed by 2 shapes and participants were asked to identify the shape that differed from the target. In the placebo task, participants were asked to indicate the location of a target shape on the screen. Following both tasks, a generalization test consisting of morphs ranging in perceptual similarity from the CS+ to the CS- was conducted. Successful fear-conditioning was observed in both physiological and behavioral measures (ps $< .041$). Further, the training group obtaining more correct responses in a general perceptual discrimination task and exhibited better discrimination between the CS+ and CS- in the generalization test. These findings offer preliminary evidence for the effectiveness of the task among children.

14. **Elena Constantinou**[1], **Kirstin L. Purves**[1], **Thomas McGregor**[1], **Tom Barry**[2], **Kathryn J. Lester**[3], **Michelle Craske**[4], **Thalia C Eley**[1]: Examining the Association Among Affective and Cognitive Components of Fear Conditioning

[1]*King's Colle London, UK* | [2]*Hong Kong University, China* | [3]*University of Sussex, UK* | [4]*University of California Los Angeles, USA*

Fear conditioning paradigms use various measures to assess learned fear, with some reflecting the affective (affective ratings) and others the cognitive (US-expectancies) component of fear. The direct association between these distinct outcome measures has not been systematically explored, even though prominent theoretical accounts of fear conditioning suggest that affective and cognitive components tap into one common learning mechanism (single process models; Lovibond & Shanks, 2002). Moreover, the association among fear responses is hypothesized to be influenced by anxiety-related traits (Beckers *et al.*, 2013). The present study examines the association among US-expectancies and affective ratings within a fear conditioning task. Sixty-eight participants completed a differential fear conditioning task providing online US-expectancy ratings during acquisition and extinction. They also rated the unpleasantness, arousal and fearfulness of CS+ and CS- at baseline and post-extinction. Results indicate modest associations between US-expectancies and affective ratings, over and above individual differences in anxiety sensitivity, carrying both methodological and theoretical implications.

15. **Jule Dehler**[1], **Andre Pittig**[1,2]: Does behavioral choice alter avoidance behavior and fear learning in an approach-avoidance-task?

[1]*Technical University Dresden, Germany* | [2]*Julius-Maximilians-University Würzburg*

This study was developed to investigate how behavioral choice in an approach-avoidance-task alters avoidance behavior and fear learning in healthy individuals. One Group (Choice Group) undergoes an acquisition-training with behavioral choice, in which they can freely choose between two options: the CS+ option is associated with a neutral stimulus followed by an aversive US whereas the CS- option is never followed by an aversive US. To induce an approach-avoidance conflict, the CS+ option is linked to high rewards whereas the CS- option is linked to low rewards. Another group (Forced Group) passively observes the acquisition training in a yoked order without behavioral choice. In a following test phase, where no more USs are presented (extinction), both groups can freely choose between both options. 60 of 70 subjects have been tested yet. It is hypothesized that the Forced Group shows increased avoidance of the CS+ option during the test phase as well as delayed extinction learning due to the passive (uncontrollable) aversive learning experience. Operationalization of behavioral choice and avoidance will be discussed.

16. **Sebastian Siehl**[1], **Manon Wicking**[1], **Sebastian Pohlack**[1], **Tobias Winkelmann**[1], **Francesca Zidda**[1], **Frauke Steiger-White**[1], **John King**[2], **Neil Burgess**[2], **Frauke Nees**[1], **Herta Flor**[1]: Virtual cue and context conditioning in posttraumatic stress disorder: an fMRI study

[1]*Ruprecht-Karls-University Heidelberg, Germany* | [2]*University College London, UK*

The neural encoding and retrieval of environmental cues and contexts are essential for forming an accurate memory of an event. In patients suffering from posttraumatic stress disorder (PTSD), the ability to discriminate between safe and dangerous contexts is believed to be impaired in comparison to trauma (TC) and healthy controls (HC) without the diagnosis of PTSD. Learning associations between contexts, objects and locations depends on cognitive functions like perspective taking and overgeneralization. To further investigate these processes in relation to context conditioning, we performed a two-days fMRI experiment, using a 3 (groups: PTSD vs. HC vs. TC) x 2 (conditions: cue vs. context) mixed between-within design including in total 60 participants. Participants were put inside a virtual reality environment, in which they were walked through different apartments during a habituation, conditioning, extinction and generalization phase. In our preliminary results, we expect individuals with PTSD to show lower activity in the contextual and executive network and higher activity in the salience network during context acquisition and extinction.

17. **Gemma Cameron**[1], **Joseph Dunsmoor**[2], **Simon Dymond**[1,3]: Category Typicality Determines Avoidance Generalization

[1]*Swansea University, UK* | [2]*University of Texas at Austin, USA* | [3]*Reykjavik University, Iceland*

Directly learned fear can become overgeneralized through conceptual similarity. How category boundaries are formed determines how directly learned fear generalizes to conceptually related stimuli. In a series of studies, we examined the effect of stimulus typicality - a determining factor in category allocation - on the generalization of learned fear and avoidance. Using fear-conditioned intermediate category exemplars, we measured fear and avoidance generalization to both typical and atypical category exemplars. We found a higher proportion of avoidance to presentations of typical, but not atypical category exemplars, and generalization of expectancy ratings to both. Findings have implications for the understanding of overgeneralization of fear and avoidance in clinical anxiety disorders.

18. **Iris van de Pavert**[1], **Karin Roelofs**[1], **Floris Klumpers**[1]: Investigating interactions between appetitive and threat processing as mechanisms underlying costly fearful avoidance behavior

[1]*Radboud University Nijmegen, The Netherlands*

Fearful avoidance behavior is a critical symptom across anxiety disorders and an important predictor of clinical outcome. Thus, it is important to investigate underlying mechanisms driving costly avoidance behavior, like threat and reward appraisal. Forty-eight subjects could choose to approach or avoid situations differing in potential threat (threat of shock/no shock) and potential reward (€0.01/€0.1/€0.50/€1) to create varying levels of approach-avoid conflict. Avoidance behavior was higher during threat ($p < .0001$) and decreased with level of potential reward ($p < .0001$). A threat X reward interaction-effect indicated that there was little modulation by reward in the safe condition, while the modulation was apparent in the threat condition ($p < .0001$). Further, subjects with higher subjective turning points for switching from avoidance to approach, avoided more in the threat condition on all reward levels ($p < .001$ - $.03$). We successfully developed a task that assesses costly fearful avoidance in interaction with different rewards. Ongoing analyses aim to elucidate relations with defensive and reward-related startle measures which will be presented at the conference.

19. **Christoph Szeska**[1], **Anke Limberg-Thiesen**[1], **Mathias Weymar**[1], **Alfons O. Hamm**[1], **Jan Richter**[1]: About the discordance between physiological and subjective indicators of defensive reactivity in patients with anxiety and depressive disorders

[1]*Universität Greifswald, Germany*

Fear and anxiety are considered to be two types of defensive responses differing in its cue-specifity: fear describes a specific response to distinct and acute threat stimuli whereas anxiety describes an unspecific response to stimuli signaling potential threat. Using the NPU-threat-test, in which an electrical shock was never, predictably or unpredictably receivable for subjects, we measured three indicators of defensive responding indicating fear, anxiety and generalization of fear to a safe context. The expression of these indicators was assessed on a subjective (self-reports) and physiological (startle response) modality. Dimensional analyses showed positive correlations between fear and anxiety and between anxiety and generalization, whereas fear and generalization correlated negatively. Relationships could only be found between indicators of equal modality and were stronger related to the verbal report. No relationship could be found between indicators across both modalities. Future research needs to prove the specificity of the association between individual differences in defensive responding and its concordance between modalities with reported symptoms of psychopathology.

20. **Anneloes Hulsman**[1], **Karin Roelofs**[1], **Reinoud Kaldewaij**[1], **Mahur Hashemi**[1], **Wei Zhang**[1], **Saskia Koch**[1], **Bernd Figner**[1], **Floris Klumpers**[1]: Are individual differences in fearful costly avoidance behavior related to basic defensive responses indexed by fear-potentiated startle?

[1]*Radboud University Nijmegen, The Netherlands*

Avoidance behavior is a critical factor in anxiety disorders, often leading to short-term safety rather than long-term reward. Even though avoidance behavior plays an important role in anxiety, the mechanisms driving avoidance remain unclear. The current study captures approach-avoidance conflicts with an adapted instructed fear paradigm, in which subjects choose to approach or avoid an outcome entailing a 50% chance of shock or monetary gain. This paradigm successfully induced an approach-avoid conflict in two independent samples (N=24 & 341): threat-induced avoidance was reduced with high reward. Startle amplitude was potentiated in anticipation of decisions involving threat of shock. In preliminary analyses of study 2, we derived four clusters of participants based on their avoidance responses (all cost threat avoiders, low cost threat avoiders, avoiders of safe conditions, non-avoiders). Interestingly, there were no differences in startle potentiation between the groups, suggesting that inter-individual differences in avoidance behavior are not strongly driven by differences in basic defensive responses.

21. **Iris Lange**[1], **Liesbet Goossens**[1], **Koen Schruers**[1]: The neurobiology of associative learning in specific phobia

[1]*Maastricht University, The Netherlands*

Background: Recent research has proposed a spectrum of pathology, ranging from more specific fears to excessive anxiety-misery. Fear and extinction learning have implicated in the pathogenesis of anxiety disorders; however, it remains elusive whether such processes may be dysregulated at the fear-side of the spectrum. Methods: Spider phobics (SP; N=46) and healthy controls (HC; N=48) completed an fMRI paradigm measuring fear learning and fear generalization (day 1), extinction learning (day 2), and extinction recall (day 3). Results: In the behavioral ratings, the SP and HC only differed in acquisition retention, with the SP-group reporting increased differential fear than the HC. Neuroimaging results revealed enhanced threat-related activation during the fear learning and generalization phases, yet only in response to the CS+. During extinction learning, responses in the SP-group dropped back to the same level as the HC. Conclusions: Results suggest that specific phobia is characterized by hyperresponsivity to the CS+ only during fear learning and its retention. There were no indications of altered fear generalization, extinction learning, and extinction retention.

22. **Thomas McGregor**[1], **Kathryn J. Lester**[2], **Kirstin L. Purves**[1], **Elena Constantinou**[1], **Tom Barry**[3], **Michelle Craske**[4], **Thalia C. Eley**[1]: The Influence of interpretation bias and intolerance of uncertainty on Post-Extinction Affect

[1]*King's College London, UK* | [2]*University of Sussex, UK* | [3]*Hong Kong University, China* | [4]*University of California Los Angeles, USA*

The tendency to interpret ambiguous information negatively and the inability to tolerate uncertainty have been observed in individuals with anxiety disorders. Treatments for anxiety often target these maladaptive cognitive styles and have had some success in doing so. However, it is unclear to what degree these maladaptive cognitive styles influence response to treatment, over and above their relationship to anxiety. Fear conditioning paradigms provide a model for the development and treatment of anxiety. This study explores the association between maladaptive cognitive styles and post-extinction ratings of fear, arousal and unpleasantness in a differential fear conditioning paradigm, over and above trait anxiety. The study uses two samples of individuals who took part in a comparable fear conditioning task and completed the Intolerance of Uncertainty Scale and the Ambiguous Social Situation Interpretation Questionnaire (n$\sim$200). Findings confirm the association between anxiety and maladaptive cognitive styles but also indicate a unique association between post-extinction affective ratings and maladaptive cognitive styles, with implications for personalised treatment for anxiety.

23. **Christine van Vliet**[1,2], **Ann Meulders**[1,2], **Linda Vancleef**[2], **Johan W.S. Vlaeyen**[1,2]: Acquisition and subsequent loss of pain-related avoidance behaviour and its effects on fear and pain

[1]*Katholieke Universiteit Leuven, Belgium* | [2]*Maastricht University, The Netherlands*

To date, not much research has studied the potential detrimental effects of losing control over pain on the report of fear and pain. We want to investigate whether avoidance of a painful movement and loss of previous avoidance, changes the fear of noxious stimulations and whether these changes also influence pain. This study used a sample of 60 participants. Participants moved their arm to a target location using a programmable robotic arm. Three trajectories led to the target location and participants were divided into two groups. For the experimental group, participants learned that they can control a painful stimulus by avoiding certain movements (acquisition phase), but later their control over pain was removed (loss-of-avoidance phase). For the yoked group, participants never had control over the painful stimulus. Verbal ratings of fear and pain were assessed as well as re-calibrations of the painful stimulus. We found support for the hypothesis that loss of avoidance results in a lower pain threshold and higher pain ratings for experimental group but not for the yoked group. We did not find higher fear ratings during loss-of-avoidance for experimental group.

24. **Bram Vervliet**[1]: The Unbearable Lightness of Avoiding

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Different experimental procedures have been developed over the years to study the biobehavioral mechanisms of avoidance and to capture individual differences in avoidance with the aim of delineating mechanistic deficits that lead to excessive avoidance. One pertinent question is whether individual differences in avoidance frequency emerge when avoidance is costly or non-costly. High costs may squash individual differences by suppressing avoidance in all participants, low costs may squash individual differences by inflating avoidance in all participants. This poster will integrate several of my avoidance experiments and discuss the effects of non-costly avoidance, avoidance with monetary costs, and avoidance with costs of different amounts of meaningless points. In these experiments, avoidance was greatly reduced with any form of cost, even a single meaningless point. I look forward to discussing with you (1) the motivational properties of the electrical shock that we typically use in human fear conditioning studies, and (2) the validity of a meaningless point as a model for real-life costs in avoidance.