



# Emotion regulation and delusions

*Emotionsregulation und Wahn*

Dissertation zur Erlangung des Doktorgrades  
der Naturwissenschaften (Dr. rer. nat.)

dem Fachbereich Psychologie  
der Philipps-Universität Marburg

vorgelegt von

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Marburg an der Lahn, 2011

Vom Fachbereich Psychologie  
der Philipps-Universität Marburg (Hochschulkenziffer 1080)  
als Dissertation am \_\_\_\_\_ angenommen.

Erstgutachterin: \_\_\_\_\_

Zweitgutachter: \_\_\_\_\_

Tag der mündlichen Prüfung: \_\_\_\_\_

## **Acknowledgement**

This thesis would not have been possible without the support from many. First of all, I am thankful to my supervisor Tania. Her scientific competence and enthusiasm manifested itself in numerous discussions and extensive feedback, which essentially contributed to this dissertation project – thank you! I am also grateful to Winfried for his profound advice and support.

I owe my deepest gratitude to my office mate Tobias who mindfully accepted my strange habits for years. Furthermore, I want to thank all my colleagues, with a special reference to Eva, Marie-Luise and Michael, for their moral and practical support. My diploma thesis students Claudia, Verena and Anna contributed lots of energy, time and competence to this dissertation project. Thank you!

I also owe special thanks to the German National Academic Foundation that made this dissertation project possible in the present form. The foundation did not only provide a doctorate scholarship and travel grants, but also thought-stimulating summer schools and great meetings.

My deepest thanks go to my friends and family. Without you I would have never made it! Ulla, although my mere expression of thanks does not suffice, I would like to thank you for your personal support and never-ending patience at all times. Anna, Annika and Frank, our daily “group therapy sessions” saved my day a million times – thank you so much! Erik, Michael and Sebastian, chatting on science and beyond with you has been incredibly enriching. Ann and Mareike, going for a beer after work with you has always been a great pleasure. Alfons, Waltraud and Theresa, last but not least, I want to thank you for all the background support!



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## Summary

Mounting evidence suggests a causal role of negative emotion in delusions (Ben-Zeev, Ellington, Swendsen, & Granholm, in press; Lincoln, Peter, Schäfer, & Moritz, 2009). Particularly, fluctuations in anxiety and self-esteem seem to trigger delusional ideation (Thewissen et al., 2011). Consequently, the ability to down-regulate negative emotions is likely to help to prevent or reduce delusional ideation. Despite the clear theoretical relevance, emotion regulation strategies such as *reappraisal* (i.e. changing the perspective on a situation in order to modify emotional responses) or *expressive suppression* (i.e. inhibiting facial expressions of emotions; ‘poker face’) have not been researched in delusions so far.

The present dissertation project fills this gap by investigating emotion regulation in paranoia- and delusion-prone samples. Study 1 revealed bivariate and multivariate associations between emotion regulation difficulties and paranoia-proneness (Westermann & Lincoln, 2011). Study 2 experimentally demonstrated that delusion-prone individuals had difficulties in successfully applying the emotion regulation strategy reappraisal while watching anxiety-eliciting pictures, but not in applying expressive suppression (Westermann, Rief, & Lincoln, submitted). Furthermore, unsuccessful emotion regulation was correlated with state delusional ideation exclusively during reappraisal. The potentially maladaptive nature of reappraisal in delusion was further corroborated in study 3 (Westermann, Kesting, & Lincoln, in press). Under social stress, paranoia-prone individuals who habitually use reappraisal experienced an increase in state paranoia.

Taken together, the present dissertation project provides subclinical evidence for specific difficulties in applying the generally helpful and adaptive emotion regulation strategy reappraisal. A working model of emotion regulation in delusions that incorporates a vulnerability-stress-approach, cognitive models of positive symptoms and the process model of emotion regulation (Freeman, Garety, Kuipers, Fowler, & Bebbington, 2002; Garety, Kuipers, Fowler, Freeman, & Bebbington, 2001; Gross, 2008; Zubin & Spring, 1977) was proposed in order to stimulate further theory-driven research in populations with clinically relevant delusions. A preliminary clinical implication might be that reappraisal in social high-stress situations should be applied with caution in delusion-proneness.

## **Zusammenfassung** [*German summary*]

Eine zunehmende Anzahl von Studien legt einen kausalen Einfluss von negativen Emotionen bei Wahn nahe (Ben-Zeev, Ellington, Swendsen, & Granholm, in press; Lincoln, Peter, Schäfer, & Moritz, 2009). Insbesondere Schwankungen von Angst und Selbstwertgefühl scheinen Wahnideen anstoßen zu können (Thewissen et al., 2011). Die Fähigkeit, negative Emotionen aktiv zu verringern bzw. herunter zu regulieren, könnte folglich hilfreich beim Abschwächen oder Verhindern von Wahnideen sein. Dennoch wurden Emotionsregulations-Strategien wie *Neubewertung* (d.h., die Perspektive auf eine Situation ändern, um die emotionale Reaktion zu beeinflussen) oder *Unterdrückung des Gefühlsausdrucks* bei Wahn bisher nicht erforscht.

Das vorliegende Dissertationsprojekt schließt diese Lücke, indem Emotionsregulation bei Wahn- und Paranoia-Neigung untersucht wird. Studie 1 zeigte bivariate und multivariate Zusammenhänge zwischen Paranoia-Neigung und Schwierigkeiten bei der Emotionsregulation auf (Westermann & Lincoln, 2011). Studie 2 demonstrierte, dass Wahnneigung mit Schwierigkeiten bei der Anwendung von Neubewertung in bedrohlichen Situationen einhergeht (Westermann, Rief, & Lincoln, submitted). Bei der Unterdrückung des Gefühlsausdrucks war das nicht der Fall. Zudem standen Emotionsregulations-Schwierigkeiten ausschließlich beim Neubewerten mit paranoiden Gedanken in Zusammenhang. Die möglicherweise maladaptive Natur von Neubewertung bei Wahn wurde in Studie 3 bestätigt (Westermann, Kesting, & Lincoln, in press). Bei sozialem Stress konnte ein Anstieg von paranoiden Gedanken nur bei Personen nachgewiesen werden, die Neubewertung als Emotionsregulationsstrategie häufig anwenden und zu Paranoia neigen.

Auf Grundlage von sub-klinischen Stichproben weist das Dissertationsprojekt insgesamt auf spezifische Schwierigkeiten bei der Anwendung der üblicherweise hilfreichen und adaptiven Emotionsregulations-Strategie Neubewertung bei Wahn hin. Ein Arbeitsmodell der Emotionsregulation bei Wahn, welches einen Vulnerabilität-Stress-Ansatz, kognitive Modelle von Positivsymptomen und das Prozessmodell der Emotionsregulation integriert (Freeman et al., 2002; Garety et al., 2001; Gross, 2008; Zubin & Spring, 1977), wird postuliert um weitere Theorie-geleitete Forschung in Stichproben mit klinisch relevantem Wahn anzustoßen. Als vorläufige praktische Implikation kann gelten, dass Neubewertung in sozial belastenden Situationen bei Wahnneigung nur mit Vorsicht angewendet werden sollte.

## 1. Introduction

### 1.1 Delusions

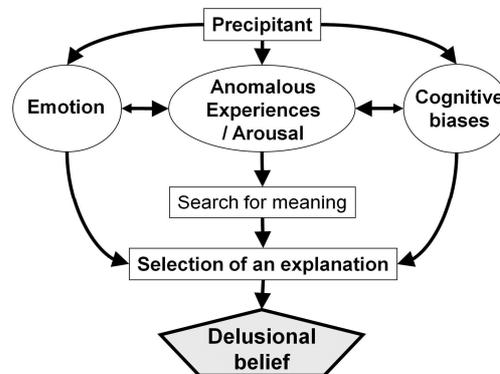
#### *1.1.1 Definition and characterization*

Delusions are “erroneous beliefs that usually involve a misinterpretation of perceptions and experiences” (DSM-IV-TR; American Psychiatric Association, 2000; p. 299). Severe delusional beliefs are unfounded, firmly held, resistant to change, preoccupying, distressing, interfering with social functioning and involving personal reference (Freeman, 2007; Oltmanns & Maher, 1988). The content of delusional beliefs is manifold, but the most frequent themes are persecution (e.g. “I’m being watched by the secret service”) and grandiosity (e.g. “I’m Napoleon”) (Appelbaum, Robbins, & Roth, 1999).

Even though delusions are a symptom that can accompany various disorders such as affective disorders (e.g. severe depression), neurological disorders (e.g. dementia or epilepsy) and personality disorders (e.g. paranoid personality disorder), they are most common and most often investigated in the domain of schizophrenia and schizophrenia spectrum disorders (Freeman & Garety, 2004). Schizophrenia is a disorder with very heterogeneous symptoms. Symptoms such as delusions and hallucinations are considered as an excess of normal psychological functioning and thus have been categorized as ‘positive’, while symptoms such as anhedonia, flat affect or social withdrawal are considered as decrease in normal functioning and thus have been defined as ‘negative’ (Olbrich, Fritze, Lanczik, & Vauth, 2009). Delusions are predominant in the paranoid subtype of schizophrenia, but are marginal in the hebephrenic/disorganized and the catatonic subtype (American Psychiatric Association, 2000). The life time prevalence of schizophrenia is about one percent and very stable across different regions of the world and cultures (Jablensky, 1995). Bio-psycho-social models of schizophrenia include multiple factors such as genetic predispositions, dopaminergic neurotransmitter dysfunction, birth complications and stress sensitivity (Olbrich et al., 2009).

Cognitive models of psychosis and persecutory delusions emphasize the psychological mechanisms that underlie psychotic symptoms such as delusions and hallucinations. Garety et al. (2001) propose that the most common route to positive symptoms begins with a triggering event that leads to emotional disturbances, unspecific

anomalous arousal and perceptions as well as a distortion of cognitive processes in predisposed individuals (see Figure 1). The unspecific arousal is supposed to initiate a search for meaning, which finally leads to the selection of an explanation of the anomalous experiences as externally caused and personally significant.



**Figure 1:** Cognitive model of psychosis (Garety, Kuipers, Fowler, Freeman, & Bebbington, 2001) adapted for delusions.

Over the last decades considerable progress in the psychological treatment of delusions and psychotic symptoms has been achieved (Wykes, Steel, Everitt, & Tarrier, 2008). Consequently, cognitive behavioral interventions for psychosis are being implemented in the general health systems (e.g. NICE, 2002) and demonstrate to be not only efficient, but also effective in psychotherapeutic standard settings (Lincoln et al., submitted). However, the effect sizes regarding positive symptoms are moderate (Garety, Bentall, & Freeman, 2008). Thus, a deeper understanding of underlying processes of delusions is needed in order to improve the interventions.

### *1.1.2 The role of emotions in delusions*

The importance of emotions in delusions is corroborated by four routes that will be outlined in detail in this paragraph: (1) emotional disturbance is a risk factor for delusions and precede them by years, (2) stress and emotions can trigger delusional ideation within minutes, (3) theoretical accounts of delusions highlight the role of emotions, and (4) individuals with delusions evaluate emotions as central.

Emotional disturbances occur prior to and parallel to psychotic symptoms. Specifically, schizophrenia, which is often accompanied by delusions, is associated with risk factors resembling emotional disturbance (trait anxiety, social anxiety, neuroticism). Also, positive symptoms including delusions are associated with affective symptoms such

as anxiety and depression (Freeman & Garety, 2004). Consequently, Freeman and Garety summarize that “the ubiquitous presence of emotional disturbance prior to full symptoms [...] is the key finding with regard to its potential influence on delusions [...]” (2004; p. 28).

Over the last decade, a growing body of evidence indicates that emotional processes can trigger delusional ideation. Thewissen and colleagues (Thewissen et al., 2011) have demonstrated that increases in anxiety and decreases in self-esteem precede paranoid ideation using an experience-sampling approach. Moreover, the impact of experimentally induced stress on paranoid ideation was mediated by changes in anxiety (Lincoln et al., 2009), and anxiety seems to affect an implicit measure of paranoid ideation (Westermann & Lincoln, 2010). Furthermore, experimentally induced social stress impacted on paranoia via changes in self-esteem in a non-clinical sample (Kesting, Bredenpohl, Klenke, Westermann, & Lincoln, in revision).

As described above, the cognitive model of psychosis emphasizes the role of emotions in the development and maintenance of delusions (Garety, Kuipers, Fowler, Freeman, & Bebbington, 2001). Emotions are considered to bias the selection of a delusional explanation of unspecific arousal, to amplify cognitive biases and to be involved in the maintenance of delusions.

Finally, qualitative studies highlight the role of emotions in delusions. For instance, when asked about the meaning of the word ‘paranoia’, an individual with delusions replied: “[5 seconds pause] It means fear.” (Boyd & Gumley, 2007, p. 9). Thus, emotions are integral to delusion to such a great extent that individuals with persecutory delusions describe delusions as an emotion and not as a belief.

Altogether, emotions such as anxiety or diminished self-esteem do not only accompany (persecutory) delusions, but are likely to trigger delusional ideation. Thus, emotions and emotional processes are integral to delusions.

### *1.1.3 Cognitive biases*

Several cognitive biases are being investigated in the domain of delusions (for an extensive review, see Freeman, 2007). The reasoning bias called ‘Jumping to Conclusions’ is characterized by hasty decision-making. In the traditional beads task paradigm, the participants have to decide whether drawn colored beads (e.g. red and blue) are from one container (e.g. with 80% red beads) or the other (with 80% blue beads) by

inferring on their color (Garety, Hemsley, & Wessely, 1991). Jumping to Conclusions is typically defined as deciding after one or two beads. A recent meta-analysis suggests that the presence of delusions is reliably associated with Jumping to Conclusions (Fine, Gardner, Craigie, & Gold, 2007). Investigations using a social variant of the beads task indicate that self-relevant, emotionally significant situations additionally support hasty decision-making (Lincoln, Salzman, Ziegler, & Westermann, 2011; Westermann, Salzman, Fuchs, & Lincoln, in revision). Thus, emotional processes are likely to amplify the Jumping to Conclusions reasoning bias. Furthermore, ‘Theory of Mind’ deficits (Frith, 2004; Mehl, Rief, Mink, Lüllmann, & Lincoln, 2010) and an external-personal attribution bias (Bentall, Corcoran, Howard, Blackwood, & Kinderman, 2001; Fear, 1996) are also discussed as cognitive factors that support (persecutory) delusional ideation.

#### *1.1.4 Continuum hypothesis*

The assumption that psychotic symptoms including delusions lie on a continuum with normality is called the continuum hypothesis. An extensive systematic review on evidence for a continuum of psychotic experiences – rather than a dichotomy between ‘normal’ and ‘ill’ – supported the continuum hypothesis (van Os, Linscott, Myin-Germeys, Delespaul, & Krabbendam, 2009). For example in a study by Freeman and colleagues, 10% to 20% of the participants from a non-clinical population had paranoid ideation with strong conviction and significant distress (Freeman et al., 2005). Also in line with the continuum hypothesis are findings from studies that compare groups with low and high subclinical paranoid ideation and clinically relevant paranoid ideation, such as a study investigating emotion perception by Combs, Michael and Penn (2006). As expected, the high subclinical group had worse emotion perception scores compared to the low subclinical groups, but better scores than the group with clinically relevant paranoid ideation. In sum, as Freeman states for persecutory delusions, “the evidence is substantial enough to conclude that studying non-clinical paranoid experiences will inform the understanding of clinically severe persecutory delusions” (Freeman, 2007, p. 431).

What are the pros and cons of research using subclinical samples? Subclinical samples help to avoid otherwise confounding factors such as psychotropic medication, neuropsychological deficits and other secondary effects of illnesses. Moreover, findings

of delusional ideation in non-clinical populations help reducing stigma when used for psycho-education purposes in psychotherapy. Additionally, a subclinical research agenda helps to encourage the use of experimental paradigms to investigate the underlying mechanisms of delusions. This is particularly relevant in emotion research. The experimental investigation of emotional processes in delusions or other positive symptoms requires the induction of emotions. Although there is evidence that research in individuals with schizophrenia is ethically viable (Taylor et al., 2010), paradigms using emotion induction techniques should be investigated in subclinical samples prior to their use in clinical samples. This procedure ensures that individuals with delusions are not stressed unnecessarily. Self-evidently, a subclinical single-symptom research approach has the drawback that the generalizability of findings in subclinical populations has always to be proven in samples with clinically relevant symptoms.

## **1.2 Emotion regulation**

### *1.2.1 What is emotion regulation?*

*Emotion regulation* can be defined as “a set of processes whereby people seek to redirect the spontaneous flow of their emotions” (Koole, 2009, p. 6). Specifically, emotion regulation refers to the ability to “influence which emotions we have, when we have them, and how we experience and express these emotions” (Gross, 2008, p. 497). Down-regulating anxiety in a job-interview in order to perform well and finally get the job is an example of applied emotion regulation. Generally, emotion regulation is related to physical and mental health (Gross & Muñoz, 1995; Sapolsky, 2007) as well as relationship satisfaction (Murray, 2005).

Importantly, the term emotion regulation has to be distinguished from other concepts in the context of emotion research. First, emotion regulation describes the regulation of emotions, not the regulation by emotions (Gross, 2008; but for another view, see Kappas, 2011). Second, difficulties in emotion regulation are often abbreviated by the term *emotion dysregulation*. Thus, emotion dysregulation in the sense of emotion regulation difficulties is not equivalent to affective or emotional lability or instability<sup>1</sup>.

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<sup>1</sup> For example, the Affect Lability Scales (Harvey, Greenberg, & Serper, 1989) assesses labile affect with questions such as “I shift back and forth from feeling perfectly calm to feeling uptight and nervous”.

### 1.2.2 *The process model of emotion regulation*

A recent and research-stimulating model of emotion regulation is the process model of emotion regulation by Gross (2008). The model posits that an emotional response develops in four steps. First, an individual enters a *situation*. Several aspects of the situation gain *attention*. Those aspects are integrated into a meaning by an *appraisal*. This meaning elicits an emotional *response*. For example, there may suddenly appear a snake during a stroll in a forest (situation). The snake, its shape and color as well as its direction of movement are attended, but not the lovely flowers by the wayside any more (attention to specific aspects). Supported by biological predispositions, the snake is appraised as a threat (appraisal produces meaning). This meaning elicits subjective anxiety, a heightened heart rate and the action tendency to run away (response).

In his generic model of emotion regulation, Gross (2008) postulates five families of emotion regulation strategies that influence the development of an emotion prior to and during the situation-attention-appraisal-response-cycle. The first family is called *situation selection*. It refers to the deliberate selection of situations in order to influence ones emotions. For example, visiting a theatre to watch a funny comedy in order to increase joy, or to avoid a forest known for its dangerous animals in order to keep the level of anxiety down, are emotion regulation strategies in the sense of situation selection. The second family refers to *situation modification*. It includes strategies that modify the (physical) situation directly in order to change its emotional impact<sup>2</sup>. For example, in order to reduce anxiety one could let down the blinds during a thunderstorm, or pick a stick from the forest floor that could serve for self-defense. *Attentional deployment* is the third family of emotion regulation strategies. Avoiding eye contact or distracting oneself by counting backwards dampens the relevance of aspects of a situation that may otherwise appear threatening. In this regard, attentional deployment is an internal “situation selection” strategy. *Cognitive change* is the fourth emotion regulation family. Changing the appraisal or meaning of a situation, for example by reappraisal, refers to this family. Reappraising the forest-snake-situation such that the snake is probably not harmful because there are no harmful snakes in the German forests is an example for cognitive change. The fifth and last emotion regulation strategy family is called *response modulation* and refers to the influence of physiological, experiential and behavioral

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<sup>2</sup> With regard to coping, this family of strategies is called „problem-focused coping“ (Lazarus & Folkman, 1984).

responses. Examples of response modulation are hiding one's expression of emotions (expressive suppression) or drinking alcohol.

The first four families of emotion regulation strategies are *antecedent-focused*, because they work prior to the full development of an emotional response (situation selection and modification, attentional deployment, and cognitive change). The last family, response modulation, is accordingly called *response-focused*.

To date, the best studied emotion regulation strategies are reappraisal (changing the interpretation of a situation in order to influence emotions) and expressive suppression (hiding one's feelings). A steadily growing body of research demonstrates that reappraisal decreases the subjective level of negative emotions such as anxiety or disgust (e.g. Gross, 1998; Hofmann, Heering, Sawyer, & Asnaani, 2009; Urry, 2009). Also, the use of reappraisal often decreases physiological arousal assessed by electrodermal activity or heart rate (e.g. Gross, 1998; Hofmann et al., 2009). Expressive suppression often successfully prevents emotional responses from being facially expressed (Gross, 1998), but is accompanied by higher physiological arousal or memory deficits (Gross & Levenson, 1997; Hofmann et al., 2009; Richards & Gross, 2000) as well as negative social consequences (Butler et al., 2003).

### *1.2.3 Emotion regulation and psychopathology*

In the DSM-IV-TR (American Psychiatric Association, 2000), the majority of disorders has at least one symptom that involves emotional disturbance. Thus, difficulties in emotion regulation seem to be inherent to psychopathology almost self-evidently. This speculation has been supported by extensive empirical evidence within the last decades. A recent comprehensive meta-analysis of emotion regulation strategies across several forms of psychopathology included 114 studies. The meta-analysis came to the conclusion that in particular maladaptive emotion regulation strategies such as rumination and avoidance are associated with psychopathology (Aldao, Nolen-Hoeksema, & Schweizer, 2010). For example, rumination was correlated to overall psychopathology ( $r=0.40$ ,  $p<0.001$ ), whereas reappraisal was inversely correlated to psychopathology ( $r=-0.14$ ,  $p<0.001$ ).

### 1.3 Emotion regulation and delusions

#### 1.3.1 *Why is emotion regulation relevant for delusions?*

At least three lines of argumentation point to the relevance of emotion regulation in delusions. First, as discussed above, (negative) emotions such as anxiety seem to trigger delusional ideation. Thus, the effective down-regulation of negative emotions should consequently reduce delusional ideation. Second, the cognitive models of positive symptoms and persecutory delusions propose a ‘search for meaning’ which results in form of a delusional belief that may be “reinforced by the relief that comes with an explanation” (Freeman, Garety, Kuipers, Fowler, & Bebbington, 2002b; Garety, Kuipers, Fowler, Freeman, & Bebbington, 2001, p. 337). Furthermore, Freeman and Garety explicitly do not rule out the possibility that delusions may reduce the level of negative emotions (Freeman & Garety, 2004). Thus, delusions may have an emotion regulation function. Third, a growing body of evidence indicates a more frequent use of dysfunctional emotion regulation strategies in patients with psychosis (Livingstone, Harper, & Gillanders, 2009). Due to the fact that persecutory delusions are the second most common symptom in psychotic disorders (Appelbaum et al., 1999), a relationship between delusions and emotion regulation is also likely.

#### 1.3.2 *Preliminary evidence*

Direct evidence of emotional regulation processes being relevant to delusions is remarkably scarce. Nonetheless, there are many studies that provide indirect evidence for emotion regulation processes in the development and maintenance of delusions. In the following, these studies are systematically discussed. Because the process model of emotion regulation is generic to a great extent (Gross, 2008), the findings are discussed according to the emotion regulation stages of this model.

*Situation selection and modification.* The approach and avoidance of situations can be viewed as anticipatory emotion regulation. Interestingly, avoidance is common in the context of persecutory delusions. Within the last month, 78% of patients with persecutory delusions avoided certain situations (Freeman et al., 2007). Moreover, 63% of those patients employed safety behaviors. This can be considered as a modification of a situation in order to regulate one’s emotions.

*Attentional deployment.* The intentional shift of attention in order to influence emotions is an instance of the attentional deployment strategies in the process model of emotion regulation. Regarding visual attention, for example Green, Williams and Davidson (2003) reported that delusions are accompanied by a controlled attentional shift away from visual properties of negative facial expressions using visual scanpath analysis. Moreover, Jones and Fernyhough (2008) demonstrated that shifting the attention away from thoughts (i.e. thought suppression) in interaction with anxiety is associated with paranoia-like thoughts.

*Cognitive change.* Interestingly, there are no investigations of emotion regulation strategies involving cognitive change such as reappraisal in the domain of delusions<sup>3</sup>. However, in a way delusion-like thoughts could be considered as (maladaptive) reappraisals of essentially neutral situations (reappraisal of a stranger as CIA agent). Apart from this speculative but theory-driven assumption, several factors associated with delusions may have the potential to disturb reappraisal processes. All cognitive biases and problems (Freeman, 2007) could impact on the generation of reappraisal of situations. For example Jumping to Conclusions may favor the selection of the first reappraisal which is not necessarily the best.

*Response modulation.* Influencing facial expressions of emotions (e.g. ‘poker face’) is one common response modulation emotion regulation strategy called expressive suppression. In a subclinical sample, paranoid ideation and expressive suppression were significantly correlated (Henry et al., 2009).

Taken together, the findings discussed above indicate that individuals with (persecutory) delusions use emotion regulation strategies. Many of them are potentially maladaptive if used inflexibly, for example excessive avoidance behavior.

## **2. The present dissertation project**

### **2.1 Open research questions and aim of the studies**

Both empirical findings and theoretical considerations suggest that emotion regulation is relevant to delusions. Emotions have a pivotal role in the formation and maintenance of delusions as they can trigger delusional ideation (Thewissen et al., 2011).

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<sup>3</sup> Except for studies that used the Thought Control Questionnaire, whose subscale “reappraisal” measures the reinterpretation of thoughts (e.g. ‘I try and re-interpret the thought’), not the reinterpretation of situations (Taylor, Graves, & Stopa, 2009).

Thus, preventing or decreasing negative emotions by means of adaptive emotion regulation strategies is desirable. Unfortunately, direct empirical investigations of emotion regulation in delusions are remarkably scarce. Broadening our understanding of the underlying processes of delusions is likely to help to improve cognitive behavioral interventions for delusions.

Anxiety is a highly relevant emotion in delusions and particularly persecutory delusions. Furthermore, social stress that leads to anxiety and other negative emotions seems to have an important role in delusions, too. The negative impact of social stress lasts longer in individuals with schizophrenia (Perry, Henry, Sethi, & Grisham, in press) and the fluctuations in self-esteem mediate the impact on paranoia (Kesting et al., in revision). Consequently, Perry and colleagues suggest that „future studies should examine the use of regulatory strategies and personal responses to stigma as potential mediators in the maintenance of the negative effects of social exclusion“ (Perry et al., in press, p. 9).

As a starting point of emotion regulation research in delusions, the overarching goal of the present dissertation project is to address three open research questions.

- 1) Is the concept of emotion regulation empirically relevant to delusions? (paper 1)
- 2) Which emotion regulation strategies are difficult to apply for delusion-prone individuals? In particular, are there specific difficulties in using the well investigated emotion regulation strategies *reappraisal* and *expressive suppression* to regulate anxiety? (paper 2)
- 3) Do the emotion regulation difficulties generalize to more complex situations that involve social stress? (paper 3)

## **2.2 Technical outline of the dissertation project**

Within the scope of this project, three independent studies were conducted. The first study was a correlative, exploratory self-report questionnaire study regarding general emotion regulation difficulties in persecutory delusions. It was conducted with a self-programmed online survey system using the programming language PHP ([www.php.net](http://www.php.net)) and the database server MySQL ([www.mysql.org](http://www.mysql.org)).

The second, experimental study addressed difficulties in applying the emotion regulation strategies expressive suppression and reappraisal in subclinical delusional ideation. The experimental paradigm was implemented with the software NeuroBS Presentation® (<http://www.neurobs.com/>). Because the study required the recording of

physiological data as objective measure of emotion regulation success (finger pulse and skin-conductance) using a standard biofeedback equipment, some technical challenges had to be overcome. Primarily, the synchronization of events in the experiment (i.e., presentation of a picture stimulus) with the physiological data stream had to be realized with a custom-built interface program using MS Visual Basic®.

The third study investigated the effects of habitual emotion regulation using expressive suppression and reappraisal on state paranoia under social stress. The experiment was conducted via the internet, using the professional survey system Unipark© (www.unipark.de). Social stress was operationalized as social exclusion in the virtual ball-tossing game Cyberball (K. D. Williams & Jarvis, 2006). Because the most recent official Cyberball version was not compatible to the modern internet browsers, I reprogrammed an alternative Cyberball version using Javascript and HTML<sup>4</sup>.

### 3. Summaries of the studies

#### 3.1 Summary of paper 1

Westermann, S., & Lincoln, T. M. (2011). **Emotion regulation difficulties are relevant to persecutory ideation.** *Psychology and Psychotherapy: Theory, Research and Practice*, 84(3), 273-287.

##### 3.1.1 Background

Research on delusions has been focusing on cognitive factors but has somewhat neglected emotional factors. However, negative emotions precede and accompany persecutory delusions. Recently, a number of studies revealed that negative emotions can trigger persecutory ideations and mediate the effect of stress on persecutory ideation. Thus, the ability to down-regulate negative emotions might be beneficial in paranoid ideation. However, there is indirect evidence for emotion regulation difficulties in paranoid ideation that stems from various studies. For example, persecutory ideation is associated with lower emotional awareness.

The study aims at exploring the association of potential emotion regulation difficulties and persecutory ideation, while taking general psychopathology as well as

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<sup>4</sup> Meanwhile, this reprogrammed Javascript version of Cyberball was also used in other studies (e.g. emotion regulation in obesity, UKE Hamburg; emotion regulation in Asperger syndrome, Stanford University). It can be requested from S. Westermann, mail@stefanwestermann.com.

positive, negative and depressive symptoms into account. In line with the continuum hypothesis and due to its pilot character, the study employs a subclinical sample.

### *3.1.2 Method*

A total of N=151 participants took part in the online-conducted questionnaire study (mean age M=31.6, SD=10.2; 85% female). Emotion regulation difficulties as well as the frequency of paranoid thoughts and other measures of psychopathology were assessed with several questionnaires. The Difficulties in Emotion Regulation Scale was used to assess emotion regulation difficulties. The Paranoia Checklist assessed the frequency of paranoid thoughts and the associated conviction and distress. The Community Assessment of Psychic Experiences provided a measure of subclinical positive, negative and depressive symptoms. The data were analyzed with bivariate correlations (Bonferroni-corrected) and canonical correlational analysis.

### *3.1.3 Results*

The frequency of and conviction in paranoid thoughts correlated with almost all assessed emotion regulation difficulties significantly and medium in effect, except for the Lack of Awareness scale. When statistically controlling for the shared variance with general psychopathology using partial correlations, the frequency of and conviction in paranoid thoughts were exclusively associated to impulse control difficulties ( $r=0.24$ ,  $p<0.01$  and  $r=0.17$ ,  $p<0.05$ ).

A canonical correlational analysis explored multivariate associations between the emotion regulation difficulties and persecutory ideation, other positive symptoms and general psychopathology. Two factor pairs (i.e., multivariate correlations) were significant. All emotion regulation difficulties and all measures of psychopathology loaded on the first factor pair. The second factor was comprised of impulse control difficulties and (inversely) non-acceptance of emotional responses as well as the frequency and conviction regarding paranoid thoughts and positive symptoms.

### *3.1.4 Discussion*

Persecutory ideation was accompanied by various emotion regulation difficulties. This is in line with the use of more dysfunctional emotion regulation strategies in schizophrenia. However, the difficulties were not specific to persecutory ideation: other positive symptoms were accompanied by emotion regulation difficulties, too, and a large

proportion of the shared variance was explained by general psychopathology. Whereas persecutory ideation was not related to emotional awareness, it was associated with lower emotional clarity. Thus, individuals with high persecutory ideation tend to know that they feel something, but do not exactly know what. Such a situation neatly resembles the unspecific arousal that is seen as important in the cognitive model of paranoia.

Further research on emotion regulation in persecutory and delusional ideation is necessary to shed light on the underlying mechanisms. In particular, experimental approaches are needed to investigate emotion regulation strategies.

### **3.2 Summary of paper 2**

Westermann, S., Rief, W., & Lincoln, T. M. (submitted). **Emotion regulation can backfire in delusions - Subclinical evidence for specific difficulties in the reappraisal of threat.**

#### *3.2.1 Background*

Mounting evidence suggests that anxiety triggers delusional ideation. Consequently, the ability to down-regulate anxiety in terms of emotion regulation would be beneficial to reduce delusions. However surprisingly, emotion regulation strategies have not been investigated in delusions.

Two emotion regulation strategies have been extensively investigated in the past and might also be particularly relevant to delusions. Reappraisal describes the deliberate cognitive change of the initial appraisal of a situation in order to impact on the emotional response. Whereas adaptive reappraisal has shown to be able to down-regulate negative emotions and thus delusional ideation, maladaptive reappraisal theoretically has the means to support delusional ideation by generating delusion-like reappraisals. Expressive suppression involves the deliberate modification of an already fully formed emotional response by inhibiting facial and other behavioral expressions of emotions (e.g. poker face). In contrast to reappraisal, the habitual use of expressive suppression is positively associated with psychopathology. Moreover, expressive suppression increases physiological arousal and thus may trigger delusional ideation.

The study aims at testing whether delusion-prone individuals have difficulty to successfully apply reappraisal, and whether unsuccessful reappraisal is associated with

heightened state delusional ideation. Additionally, the assumption that expressive suppression supports state delusional ideation is tested.

### 3.2.2 Method

The sample consisted of 86 undergraduate students (mean age  $M=21.2$ ,  $SD=2.99$ ; 97% female) who filled in measures of delusion-proneness and participated in an experimental paradigm. During the experiment, anxiety was elicited by means of aversive stimuli from the International Affective Picture System and according sound effects. The research design involved two independent variables: *delusion-proneness* (between-subject; quasi-experimental) and *emotion regulation strategy* (within-subject; reappraisal, expressive suppression, and the control condition view). The dependent variables were subjective emotion regulation success (self-report) and objective emotion regulation success (heart rate and skin-conductance level). Furthermore, state delusional ideation in terms of current conviction in paranoia-like thoughts was assessed via self-report. Data was analyzed by means of multilevel analysis in order to avoid the categorization of delusion-proneness and the associated loss of information.

### 3.2.3 Results

The induction of anxiety was successful according to the manipulation check. Generally, reappraisal and expressive suppression were more effective compared with the control condition that involved viewing. However, the interaction of delusion-proneness and emotion regulation was also significant ( $F(2,158)=3.70$ ,  $p=0.027$ ). This was due to the fact that delusion-proneness had a negative impact on emotion regulation success only during reappraisal but not during expressive suppression compared to viewing. Regarding objective emotion regulation success, the instructed strategies had no significant impact ( $p>0.30$ ).

Lower emotion regulation success was accompanied by higher state delusional ideation exclusively during reappraisal ( $r=-0.20$ ,  $p=0.01$ ), but not during viewing or suppression ( $p>0.45$ ). Moreover, higher state delusional ideation was significantly associated with higher heart rate in the reappraisal condition, but with higher skin-conductance level in the expressive suppression condition.

### 3.2.4 Discussion

Delusion-prone individuals had difficulties to successfully apply reappraisal, but not to apply expressive suppression. Moreover, emotion regulation success was (negatively) associated with state delusional ideation exclusively in the reappraisal condition.

Reasoning biases, Theory of Mind deficits and negative interpersonal schema might negatively impact on the reappraisal process. Also, maladaptive reappraisals may act as precursors of delusion-like thoughts. Improvements of cognitive behavioral therapy for delusions from an emotion regulation perspective are discussed.

## 3.3 Summary of paper 3

Westermann, S., Kesting, M.-L., & Lincoln, T. M. (in press). **Being deluded after being excluded? - How emotion regulation deficits in paranoia-prone individuals impact on state paranoia during experimentally induced social stress.** *Behavior Therapy*. [accepted August 1<sup>st</sup>, 2011]

### 3.3.1 Background

Negative emotions are ascribed a key role in paranoia. One source of negative emotions in paranoia is social stress. An important type of social stress is social exclusion, which affects self-esteem and basic human needs. Paranoia is accompanied by objective social exclusion due to prejudices of unpredictability and danger as well as by perceived exclusion due to negative interpersonal schema.

Consequently, the need for adaptive emotion regulation strategies under social stress is apparent. However, specific strategies in the context of social exclusion in delusions have not been investigated so far. The emotion regulation strategy 'reappraisal' involves the active change of the interpretation of a situation in order to modify the subsequent emotional response. Overall, reappraisal has shown to be effective to down-regulate a range of negative emotions. Thus, adaptive reappraisal may prevent the increase of state paranoia in socially stressful situations regardless of paranoia-proneness (hypothesis 1a). However, maladaptive reappraisal also has the means to support state paranoia in paranoia-prone individuals (hypothesis 1b) when reappraisal fails. In contrast, expressive suppression describes the deliberate inhibition of facial and other behavioral

expressions of emotions. Expressive suppression heightens physiological arousal and thus is likely to increase state paranoia in paranoia-prone individuals (hypothesis 2). The aim of the study is to test the hypotheses by employing a subclinical sample in order to avoid confounding factors such as medication or neuropsychological deficits.

### 3.3.2 Method

Via the internet, N=116 participants took part in the study (mean age  $M=28.52$ ,  $SD=7.85$ ; 72% female). The between-subject design was comprised of the independent variables *social stress*, *paranoia-proneness* (quasi-experimental), and *habitual emotion regulation* (reappraisal or expressive suppression; quasi-experimental). The dependent variable was state paranoia.

Social stress was experimentally induced with a virtual Cyberball ball-tossing game, in which the participants throw a ball to or catch a ball from two other virtual players (see paper 3, Figure 1). Whereas in the stressful social exclusion condition the participant never gets the ball, she or he receives the ball in the social inclusion control condition about every third time. Paranoia-proneness was measured with the Paranoia Checklist frequency scale, and state paranoia with an adapted six item state version of the Paranoia Checklist. Habitual emotion regulation was assessed with the Emotion Regulation Questionnaire.

The data was analyzed with linear regression analysis including higher-order interaction terms. For the competing hypotheses 1a and 1b, reappraisal was entered as habitual emotion regulation variable. For hypothesis 2, expressive suppression was entered. Post-hoc analyses of interaction effects were conducted with simple slope analyses.

### 3.3.3 Results

The manipulation check revealed that the social stressor Cyberball successfully induced negative emotions. The three-way interaction of social stress, paranoia-proneness and habitual reappraisal was significant ( $p=0.01$ ; overall model:  $F(8,107)=4.15$ ,  $p<0.001$ ,  $R^2=24\%$ ). The decomposition of the interaction term was in line with hypothesis 1b and revealed that the impact of reappraisal on state paranoia in the social stress condition was moderated by paranoia-proneness. Specifically, reappraisal was accompanied by increased state paranoia under social stress in paranoia-prone individuals. The model with

habitual use of expressive suppression as independent variable was not significant ( $F(8,107)=1.23, p=0.289$ ).

### *3.3.4 Discussion*

The hypothesized impact of maladaptive reappraisal on state paranoia under social stress in paranoia-prone individuals could be confirmed (hypothesis 1b). However, expressive suppression had no effect on state paranoia. Building on the process model of emotion regulation by Gross and incorporating the cognitive model of paranoia and a general vulnerability-stress-framework, an emotion regulation model of delusions is proposed. The model describes the impact of reasoning biases and other delusion-relevant factors on the reappraisal process and postulates a positive feedback loop (vicious circle).

Some preliminary clinical implications might be drawn from these findings. For example, using reappraisal during stressful situations may be maladaptive in paranoia-proneness and paranoia. Thus, cognitive restructuring under high levels of stress would be counterproductive. However, this has to be tested in samples with clinically relevant levels of paranoia.

## **4. Discussion**

Emotions play a critical role in delusions as they can precede and trigger delusional ideation (Lincoln et al., 2009; Thewissen et al., 2011). Recently, Ben-Zeev and colleagues corroborated the causal role for negative emotional states in delusions and suggested that “persecutory ideation may be addressed indirectly by interventions targeting anxiety and depression” (Ben-Zeev, Ellington, Swendsen, & Granholm, in press, p. 1). The present dissertation project has provided a starting point for developing such interventions, based on an emotion regulation approach.

Three key findings were obtained. First, delusion-prone individuals were less successful in applying the emotion regulation strategy reappraisal in threatening situations. Additionally, reappraisal was associated with state delusional ideation both in threatening and socially stressful situations. Second, delusion- and paranoia-prone individuals had no difficulties applying expressive suppression. Third, various general emotion regulation difficulties were associated with persecutory delusions and other positive symptoms.

In the following paragraphs, the findings are discussed in light of other lines of research and integrated into a process model of emotion regulation in delusions. Prior to drawing clinical implications and presenting future lines of research, shortcomings of the dissertation project are taken into account.

## **4.1 Emotion regulation difficulties in delusions**

### *4.1.1 Reappraisal*

The habitual use of reappraisal was not significantly associated with delusion- or paranoia-proneness in the present studies. This is in line with two studies that assessed delusion severity and habitual reappraisal and found no significant association between them (Henry, Rendell, Green, McDonald, & O'Donnell, 2008; Perry, Henry, & Grisham, 2011). Additionally, no group differences were revealed in most of the five studies that investigated differences in habitual use of reappraisal in samples with psychosis or schizophrenia compared to healthy controls so far. Whereas three studies did not find group differences (Badcock, Paulik, & Maybery, 2011; Henry et al., 2008; Perry et al., 2011), two studies found a significant or marginally significant less frequent use of reappraisal (Livingstone et al., 2009; van der Meer, van't Wout, & Aleman, 2009). Thus, despite the often replicated negative correlation between habitual reappraisal and psychopathology in other clinical disorders (Aldao et al., 2010), habitual reappraisal seems to be independent from symptom severity in delusions. Thus, individuals with severe delusions who use reappraisal should occur more frequently than, for instance, individuals with a severe depressive episode who use reappraisal.

However, in paranoia-prone individuals the habitual use of reappraisal was accompanied by an increase in state paranoia under social stress in study 3. Moreover, delusion-prone individuals had difficulties to apply reappraisal to threatening stimuli, and state paranoia was exclusively associated with lower emotion regulation success in the reappraisal condition. Therefore, reappraisal seems to have the potential to become maladaptive in delusions. This is in stark contrast to the generally adaptive nature of reappraisal: In various experiments in healthy samples, reappraisal effectively reduced anxiety, sadness and disgust (e.g. Gross & John, 2003; Hofmann et al., 2009; Richards & Gross, 2000). With regard to anxiety disorders, Cisler, Olatunji, Feldner, and Forsyth summarize that “reappraisal generally leads to less self-reported negative affect, less physiological reactivity, and less startle” (2010, p. 72). For instance, the instructed use of

reappraisal prior to an exposition therapy in claustrophobia lowered negative affect (Kamphuis, 2000). Also, more frequent use of reappraisal during an intervention predicted decreases in PTSD symptom severity (Boden, Westermann, et al., submitted). In the domain of depression research, reappraisal is also negatively correlated with symptom severity (Aldao et al., 2010; Garnefski, 2002), and the ability to effectively apply reappraisal seems to be a protecting factor against depressive reactions due to stress (Troy, Frank H Wilhelm, Shallcross, & Mauss, 2010). To sum up, reappraisal is indeed an adaptive strategy in many forms of psychopathology such as anxiety and depressive disorders, but seems to have the potential to become maladaptive in delusions. Given that individuals with severe delusions are as likely to use reappraisal as individuals without delusions, the use of reappraisal may not be a protective factor. In fact, maladaptive reappraisal might support the development and maintenance of delusions.

In study 1, some general emotion regulation difficulties were identified that might negatively impact on reappraisal and other emotion regulation strategies. In particular, persecutory ideation and other psychotic symptoms were accompanied by a *lack of emotional clarity*. Difficulties to identify feelings have been also found in patients with schizophrenia (van der Meer et al., 2009). The effect of low emotional clarity on emotion regulation has been investigated in some studies. The ability to differentiate between negative emotions has been shown to be associated with emotion regulation in healthy college students (Feldman Barrett, Gross, Christensen, & Benvenuto, 2001). Also, difficulties to identify the type of emotion have been shown to impair successful reappraisal in posttraumatic stress disorder (Boden, Bonn-Miller, Kashdan, Alvarez, & Gross, submitted). Therefore, the difficulties in applying reappraisal in delusional ideation might partly be due to a lack of emotional clarity.

Taken together, individuals with delusion-proneness or delusion seem to use reappraisal comparatively often. Because reappraisal might be maladaptive in delusions, frequent use of reappraisal is not necessarily advantageous. A lack of emotional clarity may impair successful reappraisal.

#### 4.1.2 Expressive suppression

In both studies expressive expression was expected to support delusional ideation via an increase in physiological arousal and negative emotions. However, no impact of habitual or instructed use of expressive suppression on delusional ideation has been

revealed. This is in line with a study that investigated emotion regulation in schizophrenia and found no association of expressive suppression and delusions (Henry et al., 2008). Interestingly, the study also revealed that flat affect is not accompanied by an overuse of expressive suppression, but a lack of amplification of expressive behavior.

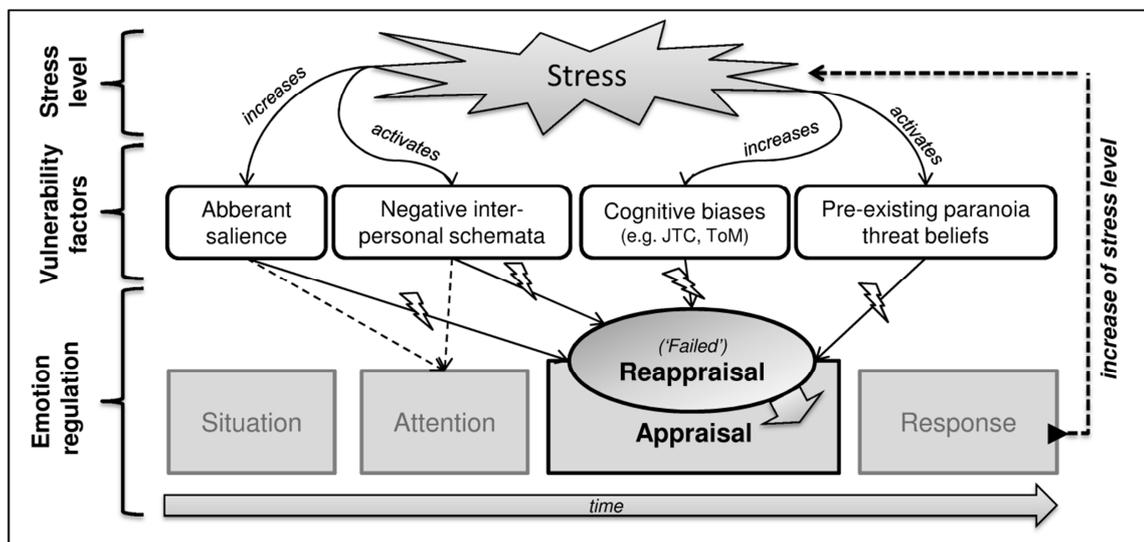
It has to be noted that the actual success of using expressive suppression in terms of facial behavior has not been measured in the present studies. Thus, the possibility that the intensity of facial behavior would have been correlated with delusion-proneness or delusional ideation cannot be excluded. However, in experimental as well as in experience sampling studies, the self-reported emotions were relevant to delusional ideation. Both theoretically and empirically, facial or other expressive behavior per se seems to be not relevant to delusional ideation and other positive symptoms. Thus, it is unlikely that the present findings regarding expressive suppression are limited by a lack of a direct measure of emotional expressiveness to a great extent.

#### **4.2 Integration of findings: The emotion regulation model of delusions**

The formulation of a working model of emotion regulation in delusions helps to integrate empirical findings from delusion and emotion regulation research as well as theoretical accounts from both fields. Additionally, a viable working model allows predictions that exceed the explanatory value of existing theories. However, a theory derived from data out of a subclinical research project is speculative in nature. Nonetheless, the advantages of a clearly formulated and testable model, the integration of findings at a process level, and the stimulation for further research may justify the risk of an over-fitting model. This being said, the emotion regulation model of delusions postulated in paper 3 will be shortly summarized, further research will be outlined and finally the model will be critically discussed.

Embedded in a vulnerability stress model (Zubin & Spring, 1977), the present working model incorporates the process model of emotion regulation (Gross, 2008) by specifying the underlying process with data and ideas from delusion and schizophrenia research (e.g. Freeman et al., 2002). The main idea of the model is that individuals with delusions or delusion-proneness try to regulate their emotions with the same means as healthy individuals. This premise allows applying the general process model by Gross. Even though the principal mechanisms of emotion regulation are assumed to be identical in individuals with and without delusions, those mechanisms are likely to be affected by known cognitive and emotional disturbances in delusions.

The present studies highlighted the role of reappraisal in delusions. Thus, we will take a closer look at this particular strategy. The cognitive reappraisal process has to establish a rival meaning of a situation. Consequently, Jumping to Conclusions, Theory of Mind deficits, pre-existing delusional beliefs, negative interpersonal beliefs or aberrant salience may negatively impact on the reappraisal process by constraining the set of available meanings (see Figure 2). For example, it is likely that Jumping to Conclusions interferes with the reappraisal process. When an alternative meaning of a situation is hastily selected, it may not be the most adaptive one. Additionally, negative interpersonal schema may attract the reappraisal process, such that an adaptive reappraisal involving positive interpersonal expectations is hard to construct.



**Figure 2:** Emotion regulation model of delusions

It is widely assumed that those biases are amplified or activated by stress, and recently some of those assumptions could empirically be corroborated. Stress seems to increase Jumping to Conclusions in delusion-prone individuals (Keefe & Warman, 2011; Moritz et al., in press), and the impact of anxiety on state paranoia was mediated by Jumping to Conclusions (Lincoln, Lange, Burau, Exner, & Moritz, 2010). Consequently, a vicious circle may emerge. Cognitive biases may hinder successful emotion regulation; unsuccessful emotion regulation may lead to more stress; stress amplifies cognitive biases; finally, adaptive emotion regulation becomes even more difficult (see the positive feedback loop in Figure 2). There are some empirical indications for such a vicious circle. Lin and colleagues found that subclinical psychotic experiences predicted emotion-oriented coping (e.g., worrying) over time and, vice versa, emotion-oriented coping

predicted psychotic experiences over time (Lin et al., in press). Furthermore, a bidirectional dose-response relationship of affective dysregulation and psychotic experience was revealed in a 10 year prospective longitudinal study (van Rossum, Dominguez, Lieb, Wittchen, & van Os, 2011). Additionally, an initially higher stress response due to heightened stress reactivity may trigger the vicious circle even more (Myin-Germeys & van Os, 2007).

Importantly, other emotion regulation stages such as attentional deployment or response modification are likely to be relevant to delusions, too. For example, the affect regulation model of substance abuse in schizophrenia (Blanchard et al., 1999) can be conceptualized as response modification *sensu* Gross. Taken together, the model describes how the known vulnerability factors of psychosis might impact on the process of emotion regulation in delusions and impede successful reappraisal.

#### *4.2.1 Predictions*

The emotion regulation model of delusions allows some novel predictions that exceed the explanatory value of the existing cognitive models (Freeman et al., 2002; Garety et al., 2001). First of all, it assumes that delusional beliefs are not primarily held because of reasoning biases and are no direct reflections of emotional disturbances, but are attempts to regulate emotions by means of reappraisal. Thus, delusional beliefs might have the hedonic function to regulate emotions (Boden & Gross, in press). Consequently, confirmatory or disconfirmatory evidence that could change the conviction in a (delusional) belief is expected to generate emotional responses. This is not in line with recent cognitive model that propose a unidirectional path from arousal to belief formation.

Second, during high-stress situations the use of reappraisal may be maladaptive. Consequently, alternative emotion regulation strategies such as distraction or mindful acceptance may be more beneficial. However, prior to and after such situations reappraisal may be a strategy that is as powerful and sustainable as it is in other forms of psychopathology.

Third, the positive feedback loop consisting of maladaptive reappraisal, stress, and the amplification of reasoning and other biases as well as dysfunctional schema explains the successive development of delusional belief in greater detail. For example, substance

that impact on physiological arousal such as caffeine or sleep deprivation may accelerate the feedback loop.

Fourth, interactive effect between different stages such as attentional deployment and cognitive change can be taken into account. For instance, a hypervigilant attention to potential threat is likely to foster maladaptive reappraisal. Moreover, the combination of reappraisal and expressive suppression or other response-focused strategies may be particularly disadvantageous.

#### *4.2.2 Mathematical modeling*

Because the emotion regulation model of delusions is precisely defined, a mathematical description and analysis may be feasible. Because many relevant variables vary over time (e.g. emotions and appraisals), the model constitutes a dynamical system. Moreover, the dynamics are likely to be non-linear. For example, a reappraisal of a situation probably emerges abruptly. Thus, the process character of the model highlights the utility of non-linear modeling. Such non-linear dynamical systems consist of one or more differential equations that precisely describe the development of a dynamical system over time.

What would be a good starting point for modeling emotion regulation in delusions? The present studies suggest that reappraisal plays an important role in delusional ideation; consequently, modeling reappraisal is straightforward. A viable mathematical model of reappraisal would provide clues under which circumstances reappraisal is adaptive or maladaptive. Additionally, several classes of maladaptive reappraisal could be mathematically identified and empirically tested. Borrowing from biological population dynamics models such as the Lotka-Volterra model (compare to Townsend, Begon, & Harper, 2009), one could model meanings of situations as different species in a shared environment. The inter-specific competition between two species may help to model the inter-appraisal competition between an appraisal and a reappraisal. Thus, the parameters under which a reappraisal competes over an appraisal could be systematically investigated.

For example, such a population-based model predicts that an appraisal and a reappraisal will coexist when their level of competition is low. Thus, when a reappraisal is based on other aspects of situations than the appraisal, it can coexist in terms of a stable equilibrium. However, when the reappraisal and the appraisal compete for the same

aspects of a situation, one of them will be competitively excluded by the other according to the Lotka-Volterra model. With regard to delusions, a “delusional reappraisal” may first be based on an unspecific internal arousal and thus coexist with other appraisals. However, there might be a point where the delusional appraisal gains such a high capacity (i.e., conviction) that it competitively eliminates initial appraisals and other reappraisals.

#### *4.2.3 Critical discussion and alternative explanations*

A main interpretation of the findings from paper 2 and 3 is that maladaptive reappraisal can precede delusional ideation. This is also one of the integral assumptions of the postulated emotion regulation model of delusions. Nevertheless, at least three alternative interpretations are possible. First, delusional ideation could always precede reappraisal. Thus, the initial appraisal would be delusional, and later reappraisal in non-delusional ways would be difficult. However, this account could not explain why state delusional ideation was exclusively associated with reappraisal. Second, an independent, third factor may account for delusional ideation and maladaptive reappraisal. For example, stress might trigger delusional ideation and impair the reappraisal process. However, this explanation is unspecific and one has to describe in which way stress impact on delusional ideation and reappraisal independently.

Additionally, there is a third alternative explanation for the association of reappraisal and delusional ideation. Counter-intuitively, delusional ideation may be a result of adaptive reappraisal. This would be the case if the down-regulation of negative emotion would not be the exclusive goal of delusion-prone individuals. Although almost all experimental emotion regulation paradigms are based on the implicit assumption that everybody wants to down-regulate negative emotions, this does not necessarily apply to delusional ideation. For example, it is conceivable that successful delusion-like reappraisals increase feelings of self-esteem, but have the ‘side-effect’ of increased anxiety. In line with this, Freeman and colleagues reported that patients who had doubt in their explanations without alternative explanations had lower self-worth compared to patients without doubt (Freeman et al., 2004).

### **4.3 Shortcomings**

The primary shortcoming of the three studies of the dissertation project is the subclinical sampling. The generalization of the findings on clinically relevant levels of delusions is not possible without caution. Moreover, the theoretical model of emotion

regulation in delusion is theory-driven to a great extent, and lacks a robust empirical basis. However, in a recent pilot study with 16 individuals with paranoid schizophrenia and current or past delusions and 19 healthy controls, the individuals with acute or past delusions were significantly worse in applying reappraisal ( $p=0.04$ ), but not in applying the control emotion regulation strategy distraction ( $p=0.10$ ), according to a preliminary analysis (Westermann & Lincoln, in preparation). Furthermore, state paranoia was highly associated with emotion regulation success in the reappraisal condition ( $r=0.45$ ,  $p<0.01$ ), but only marginally associated in the distraction condition ( $r=0.25$ ,  $p=0.06$ ). Thus, despite the small sample size, the main findings of study 2 could be replicated in a clinical sample. Additionally as predicted by the emotion regulation model, negative interpersonal schema (measured with the Brief Core Schema Scale; Fowler et al., 2006) were correlated with difficulty to apply reappraisal in individuals with acute or past delusions ( $r=0.58$ ,  $p=0.03$ ), but there was no significant correlation within healthy participants ( $r=0.35$ ,  $p=0.14$ ).

Furthermore, the specificity of the present findings necessitates discussion. First, the present studies do not allow conclusions whether the reappraisal difficulties are specific to delusional ideation compared to other symptoms within the domain of psychosis. Second, it is not clear whether maladaptive reappraisal can also occur in other disorders such as depression or anxiety. Until now, there is a lack of experimental approaches to emotion regulation in other positive symptoms such as hallucinations. Surprisingly, similar experiments with anxiety- or depressive disorders are also scarce.

However, it is unlikely that maladaptive reappraisal is an exclusive phenomenon in delusions. From a trans-diagnostic perspective, the reappraisal process may be influenced by several factors that may be more or less disorder specific. This is illustrated by the association of general psychopathology with almost any general emotion regulation difficulty in study 1. Moreover, a lack of emotional clarity may be a general, disorder-unspecific factor that impairs reappraisal. However, which specific cognitive and emotional factors impact at which point in the underlying emotion regulation mechanisms is probably very specific for each disorder. The impact of delusion-associated factors has been discussed in the prior section. However, for depression early and automatic attentional biases might be particularly relevant (for an extensive discussion, see Joormann & D'Avanzato, 2010).

Additionally, one cannot rule out the possibility that some participants did not apply the instructed emotion regulation strategies. Moreover, due to the simultaneous assessment of emotion regulation success and state delusional ideation, no conclusions regarding the causal direction of effect can be drawn from the data. Lastly, the high ratio of female participants and selection processes due to the online data assessment in studies 1 and 3 are limitations of the present studies.

#### **4.4 Clinical implications**

The empirical findings of the present dissertation project as well as the emotion regulation model of delusions allow several clinical implications. Due to the subclinical samples of the studies as well as the speculative nature of the model, these implications are preliminary.

An increase of state paranoia was absent in paranoia-prone individuals that do not use reappraisal habitually (paper 3). Moreover, in the non-stressful situation state paranoia was not increased. Thus, it may be beneficial to avoid using reappraisal *during* stressful situations and with high levels of arousal (e.g. after stressful encounters, with sleep deprivation, with high levels of caffeine, etc.). Optimally, reappraisal should take place before stressful situations. Although the recommendation to *not* use reappraisal may sound counterintuitive given the similarity of cognitive restructuring and reappraisal, similar recommendations can be found in clinical handbooks (e.g. Allen, McHugh, & Barlow, 2008, p. 230). However, the beneficial effects have to be corroborated by studies using clinical samples. For example, one could test whether distraction *during* stressful situations is more effective than reappraisal, but reappraisal is more effective than distraction *prior to* stressful situations. Additionally, enhancing emotional clarity by means of a training of emotional competences (Berking, 2007) may be useful to support successful reappraisal and other emotion regulation strategies. According to the emotion regulation model of delusions that highlights the relevance of negative interpersonal schema, schema therapy sensu Young (1994) may be beneficial for remitted or partly remitted patients.

Besides improving reappraisal or cognitive restructuring, complementary emotion regulation strategies could enhance interventions for delusions by reducing negative affect and arousal prior to reappraisal. Innovative interventions such as mindfulness trainings (Chadwick, Taylor, & Abba, 2005; Pinto, 2009) and loving-kindness meditation (Johnson et al., 2011) have already provided promising results in their pilot studies with

patients with schizophrenia. Importantly, there is evidence that mindfulness and reappraisal can support each other over time (Garland, Gaylord, & Fredrickson, 2011). This “positive spiral” might be a useful phenomenon to counteract the assumed positive feedback loop of maladaptive reappraisal and stress in the emotion regulation model of delusions. Besides intervention that target on emotions, generally stress reducing techniques such as progressive muscle relaxation sensu Jacobson (Chen et al., 2009), sleep management trainings (Myers, Startup, & Freeman, 2011) or yoga (Visceglia & Lewis, 2011) have shown to be helpful in schizophrenia, too. Thus, those interventions could also support a more successful reappraisal in individuals with delusions.

#### **4.5 Future research and outlook**

The present findings have to be replicated in samples with clinically relevant levels of delusions. Moreover, the proposed emotion regulation model of delusions could be tested by assessing potential moderators such as cognitive biases or interpersonal schema. Control conditions with other antecedent emotion regulation strategies such as distraction may be helpful to disentangle the effect of general impaired cognitive control in schizophrenia from distinct reappraisal deficits. The timing of emotion regulation and time-dependent interactions of emotion regulation strategies are worth to be investigated, too. For example, the use of mindful acceptance prior to reappraisal is expected to be more effective than using reappraisal alone in patients with heightened stress reactivity. Apart from antecedent emotion regulation, exploring the regulation of emotions that are generated by delusions is an important open research field.

Furthermore, there is a need for innovative, ecologically more valid emotion regulation paradigms. For instance, approaches that integrate experience sampling methods (Myin-Germeys, Birchwood, & Kwapil, 2011) and experimental manipulations would be desirable. When a negative emotion rises during the day, an emotion regulation strategy (or a control task) could be instructed using a handheld computer. At best, novel paradigms would also be able to assess more specific emotion regulation variables than self-reported affect. Regarding reappraisal, neuro-scientific methods such as fMRI may not only measure amygdala and prefrontal activity (Berkman & Lieberman, 2009), but also their functional connectivity during reappraisal. Interestingly, a study using connectivity analysis with psychosis-prone individuals using reappraisal revealed less prefrontal-amygdala coupling (Modinos, Ormel, & Aleman, 2010). Additionally, more

direct assessments of cognitive control such as ego depletion may be adopted to assess reappraisal effort (Baumeister, Vohs, & Tice, 2007).

Finally, emotion regulation interventions such as the training of emotional competences (Berking, 2007) should be piloted in patients with delusions in order to increase emotional clarity, emotion regulation flexibility and adaptive reappraisal. Additionally, the effects of purely cognitive training programs such as the meta-cognitive training (Moritz & Woodward, 2007), which aims at manipulating reasoning biases, on successful reappraisal are worth to be investigated.

Taken together, the present dissertation project provides valuable insights into emotion regulation in delusion by using innovative approaches (Cyberball paradigm; internet-based assessment), multiple indicators of emotion regulation success (self-reports and physiological activity), and appropriate statistical analysis techniques (multilevel analysis, simple slope analysis, canonical correlational analysis). Maladaptive reappraisal is a promising phenomenon to be investigated in individuals with clinically relevant delusions. The clinical implications that arise from the present integration of basic and clinical research may serve to improve psychological interventions for delusions and finally help to reduce and prevent suffering.

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**Appendix**

- Appendix A – Paper 1: Emotion regulation difficulties are relevant to persecutory ideation
- Appendix B – Paper 2: Emotion regulation can backfire in delusions - Subclinical evidence for specific difficulties in the reappraisal of threat
- Appendix C – Paper 3: Being deluded after being excluded? – How emotion regulation deficits in paranoia-prone individuals impact on state paranoia during experimentally induced social stress
- Appendix D – Curriculum vitae, publication list and conference contributions
- Appendix E – Eidesstattliche Erklärung [*declaration of academic honesty*]



## Appendix A: Paper 1

I

Psychology and Psychotherapy: Theory, Research and Practice (2010), in press  
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## Emotion regulation difficulties are relevant to persecutory ideation

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**Objectives.** Persecutory delusions are preceded and accompanied by negative emotions, which may be prolonged or even amplified by difficulties in the ability to regulate negative emotions. This study aims to gain insight into emotion regulation difficulties in persecutory ideation.

**Design and method.** A correlational approach was adopted to explore bivariate and multivariate associations between emotion regulation difficulties and persecutory ideation in a subclinical sample. Furthermore, general psychopathology as well as positive symptoms of schizophrenia were assessed in order to estimate the specificity of emotion regulation difficulties. Data from 151 participants acquired via an Internet-based survey were analyzed.

**Results.** There were substantial bivariate correlations between paranoid ideation and emotion regulation difficulties. However, only impulse control difficulties were specific to persecutory ideation after controlling for general psychopathology. Additionally, a multivariate analysis revealed unexpected positive associations between the acceptance of emotional responses and paranoid ideation as well as positive symptoms.

**Conclusions.** Besides the general difficulties in regulating emotion that are common to many clinical disorders and were associated with overall psychopathology, subclinical psychotic symptoms seem to be specifically associated with certain aspects of emotion regulation. Emotion regulation difficulties are likely to contribute to symptom formation and maintenance in persecutory delusions and might therefore present a valuable treatment target.

Persecutory delusions are defined as fixed false beliefs concerning a malevolent persecutor who intends harm towards oneself (American Psychiatric Association, 1994; Freeman & Garety, 2000). They are one of the most frequent delusions in schizophrenia (Appelbaum, Robbins, & Roth, 1999; Sartorius *et al.*, 1986) and are accompanied by severe distress (Appelbaum *et al.*, 1999; Lincoln, 2007). A cognitive model of persecutory delusions proposed by Freeman, Garety, Kuipers, Fowler, and Bebbington (2002) states that an interaction of arousal, emotional disturbances, and cognitive biases

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promotes a search for meaning which leads to a persecutory threat belief. This belief is maintained via the discarding of disconfirmatory and the obtaining of confirmatory evidence, for example by means of safety behaviour (Freeman *et al.*, 2007). This 'threat anticipation model' (Freeman, 2007, p. 448) hypothesizes that 'persecutory delusions are a direct reflection of [...] emotions' (Freeman *et al.*, 2002, p. 333). However, whereas abundant research has focused on underlying *cognitive* factors, for example jumping to conclusions (e.g., Garety, Hemsley, & Wessely, 1991; Freeman, 2007), theory of mind (e.g., Frith & Corcoran, 1996; Mehl, Rief, Lüllmann, *et al.*, 2010; Mehl, Rief, Mink, *et al.*, 2010), or attributional style (e.g., Kinderman & Bentall, 1997), the underlying mechanisms of *emotional* factors relevant to persecutory delusions have been somewhat neglected.

**Emotions and persecutory delusions**

Nonetheless, recent findings highlight the eminent role of emotional factors in the development and maintenance of persecutory delusions. Anxiety and persecutory delusions seem to be closely connected. Patients with persecutory delusions show high levels of anxiety (Freeman & Garety, 1999; Startup, Freeman, & Garety, 2007) and an association of paranoid ideation and anxiety can also be found in subclinical groups (Fowler *et al.*, 2006; Martin & Penn, 2001). Furthermore, anxiety-evocating stimuli result in an increase in measures of state persecutory ideation (Lincoln, Lange, Burau, Exner, & Moritz, *in press*; Moritz *et al.*, 2009; Westermann & Lincoln, 2010) and stressors seem to have an impact on the level of subclinical persecutory ideation that is mediated by state anxiety (Lincoln, Peter, Schäfer, & Moritz, 2009; Moritz *et al.*, 2010). In the naturalistic Camberwall Walk Study (Ellett, Freeman, & Garety, 2008), patients with persecutory delusions had higher levels of anxiety (and paranoia) after exposure to a deprived urban environment. Moreover, qualitative findings demonstrate that paranoia 'means fear' for patients (Boyd & Gumley, 2007, p. 9).

Persecutory delusions are a common type of delusion in schizophrenia (Appelbaum *et al.*, 1999; Sartorius *et al.*, 1986). Hence, it is worthwhile to also briefly review the findings on negative emotions and schizophrenia, in order to gain broader insight into the associations of persecutory delusions and negative emotions. Emotional disturbances and negative emotions often precede or accompany symptoms of psychosis (Appelbaum *et al.*, 1999; Freeman & Garety, 2003; Horan, Blanchard, Clark, & Green, 2008). Moreover, anxiety is likely to be a risk factor for psychotic symptoms (Krabbendam *et al.*, 2002). Furthermore, the groundbreaking work by Myin-Germeys and van Os (2007) revealed a heightened stress sensitivity in patients with schizophrenia that results in more negative emotions. Thus, even daily hassles can possibly have a strong impact on the current level of anxiety and other negative emotions.

In sum, it can be stated that anxiety often precipitates persecutory delusions or acts as a mediator between stressors and persecutory delusions. Consequently, we argue that the ability to regulate anxiety is likely to play a relevant role. Investigating emotion regulation skills in persons with persecutory delusions is therefore likely to be a promising approach.

**Emotion regulation, schizophrenia, and persecutory delusions**

According to Koole (2009, p. 6), emotion regulation can be 'defined as a set of processes whereby people seek to redirect the spontaneous flow of their emotions'. Emotion

regulation difficulties play an important role in mental health in general as well as in a range of clinical disorders (e.g., Aldao, Nolen-Hoeksema, & Schweizer, 2010; Amstadter, 2008; Werner & Gross, 2010). Despite the potential relevance of emotion regulation to persecutory delusions, to our knowledge this has not been explicitly investigated so far. Nevertheless, several studies provide indirect support for the assumption that emotion regulation is relevant. For example, there is some evidence that thought suppression is correlated with paranoid ideation in anxious states (Jones & Fernyhough, 2008), which possibly reflects a maladaptive emotion regulation strategy in form of attentional deployment (Gross, 2001) that is known to produce paradoxical effects (Wegner, Schneider, Carter, & White, 1987). Moreover, 'safety behaviours are a common form of acting on persecutory delusions' (Freeman *et al.*, 2007, p. 89) and can also be considered as maladaptive emotion regulation strategies. In addition, subclinical persecutory thoughts are possibly associated with lower emotional awareness (Boden & Berenbaum, 2007), which is an essential precondition for emotion regulation.

Beyond these indirect findings several recent studies have investigated emotion regulation in schizophrenia and schizotypy. Livingstone, Harper, and Gillanders (2009) found that patients who had experienced psychosis adopt reappraisal emotion regulation strategies (e.g., 'changing perspective') to a lesser extent than control participants, but as often as patients in a control group with anxiety and mood disorders. Additionally, both patient groups employed more dysfunctional and less functional internal emotion regulation strategies according to self-report data. These findings are corroborated by a study conducted by van der Meer, Wout, and Aleman (2009) that reported similar results in patients with schizophrenia (i.e., more suppression and less reappraisal). Also, patients with schizophrenia seem to have a higher need to control thoughts (Moritz, Peters, Larøi, & Lincoln, 2010), which can be considered as an indication of potentially dysfunctional emotion regulation in terms of attentional deployment. However, Henry and colleagues did not find differences between patients and control participants (Henry, Rendell, Green, McDonald, & O'Donnell, 2008). Moreover, several studies reported difficulties to recognize, identify, and describe feelings, i.e., alexithymia, in persons with schizotypal traits (Larøi, Van der Linden, & Aleman, 2008) or schizophrenia (Cedro, Kokoszka, Popiel, & Narkiewicz-Jodko, 2001), particularly in complex social situations (Baslet, Termini, & Herbener, 2009).

### **Aim of the study**

Anxiety and other negative emotions seem to be crucial to persecutory delusions: they are likely to antecede and accompany symptom development (Lincoln *et al.*, in press; Thewissen *et al.*, 2010), they are probably a mediating factor between stress and paranoid ideation (Lincoln, Peter, *et al.*, 2009), and they are described by patients as kernel of paranoia (Boyd & Gumley, 2007). The heightened negative emotionality in persons vulnerable to persecutory delusions suggests a demand for robust emotion regulation skills. On the other hand, a lack of emotion regulation skills is likely to further increase negative emotions and paranoid ideation. Thus, emotion regulation deficits could possibly be a key factor in paranoid symptom formation.

Some of the studies reviewed above (Fowler *et al.*, 2006; Martin & Penn, 2001) demonstrate that the association between persecutory ideation and anxiety is also present at subclinical levels. This is in line with the continuum hypothesis that implies that the psychology of persecutory delusions can be investigated at subclinical levels (Freeman *et al.*, 2005; Johns & van Os, 2001). Therefore, the present study employs

a subclinical sample. This approach has the advantage of avoiding confounding factors such as medication.

This study aims to gain insight into several open questions: is paranoid ideation associated with difficulties in regulating emotions, and if so, can specific domains of emotion regulation difficulties be identified? Specifically, we expect difficulties in emotional awareness and clarity to be associated with persecutory ideation. Moreover, it is of interest to test whether these difficulties are independent of other positive symptoms and general psychopathology.

## **Method**

### **Participants**

Participants were acquired via e-mails and several public Internet discussion forums with various topics such as life-style, family life, or esotericism but also mental problems. There was no financial incentive for participation. To take part, participants had to agree to the terms, enter their demographic data (age, sex, education, years of education), complete 12 Internet pages with questionnaires, and then enter demographic data again to assure a conscientious and correct participation. People with mental disorders were explicitly neither excluded from participation nor encouraged to take part. The survey was deployed via a custom build Internet application using PHP (version 5.2.6; www.php.net) and MySQL (version 5.0.51a; www.mysql.com). The application took measures to prevent multiple participations (cookies) and required the double fill in of demographic data at the beginning and at the end of the study to identify and exclude fake entries.

To reach a sufficient level of statistical power for the canonical correlational analysis, a sample size of 110 is recommended for 11 variables with good internal consistency (Cronbach's  $\alpha = .80$ ) (Tabachnik & Fidell, 2005, p. 570). However, a larger sample size was assessed to be able to detect rather small effects.

In total, 367 persons accepted the terms and started the survey. Sixty-nine persons aborted their participation at the first step (enter of demographic data), and 36 had to be removed due to technical problems. Furthermore, 111 participants exited the survey prior to completion. The remaining sample consisted of  $N = 151$  participants (23 male, 128 female) with a mean age of  $M = 31.6$  ( $SD = 10.2$ ) and a high educational level (55% high school degree equivalent; years of education:  $M = 16.2$ ,  $SD = 4.1$ ). Due to the fact that participants with mental problems were not explicitly excluded, 24.5% of the sample was in some kind of psychotherapeutic treatment at the time of participation. The participants who aborted the survey did not differ from the sample in regard to age ( $p = .88$ ), level of education ( $p = .99$ ), or years of education ( $p = .17$ ). However, the ratio of men was significantly higher in the non-completer group than in the final sample (25 vs. 15%;  $p < .05$ ).

### **Measures**

#### *Difficulties in emotion regulation*

A German version of the Difficulties in Emotion Regulation Scale (DERS; Ehring, 2010; Gratz & Roemer, 2004) was used to assess emotion regulation deficits. The six subscales are *Non-Acceptance of Emotional Responses* (six items; e.g., 'When I'm upset, I feel guilty for feeling that way:'), *Difficulties Engaging in Goal-Directed Behavior* (five items; e.g., 'When I'm upset, I have difficulty concentrating:'), *Impulse Control Difficulties* (six items; e.g., 'When I'm upset, I lose control over my behaviors:'), *Lack of*

*Emotional Awareness* (six items; e.g., 'I am attentive to my feelings.', reverse-scored), *Limited Access to Emotion Regulation Strategies* (eight items; e.g., 'When I'm upset, I believe that I'll end up feeling very depressed.'), and *Lack of Emotional Clarity* (five items; e.g., 'I have difficulty making sense out of my feelings.'). Higher scores reflect greater difficulties. The internal consistency of the DERS in a study with the German version was adequate to good ( $.76 < \alpha < .87$ ; Ehring, Fischer, Schnülle, Bösterling, & Tuschen-Caffier, 2008).

#### *Persecutory delusions*

To assess the frequency of paranoid thoughts with the associated levels of conviction and distress, the Paranoia Checklist (Freeman *et al.*, 2005) was used (18 items) in a German version (reliability of the German state version: Cronbach's  $\alpha = .86$ ; Lincoln, Peter, *et al.*, 2009). It has good internal reliability and is appropriate to measure subclinical persecutory ideation.

#### *Dimensions of psychosis*

A German version of the Community Assessment of Psychic Experiences (CAPE) assessed dimensions of psychosis (for psychometric properties of the German version, see Lincoln, Keller, & Rief, 2009; Stefanis *et al.*, 2002). Its three subscales are Positive Symptoms (18 items, e.g., 'Do you ever feel as if some people are not what they seem to be?'), Negative Symptoms (14 items, e.g., 'Do you ever feel that you experience few or no emotions at important events?'), and Depressive Symptoms (8 items, e.g., 'Do you ever feel pessimistic about everything?'). Due to the limited timeframe for this on-line survey, only the frequency of psychotic-like events was queried, not the associated distress.

#### *General psychopathology*

The Symptom Checklist - 27-plus (SCL-27-plus; Hardt, 2008) was used to assess an index of general of psychopathology (global severity index, GSI) with good test statistical properties (see Hardt, 2008).

#### **Data analysis plan**

First, all measures were tested for normality. Bivariate correlations between the DERS subscales, the Paranoia Checklist, and the CAPE subscales were computed. Furthermore, partial correlations between these measures, controlled for the influence of general psychopathology, were conducted. The major analysis was a canonical correlation to explore multivariate associations between emotion regulation difficulties and persecutory delusions as well as dimensions of psychosis. Whereas usual product-moment correlations explore associations between two single variables, canonical correlational analyses reveal associations between two sets of multiple variables. This is achieved by finding one linear combination of variables in each set by means of a special algorithm, resulting in two *canonical variates*. The bivariate correlation between this pair of variates is maximal. Simultaneously, all other possible pairs of variates are determined, each of them orthogonal (i.e., independent) to each other. Finally, the resulting canonical variate pairs can be tested for statistical significance (for details of this method, see Tabachnik & Fidell, 2005). All analyses were conducted with SPSS 18.0 (SPSS, 2009).

## Results

Mean scores, standard deviations, ranges, and internal consistencies for all measures are displayed in Table 1. Cronbach's  $\alpha$ s were greater than .80, indicating good internal consistency. Only the DERS lack of emotional awareness had a comparatively small, but nevertheless adequate  $\alpha = .75$ .

**Table 1.** Descriptive statistics for all measures

	Mean (SD)	Range	Cronbach's $\alpha$
<b>DERS<sup>a</sup></b>			
Non-acceptance	15.44 (5.70)	6–30	.86
Goals	14.62 (5.30)	5–25	.91
Impulse	12.72 (4.92)	5–29	.84
Awareness	15.31 (4.57)	5–27	.75
Strategies	19.32 (8.25)	6–40	.93
Clarity	11.93 (4.11)	5–23	.87
<b>Paranoia Checklist</b>			
Frequency	11.82 (10.46)	0–48	.90
Conviction	13.77 (12.57)	0–72	.93
Distress	25.46 (20.31)	0–72	.96
<b>CAPE<sup>b</sup></b>			
Positive	9.50 (5.60)	1–30	.80
Negative	15.24 (6.70)	1–34	.88
Depressive	9.97 (4.20)	1–22	.84
GSI <sup>c</sup>	61.80 (18.76)	28–120	.93

<sup>a</sup> DERS (Gratz & Roemer, 2004).

<sup>b</sup> CAPE (Stefanis *et al.*, 2002).

<sup>c</sup> GSI of the SCL-27-plus (Hardt, 2008).

The DERS means were comparable to those reported by Gratz and Roemer (2004) for a sample of  $N = 357$  healthy participants. Also, the Paranoia Checklist and the CAPE means had approximately the same magnitude as in other studies (Freeman *et al.*, 2005; Lincoln, Peter, *et al.*, 2009). The GSI of the SCL-27-plus was substantially higher in this sample than in a student sample (Hardt, 2008).

All measures were screened and tested for normality via visual inspection of P-P plots and Kolmogorov-Smirnov tests. Several measures were positively skewed and not normally distributed. Consequently, they were square-root transformed following recommendations by Tabachnik and Fidell (2005, pp. 85–86) and tested again for normality. Every transformed measure was normal except for the CAPE depressive subscale ( $p < .05$ ) and the DERS clarity subscale ( $p < .01$ ). These variables were excluded from the canonical correlational analysis and non-parametric methods were used to analyse the strength of their associations.

Bonferroni corrected bivariate correlations between the DERS and the Paranoia Checklist as well as the CAPE scales are presented in Table 2. All emotion regulation difficulties were moderately and significantly correlated with the frequency and conviction of paranoid thoughts ( $r \geq .25$ ;  $p < .001$ ), except for the Lack of Awareness scale ( $r = .21$ ; ns). However, the distress associated with paranoid thoughts was only correlated to the Non-Acceptance of Emotional Responses ( $r = .27$ ;  $p < .001$ ). Furthermore, the Negative and Depressive scales of the CAPE were significantly

**Table 2.** Bivariate correlations between emotion regulation and symptom measures, and general psychopathology

	DERS <sup>a</sup>						GSI <sup>c,d</sup>
	Clarity <sup>b</sup>	Goals	Impulse	Awareness	Non-Acceptance	Strategies	
Paranoia Checklist							
Frequency	.30*	.38*	.45*	.21	.33*	.29*	.55*
Conviction	.25*	.29*	.38*	.15	.31*	.29*	.48*
Distress	.12	.20	.17	.05	.27*	.16	.29*
CAPE <sup>e</sup>							
Positive	.12	.18	.33*	-.05	.11	.18	.40*
Negative	.42*	.50*	.48*	.27*	.50*	.43*	.75*
Depressive <sup>b</sup>	.37*	.33*	.38*	.17	.42*	.42*	.58*
GSI <sup>c</sup>	.44*	.58*	.58*	.24	.57*	.49*	–

Note. \* $p < .05$  (Bonferroni corrected, nominal  $p = .05/42 = .0012$ , two tailed).

<sup>a</sup> DERS (Gratz & Roemer, 2004).

<sup>b</sup> Kendall Tau- $b$  correlation coefficients were computed with this measure.

<sup>c</sup> GSI of the SCL-27-plus (Hardt, 2008).

<sup>d</sup> Significance levels in this column are not alpha adjusted because they are not part of the main analysis.

<sup>e</sup> CAPE (Stefanis *et al.*, 2002).

correlated with every emotion regulation difficulty ( $r \geq .27$ ;  $p < .001$ ), except for association of the Lack of Awareness scale and Depressive scale ( $r = .17$ ; ns). The CAPE Positive scale was only correlated to Impulse Control Difficulties ( $r = .33$ ;  $p < .001$ ).

The GSI was correlated to all DERS, CAPE, and Paranoia Checklist subscales ( $r \geq .24$ ,  $p < .01$ ). Due to the substantial correlations of all variables of interest with general psychopathology, partial correlations were computed, controlling for the GSI. As a result, the only significant correlations between the Paranoia Checklist and the DERS were between Impulse Control Difficulties and the frequency dimension of the Paranoia Checklist (partial  $r = .24$ ,  $p < .01$ ) as well as between Impulse Control Difficulties and the conviction dimension (partial  $r = .17$ ,  $p < .05$ ). The only significant correlations between the CAPE and the DERS was between the DERS Impulse Control Difficulties subscale and the CAPE positive scale (partial  $r = .17$ ,  $p < .05$ ).

A canonical correlation analysis was conducted to reveal multivariate associations between the two sets of variables (set 1 'clinical': SCL GSI, CAPE positive, and Paranoia Checklist; set 2 'emotion regulation': DERS). With all six canonical correlations included,  $\chi^2(25) = 126.20$  ( $p < .01$ ), and with the first canonical removed,  $\chi^2(16) = 26.87$  ( $p < .05$ ). Subsequent  $\chi^2$  tests were not statistically significant ( $p > .36$ ). Thus, the first two pairs of canonical variates accounted for the significant relationships between the two sets of variables. The first canonical correlation was .71 (50% overlapping variance), the second was .33 (11% overlapping variance).

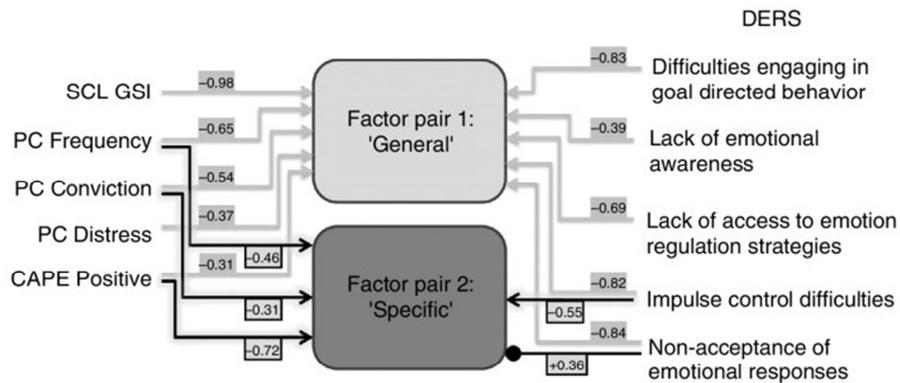
Data on the first two and significant pairs of canonical variates are presented in Table 3 and displayed in Figure 1. With the cut-off correlation set to  $\pm .30$ , all variables of the clinical set 1 were negatively correlated with the first canonical variate ( $-.98$  to  $-.31$ ). In the emotion regulation set, every variable was negatively correlated to the first canonical variate ( $-.39$  to  $-.84$ ). In sum, the first pair of canonical variates indicates that higher frequency, conviction and distress of persecutory thoughts, more psychotic experiences and higher general psychopathology are associated with more

**Table 3.** Correlations, standardized canonical coefficients, canonical correlations, proportions of variance, and redundancies between emotion regulation and delusion variables and their corresponding canonical variates

	First canonical variate		Second canonical variate	
	Correlation	Coefficient	Correlation	Coefficient
<i>Clinical set</i>				
Paranoia Checklist				
Frequency	-.65	-0.18	-.46	-0.61
Conviction	-.54	-0.00	-.31	0.02
Distress	-.37	-0.07	.29	0.61
CAPE <sup>a</sup>				
Positive	-.31	0.16	-.72	-0.79
GSI	-.98	-0.93	-.07	0.42
Percent of variance	.38		.18	Total = 0.56
Redundancy	.19		.02	Total = 0.21
<i>DERS<sup>b</sup> set</i>				
Goals	-.83	-0.46	-.04	0.41
Impulse	-.82	-0.33	-.55	-1.32
Awareness	-.39	0.05	.14	0.02
Non-acceptance	-.84	-0.51	.36	0.81
Strategies	-.69	0.15	-.04	0.09
Percent of variance	.54		.09	Total = 0.63
Redundancy	.27		.01	Total = 0.28
Canonical correlation	.71		.33	

<sup>a</sup> CAPE (Stefanis et al., 2002).

<sup>b</sup> DERS (Gratz & Roemer, 2004).



**Figure 1.** Graphical representation of the findings of the canonical correlational analysis, displaying the multivariate association of clinical (Symptom Checklist general severity index, SCL GSI; Paranoia Checklist, PC; Community Assessment of Psychic Experiences, CAPE), and emotion regulation variable sets (DERS). The structure correlation coefficients are plotted next to the corresponding arrows. Coefficients and arrows with  $|r| < .30$  are omitted with reference to Tabachnik and Fidell (2005).

difficulties in emotion regulation. This factor pair basically reflects the bivariate correlations (see Table 2).

However, the canonical analysis also revealed multivariate associations that exceed the bivariate findings: the second canonical variate in the clinical set was negatively correlated with the frequency of persecutory-like thoughts ( $-.46$ ) and the associated conviction ( $-.31$ ) as well as positive symptoms of psychosis ( $-.72$ ), and the corresponding canonical variate in the emotion regulation set was negatively correlated to 'impulse control difficulties' ( $-.55$ ) and *positively* correlated to 'non-acceptance of emotional responses' ( $.36$ ). Thus, this pair indicates that more frequent (persecutory) delusional thoughts are associated with more impulse control difficulties, but also with *fewer* difficulties in accepting emotional responses.

## Discussion

As expected, this study provides evidence that paranoid ideation is associated with emotion regulation deficits. After taking the level of general psychopathology into account, however, paranoid ideation was only specifically associated to impulse control difficulties. Additionally, the multivariate analysis revealed that the acceptance of negative emotions was also specifically associated with paranoid ideation. However, subclinical positive symptoms were associated with emotion regulation in the same way as paranoid ideation. The findings demonstrate that paranoid ideation is generally associated with a multitude of emotion regulation difficulties and is, as well as other positive symptoms, specifically connected to impulse control difficulties and, to a smaller extent, to the acceptance of negative emotions.

The present findings dovetail with studies that investigated emotion regulation in schizophrenia and found this group of patients to display less functional emotion regulation strategies (Livingstone *et al.*, 2009; van der Meer *et al.*, 2009). Surprisingly however, the expected correlations of the Paranoia Checklist and the CAPE with Lack of Emotional Clarity and Lack of Awareness according to several studies reporting an association of schizotypy and schizophrenia with alexithymia (Baslet *et al.*, 2009; Cedro *et al.*, 2001; Larøi *et al.*, 2008; Livingstone *et al.*, 2009) were equivocal. On the one hand, there were no significant correlations between lack of awareness and paranoid ideation or positive symptoms. On the other hand, a lack of clarity was associated with paranoid ideation, but not with positive symptoms. Thus, paranoid ideation seems to be independent of difficulties regarding the awareness of the presence of emotions, but to be accompanied by difficulty in identifying the type of emotion. In other words, there is diffuse emotional arousal, but it lacks clarity. This interpretation fits into the cognitive model of paranoia (Freeman *et al.*, 2002) that assumes unspecific arousal to be relevant in delusion formation. However, the Lack of Awareness scale had the lowest internal consistency in this study, which might have weakened the magnitude of the effects. Altogether, the findings demonstrate that emotion regulation difficulties seem to be relevant not only to syndromes such as schizophrenia or schizotypy as a whole, but also to the single symptom of paranoid ideation. Noteworthy is also the unexpected finding that the distress associated with paranoid ideation was not significantly correlated to most emotion regulation difficulties: only non-acceptance of emotional responses was associated with higher distress. One possible explanation is that the self-assessment of distress presupposes some degree of emotion regulation competence, especially regarding clarity, and awareness of emotional responses. According to this line of

argumentation, participants with high distress would only have been able to report this distress if they had emotion regulation skills. Such interdependence would have introduced error variance that may have hidden the 'true' correlation. This interpretation is supported by the finding that in participants with a low frequency of paranoid thoughts (median split), the distress rating did not differ between high and low levels of clarity (median split;  $T(76) = 0.73$ ). In contrast, the level of distress reported by participants with frequent paranoid ideation was dependent on the level of clarity ( $T(71) = -2.56$ ;  $p = .01$ ): the less difficulties regarding clarity of emotional responses, the higher the reported distress.

Nevertheless, the relevance of emotion regulation does not seem to be specific to paranoid ideation, since almost no emotion regulation difficulty remained significantly related to paranoid ideation after controlling for general psychopathology. In light of the clear prevalence of emotion regulation deficits in numerous mental disorders (e.g., depression, anxiety disorders, etc.; Aldao *et al.*, 2010) this finding is maybe not overly surprising. Possibly, emotion regulation difficulties are unspecific *per se*. Alternatively, the measures employed in this study were too unspecific to reveal further differential associations. Interestingly, a recent meta-analysis found the relationship between emotion regulation strategies and psychopathology to vary by strategy and disorder (Aldao *et al.*, 2010). Additionally, the inconsistent findings on schizophrenia and emotion regulation (Henry *et al.*, 2008; Livingstone *et al.*, 2009; van der Meer *et al.*, 2009) suggest that there are factors that moderate the relationship. In the case of persecutory delusions, the usually functional emotion regulation strategy of reappraising emotional evocative situations in a neutral or non-threatening manner (Gross & John, 2003) could be corrupted by hasty decisions due to jumping-to-conclusions (Garety *et al.*, 1991; Lincoln *et al.*, 2010), resulting in even more distressing interpretations. In this case, persecutory delusions could be conceptualized as 'failed reappraisal'. The potential impact of jumping-to-conclusions on emotion regulation in persecutory delusions may be reflected in our finding of an association between 'impulse control difficulties' and persecutory ideation. Thus, it is likely that specific associations between emotion regulation difficulties and persecutory ideation can be revealed by employing more complex emotion regulation measures and by including possible moderators such as cognitive biases.

The canonical correlational analysis revealed a positive association between paranoid ideation and a *greater* acceptance of negative emotions. Whereas this might seem counter-intuitive at first, it could be speculatively interpreted in terms of paranoid ideation actually being an emotion regulation strategy. That is, by providing an explanation of anomalous experiences and arousal (cf. Freeman *et al.*, 2002) persecutory delusions could be conceptualized as a dysfunctional strategy that leads to a (short-term) relief (Maher, 1988) and increased sense of control (Melges & Freeman, 1975). These considerations are not new, but an empirically corroborated emotion regulation perspective on this phenomenon could provide valuable implications for theoretical understanding and treatment of persecutory delusions.

Several shortcomings deserve discussion. The sample was affected by a high attrition rate, even though there were no significant differences in the demographic characteristics between participants who only started the questionnaire and those who actually completed it. The high rate of females, the low age and the high educational level of the sample demonstrate its non-representativeness. However, this is a problem that almost every Internet-based survey is confronted with (Birnbaum, 2004). Additionally, a growing body of evidence indicates that data collection via Internet

is comparable to conventional methods (Jones, Fernyhough, de-Wit, & Meins, 2008; Ritter, Lorig, Laurent, & Matthews, 2004) and is feasible even in populations with schizophrenia (Chinman, Young, Schell, Hassell, & Mintz, 2004; Moritz, Peters, *et al.*, 2010). Also, one can argue that a subclinical sample solely assessed by self-report measures is a meagre basis for drawing conclusions about persecutory delusions. However, self-reported data of delusions are concordant to interview-assessed data to a high degree (Lincoln, Ziegler, Lüllmann, Müller, & Rief, 2009) and several studies corroborate the continuity of paranoid ideation from low to clinically relevant (Combs, Michael, & Penn, 2006; Verdoux & van Os, 2002). Although replication in a clinical sample is required, the present findings can presumably offer valuable insight into the association of emotion regulation and clinically relevant persecutory delusions. The variance explained by the second factor pair in the canonical correlational analysis is very small, thus its interpretation remains speculative until replication. Moreover, the reported partial correlations are comparatively small and should also be considered with caution despite their heuristic value. Another shortcoming is the impossibility to deduct causal relationships due to the correlational, cross-sectional design of this study. It is plausible that emotion regulation deficits and paranoid ideation can reciprocally amplify each other, but only more sophisticated research designs can resolve this open question. Additionally, no measure of emotionality was included in the survey to avoid even higher attrition rates. Thus, the potentially moderating influence of the intensity or quality of emotions could not be investigated.

Subsequent studies could overcome these shortcomings by acquiring a sample with clinically relevant levels of persecutory delusions (to corroborate the present findings), assessing of trait and state emotionality (especially anxiety) and adopting a longitudinal (enabling the investigation of dynamics over time) or experimental research design (allowing for deductions of causal relationships). Furthermore, more differentiated measures of emotion regulation could improve the understanding of relevant underlying mechanisms of emotion regulation.

In sum, the findings support the expectation that persecutory delusions are associated with difficulties in emotion regulation. Despite the explorative character of this study with several shortcomings, some preliminary clinical implications can be drawn: the deficits in emotion regulation could be a valuable target for psychological treatment of persecutory delusions, for example by means of educating and training emotion regulation competences (Berking, 2007), by using mindfulness-based interventions (Pinto, 2009) or by integrating the concept into individual disorder models in cognitive behaviour therapy.

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Received 30 March 2010; revised version received 30 June 2010



**Appendix B: Paper 2**

Running head: *Emotion regulation and delusions*

Emotion regulation can backfire in delusions

—

Subclinical evidence for specific difficulties  
in the reappraisal of threat

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Word count (exc. figures/tables): 3.509

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**Abstract** (words: 184)

*Introduction.* Although anxiety plays a key role in delusions, its down-regulation using specific emotion regulation strategies has not been investigated. Reappraisal has been shown to be one of the most effective strategies for healthy individuals and individuals with anxiety disorders. However, individuals with delusions might have difficulties to successfully apply reappraisal. This study therefore tests the effectiveness of reappraisal compared to expressive suppression in individuals with varying levels of delusion-proneness.

*Methods.* Eighty-six healthy participants with different levels of delusion-proneness were instructed to respond to anxiety-inducing stimuli by either using reappraisal or expressive suppression. Subjective emotion regulation success, physiological arousal and state delusional ideation were assessed.

*Results.* Overall, reappraisal was more effective than expressive suppression in regulating anxiety. However, delusion-prone individuals were less successful in applying reappraisal (interaction effect:  $F(2,158)=3.70, p=0.027$ ) and had higher physiological arousal during reappraisal. Additionally, lower success in reappraising threat was accompanied by higher state delusional ideation ( $r=-0.20, p=0.013$ ).

*Conclusions.* Delusion-proneness is accompanied by difficulties in reappraising threat that might contribute to the formation and maintenance of clinically relevant delusions. Preliminary implications for the improvement of CBT for delusions are discussed.

**Keywords:** emotion regulation; delusions; reappraisal; expressive suppression; psychosis; schizophrenia

## 1. Introduction

Mounting evidence suggests that anxiety triggers (persecutory) delusional ideation (Lincoln, Lange, Burau, Exner, & Moritz, 2010; Thewissen et al., 2011; Westermann & Lincoln, 2010) and mediates the impact of stress on delusions (Lincoln, Peter, Schäfer, & Moritz, 2009). Therefore, a successful down-regulation of anxiety is likely to reduce or even prevent delusional ideation. Surprisingly, *emotion regulation* (ER) has so far barely been investigated in individuals with delusions, although ER is known to play an important role in many other forms of psychopathology (Aldao, Nolen-Hoeksema, & Schweizer, 2010). However, preliminary evidence suggests that individuals with paranoia-proneness and other psychotic-like experiences have fewer adaptive ER strategies available to down-regulate negative emotions (Westermann & Lincoln, in press).

The specific ER strategies *reappraisal* and *expressive suppression* are likely to be particularly relevant to delusions. Referring to the process model of ER (Gross, 2002), reappraisal is an antecedent-focused ER strategy and describes the alteration of the appraisal that assigns emotional significance to situations. Thus, reappraisal impacts on emotional responses prior to their full development (e.g. thinking about an examination as an opportunity to show one's strength rather than a threat to self-worth, in order to increase joy and reduce anxiety). *Adaptive* reappraisal seems to be a protective factor against psychopathology in general (Aldao et al., 2010; Gross & Munoz, 1995) and reduces negative emotions (Gross & John, 2003) that may otherwise trigger delusional ideation (Lincoln, Peter, et al., 2009). For example, the spontaneous use of reappraisal during stressful speech reduces anxiety (Egloff, Schmukle, Burns, & Schwerdtfeger, 2006). However, reappraisal has also the means to be maladaptive. According to Gross' model of ER (2002), reappraisal involves changing the meaning of a situation. New meanings are not intrinsically adaptive. Consequently, *maladaptive* reappraisal may create *new* delusional appraisals of situations despite the original intention to down-regulate negative emotions. Additionally, difficulties in effectively using reappraisal might lead to more intense (or less attenuated) anxiety that is likely to increase the risk of state delusional ideation (Lincoln, Lange, et al., 2010; Thewissen et al., 2011). Thus, we expect that unsuccessful reappraisal is associated with higher state delusional ideation.

*Expressive suppression* directly influences already fully-formed experiential, physiological and behavioral emotional responses (e.g. suppress one's facial expression

of anxiety; ‘poker face’) and is thus response-focused. In contrast to reappraisal, expressive suppression seems to be counterproductive if it is used habitually (Aldao & Nolen-Hoeksema, 2010; Aldao et al., 2010). This is found to be due to the increased physiological responses and higher cognitive costs (Gross & Levenson, 1997; Richards & Gross, 2000). Because individuals with schizophrenia have been found to be able to apply expressive suppression as effectively as healthy controls (Henry et al., 2007), we do not expect individuals with delusions to reveal specific problems in applying this strategy. However, expressive suppression maintains or increases negative emotions and physiological arousal (e.g. Gross & Levenson, 1997; Richards & Gross, 2000) that can trigger delusional ideation (Lincoln, Lange, et al., 2010; Thewissen et al., 2011). Thus, we expect expressive suppression to trigger state delusional ideation.

The present study tests whether individuals with high delusion-proneness have difficulties in reappraising threatening situations. In line with the continuum hypothesis that implies that the psychology of delusions can be investigated at subclinical levels (Freeman et al., 2005; Johns & van Os, 2001) and in order to avoid confounding factors such as medication or neuropsychological deficits, the present study investigated the hypotheses in healthy participants with varying levels of delusion-proneness.

## **2. Methods**

### *2.1 Subjects*

Eighty-six undergraduate students took part in the study. By participating they could partially fulfill curriculum requirements. Seven participants had to be excluded because the anxiety-induction failed (threat rating < 10%). The remaining 79 participants had a mean age of  $M=21.2$  years ( $SD=2.99$ , range 19-36 years) and were mainly female (97%).

### *2.2 Design*

The independent variables were *ER strategy* (within-subject: reappraisal, suppression, view) and *delusion-proneness* (between-subject; quasi-experimental). The dependent variables were *subjective ER success* and *physiological arousal* as well as *state delusional ideation* (for details see Measures).

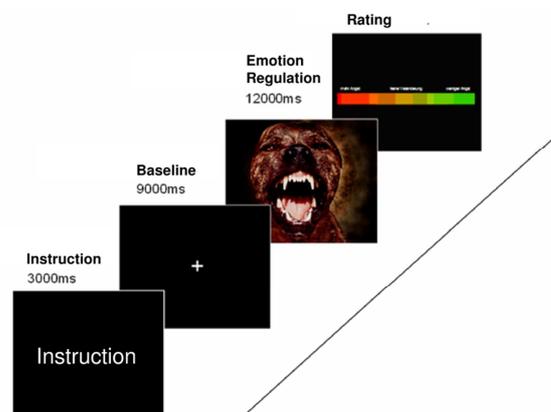
### *2.3 Paradigm*

The participants applied the instructed ER strategies (e.g., reappraisal) while attending to anxiety-inducing stimuli (e.g., a hissing snake). Each anxiety-inducing

stimulus(-compound) consisted of a picture and a sound. We selected the pictures from the International Affective Picture System (Lang, Bradley, & Cuthbert, 1999) according to norms by Mikels et al. (2005) (see footnote <sup>5</sup>). An appropriate sound effect selected from the International Affective Digital Sounds system (Bradley & Lang, 2007) was attached to each picture to facilitate the anxiety induction.

During the presentation of threatening stimuli (e.g. snakes), the participants applied the ER strategies with the aim of reducing anxiety (experimental conditions) or they viewed the stimuli attentively without using specific strategies (control condition). The instructions were: “*View the picture attentively.*” (view), “*View the picture attentively. Try to reappraise your situation realistically. This is only a picture in an experiment and there is no danger to you.*” (reappraisal), and “*View the picture attentively. Suppress the expression of your feelings (e.g. facial expression). An outside person should not know that you are feeling something.*” (expressive suppression).

The experimental paradigm consisted of three blocks that corresponded to the reappraisal, suppression and view conditions. Each block included 18 trials. Within each trial, there were two phases (see Figure 1). In the baseline phase, a reminder of the instructed ER strategy was presented for three seconds (“reappraisal”, “suppression” or “view”), followed by a black screen with a white, centered fixation cross for nine seconds. In the regulation phase, one of the anxiety-eliciting stimuli was presented for 12 seconds (sounds were repeated if necessary). The blocks and the stimuli within each block were shuffled in a random sequence for each participant to avoid order effects. We used the software Presentation® (version 14.109.21.09, Neurobehavioral Systems, Albany, CA, USA) to implement the paradigm.



**Figure 1:** Trial course

<sup>5</sup> Used IAPS stimuli: 1019, 1022, 1030, 1040, 1050, 1051, 1052, 1070, 1080, 1090, 1110, 1113, 1120, 1200, 1201, 1220, 1230, 1240, 1300, 1301, 1302, 1321, 1390, 1540, 1930, 1931, 2100, 2120, 3280, 5970, 5971, 5972, 6370, 8480, 9582, 9584, 9592, 9594

## 2.4 Measures

*Delusion-proneness.* We used the Peter's et al. Delusion Inventory (PDI; Peters, Joseph, & Garety, 1999) to assess the level of delusion-proneness at baseline with 40 items concerning delusion-relevant experiences across the lifespan (e.g. "Do you ever feel as if people seem to drop hints about you or say things with a double meaning?"). The German version has adequate reliability ( $\alpha=0.85$ ) and convergent validity (Lincoln, Keller, & Rief, 2009; Lincoln, Ziegler, Lüllmann, Müller, & Rief, 2009). Importantly, the PDI seems to be unaffected by socially desirable response styles (Galbraith, Manktelow, & Morris, 2008). The present study assessed the frequency of delusional thoughts by adopting a simplified Likert response format (1='definitely not' to 6='extreme').

*Subclinical paranoia.* The Paranoia Checklist (Freeman et al., 2005) measured the frequency of persecutory thoughts and the associated conviction and distress across the lifespan with 18 items at baseline and was used to cross-validate the PDI with an independent measure. The German version of the Paranoia Checklist has shown adequate reliability (Cronbach's  $\alpha=0.86$ ) and convergent validity (Lincoln, Peter, et al., 2009; Lincoln, Ziegler, et al., 2009).

*Habitual emotion regulation strategies.* The Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) was used to measure the habitual use of the ER strategies reappraisal (e.g. "I control my emotions by changing the way I think about the situation I'm in") and expressive suppression (e.g. "I control my emotions by not expressing them") with a Likert scale (1='definitely not' to 7='definitely') at baseline. The German version has demonstrated good reliability (Cronbach's  $\alpha \geq 0.74$ ) (Abler & Kessler, 2009).

*State anxiety, negative emotions and positive emotions.* In order to check the validity of the emotion induction, we used the state version of the Positive and Negative Affect Schedule (German version: Krohne, Egloff, Kohlmann, & Tausch, 1996; PANAS; Watson, Clark, & Tellegen, 1988) prior to (pre) and after each experimental condition. The items are single adjectives (e.g. joyful, nervous or jittery) and the response format is Likert-styled (1='very slightly or not at all' to 5='very much'). We extended the PANAS scale by three items to assess anxiety in a more reliable manner ("worried", "jumpy", and "anxious"). From the total pool of 23 items, we constructed three scales: state anxiety (6 items), state negative emotions (without anxiety; 7 items), and state positive emotions (10 items).

*Subjective ER success.* Differences in the *experiential emotion response* (i.e., subjective feeling) due to the applied ER strategy were directly reported by the participants via a visual analog scale (more anxiety - less anxiety; see Figure 1) at the end of each trial. This rating served as indicator of the subjective ER success (i.e., successful application of the ER strategy).

*Physiological arousal.* We measured the impact of the ER strategies on physiological arousal with the *skin-conductance level* (SCL) and the *interbeat interval* (IBI) of the heart rate. These data were acquired with a Thought Technology ProComp2™ device using the BioGraph Infiniti™ system (blood volume pulse sensor at 256Hz, SCL sensor at 32Hz). Due to technical problems, data could only be analyzed for a subset of n=68 participants with complete physiological datasets.

*State delusional ideation.* Participants rated their current level of conviction of paranoid thoughts after each block (i.e. three times). It was assessed with a percentage visual analog scale (“At the moment, how likely do you think is it that someone intends to do you harm?”) ranging from 0% to 100%.

### 2.5 Procedure

At the beginning, the participants were connected to the physiological sensors and a five minute relaxation phase took place. Then, participants completed the questionnaires and read the experimental instructions. After a training phase that could be extended if required, the participants completed the three experimental blocks á ten minutes with five minute pauses in between. Before the first block and after each block, participants completed the extended PANAS manipulation check questionnaire. After each block, their level of state delusional ideation was assessed. At the end of the experiment all participants were debriefed.

### 2.6 Data analysis

The hypotheses regarding the subjective ER success were tested by means of multilevel linear model (MLM) analysis with the experimental conditions nested in participants. This statistical procedure allows using delusion-proneness as continuous predictor and thereby avoids the problem of having to dichotomize it into groups which is necessary when using ANOVA approaches and leads to a loss of information (DeCoster, Gallucci, & Iselin, 2011). MLM was conducted with SPSS Mixed Models version 18.0

(SPSS Inc., Chicago, IL, USA) according to common guidelines (Field, 2009; Tabachnik & Fidell, 2005).

All variables were centered around the grand mean via z-transformation for the MLM, tested for normality and transformed if necessary. Because the distribution of the measures of state delusional ideation was extremely skewed and could not successfully be transformed, non-parametric tests were used to analyze these variables.

### 3. Results

#### 3.1 Descriptive statistics, prerequisites and manipulation check

The participants had a mean delusion-proneness score of  $M=57.79$  (PDI;  $SD=14.35$ , range 40 to 120). Their habitual ER scores were  $M=4.75$  ( $SD=0.85$ , range 2.67 to 6.83) for reappraisal and  $M=3.00$  ( $SD=1.08$ , range 1.25 to 5.25) for suppression. Delusion-proneness was positively correlated with the frequency, conviction and distress of paranoid thoughts ( $r=0.54$ ,  $r=0.42$  and  $r=0.35$ , respectively; all  $p<0.01$ ), indicating convergent validity. There were no significant associations between delusion-proneness and habitual use of reappraisal or expressive suppression (both  $p>0.476$ ).

In order to evaluate the success and the specificity of the anxiety induction (manipulation check), we conducted three paired t-tests to compare *anxiety*, *negative emotions* and *positive emotions* at baseline and while viewing anxiety-eliciting stimuli. The self-reported anxiety was significantly higher during the anxiety induction ( $t(78)=-4.82$ ,  $p<0.01$ ; view:  $M=2.37$ ,  $SD=1.05$ ; baseline:  $M=1.76$ ,  $SD=0.73$ ), while other negative emotions (excluding anxiety) did not differ ( $t(78)=0.45$ ,  $p=0.65$ ; view:  $M=1.44$ ,  $SD=0.49$ ; baseline:  $M=1.46$ ,  $SD=0.49$ ). In addition, positive emotions were lower during the anxiety induction ( $t(78)=6.16$ ,  $p<0.01$ ; view:  $M=2.76$ ,  $SD=0.70$ ; baseline:  $M=3.21$ ,  $SD=0.73$ ). In sum, the anxiety induction was successful in specifically evoking anxiety and reducing positive emotions, while not affecting other negative emotions.

#### 3.2 Subjective emotion regulation success

The effect of delusion-proneness on the successful application of the ER strategies was analyzed by means of a multilevel analysis which was developed in five steps (see Table 1). Successively, a 'null model' without predictors (M0) was extended by the ER strategy (M1:  $\chi^2(2)=49.62$ ,  $p<0.001$ ), by the PDI to assess the impact of delusion-

proneness (M2:  $\chi^2(1)=4.96$ ,  $p=0.026$ ), and by the interaction of the ER strategy and delusion-proneness (M3:  $\chi^2(2)=7.24$ ,  $p=0.027$ ). Finally, delusion-proneness was modeled as random effect (M4:  $\chi^2(1)=5.98$ ,  $p=0.014$ ). For sake of brevity, only the last model M4 will be reported in detail.

<i>Model</i>	<i>M0:</i> <i>null model</i>	<i>M1:</i> <i>+strategy</i>	<i>M2:</i> <i>+PDI<sup>a</sup></i>	<i>M3:</i> <i>+PDI<sup>a</sup> x strategy</i>	<i>M4:</i> <i>+PDI<sup>a</sup> random</i>
<b>Fixed part predictor</b>					
Intercept	6.13 (1.04)**	1.30 (1.28)	1.37 (1.25)	1.31 (1.24)	1.49 (1.20)
Condition					
Reappraisal		9.81 (1.28)**	9.81 (1.28)**	9.90 (1.26)**	9.90 (1.26)**
Suppression		4.69 (1.28)**	4.69 (1.28)**	4.76 (1.26)**	4.76 (1.26)**
Delusion-proneness			-2.42 (1.07)*	-0.46 (0.73)	0.12 (1.45)
Condition x Delusion-proneness					
Reappraisal (vs. view)				-3.36 (1.33)**	-3.56 (1.33)**
Suppression (vs. view)				-2.31 (1.33)	-2.31 (1.33)
<b>Random Part</b>					
Level 1: RM variance	89.25 (10.04)	65.20 (7.34)	65.20 (7.34)	62.28 (7.01)	62.28 (7.01)
Level 2: Person level var.	56.07 (14.06)	64.09 (13.87)	58.86 (13.05)	59.83 (13.03)	35.46 (12.14)
Deviance ( $\chi^2$ )	1820.74	1771.12	1766.16	1758.92	1752.94
BIC	1837.14	1798.46	1798.96	1802.67	1802.15

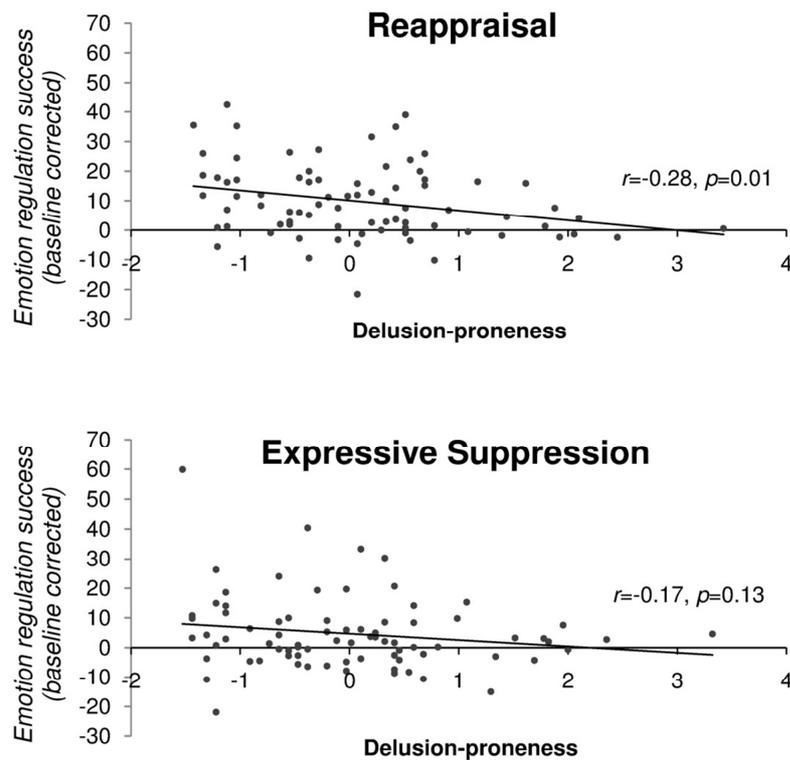
Notes. <sup>a</sup> Peters et al. Delusion Inventory (Peters et al., 1999)

\* $p<0.05$ . \*\* $p<0.01$ .

**Table 1:** Results of the multilevel linear analysis of subjective emotion regulation success

In the final model (M4; see Table 1), the type of ER strategy significantly predicted ER success ( $F(2,158)=31.10$ ,  $p<0.001$ ). Reappraisal and suppression were more effective than viewing (both  $p<0.001$ ). Delusion-proneness did not significantly predict lower ER success (fixed part;  $F(1,48.50)=2.22$ ,  $p=0.142$ ). However, the interaction of delusion-proneness and ER strategy significantly predicted ER success ( $F(2,158)=3.70$ ,  $p=0.027$ ). The interaction arose from a non-significant prediction of ER success by delusion-proneness in the suppression compared to the control conditions ( $p=0.084$ ) and a significant prediction in the reappraisal condition compared to the control condition ( $p=0.008$ ). Thus, delusion-proneness had an impact on ER success only in the reappraisal

condition. A descriptive graphical depiction of the relationship between ER success and delusion-proneness in each ER condition is presented in Figure 2.



**Figure 2:** Relationship between emotion regulation success (corrected for view baseline) and delusion-proneness (z-transformed).

### 3.3 Physiological emotion regulation success

We tested the ER success regarding physiological arousal with two repeated measure ANOVAs with the interbeat interval and the skin-conductance level as dependent variables and the condition as independent variable (view, reappraisal, suppression). Both ANOVAs were not significant (interbeat interval:  $F(2,134)=0.72$ ,  $p=0.49$ ; skin-conductance level:  $F(2,134)=1.18$ ,  $p=0.311$ ). Thus, the ER strategies had no significant impact on the indicators of physiological arousal.

### 3.4 Relationship of state delusional ideation and emotion regulation

The level of state delusional ideation did not differ across the reappraisal, suppression and view conditions (Friedman test;  $\chi^2(2)=0.12$ ,  $p=0.943$ ). However, subjective ER success and state delusional ideation were significantly correlated in the reappraisal condition ( $r=-0.20$ ,  $p=0.013$ ), but not in the expressive suppression or view conditions ( $p>0.453$ ). Thus, individuals with higher delusion-proneness were more

convinced that someone intended to do them harm at the moment, when they were (unsuccessfully) attempting to apply reappraisal.

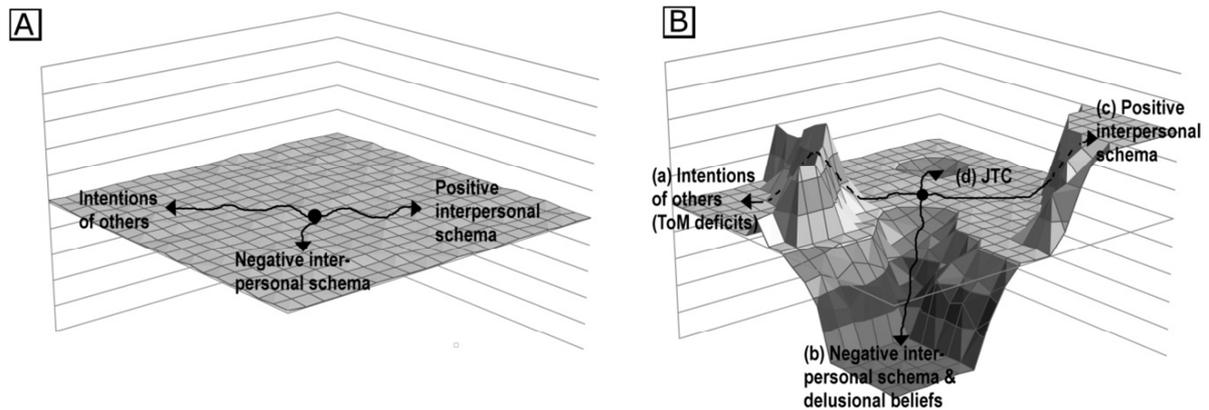
Regarding physiological arousal, we analyzed the correlation of the interbeat interval and the skin-conductance level with the relative state delusional ideation (corrected for state delusional ideation in the view condition). Higher state delusional ideation was associated with shorter interbeat interval in the reappraisal condition ( $r=-0.33$ ,  $p=0.005$ ; i.e. higher heart rate), but not in the suppression condition ( $r=0.06$ ,  $p=0.601$ ). Contrary, higher state delusional ideation was correlated to higher skin-conductance level in the suppression condition ( $r=0.25$ ,  $p=0.040$ ), but not in the reappraisal condition ( $r=0.03$ ,  $p=0.836$ ). Thus, state delusional ideation was accompanied by a higher heart rate in the reappraisal condition and by a higher skin-conductance level in the suppression condition.

#### **4. Discussion**

When faced with anxiety-inducing stimuli, participants with higher delusion-proneness were less successful in applying the usually helpful ER strategy reappraisal. Additionally, lower subjective reappraisal success was accompanied by a higher conviction in delusion-like thoughts. In contrast, the use of expressive suppression was not affected by delusion-proneness, and there was no association of subjective expressive suppression success and the conviction in delusion-like thoughts. However, state delusional ideation and skin-conductance level were correlated during expressive suppression. In sum, we could confirm the hypotheses that individuals with delusion-proneness have difficulties using reappraisal but not in using expressive suppression.

Whereas in the present and other studies the use of reappraisal reduced subjective anxiety and physiological arousal *in general* (Gross, 1998; Hofmann, Heering, Sawyer, & Asnaani, 2009; Richards & Gross, 2000), *in particular* delusion-prone individuals were less successful in adaptively applying reappraisal. Consequently, reappraisal in individuals with high delusion-proneness was accompanied by maintenance of anxiety and an increase in heart rate. Several explanations could account for this effect. Possibly, adaptive reappraisal of threatening situations is hindered by cognitive biases (e.g. Jumping-to-Conclusions, see Fine, Gardner, Craigie, & Gold, 2007), Theory of Mind-deficits (Frith, 2004; Harrington, Langdon, Siegert, & McClure, 2005), pre-existing threat beliefs (Freeman, Garety, Kuipers, Fowler, & Bebbington, 2002), or negative

interpersonal schemata (Lincoln, Mehl, et al., 2010). Specifically, reasoning biases may lead to the hasty selection of an inappropriate reappraisal, Theory of Mind-deficits may make it impossible to generate helpful reappraisal concerning the intentions of others, and negative interpersonal schema as well as pre-existing delusional beliefs may attract the reappraisal process into unhelpful directions. The hypothetical constraints and dynamics of the possible reappraisal ‘space’ of accessible meanings of a situation – taking delusion-relevant factors into account – are graphically depicted in Figure 3.



**Figure 3:** Visualization of the possible reappraisal process in healthy individuals (A) and individuals with delusions (B). Each point on the surface reflects one of the multitude of possible meanings of a situation (in the reappraisal space). Whereas many reappraisals are reachable in healthy individuals from the initial appraisal (black dot) without overcoming obstacles, the reappraisal process in individuals is hypothesized to be constrained by overcoming mountains and by the risk of falling into valleys with maladaptive meanings. Specifically, according to our model, in individuals with delusions, (a) the reappraisals that include reflection on the intentions of others are behind a huge, almost not passable mountain chain due to Theory of Mind deficits, (b) reappraisals that involve negative interpersonal expectations (e.g. paranoid beliefs) are in a valley (and thus attractive), (c) reappraisal that include positive interpersonal expectations (e.g. compassion from others) are on a plateau that is hard to reach, and (d) Jumping-to-Conclusions generates random local valleys that are not necessarily beneficial regarding emotion regulation.

Thus, the attempt to reappraise the threatening situations may generate delusion-like thoughts in delusion-prone individuals (e.g. “They are trying to upset me”) that might increase anxiety and other negative emotions in the long run. This is corroborated by the finding that only when using reappraisal, state delusional ideation was associated with unsuccessful ER. Therefore, maladaptive reappraisal in delusion-proneness might not merely be ineffective, but may even have the means to generate delusional thoughts. Consequently, we qualify this kind of maladaptive reappraisal as *‘failed reappraisal’*. Although negative emotions that emerge from failed reappraisals are expected to be

distressing, they are also a product of a deliberate attempt to reappraise a situation. Thus, the distress might be more acceptable. Indeed, persecutory delusions were both associated with higher distress and greater acceptance of negative emotions in a subclinical sample when controlled for general psychopathology (Westermann & Lincoln, in press). However, due to the correlative nature of our findings, an alternative explanation of the pattern is that higher state delusional ideation comes first and directly compromises the reappraisal attempt. To disentangle those explanations, further experimental studies are needed that manipulate state delusional ideation prior to reappraisal. However, the alternative explanation of state delusional ideation in the first place – prior to any reappraisal attempt – would predict an association of subjective anxiety regulation success and state delusional ideation also in the view and expressive suppression conditions, but this was not the case.

Delusion-prone individuals had no specific difficulties in applying expressive suppression. This is compatible to the findings of Henry et al. (2007) that suggest specific difficulties in amplifying but not suppressing emotional expressions in schizophrenia. Moreover, whereas physiological arousal was positively associated with the current conviction in delusion-like thoughts in the present study, subjective ER success had no impact on state delusional ideation during expressive suppression. This impact of physiological arousal on state delusional ideation is in line with the cognitive model of persecutory delusions that posits that unspecific arousal triggers a search for meaning that finally leads to a paranoid threat belief (Freeman et al., 2002). Interestingly, delusion-proneness had no direct impact on state delusional ideation or skin-conductance level during expressive suppression ( $r=-0.01$ ,  $p=0.89$ ). Thus, higher physiological arousal correlated with increased state delusional ideation, regardless of the level of delusion-proneness. At least three explanations for this pattern are conceivable. First, arousal may be an unspecific stressor in a general vulnerability-stress-model that “activates” many types of psychopathology and is amplified by expressive suppression. Second, higher arousal might have been interpreted by all participants as intended harm by the experimenter, such that our operationalization of state delusional ideation was disadvantageous. Third, higher arousal triggers delusion-like thoughts in everybody.

Several other shortcomings of the present study need to be noted. First, neither measures of ER were optimal: Not all participants could be analyzed regarding physiological variables due to technical problems. Additionally, the direct rating of

subjective ER success required introspection. However, the consistent finding that individuals with delusion-proneness demonstrated problems in applying reappraisal across the different measures can be considered as a strong indication of their robustness. Second, because of the subclinical nature of the present sample, only careful and preliminary conclusions regarding the population with clinically-relevant levels of delusions may be drawn and replication in clinical samples is required. Third, there was no direct measure of the effects of expressive suppression (rating of facial expressions).

Altogether, the present study provides valuable insight into ER difficulties in individuals with delusion-proneness. The application of the generally helpful ER strategy seems to be less successful in delusion-prone individuals. Additionally, failed reappraisals of threatening situations might support or even cause state delusional ideation. If the proposed failed reappraisal approach to delusional ideation can be confirmed in participants with clinically-relevant levels of delusions, it provides a basis for deriving differentiated recommendations for psychological approaches to delusions. For example, it might be advantageous to initially enable patients to use reappraisal in more neutral, low-anxiety situations before attempting to generalize these skills to high-anxiety situations in which reappraisal might have adverse side-effects. Furthermore, a straightforward implication of the failed reappraisal hypothesis would be that individuals with delusions will develop *less* delusional thoughts during and after stressful situations if reappraisal is *prevented*. Therefore, it should be beneficial to convey alternative ER strategies (e.g. mindfulness- or acceptance-based approaches; see Pinto, 2009) that can be applied during or directly after stressful situations in order to enable adaptive reappraisal later on. Such empirically driven specification may add to improving cognitive behavioral therapy of delusions (Garety, Bentall, & Freeman, 2008; NICE, 2009; Wykes, Steel, Everitt, & Tarrier, 2008). In sum, the present findings shed light on the role of ER difficulties in individuals with delusion-proneness and help to advance the understanding and treatment of delusions.

### **Acknowledgment**

We thank Claudia Lucas who kindly supported the data acquisition.

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**Appendix C: Paper 3**

Running head: *Reappraisal deficits in paranoia*

## Being deluded after being excluded?

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How emotion regulation deficits in paranoia-prone individuals impact on state paranoia during experimentally induced social stress

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Word count (exc. figures/tables): 4.933

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**Keywords:** emotion regulation; paranoia; delusion; schizophrenia; reappraisal; expressive suppression

## Abstract

**Background.** Emotion regulation (ER) has become a relevant construct to understanding paranoia. While the ER strategy called *expressive suppression* (e.g. poker face) may foster state paranoia by increasing arousal, another strategy called *reappraisal* (e.g. changing the perspective on situations) may reduce negative emotions and state paranoia when adaptively used. However, if reappraisal fails, this could increase paranoia. The aim of this study was to test the proposed effects of the ER strategies on state paranoia in the socially stressful situation of being excluded in paranoia-prone individuals.

**Methods.** We conducted an experimental online-study with N=116 participants who were randomized to a social inclusion or an exclusion condition using a virtual Cyberball ball-tossing game. They completed questionnaires on paranoia-proneness and habitual ER strategies. Before and after the Cyberball task, participants rated their level of state paranoia. The impact of habitual ER strategies, paranoia-proneness and social stress on changes in state paranoia was investigated using linear regression analysis.

**Results.** The three-way interaction of social stress, paranoia-proneness and habitual reappraisal use significantly predicted state paranoia ( $t(114)=2.62, p=0.010$ ). The decomposition of the interaction term revealed that in the social stress condition, the impact of reappraisal on state paranoia was moderated by the level paranoia-proneness. Specifically, in high paranoia-prone individuals the use of reappraisal predicted higher state paranoia. The findings regarding habitual use of suppression were not significant.

**Conclusions.** Although reappraisal is generally considered a functional strategy, its use in distressing social situations seems to be impaired in persons with higher paranoia-proneness. A working model of emotion dysregulation in delusions is presented and possible implications for cognitive therapy of psychosis are discussed.

## Introduction

A growing body of research is supporting the key role of negative emotions in paranoia. First, emotions such as anxiety and depression are positively associated with paranoia (Drake et al., 2004; Freeman & Garety, 1999; Johns et al., 2004; Startup, Freeman, & Garety, 2007). Second, theoretical models of paranoia propose emotional disturbances to be a pivotal factor in the development and maintenance of paranoid threat beliefs (Freeman, Garety, Kuipers, Fowler, & Bebbington, 2002). Third, changes in emotional states such as anxiety or self-worth could affect state paranoia (Lincoln, Lange, Burau, Exner, & Moritz, 2010; Thewissen et al., 2011; Westermann & Lincoln, 2010). Non-social stress in paranoia-prone individuals increases negative emotions (Lincoln, Peter, Schäfer, & Moritz, 2009), but so could past or acute social stress (Ellett, Freeman, & Garety, 2008; Freeman & Fowler, 2009; Myin-Germeys, van Os, Schwartz, Stone, & Delespaul, 2001).

Social exclusion is an important type of social stress. Experiences of social exclusion can stem from the ongoing stigmatization of mentally-ill persons in society. According to Angermeyer and Dietrich (2006, p. 174), “there is an observable tendency to distance oneself from people with mental disorders”, for example due to prejudices of unpredictability and danger. In addition, implicit self-stigma may lead to self-exclusion (Rüsch, Corrigan, Todd, & Bodenhausen, 2010). Also, negative interpersonal schemata such as being not accepted by relevant others accompany paranoid beliefs (Lincoln et al., 2010). Thus, paranoid beliefs may lead to perceived, albeit not necessarily factual social exclusion. However, regardless of the nature of social exclusion, the actual experience leads to deprivation of basic needs, such as belonging, self-esteem, and control (Williams, 2007). People with schizophrenia appear to undergo longer lasting effects after being socially excluded compared to controls, and are more likely to experience intense negative emotions (Perry, Henry, Sethi, & Grisham, in press). Another possible source of social stress in persons with paranoid beliefs is social anxiety (Martin & Penn, 2001) accompanied by low social rank perceptions (Gilbert, Boxall, Cheung, & Irons, 2005). Conclusively, individuals with paranoia are more likely to face socially stressful situations due to social exclusion or social anxiety, which are likely to trigger intense negative emotions and increase state paranoia.

The need for adaptive emotion regulation (ER) of negative emotions in paranoia is apparent. However, a number of studies have identified ER deficits in persons with

psychosis (Livingstone, Harper, & Gillanders, 2009; van der Meer, Wout, & Aleman, 2009). More specifically, persecutory ideation and other positive symptoms seem to be associated with difficulties in regulating negative emotions, for example impulse control problems and a lack of available ER strategies (Westermann & Lincoln, in press).

Surprisingly, specific ER strategies have not been a target of direct investigation in the domain of paranoia so far. Two common and intensely investigated ER strategies are *reappraisal* and *expressive suppression*. Reappraisal is a cognitive regulation strategy “that involves construing a potentially emotion-eliciting situation in a way that changes its emotional impact” (Gross & John, 2003, p. 349). Thus, reappraisal changes the initial and spontaneous appraisal of a situation prior to the full formation of the anticipated emotional response in order to modify the final emotional response. For example, instead of viewing a job interview as potential threat for self-worth, one could reappraise it as an opportunity to get to know the company. This would be an adaptive strategy to decrease anxiety and increase more positive emotions, such as curiosity. The habitual use of reappraisal is shown to be positively associated with mental health (Gross & Munoz, 1995) and seems to be a protective factor against many forms of psychopathology (Aldao, Nolen-Hoeksema, & Schweizer, 2010). In contrast, expressive suppression describes the deliberate attempt to inhibit the expression of emotional experiences, including reducing facial affect (Gross & John, 2003; Gross & Levenson, 1997). For example, expressive suppression in a job interview would involve displaying a ‘poker face’ and to avoid trembling. The habitual use of suppression is associated with decreased mental health and seems to be maladaptive if inflexibly used (Aldao, et al., 2010). Moreover, expressive suppression is known to increase the intensity of experienced negative emotions and physiological arousal (Gross & John, 2003; Gross & Levenson, 1997).

Although these ER strategies are well investigated in healthy individuals, it is unclear what impact their habitual use has in individuals with paranoia. Expressive suppression is likely to increase state paranoia, because it is associated with the maintenance of negative emotions and the increase of physiological arousal, which could trigger paranoia according to empirical data (Lincoln, Lange, et al., 2010; Lincoln, Peter, et al., 2009; Myin-Germeys & van Os, 2007) and theoretical considerations (Freeman, et al., 2002). The role of reappraisal in paranoia might be more complex. The adaptive nature of reappraisal in a range of different psychopathologies (Aldao, et al., 2010) would predict reappraisal to be helpful by decreasing negative emotions and, thus, the risk of

paranoia ideation. However, the adaptive use of reappraisal may be impaired by several factors in paranoia. Negative interpersonal schemata (Fowler et al., 2006; Lincoln, Mehl, et al., 2010), pre-existing threat beliefs (Freeman, et al., 2002), and cognitive biases (for a review, see Freeman, 2007) may constrain the space of possible reappraisals such that adaptive ER is unlikely. In the best case, the changed interpretations of situations may be ineffective, but in the worst case, they may be adverse and serve as a precursor of paranoid thoughts. For example, the reappraisal of a job interview such as “*The interviewer is deliberately trying to irritate me*” is likely to increase anxiety and state paranoia. In contrast, an adaptive reappraisal such as “*The interviewer is trying to help me to learn something about the company*” is likely to reduce anxiety (Gross, 2002).

The aim of this study is to investigate the effect of the habitual use of reappraisal and expressive suppression on social stress in paranoia-prone participants. The present study employs a sample without clinically relevant levels of delusions. Thus, confounding factors can be avoided, such as medication and neuropsychological deficits. Also, the long-term effects of chronic social stress due to a diagnosis of schizophrenia, which are hard to disentangle from acute social stress (Perry, et al., in press; Williams, 2007) are neglected.

We test two competing hypotheses regarding habitual use of reappraisal and one hypothesis regarding expressive suppression:

(1a) The habitual use of reappraisal is accompanied by reduced state paranoia in socially stressful situations regardless of the level of paranoia-proneness.

versus

(1b) The habitual use of reappraisal is accompanied by increased state paranoia in socially stressful situations in paranoia-prone individuals.

(2) The habitual use of expressive suppression in paranoia-prone individuals increases state paranoia in socially stressful situations.

## **Methods**

### *Participants*

Participants took part in the present online study via the internet. In total, 960 persons visited the survey homepage, and 221 (23%) provided informed consent. Of these, a total of N=116 completed the study (48% attrition rate, which is in the range of

other internet studies; e.g. Westermann & Lincoln, in press). The sampling procedure involved advertisements for the study in internet forums, social networks and public mailing lists. The advertisement included the topic of the study (how to deal with emotions), the benefits of taking part (improving scientific knowledge and methods of treatment as well as having the chance to win a shopping voucher) and the internet address. With the exception a minimum age of 18 years and sufficient German language skills, there were no specific inclusion criteria. Thus, individuals with mental disorders were neither explicitly excluded nor encouraged to take part. There was no reimbursement for time spent on the survey, but each participant had the chance to win one of eight vouchers for an online shop (total value: 150€).

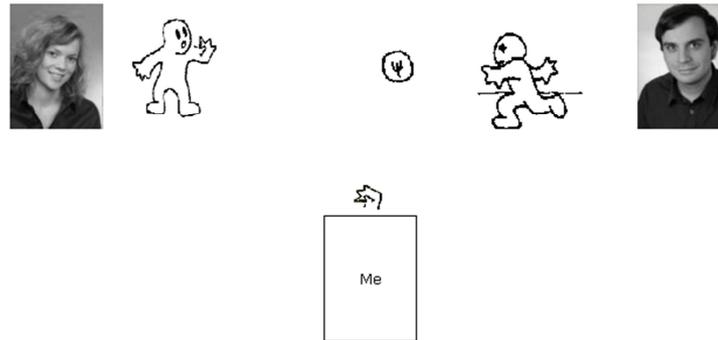
The participants were mainly female (72%) with a mean age of 28.52 (SD=7.85) and 78% had at least a high school degree equivalent (mean years of education=17.1, SD=3.3). All participants were German native speakers. Ten percent of the participants reported to be in psychological therapy at time of participation, and 6% reported to be taking psychotropic medication.

### *Design*

We tested our hypotheses regarding *state paranoia* (dependent variable) by investigating the effects of experimentally induced *social stress*, while taking trait measures of *paranoia-proneness* and *habitual ER* (reappraisal and expressive suppression) into account (independent variables).

### *Instruments*

We experimentally induced social stress with the Cyberball task (Williams, Cheung, & Choi, 2000). In this virtual ball-tossing game, the participants throw a ball to or catch a ball from two (or more) other players (see Figure 1). Either a participant is systematically excluded (the ball is not thrown to her) and therefore gets socially stressed (experimental condition), or she is socially included (the ball is thrown to her about every third time; control condition). The exclusion condition in Cyberball is known to reliably elicit negative emotional states (for a review see Williams, 2007). Thus, we used changes in the intensity of negative emotions as a manipulation check for the social stress induction.



**Figure 1.** Screenshot of the CyberBall paradigm.

State paranoia was measured by six state-adapted items of the Paranoia Checklist (e.g. “I am under threat from others” or “People are trying to make me upset”) with a 5-point Likert scale (1=“not at all” to 5=“strongly”) (Freeman et al., 2005). These items were most sensitive to a social stress induction in another study (Kesting, Rief, Westermann, & Lincoln, under review). The state-adapted instruction was “How strongly do the following thoughts apply to you *at the moment?*”. To assess the manipulation check variables, the current intensity of the emotions *frustration*, *anxiety*, *sadness*, *anger*, *shame* and *happiness* were assessed with 10-point Likert-type scales (1=“does not apply” to 10=“does apply very strong”) that use clusters of emotional adjectives and have been validated in other studies (e.g. Stemmler, Heldmann, Pauls, & Scherer, 2001). For example, anxiety was measured with the item “I feel anxious, fearful, frightened, scared”.

In addition, we administered several trait questionnaire measures. We used a German translation of the Paranoia Checklist (Freeman, et al., 2005) to assess *paranoia-proneness* (frequency of paranoia thoughts in the last month) and the associated distress. The scale consists of 18 items (e.g. “I might be observed or followed”), each rated on a Likert-type scale (frequency: 1=“never” to 5=“at least daily”; distress: 1=“none” to 5=“extreme”). The Paranoia Checklist has been shown to have excellent internal consistency (Cronbach’s  $\alpha \geq 0.90$ ) in previous studies (e.g. Westermann & Lincoln, 2010) and was developed to assess paranoia in non-clinical populations (Freeman, et al., 2005).

We used the Emotion Regulation Questionnaire (Gross & John, 2003; German version: Abler & Kessler, 2009) to assess the habitual use of the ER strategies *expressive suppression* (e.g. “I control my emotions by not expressing them”) and *reappraisal* (e.g. “I control my emotions by changing the way I think about the situation I’m in”). Each item is rated on a Likert-type scale (1=“strongly disagree” to 7=“strongly agree”). The

subscales of the German version have adequate to good internal consistencies (Cronbach's  $\alpha > 0.74$ ). The Emotion Regulation Questionnaire was designed to assess individual differences of habitual ER in non-clinical populations.

The German version of the Social Interaction Anxiety Scale (Heinrichs et al., 2002) has excellent reliability (Cronbach's  $\alpha = 0.93$ ) and was used to control for the possible impact of *social anxiety* on the extent of negative emotions caused by the Cyberball game. The questionnaire contains 20 items (e.g. "I tense up if I meet an acquaintance in the street") that are rated on a Likert-type scale (1="not at all" to 5="very strong") and has previously been used in non-clinical populations (e.g. Gore, Carter, & Parker, 2002).

### *Procedure*

After confirming the informed consent, the participants filled in demographic data and the trait questionnaires. The sequence of the questionnaires and the items were randomized for each participant to avoid order effects. The questionnaires were followed by an online version of the CyberBall task. Before and after the Cyberball task, participants rated state paranoia and current emotional state. At the end participants had the opportunity to take part in the lottery and in a follow up study by providing their email address. Finally, an email address and a phone number for further requests were provided to the participants on the last page. The online study was implemented with the Unipark software ([www.unipark.de](http://www.unipark.de); version 7.1) using a custom-build JavaScript adaption of the CyberBall paradigm.

### *Data analysis*

The hypotheses were tested using linear regression analyses with state paranoia as dependent variable. For the hypotheses regarding reappraisal (hypotheses 1a and 1b), we entered habitual use of reappraisal, paranoia-proneness and social stress as independent variables. For the hypothesis regarding expressive suppression (hypothesis 2), we entered habitual use of expressive suppression, paranoia-proneness and social stress as independent variables. Additionally, social anxiety was entered as covariate in both linear regression models.

All variables were mean-centered. In order to decompose interaction effects, subsequent analyses were conducted including simple slope analysis (see Bauer & Curran, 2005). Before the analyses, all variables were screened for normality. Initially,

the paranoia-proneness scores were not distributed normally, but could be normalized by a logarithmic transformation. The emotional state manipulation check variables were not normally distributed and were consequently investigated with non-parametric tests. All analyses are two-tailed, if not otherwise specified.

## Results

The descriptive statistics as well as the reliabilities of all questionnaires are presented in Table 1 (right-hand side). The habitual use of reappraisal and suppression ( $M=25.00$ ,  $SD=7.40$  and  $M=14.06$ ,  $SD=5.57$ , respectively) was comparable to studies with healthy individuals ( $M=24.96$ ,  $SD=6.42$  and  $M=12.76$ ,  $SD=4.12$ , respectively; Ablner & Kessler, 2009) and patients with psychosis (for example  $M=24.19$ ,  $SD=8.63$  and  $M=16.81$ ,  $SD=5.76$ , respectively; Livingstone, Harper, & Gillanders, 2009). Our measure of paranoia-proneness, which was the frequency of paranoid thoughts, was lower than in a sample with acute and remitted delusions ( $M=24.74$ ,  $SD=9.40$  vs.  $M=34.92$ ,  $SD=3.52$ ; Lincoln, Ziegler, Lüllmann, Müller, & Rief, 2009). All measures demonstrated good reliability (Cronbach's  $\alpha \geq 0.79$ ; see Table 1 right-hand side). The intercorrelations of the questionnaires are displayed in Table 1 (left-hand side): Paranoia-proneness and the associated distress were highly correlated. Habitual use of reappraisal and expressive suppression were not significantly correlated. Social anxiety was positively correlated with paranoia-proneness and the associated distress as well as with expressive suppression. Moreover, social anxiety was negatively correlated with reappraisal.

	PC Distress	ERQ		SIAS Total	M (SD)	Range	Cron- bach's $\alpha$
		Reappraisal	Suppression				
Paranoia Checklist (PC)							
Paranoia-proneness <sup>a</sup>	0.74**	-0.16	0.18 <sup>#</sup>	0.50**	24.74 (9.40)	18-63	0.93
Distress		-0.18 <sup>#</sup>	0.07	0.43**	25.90 (10.49)	18-75	0.93
Emotion Regulation Questionnaire (ERQ)							
Reappraisal			-0.17 <sup>#</sup>	-0.24**	25.00 (7.40)	6-39	0.83
Suppression				0.22*	14.06 (5.57)	4-28	0.79
Social Interaction Anxiety Scale (SIAS)							
Total score					42.87 (10.67)	20-78	0.84

Note. <sup>a</sup>: Frequency of paranoid thoughts.

\*\* $p < 0.01$ , \* $p < 0.05$ , # $p < 0.10$

**Table 1.** Bivariate correlations between all questionnaire measures (left-hand side) as well as descriptive statistics and reliability (right-hand side).

*Manipulation check*

First, we investigated whether the Cyberball task was successful in inducing social stress. For this purpose, we tested whether the intensity of negative emotions was higher in the social exclusion condition than in the social inclusion condition using multiple one-tailed Mann-Whitney U-tests. Before the analysis, we corrected each score for baseline differences (i.e. subtraction of baseline score).

As expected, the intensities of negative emotions were significantly higher in the social exclusion condition compared to the social inclusion condition with regard to frustration ( $M_{\text{exclusion}}=0.21$  vs.  $M_{\text{inclusion}}=-1.32$ ;  $p<0.001$ , effect size  $r=0.31$ ), shame ( $0.33$  vs.  $-0.75$ ;  $p=0.002$ , effect size  $r=0.26$ ), anger ( $0.35$  vs.  $-0.83$ ;  $p=0.013$ , effect size  $r=0.21$ ), anxiety ( $-0.25$  vs.  $-1.03$ ;  $p=0.025$ , effect size  $r=0.18$ ) and sadness ( $-0.79$  vs.  $-1.80$ ;  $p=0.027$ , effect size  $r=0.18$ ). The intensity of happiness did not differ between the conditions ( $M_{\text{exclusion}}=-0.70$  vs.  $M_{\text{inclusion}}=-0.24$ ;  $p=0.36$ , effect size  $r=0.03$ ). Thus, the induction of social stress by means of social exclusion was effective.

*Hypothesis tests*

Having found the induction of social stress to be successful, we then tested our main hypotheses using linear regression analysis. The dependent variable for each following analysis was the baseline-corrected state paranoia score (state paranoia = state paranoia<sub>post</sub> - state paranoia<sub>baseline</sub>). Social anxiety was used as a covariate due to its impact on the social stress induction (see above) and its correlation with every other variable of interest.

As a first step, we tested the two competing hypotheses regarding reappraisal. For this purpose, state paranoia was regressed on *social stress*, *reappraisal*, *paranoia-proneness*, and their two-way and three-way interaction terms as well as on the covariate social anxiety (see Table 2, left-hand side). If reappraisal is adaptive under social stress, regardless of the level of paranoia-proneness (hypothesis 1a), the interaction term *social stress\*reappraisal* would be expected to be significant and the interaction term *social stress\*reappraisal\*paranoia-proneness* would be expected to be non-significant. Specifically, in the social stress condition, the more frequent use of reappraisal is, the less state paranoia is expected. In the social inclusion condition, we expect no association between reappraisal and state paranoia. If, however, the adaptivity of reappraisal under social stress is a function of paranoia-proneness (hypothesis 1b), we would expect the three-way interaction term to be significant. In this case, we expect in the social stress

condition that the more frequent paranoia-prone individuals use reappraisal, the higher their level of state paranoia is. In contrast, in not paranoia-prone individuals no impact of reappraisal on state paranoia is expected. Overall, the linear regression model significantly explained 24% of the individual differences in state paranoia,  $F(8,107)=4.15, p<0.001$ . In accordance with hypothesis 1b, the three-way interaction of social stress, reappraisal, and paranoia-proneness significantly predicted state paranoia ( $b=0.44, p=0.010$ ), but not the two-way interaction of social stress and reappraisal ( $b=0.22, p=0.207$ ). Also, no other predictor variable was significant, including the covariate social anxiety ( $p\geq 0.336$ ). Thus, we rejected hypothesis 1a.

<i>Effect</i>	<b>Reappraisal</b>			<b>Expressive suppression</b>		
	<i>b</i>	<i>SE</i>	$\beta$	<i>b</i>	<i>SE</i>	$\beta$
Social anxiety	0.07	0.10	0.07	0.03	0.11	0.03
Social stress	-0.01	0.17	-0.01	-0.04	0.19	-0.02
Emotion regulation <sup>a</sup>	0.04	0.13	0.04	-0.02	0.14	-0.02
Paranoia-proneness	0.13	0.13	0.13	0.17	0.14	0.17
Emotion regulation <sup>a</sup> * Social stress	0.22	0.18	0.18	-0.07	0.19	-0.05
Emotion regulation <sup>a</sup> * Paranoia-proneness	-0.04	0.14	-0.05	0.19	0.13	0.22
Social stress * Paranoia-proneness	-0.10	0.18	-0.07	-0.23	0.19	-0.16
Emotion regulation <sup>a</sup> * Social stress * Paranoia-proneness	0.44	0.17	0.43**	-0.41	0.17	-0.37*

*Note.*  $R^2=0.24$  for reappraisal ( $F(8,107)=4.15, p<0.001$ ) and  $R^2=0.08$  for expressive suppression ( $F(8,107)=1.23, p=0.289$ ). <sup>a</sup>: Emotion regulation represents reappraisal in the left-hand side columns and expressive suppression in the right-hand side columns.

\*\* $p<0.01$ . \* $p<0.05$ .

**Table 2.** Regression of state paranoia (baseline corrected) on social anxiety (covariate), social stress (dichotomous: 0=social inclusion, 1=social exclusion/social stress), emotion regulation strategy (left-hand side: reappraisal; right-hand side: expressive suppression), paranoia-proneness and their interaction effects (two-way and three-way).

We then decomposed the three-way interaction of *social stress*, *paranoia-proneness*, and *reappraisal* in two steps. For the sake of simplicity, we omitted the covariate social anxiety from these analyses due to its statistical insignificance in the main analysis. In the first step, two separate linear regressions with *reappraisal*,

*paranoia-proneness*, and their interaction were computed for social inclusion and social exclusion (see Table 3). In accordance with our hypothesis 1b, the linear regression model was not significant in the social inclusion condition,  $R^2=0.03$ ,  $F(3,55)=0.58$ ,  $p=0.629$ , but was significant in the social exclusion condition,  $R^2=0.43$ ,  $F(3,53)=13.53$ ,  $p<0.001$ . State paranoia in the social exclusion condition was significantly predicted by the two-way interaction of reappraisal and paranoia-proneness ( $b=0.39$ ,  $p<0.001$ ) as well as reappraisal ( $b=0.26$ ,  $p=0.011$ ).

<i>Effect</i>	<b>Social stress</b>					
	<i>Social inclusion</i>			<i>Social exclusion</i>		
	<i>b</i>	<i>SE</i>	$\beta$	<i>b</i>	<i>SE</i>	$\beta$
Reappraisal	0.03	0.15	0.03	0.26	0.10	0.28*
Paranoia-proneness	0.16	0.14	0.16	0.06	0.11	0.06
Reappraisal * Paranoia-proneness	-0.04	0.16	-0.04	0.39	0.08	0.55**

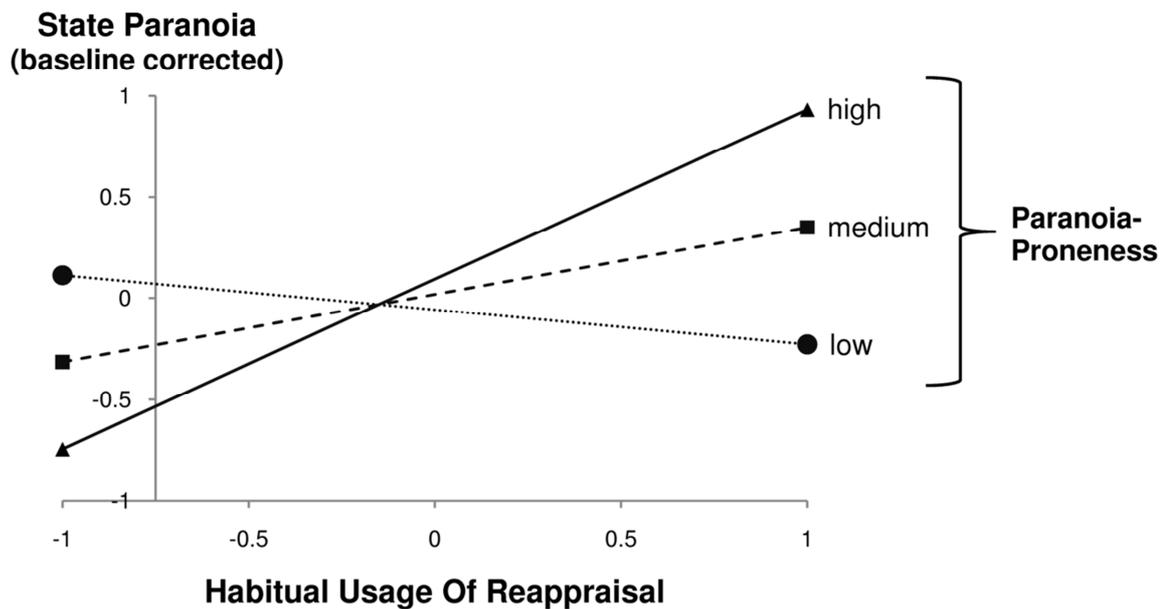
*Note.*  $R^2= 0.03$  for social inclusion ( $F(3,55)=0.58$ ,  $p=0.629$ ) and  $R^2=0.43$  for social exclusion ( $F(3,53)=13.53$ ,  $p<0.001$ ).

\*\* $p<0.01$ . \* $p<0.05$ .

**Table 3.** Results from the post-hoc regression of state paranoia (baseline corrected) on reappraisal, paranoia-proneness and their two-way interaction for social inclusion (left-hand side) and social exclusion (i.e. social stress; right-hand side).

To further probe the two-way interaction between reappraisal and paranoia-proneness under social stress, we computed simple intercepts and simple slopes for the prediction of state paranoia by reappraisal at the mean of paranoia-proneness and at one standard deviation above and below the mean (see Figure 2). The simple slopes of reappraisal at medium and high paranoia-proneness were statistically significant ( $b=0.26$ ,  $p<0.001$  and  $b=0.66$ ,  $p=0.041$ , respectively; two-tailed). Furthermore, we computed the regions of significance for paranoia-proneness, which contain the values of paranoia-proneness at which the simple slope is significant. The lower region of significance was  $z=-\infty$  to  $-1.47$  and the upper region of significance was  $z=-0.15$  to  $\infty$ . Thus, in average paranoia-proneness and above ( $>$ mean) the use of reappraisal significantly predicted higher state paranoia. Also, in very low levels of paranoia-proneness (about  $<1.5SD$ ), the use of reappraisal significantly predicted lower state paranoia (compare to Figure 2). Conclusively, we could confirm our hypothesis 1b that states that the use of reappraisal

under social stress is associated with higher state paranoia in individuals with higher paranoia-proneness.



**Figure 2.** Plot of the simple slopes of the relation between (baseline-corrected) state paranoia and habitual usage of reappraisal as function of high, medium and low paranoia-proneness. *Note.* High, medium and low values of paranoia-proneness are defined as 1SD above the mean, at the mean and 1SD below the mean, respectively.

We then tested our hypothesis regarding the impact of expressive suppression on state paranoia under social stress in individuals with higher paranoia-proneness. State paranoia was regressed on social stress, suppression and paranoia-proneness as well as the two- and three-way interactions. The linear regression model did not reach significance,  $F(8,107)=1.23$ ,  $p=0.289$ , and explained only eight percent of the individual differences of state paranoia ( $R^2=0.08$ ). However, the three-way interaction term was significant,  $b=-0.41$ ,  $p=0.019$ . Nonetheless, we did not conduct subsequent analyses because the amount of explained variance was small and lacked practical significance.

## Discussion

The present study aimed to test hypotheses regarding the habitual use of the ER strategies reappraisal and expressive suppression in paranoia-prone individuals during social stress. The habitual use of reappraisal was accompanied by higher state paranoia after social exclusion in paranoia-prone individuals (hypothesis 1b). A generally functional effect of reappraisal in social stressful situations could not be confirmed (hypothesis 1a). Hypothesis 2 stated that expressive suppression is accompanied by an

increase in state paranoia and had to be rejected, because no impact of habitual suppression on state paranoia was revealed.

Contrary to the view that reappraisal is generally an adaptive way to regulate emotions (Aldao, et al., 2010), the present findings indicate that the use of reappraisal in socially stressful situations can be maladaptive in paranoia-prone individuals. The finding of maladaptive ER is in line with a recent study by our group that reports an association of limited access to effective ER strategies with paranoia and other positive symptoms (Westermann & Lincoln, in press). Moreover, the reappraisal of *anxiety*-eliciting stimuli has also been shown to be impaired in a subclinical sample in high levels of delusion-proneness (Westermann, Rief, & Lincoln, in preparation). Additional evidence for a critical role of reappraisal in paranoia is provided by a study focusing on meta-cognitive beliefs in subclinical paranoia (Taylor, Graves, & Stopa, 2009). The habitual use of the strategies *worry* and *punishment* (i.e., self-punishment for having a thought) measured by the Thought Control Questionnaire (Wells & Davies, 1994) was accounted for by anxiety, but *reappraisal* was exclusively accounted for by trait paranoia. Thus, there are several lines of evidence that indicate that persons with higher paranoia-proneness seem to have difficulties in using reappraisal strategies to down-regulate negative emotions. Since maladaptive reappraisal may lead to higher levels of negative emotions and trigger delusions, not using reappraisal in stressful situations may be beneficial for individuals with paranoia-proneness or paranoia.

Social exclusion was not accompanied by an increase of state paranoia in paranoia-prone individuals who reported to habitually use expressive suppression. Although this finding is not in line with our expectations, it is in line with other studies that did not reveal an association of expressive suppression and levels of delusions in delusion-prone individuals or patients with clinically relevant delusions (Henry, Rendell, Green, McDonald, & O'Donnell, 2008; Westermann, et al., in preparation). Interestingly, another experimental study showed that individuals with schizophrenia have difficulties with the amplification of expressive behavior, but not with its suppression (Henry et al., 2007).

Several limitations of the present study should be mentioned. First, even though the Emotion Regulation Questionnaire (Gross & John, 2003) that measured habitual reappraisal and expressive suppression is a frequently used, reliable, and valid instrument, the actually applied ER strategies during the experimental manipulation were not

assessed. Therefore, it is possible that individuals who reported a habitual use of reappraisal or suppression did not apply these strategies in this specific experimental situation. However, Egloff, Schmukle, Burns and Schwerdtfeger (2006) found habitual use of reappraisal and suppression to be correlated to its actual use during an imaginative speech scenario in healthy individuals with a medium effect-size. Moreover, habitual use of reappraisal accounted for similar neural activation as instructed reappraisal (Drabant, McRae, Manuck, Hariri, & Gross, 2009). Consequently, it is likely that the participants used those ER strategies during the Cyberball game that they reported to habitually use. Nonetheless, future studies should directly examine the strategies used in these specific situations. Furthermore, not only the habitual use of specific ER strategies should be assessed, but also their efficacy.

Second, building on the empirical evidence for a continuum between normal and delusional beliefs (see e.g. Freeman, et al., 2005; Johns & van Os, 2001) and their risk factors (Combs, Michael, & Penn, 2006), the sample comprised of individuals with not clinically relevant paranoid beliefs. Even though this approach avoids confounding factors, such as neuroleptic medication, neuropsychological deficits and severe negative symptoms, the present findings cannot directly be generalized to clinical paranoia.

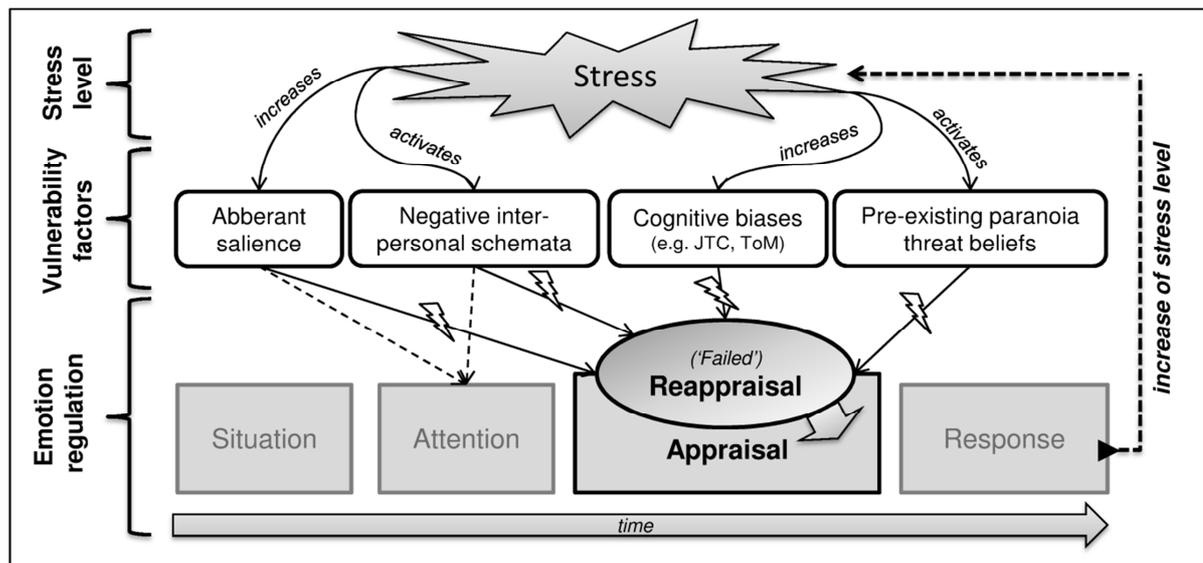
Third, the present study was deployed via the internet. Whereas this is not a shortcoming per se, online-conducted experimental studies are a novel approach. However, there is growing literature which indicates that classical and online-based data collection is essentially equivalent (Jones, Fernyhough, de-Wit, & Meins, 2008; Ritter, Lorig, Laurent, & Matthews, 2004). Even in samples with schizophrenia patients, online studies are feasible (Chinman, Young, Schell, Hassell, & Mintz, 2004; Moritz, Peters, Larøi, & Lincoln, 2010). Therefore, the validity of the present study is likely to be comparable to traditional laboratory experiments. Technical mechanisms were implemented to avoid multiple or non-serious participation (via cookies, double check of demographic data). Generally, attrition rates are higher in online studies (Birnbbaum, 2004) and the present rate is comparable to other internet-based studies in German-speaking countries (e.g., 42% attrition rate in Westermann & Lincoln, in press).

Finally, the specificity of the reappraisal impairments to paranoia cannot be evaluated with the present design, because no other positive symptoms such as hallucinations or other types of delusional beliefs were assessed. Nonetheless, a recent study on ER in patients with schizophrenia and auditory hallucinations revealed no

differences in reappraisal compared to a healthy control group, and no association of reappraisal and severity of auditory hallucinations (Badcock, Paulik, & Maybery, 2011). Thus, the current findings could be specific to paranoia.

In sum, the present finding of an adverse effect of reappraisal in paranoia-prone individuals during social stress, in accordance with the discussed literature on this topic, provides the impetus for the formulation of an ER perspective on delusional ideation. On the basis of the process model of ER (Gross, 2001), the cognitive model of paranoia (Freeman, et al., 2002), and a general vulnerability-stress-model (Zubin & Spring, 1977), we developed a working model of emotion dysregulation in delusions (see Figure 3). This working model includes four essential assumptions: (1) Similar to healthy individuals, persons who are prone to persecutory delusions try to down-regulate their negative emotions by using reappraisal and other strategies (Gross, 2001; Koole, 2009). (2) However, cognitive biases [such as Jumping to Conclusions (Fine, Gardner, Craigie, & Gold, 2007) and Theory of Mind deficits (Bora, Yucel, & Pantelis, 2009)], negative interpersonal schemata (Lincoln, Mehl, et al., 2010), pre-existing delusional beliefs (Freeman, et al., 2002; Garety, Kuipers, Fowler, Freeman, & Bebbington, 2001) and aberrant salience (Kapur, 2003) disturb the successful reappraisal, resulting in *failed reappraisal*. (3) These failed reappraisals give rise to - or already are - paranoid thoughts, which increase negative emotions and arousal. (4) In terms of a positive feedback loop, the negative emotions increase the level of stress, so that cognitive biases, pre-existing beliefs, and interpersonal schemata are even more strongly activated.

For example, a delusion-prone individual who experiences himself as being excluded in a game, will attempt to down-regulate his negative emotions via reappraisal, and in doing so is likely to jump to conclusions that are congruent with his interpersonal schema (“others are bad”) resulting in a failed reappraisal (“They are excluding me on purpose”). As a result he or she would experience an increase anxiety, which is likely to reinforce the schema and amplify the biases. Additionally, in following iterations of the process the individual may even generate more dysfunctional reappraisals (e.g. “They are deliberately trying to harm me”, “They would kill me if they could”), which reinforce paranoid beliefs such that they reach clinically relevant levels of delusions.



**Figure 3.** Emotion regulation model of delusional ideation

However, there is at least one plausible alternative explanation for our findings. A cognitive behavioral perspective might predict that distressed individuals in general and thus also paranoia-prone individuals experience more disabling automatic thoughts overall and may habitually attempt to use reappraisal simply due to their higher level of distress. Therefore, one would expect to find other indicators of higher distress to be associated with more frequent use of reappraisal. However, this does not seem to be the case, as for example symptoms of depression and anxiety have been found to be negatively correlated to the frequency of reappraisal strategies in a recent meta-analysis investigating a diverse patient population ( $r=-0.14$ ,  $p<0.001$ ; Aldao, et al., 2010).

Our proposed ER working model of delusions allows several interesting implications. It can soundly explain why neutral situations can trigger state paranoia when a sufficient level of stress is present. Moreover, the positive feedback loop explains the reinforcement of delusional beliefs and interpersonal schemata. This could explain why paranoia-prone individuals more willingly accept the truthfulness of paranoid reappraisals (Lincoln, Reumann, & Moritz, 2010). Lastly, the level of stress is the main moderator in the model that determines the influence of cognitive biases, pre-existing threat beliefs, and interpersonal schemata on the reappraisal process. Furthermore, the model has important clinical implications which imply that delusional ideation may be a genuine attempt to regulate one's own emotions. In addition, the working model is able to easily integrate other ER processes and helps to understand and disentangle their temporal

interactions. For example, the difficulties in the amplification of (positive) emotions (Henry, et al., 2008) are likely to be relevant in the response ER stage.

However, even though the parsimonious and experimentally testable working model integrates aspects from several models and many empirical findings (Beck, Rector, Stolar, & Grant, 2008; Freeman, et al., 2002; Garety, et al., 2001; Gross, 2001; Lazarus & Folkman, 1984), it is currently speculative and requires further research with experimental and longitudinal designs. Nonetheless, clinicians may take emotion dysregulation into account when formulating individual disorder models. In particular, reappraisal seems to unfold adverse effects when applied by individuals with delusions in stressful situations. Also, the use of expressive suppression per se does not seem to trigger paranoia if it is flexibly used, although the chronic use of suppression is likely to have the same adverse effects on interpersonal functioning as in healthy individuals (Gross & John, 2003). Trainings of alternative ER strategies as promoted in a training program by Berking (2007) may be useful. For example, mindfulness-based strategies to reduce the overall stress level *prior to* reappraising prospective or past situations may be a beneficial recommendation. Furthermore, alternative in-situation strategies such as acceptance or distraction may be more helpful to regulate negative situations under stress than reappraisal, but further research is needed to corroborate this deduction. Conclusively, the present basic research findings underline the importance and usefulness of cognitive interventions for delusions in order to support adaptive reappraisals, but also help to understand its current limitations in patients with delusions.

### **Role of funding source**

The present study was not funded by a specific sponsor. Only the authors had a role in the study design, data collection, analysis, interpretation of the data, in the writing of the report, and in the decision to submit the paper for publication.

### **Contributors**

Stefan Westermann, Tania M. Lincoln, and Marie-Luise Kesting designed the study. Stefan Westermann managed the literature searches and analyses, undertook the statistical analysis, and wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

### **Disclosure Statement**

All authors declare that they have no conflicts of interest.

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## Acknowledgment

We thank Kathryn Kalaf for helpful comments on this report. We thank Christian Rosenau who helped in publishing the online study. We thank the reviewers for their helpful comments.

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**Appendix D: Curriculum vitae, publication list and conference contributions**

*Die Seiten 107-110 (Lebenslauf) enthalten persönliche Daten. Sie sind deshalb nicht Bestandteil der Online-Veröffentlichung.*







**Appendix E: Eidesstattliche Erklärung [*declaration of academic honesty*]**

Ich versichere, dass ich meine Dissertation

**„Emotion regulation and delusions“**

selbständig, ohne unerlaubte Hilfe angefertigt und mich dabei keiner anderer als der von mir ausdrücklich bezeichneten Quellen und Hilfen bedient habe.

Die Dissertation wurde in der jetzigen oder einer ähnlichen Form noch bei keiner anderen Hochschule eingereicht und hat noch keinen sonstigen Prüfungszwecken gedient.

Marburg, im September 2011

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Stefan Westermann