Individual Differences in Emotion Regulation Abilities:

Action Orientation's Impact on Intuition,

Negativity Bias in Depression,

and Self-Infiltration

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Danksagung

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Weitere Personen waren an der inhaltlichen materiellen Erstellung der vorliegenden Arbeit nicht beteiligt. Insbesondere habe ich hierfür nicht die entgeltliche Hilfe von Vermittlungs- bzw. Beratungsdiensten (Promotionsberater oder andere Personen) in Anspruch genommen. Niemand hat von mir unmittelbar oder mittelbar geldwerte Leistungen für Arbeiten erhalten, die im Zusammenhang mit dem Inhalt der vorgelegten Dissertation stehen.

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"I like crossing the imaginary boundaries

people set up between different fields — it's very refreshing.

There are lots of tools, and you don't know which one would work.

It's about being optimistic and trying to connect things." [1]

Maryam Mirzakhani

[1] Klarreich, E. (2014, August 12). A Tenacious Explorer of Abstract Surfaces: Maryam Mirzakhani's monumental work draws deep connections between topology, geometry and dynamical systems. [Series: 2014 Fields Medal and Nevanlinna Prize Winners]. Quanta Magazine. Retrieved (2018, October, 24) from https://www.quantamagazine.org/maryam-mirzakhani-is-first-woman-fields-medalist-20140812/

Individual Differences in Emotion Regulation Abilities: Action Orientation's Impact
on Intuition, Negativity-Bias in Depression, and Self-Infiltration

Contents

In this electronic version of the dissertation thesis,
(i) Pages 29-116 (Studies 1 to 3) are replaced by short summaries of the studies
(ii) and Pages 184-186 (Action Control Scale) are omitted
due to copyright reasons.

1. General Abstract

Using action orientation after failure as a measure of individual differences in emotion regulation abilities (ERA), this thesis' studies investigated the impact of ERA on cognition, behavior, and own versus imposed goals differentiation. The first study used cortisol as a physiological stress marker to replicate the link between ERA and the ability to make intuitive judgments under stress. High ERA were associated with increased performance in an intuition task under stress. In contrast, when feeling no stress, low ERA were associated with increased performance in an intuition task. The second study showed that ERA can compensate for depression-associated biased processing of negative stimuli. This effect was present even at mild to moderate depression levels. Replicating earlier findings, the third study showed that ERA are associated with an increased ability to distinguish self-chosen from imposed goals. Most importantly, the study identified activation in the right medial prefrontal cortex as a neural correlate of identifying self-chosen goals, and activation in the anterior cingulate cortex, as a correlate of falsely identifying imposed goals as self-chosen ones. Altogether, these studies show the necessity to consider individual differences in ERA in stress, clinical, and motivational research. The findings are discussed with respect to three theories that relate to motivation and personality from behavioral and neurobiological perspectives, namely, Personality Systems Interaction Theory, Predictive and Reactive Control Systems Theory, and Self-Determination Theory.

2. General Introduction

2.1. Introduction

Experiencing stress is and has always been a part of everyday life. However, while some individuals cope well with stress and are even able to increase their performance, for others, stress is associated with adverse effects on their performance and possibly on their health. These differences in dealing with stress can be explained by individual differences in the ability to regulate emotions. The studies in this dissertation thesis deal with the effect of individual differences in emotion regulation abilities (ERA), specifically in terms of action orientation as termed in Kuhl's personality systems interaction theory (PSI theory; Kuhl, 2000, 2001), on cognition and behavior. The focus lies on effects of ERA on (1) intuitive decision making, (2) effects of biased processing of emotional self-relevant stimuli, and (3) distinguishing own versus assigned goals and associated neural correlates.

Emotion regulation has been a relevant topic for decades, and every layperson can presumably relate to it. Although this societal interest in the topic is an advantage for preventing adverse effects in case of a lack thereof, the complexity of ERA is often underestimated. Emotion regulation is a complex process that affects many areas of cognition and psychology research. Emotion regulation as a process needs to be distinguished, for example, from coping, mood regulation, defense mechanisms, and affect regulation (Gross, 1998). Gross summarizes that the term *affect* is mostly used to refer to a superordinate construct for valenced states (Scherer, 1984), *emotions* are characterized by unfolding over a relatively short time period and can fluctuate (Frijda, 1993; Stein, Trabasso, & Liwag, 1993), and *moods* are rather pervasive and sustained (Nowlis & Nowlis, 1956; Parkinson, Totterdell, Briner, & Reynolds, 1996) and more diffuse (Morris, 1989). Therefore, investigating emotion regulation mechanisms in this thesis is about the regulation of short

time valenced states, may it be automatically or controlled, consciously or unconsciously and with effects on for example, situation selection, attention modification or cognitive change, or response modulation (Gross, 1998).

2.2. Process Model of Emotion Regulation

The most prominent model of emotion regulation is the process model by James Gross and colleagues (Gross & Muñoz, 1995; for an overview see Gross & John, 2003). During the process of emotion generation until reaction and down-regulation there are some points in time at which regulation can set in. The various emotion regulation strategies identified by Gross and colleagues are based on these moments before and during the process of emotion generation at which it is possible to by reducing the intensity of negative affect. They distinguish antecedent-focused from response-focused emotion regulation strategies (Gross & Muñoz, 1995). Antecedent-focused emotion regulation strategies take effect before the emotions arise and include modifying the input to the system. This is, for example, the case, when a person circumvents specific physical (e.g., not visiting the dentist) or mental (e.g., decreasing the frequency of specific thoughts) situations in order to prevent a specific emotional response. Regulation strategies can also take effect through changing the appraisal of a situation (e.g., reinterpreting an allegation). Response-focused emotion regulation strategies take effect after the emotion has arisen and consists of modifying the explicit response towards the emotion, for example, masking feelings of sadness by a smile. However, some challenges make it necessary to consider an alternative measurement of emotion regulation such as action orientation. For example, when aiming to investigate regulation processes independently from process-specific aspects of emotions, that is, when the intuitive and individual differences aspect of regulation is more important than the antecedent or response focus.

2.3. Emotion Regulation in Terms of Action Orientation

A well-validated (Diefendorff, Hall, Lord, & Strean, 2000; Kuhl, 1994) and often used questionnaire to measure ERA is the Action Control Scale (ACS-90; Kuhl, 1994) which distinguishes between state-oriented and action-oriented individuals (Kuhl, 1994, 2000). Action orientation is one of the core concepts within an integrative theory of personality and motivation, termed PSI theory (Kuhl, 2000, 2001). PSI theory can be described as "comprehensive framework for understanding human motivation and personality" (Koole, Schlinkert, Maldei, & Baumann, 2019) and explains behavior not only based on the content of thoughts/cognition or pure intentions. Instead, PSI theory focuses on the interaction between different intrapersonal systems and their functions (Kuhl, 2000, 2001).

Within this framework, action orientation is further subdivided into two dimensions. Decision-related (also known as demand-related) action orientation indicates the extent to which individuals can implement difficult intentions. This dimension is measured, for example, by the question "When I have work to do at home: (1) It is often hard for me to get the work done, (2) I usually get it done right away", where (1) is the state-oriented answer and (2) the action-oriented answer. Failure-related (also known as preoccupation-related) action orientation indicates how much individuals can motivate themselves after stress or failure. This dimension is measured, for example, by the question "When I have lost something that is very valuable to me and I can't find it anywhere: (1) I have a hard time concentrating on something else, (2) I put it out of my mind after a little while", where (1) is the state-oriented answer and (2) the action-oriented answer. The complete questionnaire is reprinted in the Appendix of this thesis.

Within PSI theory (Kuhl, 2000, 2001), decision-related action orientation is associated with the ability to upregulate dampened positive affect in order to initiate an

action. Failure-related action orientation is associated with the ability to downregulate negative affect. In this dissertation, the studies examined the effect of emotion regulation in terms of action orientation after failure, that is, the effect of individual differences in being able to downregulate negative affect. The term action orientation will be used in the following for the failure-related dimension.

Other core concepts of PSI theory include the distinction of so-called macro systems. The first two systems, namely *object recognition system,* and *intuitive behavior control* are elementary systems and presumably are supported by the parietal cortex (Culham & Valyear, 2006; Mishkin, Ungerleider, & Macko, 1983). The third and fourth system, are called *intention memory* and *extension memory*. According to PSI theory, intention memory is associated with analytical thinking and planning, whereas extension memory is associated with holistic thinking and parallel processing. These systems are operating on a higher processing level. Like many other self-regulatory ("executive") systems those two systems are presumably supported by the prefrontal cortex (PFC; Diekhof & Gruber, 2010).

Each one of the four systems has specific functional characteristics. For example, the object recognition system and intention memory use analytical processing and are vulnerable systems while intuitive behavior control and extension memory use holistic/parallel processing and are thus robust systems (Table 1 in Kuhl, 2000, Tabelle 5.1 in 2001). The object recognition system "focuses on single objects and isolates them from the entire context" and "is specialized in detecting perceptual or conceptual information that is not congruent with our expectations or needs" (Kazén & Quirin, 2018). The extension memory "includes the self, which integrates congruent and incongruent experiences in existent parallel networks of life experience and provides information about own needs, motives, value, and emotions related to these experiences. […] It mostly processes without explicit conscious awareness, although content processed by it can be made conscious. […] In

addition, extension memory is capable of integrating positive and negative experiences to form integrated schemas of individuals and the world to provide meaning for an individual." (Kazén & Quirin, 2018).

These four macro systems are continuously activated. Depending on personality traits, however, the specific activation of each system and the specific interaction intensities between these macro systems differ. Thus, individual differences in ERA affect the specific interaction between intention memory, extension memory, object recognition system and intuitive behavior control and therefore affect cognition and behavior (Kuhl, 2000, 2001).

One assumption in PSI theory is that excessive negative affect inhibits the connection between object recognition system and extension memory. In other words, the integration of new negative experiences via a holistic network of personal experiences into the self is hampered. Rather, these adverse events or incongruences remains in focus. The downregulation of negative affect and integration into the network of experiences prevents the "alienation" from one's interests and excessive perception of self-incongruent "objects" (Kazén & Quirin, 2018; Kuhl, 2001). The ability to cope with negative affect without ruminating and to be able to deal with these emotions is precisely what is referred to as *action orientation after failure* within PSI theory and measured via the ACS-90 questionnaire. Investigating the effect of ERA, in particular, action orientation after failure and therefore the interaction of the object recognition system and extension memory under different conditions is the goal of this dissertation thesis. The following characteristics of action orientation that play a role in the research presented in this thesis will be explained in more detail in the following sections:

1) Action orientation measures individual differences in emotion regulation
2) Action orientation refers to down regulating negative affect and to increased self-activation

3) Action orientation is a secondary response

4) Action orientation is an intuitive regulation strategy

5) Action orientation measures behavioral aspects of emotion regulation

2.4. Relevant Characteristics of Action Orientation

2.4.1. Action Orientation Measures Individual Differences in Emotion Regulation

Emotion regulation researchers acknowledge the importance of studying ERA from an individual differences perspective (e.g., Diaz, 2015; Gross, 1998). So far, existing research about emotional control, negative-mood regulation, repression, and rumination-distraction has focused on emotional expression, experience, and physiological responding. Although the process model and measures based on it such as the emotion regulation questionnaire (ERQ; Gross & John, 2003; German version by Abler & Kessler, 2009) can be used to measure individual differences, its theory and resulting research was not originally designed to study individual differences. It rather concentrated on the situation-specific use of strategies.

However, individuals differ in their ability or preference to apply strategies successfully. For example, at a dentist, individuals might prefer to distract themselves while others prefer detailed explanation or explicitly reappraising the situation in order to down-regulate their negative emotions or affect. Studies have shown that individual preferences for different strategies such as reappraisal and suppression vary among individuals (Gross & John, 2003). In this thesis we measured action orientation as a personality trait to investigate its influence on cognition and action.

2.4.2. Action Orientation Refers to Down Regulating Negative Affect and to Increased Self-Activation

Down Regulating Negative Affect

Research into the downregulation of negative emotions originates from Sigmund and Anna Freud (A. Freud, 1936; S. Freud, 1909, 1915), who mentioned defense mechanisms (Abwehrmechanismen) as part of their drive theory (Triebtheorie). For them, defense mechanisms were unconscious processes that are used to deal with internal threat and conflict. These mechanisms include regression, avoidance, and projection. However, Freud regarded all these mechanisms to be pathological (Parker & Endler, 1992) . This is not too far from current practice, because all personality traits and therefore "strategies" can be considered pathological or are at least part of psychiatric disorders when overused or if the individual suffers.

In contrast to Freud, current research mostly refers to Lazarus as the starting point of empirical investigations into emotion regulation and the related concept of coping. Lazarus and Folkman (1984) define coping as "constantly changing cognitive and behavioral efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resource of the person" and Eisenberg and colleagues (Eisenberg, Fabes, & Guthrie, 1997) define coping as involving regulatory processes in stress-involving situations (Compas et al., 2014).

Resilience

Similarly, the concept of resilience evolved, which was based on studying protective factors in stress-resistant children (for a review see Rutter, 1987). Resilience originally referred to the innate ability to restore mental health after stressful life events. Nowadays, resilience is

defined as a personality trait that evolved as a result of adapting to stressful life events (Kunzler, Gilan, Kalisch, Tüscher, & Lieb, 2018). In a review, Kalisch and colleagues elaborate on global resilience mechanisms (Kalisch, Müller, & Tüscher, 2015). They identify a positive (non-negative) reappraisal style as the central process in the generation of emotions which leads to resilience. However, the integration of novel or negative experiences into internal schemata as being the fundamental mechanism underlying resilience has not been considered in this framework (Quirin, Kent, Boksem, & Tops, 2015). In this thesis, we did not investigate resilience as such, but ERA are closely related to resilience and research into ERA helps to understand resilience effect, as well as the other way around, that is emotion regulation research is well-informed by resilience research. Therefore, resilience will be elaborated in the discussion section of this thesis against the background of this thesis studies' results.

Self-Activation

In PSI terms, a fully functioning person with an integrated self can integrate negative experiences and as a consequence show extended resilience (Kuhl, Quirin, & Koole, 2015). Firstly, before integrating a negative experience, it is necessary to downregulate the negative affect that is associated with the experience(Kuhl, 2001). A prominent mechanism to do so is ERA. This can be achieved through right-hemispheric processes, which are known to be involved in emotion regulation (Eisenberger & Lieberman, 2004; Lévesque et al., 2003; Lieberman et al., 2007; Torrisi, Lieberman, Bookheimer, & Altshuler, 2013; cited in Kuhl et al., 2015). This feature is relevant for the first study of this thesis, where holistic processing (associated with right hemispheric activation) is tested. Alternatively, individuals who integrate negative and positive self-attributes within their self-image are better able to cope with induced negative affect (Showers & Kling, 1996; cited in Kuhl et al., 2015). The second

study of this thesis taps into these mechanisms, as self-relevant negative and positive words were presented and related negativity bias was measured in depressed and non-depressed individuals with high compared to low ERA.

This thesis' studies contribute to understanding the relationship between down-regulating negative affect and cognition/behavior, via assessing intuition, biased processing, and self-other goal discrimination. Because resilience is difficult to measure at the personality level (Kunzler et al., 2018), it was not explicitly included in our study. Nonetheless, in a broader sense, this thesis' studies investigate the effect of resilience on cognition/behavior or in general on integrating (negative) experiences into extension memory. Additionally, because strictly speaking we do not know whether the individuals in our studies truly integrate negative experiences/emotions or whether they repress them, will be part of this thesis' discussion.

Above all, studies have shown that self-activation functions as a mediator between demand priming and intuitive affect regulation. The self-activating function of action orientation was confirmed in a study where subliminal self-primes were associated with down-regulation of negative affect in action-oriented but not state-oriented individuals. (Koole & Coenen, 2007). Self-activation in action-oriented individuals was interpreted by the authors as evidence for the mediating role of extension memory as a hypothetical construct in PSI theory, that contains implicit representations. These representations, in turn, provide integrated knowledge about the self and the environment (Koole & Jostmann, 2004). Action orientation also takes effect when individuals are subliminally primed with self-relevant stimuli (Jostmann, Koole, van der Wulp, & Fockenberg, 2005; Koole & Coenen, 2007). Furthermore, action orientation is negatively associated with mistakenly remembering assigned task as one's own (Baumann & Kuhl, 2003; Kazén, Baumann, & Kuhl, 2003; Kuhl & Kazén, 1994a), a phenomenon strongly related to self-activation and

termed self-infiltration. Therefore we used this self-infiltration paradigm in the third study of this thesis. As visualized in Figure 1, the studies investigated ERA's impact on intuition, biased processing in depressed individuals and on self-discrimination of tasks, which are all self-related processes.

2.4.3. Action Orientation is a Secondary Response

Before the more known Richard Lazarus, Magda Arnold (Arnold, 1960, 1970; cited in Lazarus & Folkman, 1984) came up with a cognitive theory of emotion, namely appraisal theory. According to her, emotions arise from a rapid and mostly unconscious process that in turn arises from the combination of wishes and reality – resulting in a quasi-intuitive assessment of the "here and now" (Roseman & Smith, 2001). Although Arnold speaks of intuitive appraisal, the emergence of emotions does not exclude high-level interactions and should not be equated with primitive fight-flight responses (Lazarus & Folkman, 1984).

For his transactional model of stress and coping, Lazarus and colleagues (Lazarus, 1991; Lazarus & Folkman, 1987) added secondary appraisal as a subsequent factor, where individuals analyze their available resources first. According to this theory, in a third step after primary and secondary appraisal, individuals apply regulation, which can be problem-focused and/or emotion-focused. Problem-focused coping aims to change the relationship between the environment and the person by acting on either of them, while emotion focused coping acts on what is on the individual's mind by attention shifts, deployment, denial or distancing (Lazarus, 1991).

From a process model perspective it obviously matters whether emotions are regulated early in an antecedent-focused style or late in a response-focused style (Gross & Barrett, 2011). Similarly, PSI theory distinguishes between primary reactions and secondary reactions (Baumann, Kaschel, & Kuhl, 2007; Koole, Van Dillen, & Sheppes, 2011). The

primary reaction, also known as affect sensitivity, refers to individuals' immediate, raw response. The secondary response, also known as affect regulation, refers to individuals' ability to cope with the primary response. For example, the primary reaction of feeling stress in an adverse event is distinguished from the secondary reaction of possibly employing emotion regulation such as action orientation. Of course, primary and secondary reaction are related to each other, for example, an individual with high temperament (general increased sensory or motor activity) or high neuroticism (related to a specific target) will more often find him/herself in a situation that needs a secondary reaction, respectively emotion regulation.

Apart from the theoretical perspective, the differentiation between affect sensitivity and affect regulation is important for practical reasons. For example, in one study affect sensitivity and affect regulation had an interactive effect on emotional well-being (Baumann et al., 2007). Individuals with low sensitivity (low neuroticism) to negative affect had no differences in psychosomatic symptoms depending on action orientation, but in individuals with high sensitivity to negative affect (highly neurotic) action orientation was positively associated with less psychosomatic symptoms. The three studies presented in this thesis used action orientation as an emotion regulation measure because we did not want to investigate general temperament or primary appraisal processes or affect sensitivity (e.g., as measured by neuroticism) but the aim was to investigate the effect of emotion regulation as a secondary response.

2.4.4. Action Orientation is an Intuitive Regulation Strategy

Apart from their antecedent-focused versus response-focused distinction of emotion regulation strategies, Gross and colleagues (e.g., Ochsner & Gross, 2005) distinguish two general possibilities to regulate emotions. Firstly, there is attentional control, that is,

selective inattention, performing distracting secondary task, and attention to and judgment of emotional vs. non-emotional stimulus attributes. Secondly, there is cognitive change, comprising controlled emotion *generation* (i.e., anticipatory/expectancy driven emotion, top-down appraisal, reappraisal) and emotion *regulation* (i.e., stimulus-reinforcer, reversal/extinction, placebo).

The approach of Gross and colleagues and their process model has two main problems: Firstly, both, attentional control and cognitive change mechanisms are rather *cognitive* mechanisms and constitute a rather deliberate (versus automatic or intuitive) style of emotion regulation. Secondly, mostly specific strategies are investigated, such as reappraisal or change of attention. It seems obvious, however, that in everyday life, one may not be consciously able to regulate an emotion in a situation or one would use an intuitive way of regulating emotions without a specific strategy. For example, conscious emotion regulation would probably work for a dentist visit, but not necessarily for the emotional strain after a failed speech. In line with this, it is argued (e.g., Mauss, Bunge, & Gross, 2007) that Gross and colleagues' form of emotion regulation leaves out an important component of emotion regulation, that is *automatic* emotion regulation.

Some argue (e.g., Karoly, 1993; Masters, 1991) that emotion regulation can be either, deliberate or automatic. Specifically, (1) emotion regulation goals are implicitly activated and monitoring takes place, (2) individuals' suitable emotion regulation strategies are selected via implicit processes, (3) emotion regulation strategies are enacted (Koole, Webb, & Sheeran, 2015). Gross and colleagues stressed the importance of investigating implicit (compared to explicit) emotion regulation, such as measured by the construct of action orientation (Gross, 2015a, 2015b; Gyurak, Gross, & Etkin, 2011). This automatic, intuitive emotion regulation is the focus of this thesis.

Several studies have shown the implicit characteristic of action orientation. For

example, in a multi-study design, action-oriented individuals were able to down-regulate negative affect in explicit self-reports after a demanding arithmetic task with performance-incongruent feedback, in an affective Simon task, and in a face-discrimination task that measured fast efficient, unintentional emotion regulation (Koole & Jostmann, 2004).

Both, implicit emotion regulation mechanisms as well as regulation according to Gross and colleagues' model, do not only serve an overarching purpose, that is, to help self-regulate emotions flexibly (Koole et al., 2015). At best, one can assume a dual process model that integrates explicit and implicit forms of emotion regulation as they are not mutually exclusive and individuals can fluctuate rapidly between explicit and implicit forms of emotion regulation (Gross, 2015a, 2015b; Gyurak et al., 2011). Within this framework, action orientation is recognized as individuals' predisposition "to 'intuitively' regulate emotion and quickly decrease negative affect in demanding situations". Because this type of emotion regulation might be specifically helpful in social stress situations and for depressed individuals and it has been shown to be linked to self-infiltration (Baumann & Kuhl, 2003; Kazén et al., 2003; Kuhl & Kazén, 1994a) all due to its implicit regulation mechanisms, as explained, we used this measure in the three studies of this thesis.

2.4.5. Action Orientation Measures Behavioral Aspects of Emotion Regulation

Psychology is the scientific study of behavior and mental processes (Hockenbury, Nolan, & Hockenbury, 2015). This macro-definition of psychology, in turn, fits with an approach of differentiating micro-processes that are elementary components of emotion regulation. A possible classification of emotion regulation is based on individuals' explicit reports and categorizing of regulation strategies distinguishes between three strategies where each one has a cognitive and a behavioral component (Parkinson & Totterdell, 1999): One engagement-strategy (cognitive: e.g., reappraisal; behavioral: e.g., seek help or comfort from

others) and two diversion-strategies, that is, *disengagement* (cognitive: e.g., avoid thinking about the problem; behavioral: e.g., avoid problematic situation) and *distraction* (cognitive: e.g., think about something pleasant; behavioral: e.g., do something pleasant).

Action orientation differs from other forms of emotion regulation in the following aspects: The action orientation questionnaire only assesses behavioral consequences, that is, whether the person was able to disengage from ruminative behavior. Other emotion regulation questionnaires focus on cognitive aspects. For example, the ERQ uses cognitive questions about positive and negative emotions exclusively and the Affective Styles Questionnaire (ASQ; Graser et al., 2012) uses questions that range between showing and controlling emotions but no explicit behavioral questions as well. The Rumination Suppression Questionnaire (RS-8; Pjanic, Bachmann, Znoj, & Messerli-Bürgy, 2013) asks to evaluate statements like *'Often the same thoughts come back several times a day'* and *'I feel at the mercy of certain thoughts.'* Altogether, two (questions 5, 8) out of eight questions, that is, 25.00%, focus on behavioral aspects of emotion regulation. In contrast, the ACS-90 has a mixed approach with a behavioral focus. While some questions focus on cognition, for example, *'When I have lost something valuable and can't find it anywhere: a) I have a hard time concentrating on anything else. b) I don't dwell on it.'*, many others focus on behavior, for example, *'When something really gets me down: a) I have trouble doing anything at all. b) I find it easy to distract myself by doing other things.'* Altogether, five (questions 15, 17, 19, 21, 23) out of twelve questions, that is, 41.67%, focus on behavioral aspects of emotion regulation. This questionnaire pays tribute to the theory according to which action orientation is an implicit automatic process. Consequently, one would fail to measure action orientation directly via cognition-related questions, but it can only be measured via the behavioral outcome.

The fact that many of the other prominent emotion regulation questionnaires focus

on cognitive aspects of emotion regulation but not on behavioral ones, illustrates the importance of further studies with a focus on behavioral aspects of individual differences in ERA. Therefore, with their usage of a behavioral focused emotion regulation strategy questionnaire, the studies in this thesis extend previous research.

2.5. Neural Correlates of Action Orientation and Self-Infiltration

Neural correlates of emotion regulation include the ventral anterior cingulate and ventromedial prefrontal cortices, as well as the lateral prefrontal and parietal cortices (Etkin, Büchel, & Gross, 2015; Quirk & Beer, 2006). Automatic emotion regulation has been associated with activity in the right inferior frontal gyrus and ventro-parietal cortex presumably reflecting the attentional control process (Hallam et al., 2015). However, far less is known about the neural correlates of action versus state orientation. Study 3 of this thesis is one of the very few studies investigating the neural underpinnings of action versus state orientation and its impact on cognition and behavior. There exist five published electroencephalogram (EEG) studies including action orientation, two reporting effects of demand-related action orientation (Düsing, Tops, Radtke, Kuhl, & Quirin, 2016; Pinnow, Laskowski, Wascher, & Schulz, 2015), and three reporting effects of action orientation after failure (Haschke, Tennigkeit, & Kuhl, 1994; Kuhl, Schapkin, & Gusev, 1994; Rosahl, Tennigkeit, Kuhl, & Haschke, 1993). There exists one study using structural and functional magnetic resonance imaging (MRI) to investigate neural correlates of demand-related action orientation (Schlüter et al., 2018). Only one study used MRI to study action orientation after failure (Ruigendijk, 2018) but as they used structural MRI, no study to date has investigated functional MRI to study neural correlates of action orientation after failure.

The first study that investigated EEG and action orientation after failure (Rosahl et al., 1993) showed that subjects who reacted with a positive shift to the presentation of

task-irrelevant critical words before the actual task had a lower action orientation score than subjects who reacted with a negative shift. According to them, because the preparation of a movement is associated with negative shifts, the results suggest that the negative potential shifts in action-oriented individuals are a neural correlate for maintaining an intention and executing it after the negative event. This facilitation of volitional functions in action-oriented individuals and inhibition thereof in state-oriented individuals was confirmed in two similar studies and interpreted in terms of reduced prefrontal coordination of task-relevant processes in state-oriented individuals similar to processes in patients with prefrontal lesions (Haschke et al., 1994; Kuhl et al., 1994).

In the structural MRI study action orientation after failure was positively correlated with gray matter volume in the left cerebellum (Ruigendijk, 2018). The positive correlation of action orientation and gray matter volume in the cerebellum is in line with findings showing the important function thereof "in implicit or intuitive control of mental activities (Ito, 2005, 2006, 2008)" and that this "indicates the ability to implicitly think could help to integrate new experiences into the existing self-system in a non-conscious manner". This also fits well with the framework of PSI theory stating the integrative competence as one of the seven functions of the self (Kuhl et al., 2015). In the second study of this dissertation thesis, the decreased negativity bias of depressed individuals that at the same time have high action orientation scores might well be related to this integrative competence of action-oriented individuals and their increased gray matter volume.

To summarize, the EEG and MRI studies reveal functional and structural differences in action versus state-oriented individuals in volitional facilitation and in down-regulation of negative affect. As neural correlates, slow potential shifts have been found. At least some effects in these studies have been described extensively on a descriptive basis and should therefore be interpreted with caution. Further research into slow potential shifts is needed in

order to reveal their precise function. Therefore, the research into neural correlates of action versus state orientation after failure should be replicated with sufficient numbers of participants, with additional statistical tests and complemented with other methods, such as functional MRI. In the third study of this dissertation thesis, we have taken the first step into this direction by investigating neural correlates of self-alienation using functional MRI.

2.6. Investigating Extension Memory with Three Studies: Intuition, Effects on Negativity Bias, and Self-Discrimination

As explained, action orientation measures how well individuals can shift from object recognition system to extension memory. In terms of study designs and analyses, individual differences in action orientation are a moderator in a variety of relationships. Specifically, we have examined the following three domains: (1) intuitive decisions, (2) attentional bias with respect to negative self-aspects, and (3) self-other discrimination of tasks. Figure 1 summarizes the studies' measures and their relation to the systems in PSI theory.

As explained, extension memory is a parallel processing system and negative affect is linked to increased activity of the object recognition system and downregulating this negative affect is associated with activation of the extension memory, where self-related processes take place (Kuhl et al., 2015). Therefore, in the first study we focused on this characteristic by investigating the potentially moderating effect of action orientation on the stress-intuition-relationship. In particular, we extended previous studies by inducing social stress and measuring stress via cortisol elevations.

Secondly, we investigated the depression-biased-processing-relationship. Many studies have shown that depressed individuals show negatively biased processing as already proposed for example by Beck's schema model (Beck, 1976) and Bower's network theory (Bower, 1981). In this study we investigated whether action orientation can moderate this

effect, that is, whether depressed individuals with high action orientation scores show less negativity bias than depressed individuals with low action orientation scores. This would also prove a shift from object recognition system to extension memory which should be associated with increased action orientation. In line with the characteristic of the self / extension memory to be more prone to reactions to negative self-relevant stimuli, these were used in this study.

Gross and Muñoz (1995) also highlighted that apart from work and relationships, ERA have a profound effect on what they call "inner life" and a sense of meaning. In PSI theory, extension memory / the self resembles this function. Extension memory is responsible for integrating own ideas, goals and tasks. As described above, action orientation is negatively associated with mistakenly remembering assigned tasks as one's own. In the third study, we therefore extended previous studies by investigating neural correlates underlying this effect.

3. **Study 1: Personality, Stress, and Intuition: Emotion Regulation Abilities Moderate the Effect of Stress-Dependent Cortisol Increase on Coherence Judgments**

Abstract

Objective: Findings on the relationship between hypothalamus-pituitary-adrenocortical (HPA) activity and cognitive performance are inconsistent. We investigated whether personality in terms of emotion regulation abilities (ERA) moderates the relationship between stress-contingent HPA activity and intuition. **Method:** Participants' (N = 49, aged 18 to 33 years, $M = 22.48$, $SD = 3.33$, 32 female) ERA and cortisol responses to social-evaluative stress as induced by a variant of the Trier Social Stress Test were determined. Subsequently, in a Remote Associates Task they provided intuitive judgments on whether word triples, primed by either stress reminding or neutral words, are coherent or not. **Results:** Under relative cortisol increase participants low in ERA showed reduced performance whereas individuals high in ERA showed increased performance. By contrast, under conditions of low cortisol change, individuals low in ERA showed increased performance compared to individuals high in ERA. **Conclusions:** ERA can moderate the link between stress and cognition so that existing effects may not be discovered across all individuals, which highlights the necessity to consider individual differences in ERA in stress research, or personality differences in general. We discuss the findings with respect to individual differences in neurobehavioral mechanisms potentially underlying ERA and corresponding interactions with cognitive processing.

4. Study 2: Emotion Regulation Abilities Compensate for Depression-Related Negativity Bias

The full manuscript has been submitted as

Radtke, E. L., Düsing, R., Kuhl, J., Konrad, C., & Quirin, M. (2019). Emotion Regulation Abilities Compensate for Depression-Related Negativity Bias.

Submitted to *Acta Psychologica*.

Abstract

Major depression is associated with a biased processing of negative stimuli, while the underlying neural mechanisms are still discussed. Emotion regulation abilities (ERA) are important for being able to disengage from negative stimuli. Here, we investigated the role of ERA in the depression-related negativity bias. Eighty-three individuals with major depressive disorder and 74 healthy individuals were assessed for depressiveness (Beck Depression Inventory) and ERA (Action Orientation after Failure Scale). They engaged in a classical Stroop task variant where color words were preceded by either a self-relevant positive (success-related), negative (failure-related) or neutral word prime. Whereas the expected Depressiveness x Emotional Prime interaction did not reach significance, the expected ERA x Emotional Prime interaction did. The latter was qualified by the three-way interaction of ERA x Depressiveness x Emotional Prime where ERA predicted the negativity bias within individuals with high depressiveness scores. This effect emerges at mild to moderate depression scores as indicated by a Johnson-Neyman analysis. Reduced ERA in depressiveness might thus constitute a central mechanism causing depression-related negativity bias. Future research might investigate how ERA influence everyday-life functioning and treatment outcomes for individuals with depression.

5. Study 3: Autonomy or Alienation: Neural Correlates of Self-Chosen versus Introjected Goals

The full manuscript has been submitted as

Abstract

Individuals do not know what they really want as they are continuously confronted with social expectations and norms. Often enough they unwittingly mistake these expectations for their own goals, typically called introjection. In this pioneering experimental brain imaging study recognition of self-chosen task goals involved the right medial prefrontal cortex (MPFC). Introjections as indicated by imposed tasks falsely recognized as self-chosen involved bilateral MPFC and the dorsal anterior cingulate cortex (ACC). Here, reduced right MPFC activation and high numbers of introjections were correlated with each other, and were both correlated with rumination tendencies and reduced emotional self-awareness. Thus, the right MPFC may support the maintenance of autonomy and counteract self-alienation. The present research has significant implications for the study of internalisation of goals and norms, decision-making, and autonomous motivation, and is thus of interdisciplinary relevance for psychology, philosophy, law, social sciences, education, economics, theology, and health sciences.

6. General Discussion

6.1. Summary of Results

The aim of the present studies was to investigate conditions in which action orientation as a personality trait acts as a moderator and influences extension memory or self-related processes. The results and their relation to PSI theory systems is depicted in Figure 2. In particular, the three studies presented evidence that ERA can have a profound effect on the stress-intuition relationship, on the negativity bias in depressed individuals, and on self-other goal discrimination (see right part of Figure 2). Study 1 showed that emotion regulation can moderate the link between stress and cognition. That is, under relative cortisol increase participants with low ERA showed reduced holistic processing whereas individuals with high ERA showed increased performance in a holistic processing task. In Study 2, ERA predicted the depression-related negativity bias which is closely related to extension memory function according to PSI theory. In Study 3 we replicated earlier findings in which action orientation was associated with increased ability to discriminate own versus assigned goals. Additionally, we identified brain regions that are associated with this function.

Furthermore, Study 1 showed that state orientation is not a flaw per se, but can also be associated with benefits. Under low-stress conditions, state orientation was associated with better intuition performances than action orientation. Additionally, study 2 showed that action orientation takes effects already at depression scores below the well-known cut off score for depression diagnosis of 18 points in the Beck Depression Index and suggests that ERA in depressiveness might constitute a central mechanism causing depression-related negativity bias.

Overall, these findings extend previous research and link to PSI theory, as visualized in Figure 2. The studies show that ERA can moderate the potentially negative relationship

between object recognition system (measured via depressive symptoms and stress induction) and extension memory (measured via negativity bias and intuitive judgment). They also show that ERA have a positive relationship with extension memory, measured via the ability to discriminate assigned versus own goals . Furthermore, they showed medial PFC activation in areas associated with functions of extension memory or the so-called self.

6.2. The Three Studies in Context

6.2.1. Study 1: Cortisol as a measure of stress reactivity in action-oriented and state-oriented individuals

In the first study, we used changes in salivary cortisol level as a measure of stress reactivity. Increased cortisol level was an indicator of successful stress induction and low cortisol increase and cortisol decrease were indicators of feeling unstressed. However, firstly, the action orientation assessment, cortisol measurement, and remote associates test were part of a larger assessment battery used in the experiment, which took approximately 3 hours. The other tasks and assessments might have had an effect on the reported measurements. For example, we cannot be sure that the Trier Social Stress Test was the stress-inducing part of the experiment. We cannot exclude that some of the other tasks or the whole setting induced stress. Secondly, as explained in the study's method section, not many individuals in our study were so-called responders. This raises the question whether our stress induction was successful in general. The cortisol increase in a third of participants might be the response to any other adverse events or even any "random" fluctuation in participants' cortisol response. Thirdly, and related to the second concern, it would have been optimal if we had a control group with no Trier Social Stress Test induction. However, the results would still be valid in the sense that cortisol increase in combination with state orientation is associated

with worse performance in coherence judgments.

Future studies should consider using other biomarkers of defense motivation, such as heart rate variability, skin conductance, or the startle reflex. All of these are associated with changes in arousal level when viewing pictures depicting threat, violent death, and erotica (Bradley, Codispoti, Cuthbert, & Lang, 2001). Measuring these markers, additionally to saliva cortisol, would help to investigate the underlying mechanisms of the stress-intuition relationship moderated by emotion regulation. For example, heart-rate variability at rest, as an indicator of flexibility of the autonomous nervous system, has been suggested as a biological correlate of self-control/self-regulation (e.g., Thayer & Lane, 2000) and the effect was confirmed in a meta-analysis to be a presumably small, but present, effect (for a meta-analysis see Zahn et al., 2016). By combining the measurement of these biomarkers with the concepts of action orientation and self-infiltration, research can be significantly advanced. For example, it could be investigated whether self-regulation mediates the action-orientation-intuition relationship during stress experiences or whether self-regulation explains additional variance in the relationship independently of action orientation.

6.2.2. Study 1 and Study 2: Data Extrapolation

One should not draw conclusions based on the extrapolation of data. Two limitations regarding the distribution of sample characteristics should be noted for the first two studies. In the described studies, action orientation and even more depression show different distributions in the population. Even in psychiatric clinics, one will not find a large number of highly depressed individuals who also want to participate in a study. Additionally, it is very unlikely that within highly depressed individuals there are "enough" individuals with high action orientation scores. These distribution problems possibly lead to limitations of the studies because extrapolation from the data is not valid and therefore statements about,

for example, extremely depressed but action oriented individuals which is of high interest, would be impossible to draw from the research results.

To explore the extent of this possible problem, I took a closer look at the range of depression, action orientation, and cortisol increase scores to evaluate whether enough participants have been measured at certain combinations thereof. Contrary to conventional discussion sections of dissertation theses, but in favor of discussion depth, this will include some additional statistics here.

For both studies, for each of the two variables, a median split was conducted and the resulting distributions are depicted in Figure 3. I calculated two X^2 tests. The first X^2 test checked, within the data of Study 1, whether the cortisol increase (high vs. low AUCi) was independent of action orientation scores (high vs. low). There was no significant effect, $X^2(1) = 0.186$, $p = .665$. The second X^2 test checked, within the data of Study 2, whether depression scores (high vs. low) were independent of action orientation (high vs. low). As a result, action orientation was 7.68 times higher in non-depressed individuals than in depressed individuals, $X^2(1) = 36.561$, $p < .001$. In other words, 9.6% of all participants were highly depressed and at the same time action-oriented, while 17.8 to 39.5% fall in each of the other three categories resulting from the median splits. For example, in individuals with a BDI score of 31 or larger, the maximum action orientation score is 4.

Another specificity related to the distribution of behavioral outcome, that is, intuition scores in the second study, is evident in Figure 2 of Study 2: In depressed individuals (BDI+1SD), the confidence interval for action-oriented individuals (*high ERA* in the figure) is visibly larger than the confidence interval for state-oriented individuals (*low ERA* in the figure). In line with this, the confidence interval (dotted line in Figure 4 of Study 2) also gets wider with increasing BDI scores, that is, the estimated impact of ERA becomes less "precise" with increasing BDI scores. This is due to the low number of individuals with depression

and rather high action orientation scores. Having enough participants from this group of individuals is of great importance as this is the group of individuals, we wish to make predictions about.

Therefore, future studies should consider increasing the number of participants with high depression scores in combination with high action orientation. Alternatively, one could conceptualize action orientation as a state instead of a trait. This would allow for an experimental approach to the investigation of depression and negativity bias where action orientation could be induced in depressed individuals.

6.2.3. Study 3: Self-Infiltration and Action Orientation Studies and the Role of Negative Affect

Proposed by PSI theory (e.g., Kuhl, 2000, 2001) and supported by studies as explained in the introduction of this thesis, negative affect is assumed to reduce self-activation. According to PSI theory, action-oriented individuals can down-regulate negative affect and regain self-access which is associated with decreased self-infiltration. Due to the above-described relationship between action orientation and self-access, one would expect negative affect crucially affect the investigated relationships. That is, only in combination with negative affect or, for example, a stress situation, action orientation should be associated with increased self-infiltrations. To shed light on this implication of PSI theory, previous research will be examined more closely in the following. Apart from the study in this thesis there are currently five journal articles covering ten studies that use the self-infiltration paradigm (Baumann & Kuhl, 2003; Baumann, Kuhl, & Kazén, 2005; Kazén et al., 2003; Kuhl & Kazén, 1994a; Quirin, Koole, Baumann, Kazén, & Kuhl, 2009) – for a summary see Table 1.

The methods and results of four studies were in line with the mentioned assumption. In one study (Study 2 in Kazén et al., 2003), external pressure was induced in a subgroup of

participants and self-infiltration in combination with action orientation only occurred in the stressed group. In three studies, sad mood, was either measured via self-report or induced via film-clips (both studies in Baumann & Kuhl, 2003; Study 3 in Kazén et al., 2003).

Surprisingly, the very first study in the first published paper about self-infiltration (Study 1 in Kuhl & Kazén, 1994a) did not include the measurement or induction of negative affect. Similarly, the second study in the same research paper (Study 2 in Kuhl & Kazén, 1994a) induced completed versus uncompleted intentions as a manipulation. The reason for these two manipulations might be that in 1994, the authors investigated action orientation and self-infiltration against a then current pre-PSI-like theory (Kuhl, 1992) which did not involve negative affect. Negative affect was included in the theory only later (e.g., Kuhl, 2000, 2001). Therefore, in the following studies investigating action-orientation and self-infiltration (Baumann & Kuhl, 2003; Kazén et al., 2003) negative affect or similar potentially moderating factors were included in the studies. This is a perfect example how a good theory and particularly its expansion over time informs research. A third study where stress-unrelated manipulation was used (Study 1 in Kazén et al., 2003) examined the influence of task attractivity in the sense of meaningfulness of tasks and therefore refrained from stress induction.

In contrast, another study did not find a relationship between stress and action orientation (Quirin et al., 2009). However, in this study, stress was induced via randomly applied uncontrollable and unpredictable auditory startles for 500 ms and 102 dB for 8 min during an unrelated visual-classification task. For this study, the authors did not report that action orientation had an effect, but according to personal communication it was measured and yielded no result in the analyses. There are at least four possibilities that I outline which could have contributed to the null findings: Firstly, it might be that on average, the induced stress was not stressing enough to elicit effects. In line with this, the authors stated that they

intentionally did not use the well-know Trier Social Stress Test but an auditory stressor because the latter would be "less than optimal to reveal relationships between cortisol changes and psychological variables (Gerra et al., 2001; Pruessner et al., 1997)". Therefore, future studies should vary the stress intensity and/or check how the cortisol response after stress induction affects action orientation's impact on self-infiltration. Particularly, as explained in this thesis' Study 1, cortisol is known to have an inverted-u-shaped effect on many cognitive functions. This might be the case for the link between stress, action orientation, and self-infiltration investigated by Quirin et al. (2009). Therefore, due to the inverted-u-shape-relationship, the induced stress might not have been optimal. A strength of the first study, although not being related to self-infiltration, but investigating action orientation effects is that we referred to the inverted-u-shaped effect of cortisol in the introduction. Thirdly, the authors could have calculated the area under the curve with respect to increase for the cortisol measurements instead of the Time 2 minus Time 1 (baseline) measurements. Doing this, information from more than two time points of potential cortisol increase could be used, which is a more robust measure as it, for example, goes along with more information about the cortisol secretion over the specific period of time (Fekedulegn et al., 2007; Pruessner, Kirschbaum, Meinlschmid, & Hellhammer, 2003). Although our first study was not investigating self-infiltration, we used the area under the curve with respect to increase as a measure of stress reactivity. Secondly, we used the well-known Trier Social Stress Test to induce stress. In these studies we succeeded in replicating action orientation effects – although these effects were on holistic thinking, this adds to action orientation and the relationship to stress / negative affect. Fourthly, and not least, with only 48 participants, the power of the study might have been too low in order to detect such an interaction effect. This is similarly a problem with this thesis' Study 1 and 3 as well. This should be improved in future studies by measuring more participants and optimally additionally calculating a

priori power analyses.

Two studies induced left versus right hemisphere activation (both studies in Baumann et al., 2005). As Baumann and colleagues describe, previous research has shown that the left hemisphere is more involved in analytical, sequential and monosemantic information processing (Beeman et al., 1994; Rotenberg, 2004) and helps to maintain intentions (Goschke & Kuhl, 1993) while the right hemisphere, particularly the frontal lobe, is more involved in self-relevant tasks, than in processing integrated self-aspects and in self-related judgments (Craik et al., 1999; Keenan, Nelson, O'Connor, & Pascual-Leone, 2001; Ranganath & Paller, 1999). In Baumann and colleagues' first study (Baumann et al., 2005), participants did left versus right hand contractions to activate the contralateral hemisphere before the task. In the second study, hemispheric dominance was additionally tested by the line bisection task. In both studies, left hemispheric activation was associated with increased self-infiltrations, surprisingly irrespective of individual differences in action versus state orientation. Therefore, as underlying process, activity of the right hemisphere was assumed to facilitate the access to self-compatibility checking and therefore to be associated with less self-infiltrations. At first sight it might be surprising, that in both experiments, the experimental induction of right versus left-hemispheric activation was effective for all participants. In other words, increased self-infiltration after right hemisphere activation was present to the same degree in state-oriented as well as action-oriented individuals. However, this is in line with previous research, as it might well be that during negative affect due to the different abilities to down regulate this negative affect, state versus action orientation is associated with different activation of the left versus right hemisphere which in turn is associated with different abilities to self-access. This difference in self-access is what is measured via differences in self-infiltrations. Therefore, in the two studies by Baumann and colleagues, action orientation may not have an effect because the left versus right hemisphere

activity was manipulated (Study 1) or measured (Study 2) directly. In other words, activation of the right compared to the left hemisphere might mimic action compared to state orientation.

To summarize, most of the self-infiltration studies did not induce negative affect and against the background of PSI theory the results therefore seem to be arbitrary at first sight. However, as explained, the results contribute to understanding the relationship between action orientation and self-infiltration. This also holds for the results of this thesis' studies. For example, in the third study of this thesis, we did not induce negative affect but still showed action orientation effects on the number of self-infiltrations. This makes sense from a purely self-regulation perspective, similarly to Kuhl & Kazén's very first study (1994a). However, MRI scanning has been shown to trigger sympathetic arousal, especially at the beginning of the scanning session (Muehlhan et al., 2013) and anxiety (Chapman, Bernier, & Rusak, 2010). Therefore, the participants in our study might have experienced negative affect due to the MRI environment. Future research into action orientation and self-infiltration should lay a focus on controlling this confounding factor. Similarly, this also holds for the other two studies. They were not self-infiltration related but might at first sight not be totally in line with PSI theory. Particularly, in the first study, we did not induce negative affect. However, we measured cortisol as an endocrine marker of the stress-reaction. In the second study of this thesis, we investigated the negativity bias in depressed individuals. In that case, the self-related negative stimuli activate the object recognition system instead of negative affect. In general, it is important for future studies to include a measure of negative affect in the studies as well as in the analyses.

6.2.4. Action Orientation as a Continuous Measure in all Three Studies

Having used action orientation as a continuous measure in all analyses of the three studies

of this thesis is a decisive advantage. While some years ago, median split was performed regularly, nowadays, regression poses no computational problem. However, most studies investigating action orientation, especially by Kuhl, Baumann, Kazén, Koole and colleagues, perform a median split before the data is usually evaluated with an ANOVA.

Some arguments speak in favor of dichotomization. Farrington and Loeber (2000) claim that dichotomization does not necessarily decrease measured strengths of associations, at least in their example studies of delinquency. In an examination of justification of dichotomization (DeCoster, Iselin, & Gallucci, 2009), researchers who were asked to name reasons for dichotomization named three type of reasons, namely (1) distribution of the variables, for example, the latent variable being truly categorial, (2) ease of analysis, for example, results from categorial versus continuous analysis leading to same results, ease of data analysis and results presentation, (3) prior use of the variables, for example, established meaningful cut points for dichotomization, past research having dichotomized. Particularly, for constructs that are measured as continuous variables, but which are conceptually discrete, dichotomization is a favored method to optimally match the construct conceptualization. Internal vs. external locus of control, low vs. high self-monitoring, low vs. high need for closure, introversion vs. extraversion, liberal vs. conservative attitude are examples for dichotomous psychological concepts (Iacobucci, Posavac, Kardes, Schneider, & Popovich, 2015). Simulations have shown that when the latent variable is categorical, the continuous and proportional split perform equally well in analysis. However, the continuous variable is more robust independently of the distribution of the latent variable (DeCoster et al., 2009). Definitely, action versus state orientation falls into this kind of traits that match a dichotomous concept.

Contrary, some arguments speak against dichotomization. The convenience-related arguments, such as ease of analysis etc., from above can be invalidated easily (DeCoster et

al., 2009; Rucker, McShane, & Preacher, 2015). Methods for investigating interaction effects in regression or ANCOVA exist (Aiken & West, 1991; Cohen, Cohen, West, & Aiken, 2003) and there is even a plugin for SPSS since some years (Hayes, 2013). For result visualization, simple effect tests or simple slope analysis can be performed. Descriptions can be found in the literature that also includes internet links with helpful tools (e.g., DeCoster et al., 2009; Rucker et al., 2015).

A striking argument against dichotomization is that of power loss and a potential increase in type II errors (McClelland, Lynch, Irwin, Spiller, & Fitzsimons, 2015; Rucker et al., 2015) because of inefficient effect sizes resulting from calculations based on dichotomized variables (Iacobucci et al., 2015; Rucker et al., 2015). This in turn can bias meta-analyses (DeCoster et al., 2009). Furthermore, dichotomization is criticized because of the associated loss of information. Particularly in the study of individual differences, this alters the received information drastically (MacCallum, Zhang, Preacher, & Rucker, 2002; Rucker et al., 2015). In addition, nonlinear effects are more easily overlooked when dichotomizing (MacCallum et al., 2002). Some go as far as demanding „Death to dichotomizing" (Fitzsimons, 2008).

To pick up the argument from the beginning, although dichotomization should be avoided in general, action orientation might be one of the view constructs to be viable to dichotomization. The norm for splitting action orientation states that individuals with a score between 0 and 4 are classified as state-oriented (= low ERA) and individuals with a score between 5 and 12 are classified as action-oriented (= high ERA). There is a theoretical and practical/statistical perspective to that suggestion. According to PSI theory, action orientation and state orientation might be associated with two qualitatively different processing modes (Kuhl, 2001) and different mechanisms might underlie action versus state orientation. In action-oriented individuals, extension memory is activated more frequently

while in state-oriented individuals object recognition system is activated more frequently. As will be explained later, these systems in PSI theory might reflect different underlying systems.

From a practical/statistical perspective, some of the data in this thesis are perfect for testing whether action orientation scores are unimodally or bimodally distributed among the general population. Therefore, again, contrary to conventional discussion sections of dissertation theses, but in favor of discussion depth, this will include some additional statistics here. Two Hartigan's Dip Statistics (J. A. Hartigan & Hartigan, 1985; using the R package "diptest", based on P. M. Hartigan, 1985) to test for unimodality were performed, one for the action orientation scores of the first study of this thesis (N = 49) and one for the subgroup of participants that were recruited externally in the second study (N = 83). Also, I did not analyze the action orientation scores of the third study, because we had only 17 participants. I did not analyze the action orientation scores for the subgroup from the psychiatry clinic from the second study, because they do not fit into the normal distribution on which PSI theory and action-state orientation as construct are based on. In this subgroup, we would assume increased state orientation scores, and in fact showed a positive correlation between action orientation and depression scores, and therefore cannot include their action orientation score into the tests for unimodal distribution. The tests for modality revealed that the distribution of action orientation scores in the first study resembles a unimodal distribution, $d(48) = 0.065$, $p = .114$, and the distribution of action orientation scores in the subgroup of the second study resembles a non-modal, that is, at least bimodal distribution, $d(82) = .062$, $p = .017$. Figure 4 shows a visualization of distributions of the action orientation scores in the two participant groups and distribution curves calculated with the Kernel Density Estimation with the R Statistics Package. Further calculations on the resulting distribution showed that in the subgroup of the second study, the bimodal

distribution is characterized by maximum values at action orientation scores of 4 and 9 the

through of the bimodal presentation lying at an action orientation score of 7.14, that is, the

distribution can be characterized as being composed of a subgroup of individuals with scores

from 0 through a peak at 4 up to a score of 7 and a subgroup with scores from 8 through a

peak at 9 up to a score of 12.

However, in order to find true effect sizes and at last if a small number of participants

or any non-norm data are analyzed or correlation with another independent variable occurs,

one should use the continuous measure / regression analysis instead of a dichotomized

variable / ANOVA as it was done in the three studies of this thesis. From the additional

analyses of data from Study 1 and Study 2 it follows that action orientation does not

necessarily show a bivariate distribution. Therefore, one should rather perform regression

analysis in future studies. Future research should investigate the distribution properties of

the action orientation scale for justifying ANOVA analyses.

6.2.5. Avoiders and Sensitizers, and Action Orientation

In our studies, action orientation was associated with increased intuition performance

(Study 1), with less negativity bias (Study 2), and with less susceptibility to self-infiltration.

It can be concluded that action-oriented individuals deal better with stress in order to

maintain their performance. In stress research, however, a distinction is made between

copers who are *vigilant* to the stimulus and adapt to it at the same time, including

psychoanalytic related defenses such as intellectualization, reaction formation and projection,

versus *avoiders* who avoid recognizing the threatening stimulus, including repression and

denial in psychoanalytic terms (Goldstein, 1973; Hock, Krohne, & Kaiser, 1996) or in other

words *sensitizers* who turn to threat-related stimuli, and deal with them intensively versus

repressors who avoid attending to threat-related stimuli or interpret them in a nonthreatening

fashion (Byrne, 1961; Davis, 1987; Derakshan & Eysenck, 1997). Importantly, repressors seem to avoid threatening stimuli, but in fact they have an initial rapid vigilant response which is followed by an avoidance stage (Derakshan, Eysenck, & Myers, 2007).

Sensitizing and coping with the situation and associated negative affect is associated with a deeper confrontation and downregulation of the affective situation such that the situation can be integrated into the self. This process is necessary for increased resilience thereafter (Quirin et al., 2015). In general, it has been shown that action orientation is associated with a sudden increase in initial vigilance but followed by immediate repression sensitizing (Haschke et al., 1994; Rosahl et al., 1993).

However, it is yet unclear whether action orientation is also associated with sensitizing in the sense of "deep" coping. Repressed events can sometimes not be remembered at all or the repressed event will come to consciousness at a later time. An example is the repression of memories of traumatic sexual child abuse. According to the *repression interpretation* of child sexual abuse, victims encode the traumatic experience but are unable to remember it until it does less harm to psychological well-being (e.g., Davis, 1987). In PSI terms, the self shields the memory of traumatic experience until it is able to cope with it actively by down-regulating negative affect to include the event into the self afterwards (e.g., Kuhl, 2001; Kuhl et al., 2015). Assuming that experiencing negative situations can sometimes go along with repression it is obvious that this repression can have negative effects. Nonetheless, in such situations, an individual would be labeled action-oriented although this person is not coping actively with the situation and may even experience repression-associated side-effects such as negative health impacts (Schwartz, 1995). On the other hand, successful coping is associated with increased resilience which in turn has positive impacts on health (Kalisch et al., 2015; Quirin et al., 2015).

This shows that it is important to investigate action orientation with respect to

underlying processes. Firstly, action orientation should be investigated with respect to predominant coping mechanisms. Secondly, in action-oriented versus state-oriented individuals, performance stressors may have other consequences than sexual child abuse.

6.2.6. Correlational versus Experimental Method

The gold standard in research is the experimental method (e.g., in our studies, induction of stress or affect) over correlational methods. In correlational studies, confounding variables might not be measured and false conclusion might be drawn and true underlying factors might be overlooked. Contrary, experimental studies can provide information about causal effects. Unfortunately, in personality psychology it is an inherent problem that individual differences cannot be induced but are measured and used in correlational study designs. With respect to the studies in this thesis, two things should be noted. Firstly, action orientation was always measured via questionnaire and not induced in a truly experimental study design. Secondly, however, the strength of these studies is that they measure an intuitive way of emotion regulation, which was by no means common in previous research studies investigating ERA (for the prominent process model see Gross, 1998; for a review see Joormann & Stanton, 2016).

While the well-known and widely used construct of rumination which is closely related to action orientation after failure is sometimes measured via questionnaires (E. J. Lewis, Yoon, & Joormann, 2018) and sometimes experimentally induced (e.g., in Watkins & Brown, 2002 in depressed versus non-depressed individuals), action orientation after failure is almost exclusively measured via questionnaire. I am aware of only two studies where action orientation after failure (cf. induction of decision-related action orientation in e.g., Harmon-Jones & Harmon-Jones, 2002) has been induced (Kuhl, 1981; Van Putten, Zeelenberg, & Van Dijk, 2009). This low number of induction studies, their thematic

differences and in some studies the absence of state-orientation-inductions show that there is definite a need of further research to investigate how one could induce action orientation.

In the well-known studies by Gross, John, and colleagues, emotion regulation has commonly been experimentally induced, for example, participants are explicitly asked to reappraise. So, these studies examine processes associated with conscious strategies when asked to do regulate in a specific way. However, there is a difference in whether one sits at the dentist or whether one has to down-regulate negative effects in everyday life. Firstly, there is no person who instructs individuals about which strategy to use in a real-life situation and secondly, intuitive regulation as opposed to for example, conscious reappraisal is required in everyday situations. In line with this, the three studies of this thesis contribute to a better understanding of individual differences in emotion regulation strategies, as they are used by individuals in the same manner as they would in real-life.

6.3. Integration into Current Theories: PSI, PARCS, & SDT

In the following, the results of the three studies will be set into context not only with PSI theory but with two other theories as well. One will be predictive and reactive control systems (PARCS) theory, which was introduced by Tops and colleagues in 2014 (Tops, Boksem, Quirin, IJzerman, & Koole, 2014) but whose processes have already been described in earlier articles (e.g., Tops & Boksem, 2011; Tops, Boksem, Luu, & Tucker, 2010). This theory focuses on neurobiological processes and is therefore a perfect addition to PSI theory in putting the findings in context. The other one will be self-determination theory (SDT) which originated in studies about external reward (Deci, 1971) and was put forward by Ryan and Deci in the 1980s (e.g., Deci & Ryan, 1985) but became prominent in the 2000s mostly due to their American Psychologist article (Ryan & Deci, 2000b). SDT and PSI theory are closely related to each other (as laid out by a very recent article: Koole et al., 2019), PARCS

theory complements the two perfectly and therefore it will be used for integrating the findings. Figure 2 puts the findings into context, mostly within PSI systems, and will be the basis for the following explanations.

6.4. Emotion Regulation and The Self – Psychologically

6.4.1. The Self in Psychological Terms

„Defining myself, as opposed to being defined by others,

is one of the most difficult challenges I face."

(Carol Moseley Braun)

This thesis aimed to investigate functions of the self, particularly the impact of ERA on the self, as visualized in Figure 2. It was recently stated that, "the notion that some parts of the self are more authentic than others crops up frequently in psychological research, albeit under a slew of guises. Sometimes it is called the real self (Koole & Kuhl, 2003; Masterson, 1988; Rogers, 1961; Sloan, 2007; Turner, 1976), the ideal self (Chodorkoff, 1954; Higgins, 1987; Kenny, 1956), the authentic self (Cable, Gino, & Staats, 2013; Johnson & Boyd, 1995), the intrinsic self (Arndt, Schimel, Greenberg, & Pyszczynski, 2002; Schimel, Arndt, Pyszczynski, & Greenberg, 2001), the essential self (Strohminger & Nichols, 2014), or the deep self (Sripada, 2010)." (Strohminger, Knobe, & Newman, 2017). According to Strohminger and colleagues, the more general self encompasses the entire range of personal features, it can be positive or negative, holds the first- as well as the third-person perspective and is cross-culturally variable. In contrast, the true self emphasizes moral features, is valence-dependent, positive by default, perspective-independent and cross-culturally stable. This understanding of the true self is in line with the definition of the self in our studies and

in PSI theory.

As described in the introduction of this dissertation thesis and visible in Figure 2, in PSI theory, extension memory integrates information and allows the formation of extended "cognitive-emotional maps" and these features are considered to be an essential part of the self (Kuhl, 2001; Kuhl, Kazén, & Koole, 2006). Kuhl and colleagues (Kuhl et al., 2015) derive seven functions of the self, namely emotional connectedness, broad vigilance, utilization of felt feedback, unconscious processing, integration of negative experiences, extended resilience, and extended trust. The three studies in this dissertation thesis contribute to understanding some of these functions of the self. The first study of this thesis relates to unconscious processing. We have shown that action orientation moderates the effect of stress on intuitive processing. The second study investigated the self-function of integrating negative experiences. We used prime words that related to negative achievement situations chosen by the participants themselves. We have shown that action orientation acts as a moderator between depression and associated negativity bias related to these prime words.

The third study shed light on the neurobiological correlates of the self, particularly, retrieving self-related goals. Where self-related refers to the intrinsic, deep self kind of goals. Using the self-infiltration paradigm, we were able to dig into this true self and not only ideal self-representations. We identified correlates of conflict-related retrievals, that is, when goals are retrieved as self-chosen but truly assigned – which is a conflict between the ideal self and the true / deep / intrinsic self. Further research should investigate how self-access, as for example measured by the newly developed self-access form (Quirin & Kuhl, 2018) relates to goal processing and retrieval and to self-infiltration and health as well as the neuronal correlates to find commonalities and differences of the self-system and memory systems in the brain.

6.4.2. Emotion Regulation, Depression, and Self-Attention

According to PSI theory depression is associated with increased intention memory activation due to increased dampened positive affect (Kuhl, 2001). Therefore, one might argue that there is a relationship between intention memory and intuitive behavior control. This implies that we should have investigated demand-related action orientation instead of failure-related action orientation as a moderating factor. Demand-related action orientation and its relationship with depression has been investigated in previous studies (e.g., Kuhl & Kazén, 1994b). However, as this dissertation project deals with action orientation after failure, the data of Study 2 were analyzed with respect to this. Still, the results fit into PSI theory and extend previous research accordingly.

As Kuhl (Kuhl, 2001, pg. 253 ff.) explains, only by differentiating between *integrated self-perception* and *perceiving individual self-aspects,* the partially contradictory findings concerning depression and self-attention can be explained. Integrated self-perception facilitated by positive affect or extension memory activity and associated holistic availability of extended networks. In contrast, perceiving individual self-aspects is facilitated by negative or reduced positive affect or object recognition system activity and associated with reductionist-like ego-perception. Greenberg and Psyszczynski (1986) measured self-focus via the number of self-references in a sentence completion test. In general, individuals showed increased self-focus after failure, but while it shifted to more hedonic beneficial focus in non-depressed individuals, this increased self-focused persisted over time in individuals with depression. This self-focus measured as self-references in sentences refers to linguistically explicit qualities of self-aspects and can therefore be interpreted as increased perception of individual self-aspects (as compared to integrated self-perception) in depressed individuals (Kuhl, 2001, pg. 253 ff.).

The findings of the second study in this thesis extend the findings and resulting models of depression and self-attention, as described by Kuhl (2001, pg. 253 ff.). We used positive and negative achievement-related self-relevant words that were presented preceding the Stroop task. Assuming that the delayed reaction time to the Stroop word is an indicator of increased self-attention, the following can be claimed: In individuals with high depression, state orientation is linked to increased self-attention in the sense of the perception of individual aspects, which is reflected in slower reaction times after negative compared to neutral priming and speaks for the activation of individual self-aspects by the negative affect. High depression scores in combination with high action orientation scores are linked to less self-attention in the sense of the perception of individual aspects, which is shown by faster reaction time in negative comparison to neutral words.

These results are in line with Koster and colleagues' disengagement hypothesis (Koster, De Lissnyder, Derakshan, & De Raedt, 2011) which was explained in the discussion section of Study 2. According to them, prolonged processing of negative self-relevant stimuli is due to impaired attentional disengagement. According to them, rumination is a certain style of self-referential thinking. This style can be interpreted as thinking about self-aspects in small fragmented pieces and this in turn is what Kuhl's PSI theory (Kuhl, 2001) refers to as increased perception of individual self-aspects instead of integrated self-perception .

Therefore, two conclusions can be drawn: Firstly, depression may be associated with increased self-attention in terms of perceiving individual aspects. In PSI terms, this is driven by object recognition system. Secondly, action orientation can down-regulate the negative affect before it can trigger the focus on self-aspects. Therefore, action orientation enables the shift from object recognition system to extension memory. Nonetheless, future studies are necessary to shed light on the distinction between integrated self-perception and perceiving individual self-aspects and its relation to affect (e.g., negative and reduced

positive) in general and depression particularly. For these studies, it is not necessary to employ the Stroop task, but specific attention paradigms should be used. Additionally, specific self-access questionnaires should be used, for example, the Self-Access form (Quirin & Kuhl, 2018). Additionally, more specific ones that can distinguish between perceiving individual self-aspects versus integrated self-perception should be developed.

6.4.3. Functions of Extension Memory and the Self: Relationship Between Negativity Bias and Holistic Thinking

PSI theory states that (reduced) negativity bias and intuitive judgment or holistic thought are subsumed under one system, namely extension memory (see Figure 2). However, it is yet unclear, how they relate to each other. According to PSI theory, two functions of the self are extended resilience and extended unconscious processing (Kuhl, 2001; Kuhl et al., 2015). Extended resilience refers to the downregulation of negative affect in order to integrate negative experiences. Therefore, emotion regulation plays an important role. In line with the results of our third study (visualized in Figure 2), extended unconscious processing is processed in the right hemisphere and facilitated in quiet and relaxed atmospheres (Kuhl et al., 2015).

The link between negativity bias and holistic processing can be elaborated in the following way: Bledow, Rosing, and Frese (2013) argue that increased creativity is a result of experiencing negative affect that is down-regulated and associated with increased positive affect, the so-called affect shift. However, as explained in the introduction of the first study, it is assumed in a meta-analysis, that not the mere valence of the stimulus (positive vs. negative) or the mere activation (activating vs. deactivating) but the mood-associated regulatory focus (promotion vs. prevention focus) that determines the mood holistic thinking relationship (Baas, De Dreu, & Nijstad, 2008). Activating promotion-focused states (e.g.,

happiness) enhance creativity and activating prevention-focused states (e.g., fear) impede creativity. The negative self-related prime words in our second study might have led to such an activating prevention-focused state, particularly in depressed individuals. This was associated with increased negativity bias in individuals with low ERA while it had not such a profound effect in individuals with depression but high ERA.

A second example, visualizing the link between negativity-bias and reduced holistic thought which might be related to reduced activity in one system – the extension memory or the self – is posttraumatic stress disorder. In life-threatening situations, individuals focus on survival and self-protection. In extreme cases, individuals are not able to cope with the experience and posttraumatic stress disorder may evolve (Van der Kolk, 2004). Symptoms criteria for diagnosing this disorder include among others (i) negative alterations, such as negative cognition, mood, and negative thoughts and assumptions about oneself or the world, and (ii) intrusion symptoms (DSM-5; American Psychiatric Association, 2013). Victims may respond with confusion, shock, and maybe even speechless terror (Van der Kolk, 2004). Most of these symptoms are closer to analytic rather than holistic thinking. Altogether, posttraumatic stress disorder is an example for reduced activity of extension memory / the self and symptoms going along with this. One possible therapy that is not yet fully understood, but whose effects are in line with PSI theory is eye movement desensitization and reprocessing (EMDR) therapy. During EMDR, the patient concentrates on the most distressing memory of the traumatic event and is asked to make eye movements or is exposed to bilateral tones or tapping while recalling the event (e.g., Acarturk et al., 2016; for a review see Wilson et al., 2018). One possible explanation is that cortical integration takes place similar to processes during sleep (Stickgold, 2002). This is in line with PSI theory and would suggest that this method facilitates integration into the self by forming new cortical networks via holistic processing.

Emotion regulation might play a very important role in helping to reduce affective reactions while re-experiencing the trauma in a safe environment and integrating it. Future research needs to determine whether reduced negativity bias and holistic thinking can be subsumed under one system (extension memory) and how these functions operate within this system.

6.5. The Neural Basis of Emotion Regulation and the Self

6.5.1. Action Orientation and Studies of Neural Correlates in this Thesis

By investigating neural correlates of self-alienation in the third study of this thesis, we have taken the first step into investigating the neural correlates of action orientation. While falsely classifying assigned tasks to be self-chosen was associated with increased activation of the medial PFC and dorsal anterior cingulate cortex. Preliminary analyses of a second pilot MRI study with a similar design found a positive association between the corpus callosum activity and action orientation score (Radtke, Zimmermann, Jansen, & Quirin, 2017). The results strengthen the assumption that differences in action orientation and state orientation might be related to differences in hemispheric and PFC activity.

6.5.2. Midline Structures

Previous studies connected the midline regions to self-relevance. For example, a review (Northoff & Bermpohl, 2004) and a meta-analysis (Northoff et al., 2006) showed that in general, cortical midline structures (CMS) are activated when self-relevant stimuli are presented. The activation of these CMS occurs across all functional domains, that is, verbal, spatial, emotional, and facial. A cluster and factor analysis indicated functional

specifications into ventral, dorsal and posterior CMS. The ventral parts of the CMS (medial orbitofrontal cortex, ventromedial PFC, and the sub- and pregenual part of the anterior cingulate cortex) are suggested to be involved in coding and representing the self-related stimuli. The dorsal CMS (dorsomedial PFC and the supragenual anterior cingulate cortex) are suggested to be involved in reappraisal processes and in evaluating the self-related stimuli. The posterior CMS (posterior cingulate cortex, retrosplenial cortex, and medial parietal cortex) are suggested to be involved in putting self-related stimuli into a temporal context and linking them to past self-referential stimuli. Because the CMS are densely connected to subcortical midline regions, the authors assume an integrated cortical-subcortical midline system underlying the human self. However, Northoff and colleagues (2006) pointed out that these differential roles of ventral, dorsal, and posterior regions still need to be addressed directly by future studies. The fact that our study identified the ventromedial PFC in retrieving self-referential goals fits into this model of functional specifications. Because action orientation is positively correlated to activity in this region during retrieval, these the neural correlates of self-related brain activity may also be important in processes like emotion regulation, particularly, action orientation.

Even though the mentioned research tries to be precise about measuring the neural correlates of the self, one should always be aware that they might not measure the true self as conceptualized in PSI theory and as described earlier on Page 48 of this dissertation – the true self that incorporates emotional connectedness, broad vigilance, utilization of felt feedback, unconscious processing, integration of negative experiences, extended resilience, and extended trust (Kuhl et al., 2015). However, many studies of neural correlates compare self-perception with perception of close others or familiar ones (e.g., D'Argembeau et al., 2005; Qin et al., 2012) or rely on investigating correlates of self-description versus other-description (e.g., D'Argembeau et al., 2007; Heatherton et al., 2006) or

autobiographical reasoning (D'Argembeau et al., 2014) and reviews and meta-analyses build on results from these kinds of research (e.g., D'Argembeau, 2013; Decety & Sommerville, 2003; Northoff & Bermpohl, 2004; Northoff et al., 2006; Qin & Northoff, 2011; Uddin, Iacoboni, Lange, & Keenan, 2007; Wagner, Haxby, & Heatherton, 2012; Zaki & Ochsner, 2011). This conceptualization of self-perception does not necessarily reflect the true self, as defined in the framework of PSI theory and earlier in this thesis. This conceptual confusion is an example why psychology and neuroscience are of equal importance when investigating this topic. Specifically, our functional MRI study, using an objective measure of self-related goals can give a true hint but is only the first step hopefully leading to future research into this direction.

6.5.3. Default Mode Network

Apart from the midline structures, the self has been found to be associated with activity during resting state measurements. In a resting state measurement, the participants are not given a concrete task. They were only advised to keep their eyes open - therefore a fixation cross is presented to the participants without further instructions. Resting state measurements are suitable for measuring the Default Mode Network (DMN; Greicius, Supekar, Menon, & Dougherty, 2009; Raichle et al., 2001) - a network of brain areas associated with task-independent introspection (Molnar-Szakacs & Uddin, 2013) and self-referential thought (Buckner & Carroll, 2007; Gusnard, Akbudak, Shulman, & Raichle, 2001; Wicker, Ruby, Royet, & Fonlupt, 2003). Specifically, the "core-self" DMN regions consist of the medial PFC, posterior cingulate cortex, and inferior parietal lobule (Davey, Pujol, & Harrison, 2016). Because there are several DMN regions which are involved in self-referencing, Qin and Northoff (2011) defined the so-called „default self" (Beer, 2007; Boly et al., 2008; Christoff, Ream, Geddes, & Gabrieli, 2003; David et al., 2007; Golland et al.,

2007; Gusnard et al., 2001; Wicker et al., 2003). In future studies, it is of highest interest to measure the resting state activity of participants while they perform the self-infiltration task. One should plan precisely at what point during the experiment to measure resting state activation. Because resting state activity involves self-introspection, the timepoint of resting state measurement is of crucial importance. If resting state activity is measured directly following the self-infiltration paradigm, then introspection may be associated with that task in general. If it is measured between the two phases of choice/assignment and retrieval it may be associated with self-introspection relating to the chosen/assigned tasks. In line with this, future research should investigate whether rumination and introspection are related to task specific content, such as the (self-related) tasks, or altered activity during more general thoughts before or after the task.

Action orientation after failure is associated with the ability to maintain self-regulation even under stressful or challenging conditions. Previous studies have shown that depressive patients (depression can be seen as a clinical expression of situational orientation, an operationalization of emotion regulation) show altered activation in regions associated with emotion processing and affect regulation, that is, in the anterior insula and the dorsal anterior cingulate cortex, ventromedial PFC, temporal poles and the amygdala (Veer et al., 2010). Although neural correlates of "simple" self-associated mental states, often measured by the presentation of known stimuli versus unknown stimuli and the actual self, are not necessarily identical (Kuhl et al., 2015), these studies offer implications for the functional differences in the DMN of individuals with high versus low emotion regulation and the effects on the self-infiltration task. I assume that individuals with high emotion regulation will show increased DMN activation in this experiment during resting state measurement as markers of introspection and self-referential thoughts after task selection and assignment. To summarize, the association of right medial PFC activity during the

retrieval of self-chosen tasks and action in the third study of this thesis is in line with the previously described findings about self-related areas and the DMN. Future studies should further investigate this link, especially with respect to resting state activity between the choice and retrieval phase.

Previous studies have connected depression with abnormal resting state activity (Grimm et al., 2011; Sheline et al., 2009). Therefore in our second study, the depressed individuals that show low action orientation might have abnormal resting state activity that in turn is associated with decreased activation of self-related areas / extension memory (see Figure 2) which, in turn, is associated with increased negativity bias. Individuals with high depression and high action orientation, however, might show normal resting state activity and self / extension memory activation and therefore do not show this bias. Although other research has started to show connections between DMN and memory retrieval (e.g., Sestieri, Corbetta, Romani, & Shulman, 2011), and autobiographical memory in particular (e.g., Philippi, Tranel, Duff, & Rudrauf, 2015), future research should investigate how the DMN, as a resting state mechanism, interacts with the retrieval in our self-infiltration paradigm and its connection to depression in more detail.

6.5.4. Right Hemisphere

In theory, the self has been associated with right hemispheric activity for some years (Kuhl et al., 2015; Schore, 2011, 2018). Studies have found evidence that the right hemisphere plays a stronger role in the processing of stimuli self-aspects stimuli than the left hemisphere (Craik et al., 1999; Keenan, Nelson, O'Connor, & Pascal-Leone, 2001; Keenan, Wheeler, Gallup Jr, & Pascual-Leone, 2000; but see Gillihan & Farah, 2005). In a study by Jarcho and colleagues (2011), the decision-related reassessment of the attractiveness of a self-selected task in a cognitive dissonance paradigm was associated with increased activity in right

hemispheric areas, for example, the right frontal gyrus inferior, medial fronto-parietal areas, and the ventral striatum. According to Jarcho and colleagues, this suggests that emotion-regulating processes play a role in the selection from similarly unattractive objects and the associated reevaluation. The findings of Baumann and colleagues (Baumann et al., 2005) also speak for the role of the right hemisphere in the task selection phase. They found that the activation of the right hemisphere by contralateral ball pressing before the selection phase led to an increased ability to distinguish foreign targets from one's own. Left hemispheric activation led to a lower discrimination ability.

Notably, dissociation (being a dis-association) as a key symptom of posttraumatic stress disorder following early trauma has an adaptational function for the survival of the catastrophic event, but if it occurs frequently it impairs the development of higher circuit control (Schore, 2004). Specifically, this is associated with "an inefficient right brain hemisphere vertical cortical-subsystem with poor right-to-left orbitofrontal communication" and problems in the development of the sense of self (Schore, 2004). Dissociation being associated with reduced activity in the right hemispheric is an additional hint at the possible role of the right hemisphere for self-related cognition. Activity of the right medial PFC in the third study of this thesis being activated when self-chosen tasks are retrieved and its correlation with action orientation is in line with these suggestions.

6.5.5. Integration into PARCS Theory

Similar to PSI Theory, PARCS theory (reviewed in Tops et al., 2010) makes predictions about coping with stress. Additionally, the model emphasizes neural correlates of psychological reactions and is therefore a good addition to PSI when integrating the results of this thesis into past research and theories. PARCS differentiates between reactive and predictive control as two modes of processing. Reactive control is model free, characterized

by feedback control and is mapped onto ventral brain areas, for example, the amygdala, and occipitotemporal cortex. Predictive (also called proactive) control is based on internal models and feedforward mechanisms and is mapped in dorsal brain areas, for example, in the dorsal (medial and lateral) PFC, posterior and cingulate cortex, and the precuneus. Areas like the orbitofrontal cortex, striatum, the dorsal anterior cingulate cortex, and the tempoparietal junction are involved in both kinds of processing in a continuum-like way they are involved in predictive and reactive control (Tops et al., 2014).

In our study, predictive and reactive control might have played the following role: Once participants are stressed, as in case of our first study, the system shifts from automatic predictive processing to reactive processing. That is, processing shifts from the dorsal to the ventral stream. According to Tops and colleagues (Tops et al., 2014), the reactive system "represents a specialized mode of operation for detecting new information, encoding it in memory and assimilating it into preexisting internal models, thus facilitating future control by the [predictive control] system (Hasher & Zacks, 1979; Tops & Boksem, 2011)." (Tops, IJzerman, & Quirin, 2018). Therefore, it is possible that state oriented individuals shift their control strategy during stressful situations. In contrast, action-oriented individuals were able to retain predictive system activation which is characterized by processing familiar stimuli and controlling behavior in predictable environments, guided by models which incorporate the social and self-referential information (Tops et al., 2018). This is in line with PSI theory, which assumes that with the shift from object recognition system to extension memory in action-oriented individuals, access to the self-system is granted. Future research should investigate the relationship between predictive/reactive control systems and action orientation. For example, it is proposed that predictive control is closely related to conscientiousness (Tops, Quirin, Boksem, & Koole, 2017). Based on this link and the theoretical link between conscientiousness and action orientation, future research could aim

to investigate similarities and divergent facets of the concepts and neural correlates.

In our first study, participants were stressed via the Trier Social Stress Test, hence inducing reactive control processing. State-oriented individuals may persevere in this state and thus show increased appraisal of the situation and due to increased local focused processing, decreased intuition performance. Future research should investigate whether this relationship is truly linear or whether it is better represented by an inverted u-shaped function, which is in line with PARCS theory (Tops, 2017; Tops, Schlinkert, Tjew-A-Sin, Samur, & Koole, 2015) and as other cortisol-performance-relationship research proposes (Lupien, Buss, Schramek, Maheu, & Pruessner, 2005). In our third study, PFC activation during the retrieval of self-chosen goals is in line with PARCS theory as it suggest that prefrontal right hemispheric activation is part of the reactive system (Tops et al., 2017). Specifically, the right hemisphere consists of internally driven models. Furthermore, the additional activation of dorsolateral PFC during the correctly retrieving self-chosen tasks can be perfectly associated with the activity of the predictive system.

There are still some open questions. For example, whether after stress, action-oriented individuals are better able to stay in predictive processing than state-oriented individuals. Then, action versus state-oriented individuals should show different concentrations of cortisol as a marker of processes shifting and different degrees of energy mobilization. However, action-oriented and state-oriented individuals may initially both shift to reactive processing. This is associated with similar cortisol release. Crucially, I would predict that action-oriented individuals are able to shift back to predictive processing faster. This would enable them to cope with the situation while maintaining their performance level. This is line with PSI theory, hypothesizing that action orientation is associated with the ability to shift between the two systems, that is, to be able to shift from rather ventral stream operating object recognition systems to global processes constituting

extension memory.

6.6. Combining Psychological and Neuroscientific Methods

In the following, I will explain one detailed example to show why the combined use of both psychological as well as neuroscientific methods is of great importance in order to understand human cognition and behavior in all its facets. The self-infiltration paradigm (Baumann & Kuhl, 2003; Baumann et al., 2005; Kazén et al., 2003; Kuhl & Kazén, 1994a; Quirin et al., 2009) is used in order to distinguish tasks that individuals retrieve as self-chosen but which are actually assigned to them from truly self-chosen tasks that are correctly recalled as self-chosen tasks. However, to be precise, this paradigm does not truly reveal where on the internalization-continuum according to SDT by Ryan, Deci, and colleagues (La Guardia, 2009; Ryan & Deci, 2000a, 2000b), these infiltrated tasks can be located.

The degree of internalization of a goal is a major determinant of willpower, motivation, and well-being (La Guardia, 2009; Ryan & Deci, 2000a, 2000b). Two important levels of internalization are introjection and identification. Introjection refers to the level of internalization where an individual pursues a goal (although not being forced) that is, of relatively low inherent attractiveness and relatively unconnected to the individual's needs, interests, or values. By contrast, identification refers to the individual pursuing a goal that does conform with these self-aspects, is thus of higher attractiveness, and typically comes with a feeling of autonomy. Within this continuum, it is important to distinguish, for example, whether a previously external goal is still externally regulated, introjected, identified with, or fully integrated. Pursuing integrated goals does not only increase the motivation to further pursue them but constantly following external goals without consciously knowing, is associated with adverse health effects (Ryan & Deci, 2000b). Therefore, it is important to

elaborate on the degree of internalization of self-infiltrated goals.

In our study, we have laid the first steps in order to understand the neural correlates of self-infiltrated items. However, we need psychological methods now to be able to further investigate further the mechanisms underlying the effects. Distinguishing introjected from identified goals should be the next research focus. Individuals who had the possibility to choose between alternative tasks that they can engage in, do identify with this task, feel more autonomous and satisfied than when a task was assigned (Leotti & Delgado, 2011). Although identification can more readily be instituted by the opportunity to choose, individuals may also identify with tasks assigned by other individuals such as parents or superiors (i.e., they make it their own goal). This is a meaningful process as it provides the individual with more emotional energy and happiness when they pursue an assigned goal. However, there is also the possibility that individuals may introject the assigned goal rather than to identify with it. As a consequence, goal pursuit typically feels much like a burden. In the long run, a tendency towards introjection rather than identification can lead to chronic feelings of alienation, low life satisfaction, burnout, or even depression (Chirkov, Ryan, Kim, & Kaplan, 2003; Kasser & Ryan, 1996; Niemiec, Ryan, & Deci, 2009), which points to the relevance of investigating the mechanisms underlying these two processes. To summarize, in our study and with the current use of the self-infiltration paradigm, we are unable to tell whether individuals self-identified with the misremembered assigned goals and even integrated them into their true self, or whether the goal is still driven by external regulation only.

However, identification can be relatively easy distinguished from introjection. Precisely, the increase of attractiveness of tasks from before to after the experiment, as can be measured via self-report, may function as a proxy of identification, whereas a non-increase may function as a proxy of introjection. In fact, changes of attractiveness of chosen alternatives (but not assigned alternatives), has been investigated in the context of

cognitive dissonance reduction. For example, after making a decision between equally attractive tasks (e.g. "free choice paradigm" as in Festinger & Carlsmith, 1959), or after being told to perform an unattractive task (e.g., "induced dissonance" paradigm as in Brehm, 1956) the task at hand has been found to be revaluated. This process has been interpreted as a mechanism to reduce so-called cognitive dissonance that may arise after conflictual decisions (Festinger, 1957). As de Vries and colleagues (2015) noticed, there are only five studies to date that investigated cognitive dissonance using functional MRI. One study used the induced dissonance paradigm which is comparable to the assignment part of the present study. Here, anterior insular activation predicted of attitude change (van Veen, Krug, Schooler, & Carter, 2009). Four other studies used the free choice paradigm which is comparable with the self-choice phase of the present study. In these studies, attitude change has been associated with increased activity in the dorsolateral PFC (Izuma et al., 2010), posterior cingulate cortex (Kitayama, Chua, Tompson, & Han, 2013), right inferior frontal gyrus, medial fronto-parietal regions, ventral striatum, as well as decreased activity in the anterior insula (Jarcho, Berkman, & Lieberman, 2011). A recent transcranial magnetic stimulation study, where the dorsomedial PFC was inhibited in an experimental group and compared to control groups, confirmed a causal role for the dorsal PFC in choice-induced preference change (Izuma et al., 2015).

This shows how neuroscientific research aiming to find neural correlates of self-related choice or even the true self is dependent on psychological research as well. Without the knowledge about the self-continuum established by Deci, Ryan, and colleagues and about research on motivation and the self-infiltration paradigm by Kuhl and colleagues, it would be impossible to do this neuroscientific research, that is to establish hypotheses, to create suitable paradigms, and to interpret the results and most importantly to put it in perspective with other mechanisms that have already been investigated.

6.7. Outlook

Overall, the results of our study are in line with PSI theory predictions (Figure 2). For example, it suggests that depression as a result of increased object recognition system activation is associated with decreased activation in the right medial PFC, or in the DMN in general. Studies started to investigate the link between depression and deactivation of the right hemisphere (e.g., Moratti, Rubio, Campo, Keil, & Ortiz, 2008; Rotenberg, 2004), but further research is needed, particularly, in the context of PSI theory, using the self-infiltration measure, for example, to stay within this dissertations' line of research. Secondly, it suggests a positive relationship between ERA and DMN activation. Similar links have been studied mostly in mindfulness and meditation studies (e.g., Brewer, Garrison, & Whitfield-Gabrieli, 2013; Farb, Anderson, & Segal, 2012; Xie et al., 2016) but further and more specific research is needed here as well. Not least, the studies' results in combination with PSI theory suggest a negative relationship between negativity bias and self-other goal discrimination. It might well be that this relationship would be mediated by the underlying construct of self-access, for example. To my knowledge, there has been no study yet to investigate this relationship. The self-access form (Quirin & Kuhl, 2018) might be an appropriate tool to investigate this relationship. These open questions can best be clarified by studies using psychological and neuroscientific methods in combination. Just like a fully functioning person is able to integrate various views and is open to different experiences, researchers should be able and willing to integrate neuroscientific and psychological findings into their research to get a complete picture of human cognition and behavior.

7. General References

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8. General Tables and Figures

Table 1.

Studies using the self-infiltration paradigm, in chronological order.

Study	Results	Action orientation after failure measured?	Stress / negative affect / something similar?	Action orientation as continuous or grouped variable?
Kuhl & Kazén (1994a)				
	Study 1: - higher self-infiltration in state-oriented versus action-oriented individuals Study 2: manipulation of incomplete intentions group versus control group - completed intention: no effect - incomplete intention: higher self-infiltration in state-oriented versus action-oriented individuals	Yes	Study 1: no Study 2: effect of incomplete versus completed intentions	High versus low
Baumann & Kuhl (2003)				
	Study 1: measured sad mood - State orientation: higher self-infiltration in high versus low sad mood - Action orientation individuals: no difference in self-infiltration scores	Yes	Study 1: sad mood effect	High versus low; but according to a footnote results

|			
Study 2: film-induced sad mood group versus happy mood group		Study 2: sad mood effect	persisted in a hierarchical regression
- State orientation: higher self-infiltration in sad versus happy mood induction			
- Action orientation: no differences in self-infiltration scores			
Kazén, Baumann, & Kuhl (2003)			
Study 1: suggested meaninglessness of the items for all participants	Yes	Study 1: meaninglessness "effect"	High versus low
- State orientated individuals showed higher self-infiltration than action-oriented individuals.			
Study 2: pressure induction versus control group		Study 2: pressure effect	
- Pressure group: State-oriented individuals show higher self-infiltration than action-oriented individuals			
- Control group: no difference in self-infiltration scores			
Study 3: sad mood group versus control group based on self-report		Study 3: sad mood effect	
- Sad mood group: State-oriented individuals showed higher self-infiltration than action-oriented individuals			
- Control group: no difference in self-infiltration scores			
Baumann, Kuhl, & Kazén (2005)			
Study 1 and 2:	Yes, but had no effect	No (left versus right hemisphere activation)	High versus low
- No effect of personality (action versus state orientation)			
Quirin, Koole, Baumann, Kazén, & Kuhl (2009)			
- No effect of personality reported	Not reported	stress induction and cortisol measurement as stress marker	High versus low
- Self-infiltration was predicted by pre- and post-manipulation cortisol levels			
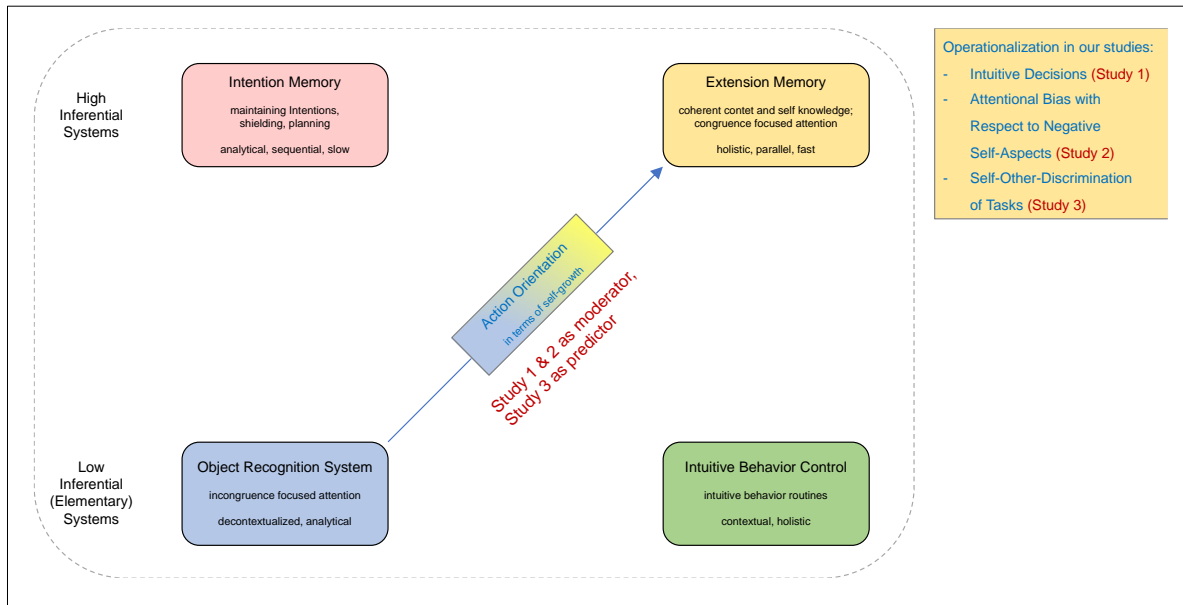
Figure 1. Four systems in PSI theory, action orientation and operationalization in this thesis' studies. Figure is based on Figure 5.1 of Kuhl, 2001 and Table 1 of Kuhl, 2000.
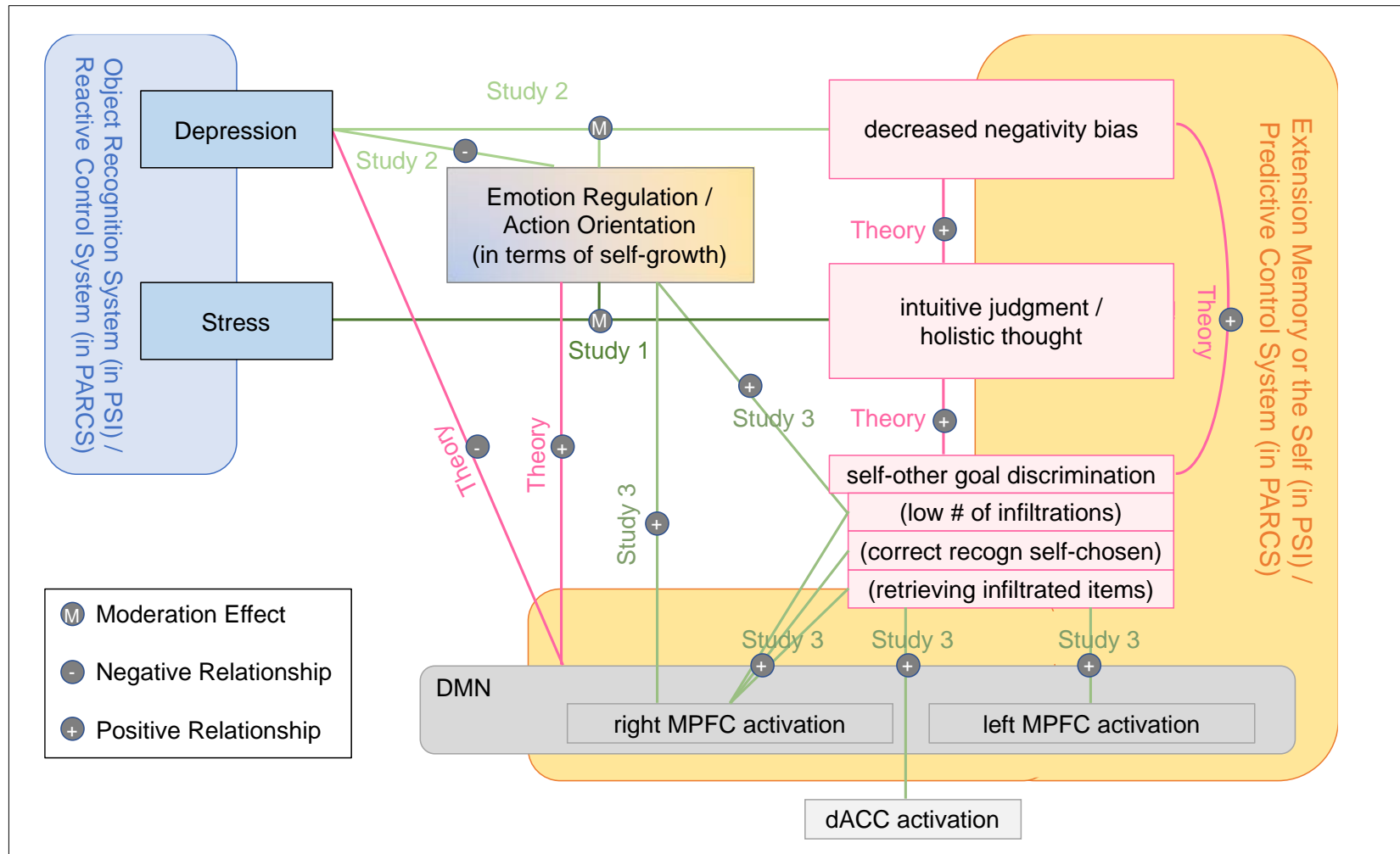
Figure 2. Visualization of the Results and integration into PARCS and PSI theories

The following tables appear within the figure:

(A)

Cortisol AUCi		AOF Low	AOF High	Total
	Low	13	11	24
	High	12	13	25
	Total	25	24	49

(B)

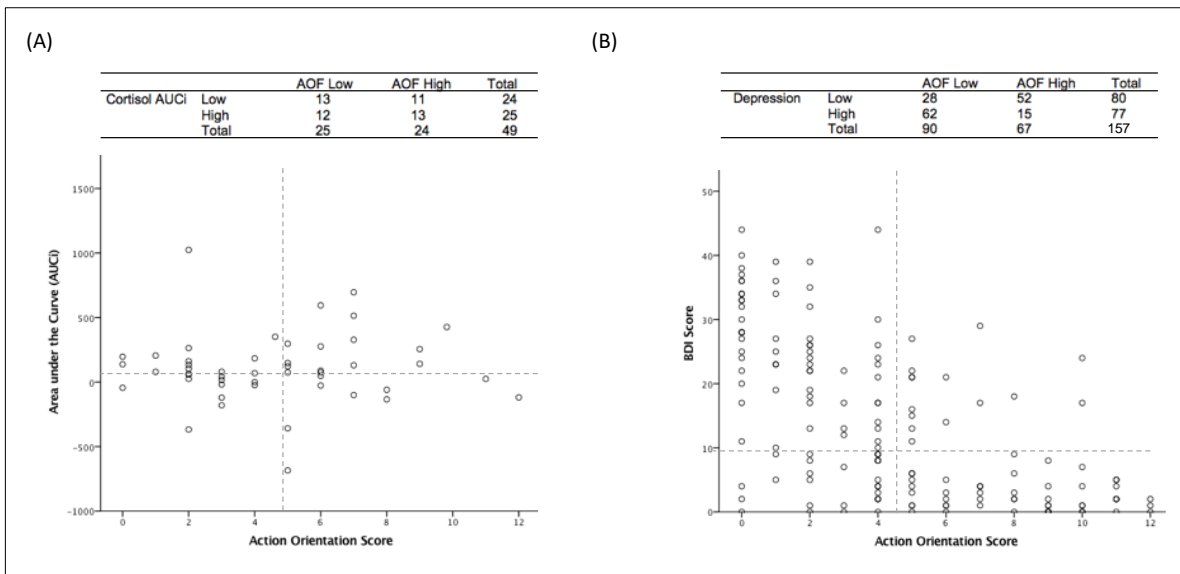| Depression		AOF Low	AOF High	Total
	Low	28	52	80
	High	62	15	77
	Total	90	67	157

Figure 3. Distribution of high and low action orientation (AOF) scores in combination with high and low cortisol change (AUCi) and with depression (BDI) scores.
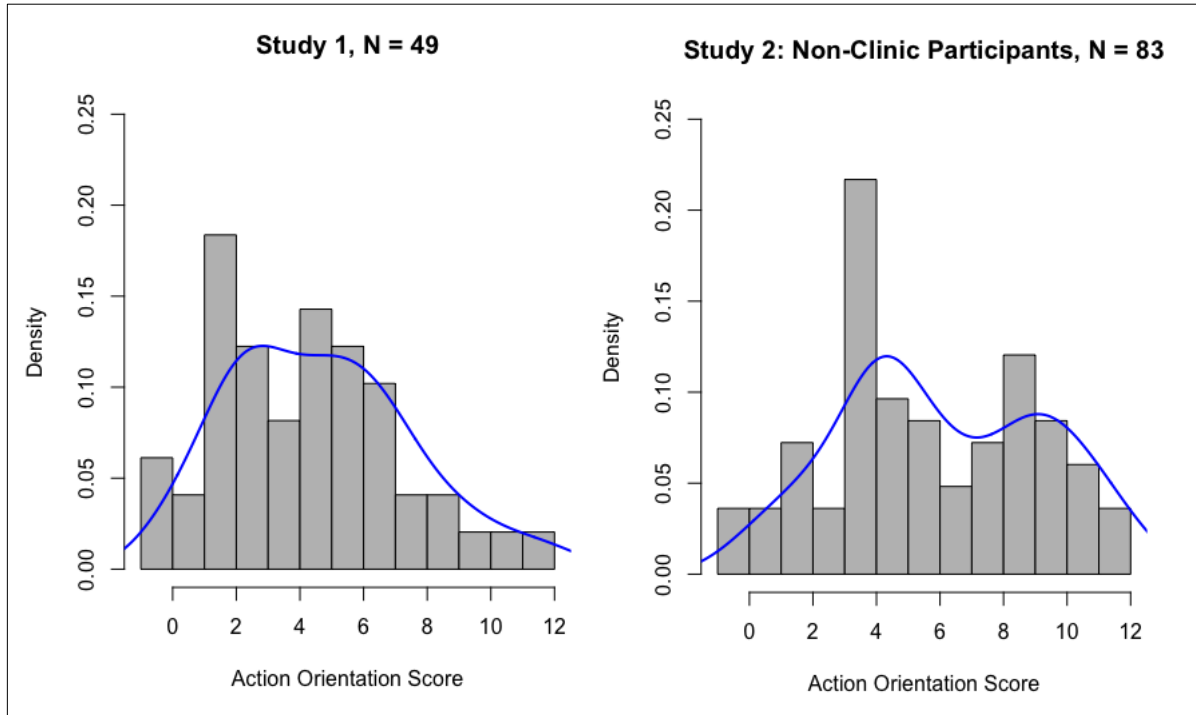
Figure 4. Distribution of action orientation scores and distribution curves.