

Dissertation

**The Role of Attachment in Substance Use Disorders:
A Neuro-Evolutionary Perspective**

submitted by

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Statutory Declaration

I hereby declare that this thesis is my own original work and that I have fully acknowledged by name all of those individuals and organisations that have contributed to the research for this thesis. Due acknowledgement has been made in the text to all other material used. Throughout this thesis and in all related publications I followed the “Standards of Good Scientific Practice and Ombuds Committee at the Medical University of Graz“.

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Michaela Hiebler-Ragger

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Abstract in German

Aufgrund der damit einhergehenden sozialen, psychischen und physischen Probleme, hat die weltweite Epidemie der Substanzabhängigkeit für die betroffenen Individuen und für die Gesellschaft weitreichende negative Folgen. Prominent als „Bindungsstörung“ definiert, steht diese Erkrankung vor allem in Zusammenhang mit Beeinträchtigungen in der Selbstregulation und der sozialen Funktionsfähigkeit. Während in den letzten Jahrzehnten einige wichtige Fortschritte in der Entwicklung und Validierung von Programmen zur Behandlung der Substanzabhängigkeit gemacht wurden, müssen die Parameter für den Erfolg dieser Ansätze erst vollständig erforscht werden. Besonders die Charakteristika und Behandlungsanforderungen der Polytoxikomanie bedürfen einer genaueren Betrachtung, da diese Diagnose bei Personen in Behandlung für Substanzabhängigkeit häufige auftritt, aber zugleich mit einem geringen Behandlungserfolg in Verbindung steht.

Ziel der in dieser Arbeit beschriebenen Forschung war es, die Relevanz der Bindungstheorie und damit verbundener Parameter für das Verständnis und die Behandlung der Polytoxikomanie genauer zu explorieren. Die Berücksichtigung einer neuroevolutionären Perspektive schafft dabei eine konzeptuelle Basis für die Integration biologischer, psychologischer und sozialer/umweltbezogener Theorien und Ergebnisse. Im Detail untersuchten die auf diesem Verständnis aufbauenden sieben Studien die Zusammenhänge zwischen Bindung, Persönlichkeitsstruktur, primären und höheren Emotionen (inkl. Spiritualität) sowie strukturellen und funktionellen neuralen Parametern.

Die Ergebnisse unterstützen nicht nur die Konzeptualisierung von Substanzabhängigkeit als „Bindungsstörung“ auf einer behavioralen sowie neuralen Ebene, sie unterstreichen auch die Bedeutung eines ganzheitlichen bio-psycho-sozialen Zugangs in diesem Forschungsbereich. Besonders der Einfluss bindungsbasierter Interventionen auf die Emotionsregulationsfähigkeit und eine damit potentiell einhergehende Neuroplastizität, sollten aufbauend auf diesen Ergebnissen in zukünftigen Studien exploriert werden.

Abstract in English

Including social, occupational, mental and physical problems, Substance Use Disorders represent a worldwide epidemic with extensive costs to the individual and to society. Most prominently described as an “Attachment Disorder”, they have been linked to various impairments in self-regulation and social functioning. However, while there have been significant advances in the development and validation of treatment strategies for Substance Use Disorders in the last decades, the parameters for the success of these approaches have yet to be fully explored. Especially the characteristics and treatment requirements connected to Poly Drug Use Disorders need to be addressed in more detail, as this diagnosis is highly common in individuals seeking treatment, while simultaneously being associated with poor treatment success.

The original research presented in this thesis aimed at further exploring the relevance of attachment and related parameters in Poly Drug Use Disorder and its treatment by applying a neuro-evolutionary perspective. This perspective offers a conceptual common ground for the integration of biological, psychological and social/environmental theories and findings. In detail, the seven studies build on this understanding investigated connections between attachment, personality structure, primary and higher emotions (including spirituality) as well as structural and functional neural parameters.

The results not only support the conceptualization of Substance Use Disorders as “Attachment Disorders” on a behavioural as well as on a neural level, but also highlight the importance of an integrated bio-psycho-social approach in this research area. Especially the influence of attachment-based interventions on emotion regulation abilities and the potentially related neuroplasticity should consequently be explored in future studies.

Disclosure

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Related Papers

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- Hiebler-Ragger, M.**, Falhansl-Scheinecker, J., Birnhuber, G., Fink, A., & Unterrainer, H.-F. (2016). Facets of Spirituality Diminish the Positive Relationship between Insecure Attachment and Mood Pathology in Young Adults. *PLoS ONE*, *11*(6), 1–9. <https://doi.org/10.1371/journal.pone.0158069>
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Attachment in Substance Use Disorders

“Once we postulate the presence within the organism of an attachment behavioural system regarded as the product of evolution and as having protection as its biological function, many of the puzzles that have perplexed students of human relationships are found to be soluble.” (Bowlby, 1991, p. 293; Postscript to “Attachment Across the Life Cycle”)

Substance Use Disorders represent a worldwide public health problem (e.g., UNODC, 2012). As the social, occupational, mental and physical problems connected to these disorders often persist even after abstinence is achieved, the direct and indirect costs of Substance Use Disorders to the individual and to society are extensive (Koob & Le Moal, 2006). However, while countless studies have focused on understanding the multifactorial and complex nature of Substance Use Disorders in order to optimize prevention and treatment, “many challenges remain to understand and treat drug addiction” (MacKillop & de Wit, 2013, p. 1). Especially challenging is the exploration of causal inferences regarding the often-described connections between early adversity and Substance Use Disorders: While animal studies allow for a randomization regarding early adversity, this factor is inherently interconnected with other important parameters (e.g., parental substance abuse and heritability) in human studies (Chassin, Presson, Il-Cho, Lee, & Macy, 2013). Furthermore, while the impact of Substance Use Disorders is most pronounced in adults, their roots can often be traced back at least to adolescence, making it important to consider and investigate the full developmental progression (Chassin et al., 2013).

Conversely, most theories of development include the fundamental concept that social relationships both influence and are influenced by the development of psychopathology: Therein, secure attachment is generally thought to act as a protective factor, while insecure attachment is thought to increase the vulnerability for psychopathology (for an overview, see DeKlyen & Greenberg, 2016). As an increased prevalence of insecure attachment in individuals diagnosed with a Substance Use Disorder has been reported numerous times (Schindler et al., 2005), Substance Use Disorders have consequently been conceptualized accordingly, most prominently by Flores (2011) in “Addiction as an Attachment Disorder”. Prone to extreme emotions that are either absent or overwhelming and unbearable, individuals with Substance Use Disorders show a distinct inability for self-regulation with the impaired sense of self leading to an impaired ability to relate to others. These impairments in regulating emotions and behaviours are already playing a crucial role in the development of Substance Use Disorders (Khantzian, 2002).

Consequently, substance abuse and the capacity for attachment and intimacy can be considered inversely related, with the substance abuse representing both the consequence of and the failed solution to an inability regarding the formation of healthy relationships (Flores, 2004). Importantly, however, the possible influence of attachment always has to be considered in the context of other risk factors (for an overview, see DeKlyen & Greenberg, 2016).

In this thesis, I will first give a short introduction into attachment theory and research – from the initial work of John Bowlby (e.g., 1973, 1980, 1982) to a summary of relevant recent studies and conceptualizations – with a special focus on the assessment and underlying mechanisms of attachment as well as its connection to psychopathology. Then I will focus on the implications of attachment theory and research for the understanding of Substance Use Disorders, including current diagnostic criteria, different developmental perspectives, frequent comorbid diagnosis and treatment approaches. To introduce a neuro-evolutionary perspective of attachment, I will then describe the evolutionary importance and connected cross-cultural universality of attachment, linking it with different aspects of emotion regulation and brain development as well as their implications for Substance Use Disorders. Lastly, I will give a concise overview of the original research based on this extensive background and summarize its implications for clinical practice and future studies.

While both “Addiction” and “Dependence” are often and interchangeably used in the relevant literature, this dissertation will primarily refer to “Substance Use Disorders” when addressing this final stage of the development from use to abuse to dependence on psychotropic substances.

Attachment Theory

According to attachment theory, attachment is not a mere secondary drive but has to be seen as a fundamental primary motivation with its own dynamics (Bowlby, 1973). Furthermore, attachment serves an evolutionary purpose in promoting parent-child proximity, which in turn serves the biological functions of securing assistance and promoting survival (Flores, 2011).

As it – ideally – establishes a “secure base” from which the individual can explore the world as well as a “safe haven” to retreat to in times of distress (Bowlby, 1982), the attachment system has an important impact on everyday person-environment interactions (Sheinbaum et al., 2015). In detail, early family environment forms our attachment style, thereby preparing us for the risks and uncertainties we are likely to encounter throughout life: It adaptively regulates psychological and physiological development, affecting mating behaviour, and relationships stability (Belsky, 1997). Attachment theory therefore provides a bio-psycho-social model for human behaviours and experiences in relation to the regulation of stress and emotions in social situations (Cassidy, 2016).

Consequently, attachment theory conceptualizes human beings as fundamentally interpersonal, i.e., always “situated in relations with others” (Flores, 2011, p. 43). This need for attachment is not limited to a certain phase in life but is of lifelong importance. However, as our society has become more and more focused on autonomy and the flawed conviction that we should be able to regulate our own emotions, dependency and needing have in turn been branded as pathological and shameful (Walant, 1995). Importantly, secure attachment does not interfere with autonomous self-regulation and independence but rather supports it, as the primary caregivers early availability as a secure attachment figure also forms the basis for the development of self-regulatory skills (e.g., through the internalization of functions originally accomplished by the attachment figure) (Mikulincer & Shaver, 2003).

Before Bowlby’s work on attachment theory, the two accepted theories on the child’s strong ties to the mother – psychoanalytic and social learning theory – were based on secondary drives (Cassidy, 2016). Sigmund Freud (1964) already stated that the infant-mother relationship is “unique, without parallel, established unalterably for a whole lifetime as the first and strongest love-object and the prototype of all later love-relations” (p. 45). Conversely, social learning theories as well as psychoanalytic theories proposed that the act of feeding the child forms the relationship with the mother (e.g., S. Freud, 1957; Sears, Maccoby, & Levin, 1957) whereby the satisfaction of hunger drives leads to an experience of pleasure that in turn becomes associated with the mother’s presence.

Bowlby, however, noticed that a separation from the mother leads to a predictable pattern of intense distress in the child, even if food and care are provided (Robertson & Bowlby, 1952) and systematic observations based on similar findings in animal studies (e.g., Harlow, 1958) soon confirmed that human infants could become attached to someone who did not provide food (e.g., Ainsworth, 1967). Furthermore, the formation of attachment seems to be independent of pleasurable associations, as infants were observed to become attached even if the mother was abusive (Bowlby, 1956). This led Bowlby to the conclusion that attachment is not a secondary drive but a biologically based mechanism with deep evolutionary roots (Cassidy, 2016).

Bowlby first outlined his attachment theory in several papers starting with “The Nature of The Child’s Tie to His Mother” (1958) and later refined them in his trilogy “Attachment and Loss” (1973, 1980, 1982). In detail, Bowlby proposed that attachment behaviours were favoured by genetic selection, because an increased proximity between child and attachment figure provided protection and therefore a survival advantage. Accordingly, perceived threat and distress should lead to increased attachment behaviours (Cassidy, 2016). While Bowlby’s theories were established “at a time when scientific understanding of infancy and early childhood underestimated the cognitive and behavioural sophistication of the young child and the dynamics of early parent-child relationships”, they still provide “a conceptual umbrella for broad and narrow constructions of the developmental impact of attachment relationships” (Thompson, 2016, p. 331).

Furthermore, although research focused on attachment already contributed important insights into the characteristics of our social nature, “an important enterprise for the future is to consider how attachment is differentiated from, and integrated with, other features of development” (Cassidy, Jones, & Shaver, 2013, p. 25).

How Attachment Works

Attachment Behavioural System, Internal Working Models and Attachment Bonds

Attachment behaviours aim to increase proximity between the child and the attachment figure by signalling the child's wish to interact (e.g., through smiling, vocalizing), creating aversive stimuli that need to be terminated (e.g., crying) or actively moving the child towards the attachment figure (e.g., approaching, following) (Cassidy, 2016).

The attachment behavioural system organizes these attachment behaviours dependent on the individual's history and related external as well as internal cues (Cassidy, 2016). It is defined by inherent motivation (compatible with the inherent motivation for exploration formulated by Piaget (1954)) and therefore does not depend on any more fundamental "drives" (Cassidy, 2016). Furthermore, the attachment behavioural system is "not a set of behaviours that are constantly and uniformly operative" (Sroufe & Waters, 1977, p. 1185), it rather includes a variety of behaviours with similar functions and meanings because "whether a child moves toward a mother by running, walking, crawling, shuffling or, in the case of a thalidomide child, by rolling, is thus of very little consequence compared to the set-goal of his locomotion, namely proximity to mother" (Bowlby, 1982, p. 373). A certain behaviour is selected depending on which behaviour is deemed most useful in a certain situation and with a certain person. With experience and further development, the variety of possible behaviours becomes more extensive and the assessment of their effectiveness in certain situations becomes more accurate (Cassidy, 2016). This allows for stability in the internal organization of the attachment behavioural system in relation to a certain attachment figure, while specific behaviours may vary considerably over contextual and developmental changes: For example, a child may start crying or crawling towards the attachment figure depending on its mobility (Sroufe & Waters, 1977). Furthermore, the choice of attachment behaviour might change within one situation due to certain changes in the environment and perceived effectiveness of the demonstrated behaviour (Cassidy, 2016).

Importantly, the goal of attachment behaviour is not an object (e.g., the mother) in itself but rather the maintenance of the desired proximity to this object. It can therefore be seen as following an ideal of behavioural homeostasis (Cassidy, 2016). The degree of this desired proximity might vary dependent on the conditions of the child (e.g., pain, hunger, or fatigue) and the environment (e.g., presence of stressful stimuli). In addition, both the degree of activation of the attachment behavioural system as well as the required stimulus to terminate attachment behaviour might vary over different situations (Cassidy, 2016).

The degree of activation of the attachment behavioural system might furthermore be linked to activation of other behavioural systems (e.g., the exploratory behavioural system or the fear behavioural system) (Cassidy, 2016).

Especially the interaction between the attachment and exploratory systems is of significance for development (Ainsworth, 1972) and can best be understood in the framework of the child's reliance on the attachment figure as "a secure base from which to explore", a central concept of attachment theory (e.g., Bowlby, 1982).

A dynamic equilibrium between these systems allows most individuals to flexibly respond to a certain situation after the attachment figures availability and the environment's characteristics have been assessed (Cassidy, 2016): While a threatening environment and/or the unavailability of an attachment figure activate the attachment system and make exploratory behaviour unlikely, exploration is enhanced when the attachment system is not activated. Conversely, a threatening environment is also likely to activate the fear system, which in turn furthers the activation of the attachment system. However, the availability of an attachment figure decreases the individual's susceptibility to fear (Morgan & Ricciuti, 1969; Sorce & Emde, 1981).

Within the attachment behavioural system, mental representations of the self, the attachment figures and the environment are largely formed by experiences. These cognitive components are described by Bowlby (Bowlby, 1982) as internal working models. These models are used by the individual to select and plan attachment behaviours in response to specific circumstances. Ideally, they are relatively accurate reflections of reality and therefore allow efficient planning and a certain anticipation of the future (Cassidy, 2016).

When impaired attachment capacities hinder individuals from having satisfactory interpersonal relationships, internal working models perpetuate these difficulties (Flores, 2011): According to object relations theory, introjected self and object representations comprise intense affects and influence the projection of an internal reality onto the external environment (Ogden, 1982). However, while internalization in psychoanalysis is often described as the rather mechanical process of replicating internally what is external, Bowlby's internal working model leans more towards Piaget's (1954) theory of representation and intersubjectivity theory (Stolorow, Brandchaft, & Atwood, 2014) as it focuses on the way two individuals form the interpersonal field in a relationship (Flores, 2011). Therefore, the estimation that an attachment figure is both accessible and likely to be responsive depends on two variables: (a) whether the attachment figure is generally thought to be responsive to calls for support and (b) whether the self is thought to be the sort of person others and especially the attachment figure would respond to in a supportive way (Bowlby, 1973). Although principally independent, these variables tend to be confounded as the model of the self and the model of the attachment figure are prone to develop to be mutually confirming (Bowlby, 1973).

Consequently, the attachment figure's emotional availability, i.e., how this individual "is with" the child, is the determining factor for the composition of the internal working models and therefore of greater importance than what this individual "does" with the child (Flores, 2011). What is internalized is "the experience of being with" (Stern, 1995) or "the relationship and not the parent as a separate entity" (Marrone, 1998, p. 44).

Correspondingly, the attachment bond is an affectional tie, described by Ainsworth (1989) as a characteristic of the individual: It is not dyadic but rather a bond that one individual has to another. Here, it is necessary to clarify that the attachment bond is a specific type of affectional bond. While a child is usually attached to its parents, they are not in turn attached to the child, while another form of affectional bond is usually present (Cassidy, 2016). According to Ainsworth (1989), an affectional bond is characterised by its persistence over time, its focus on a specific (not interchangeable) individual, its emotional significance, the strong wish to remain in contact with this individual as well as the experience of distress when contact is involuntarily interrupted and/or proximity is prevented. The attachment bond is characterised by these five as well as one additional criterion: When experiencing distress, the individual seeks comfort and security in the interaction with the attachment figure (Ainsworth, 1989). Consequently, attachment is defined as "secure" or "insecure" dependent on whether security is achieved (Cassidy, 2016).

However, the existence and strength of an attachment bond cannot simply be inferred from the absence, presence or strength of attachment behaviour (Cassidy, 2016): While distress activates the attachment system and consequently promotes attachment behaviour, this behaviour might also be directed towards a stranger (where an attachment bond cannot be assumed to exist) when the attachment figure is unavailable. On the other hand, the attachment bond to a certain individual – defined by its persistence over time – is present even if the attachment system is temporarily not active. Furthermore, the attachment bond is only one of many features of the child's relationship with an attachment figure (for an overview, see Cassidy, 2016).

While the interactions between child and caregiver are formed by the attachment system of the child and the corresponding caregiving system of the attachment figure, it is important to keep in mind that both the child's as well as the attachment figure's behaviour can also be motivated by other systems (Cassidy, 2016). Furthermore, the dominance of different behaviour systems in the attachment figure show a high variability across as well as within cultures. It is therefore possible that an attachment figure is comfortable in interactions with the child in one area (e.g., as a playmate or teacher) but unable to provide appropriate attachment-related interactions, or vice-versa (Cassidy, 2016).

Discomfort or anxiety may arise in the attachment figure in situations where the child's behaviour disturbs the attachment figure's "state of mind that had seemed optimal for maintenance of the relationship to their own parents during childhood" (Main, Hesse, & Kaplan, 2005, p. 292). Conversely, if the attachment figures caregiving system is active, the child's attachment system can be relatively inactive as attachment behaviours are not needed. Like most behavioural systems, the caregiving system also relies on internal (e.g., hormones, beliefs, emotions) as well as external (e.g., state and behaviour of the child, characteristics of the environment) cues (Cassidy, 2016).

An important distinction also has to be made between the attachment behavioural system and the sociable behavioural system which "is a much broader concept than attachment and is not intended to cover behaviour that is directed towards one or a few particular figures" (Bowlby, 1982, p. 229). It rather "leads individuals to seek to maintain proximity to conspecifics, even to those to whom they are not attached or otherwise bonded, and despite the fact that wariness is likely to be evoked by those who are unfamiliar" (Ainsworth, 1989, p. 713). While the sociable behavioural system is of evolutionary importance for the individual's reproductive fitness and survival (e.g., as cooperation with others makes it easier to acquire food, shelter, or a suitable mate), it is most likely only activated when there is no need for the attachment system to be active. Furthermore, the connection between attachment and social functioning is mediated by the capacities for emotion regulation developed through attachment relationships (for an overview, see Cassidy, 2016). These interactions will be described in more detail in later sections on evolutionary theory and emotion regulation.

Multiple Attachments and Attachment Hierarchy

As the "strength" of an attachment bond cannot be inferred from the strength of attachment behaviour, individual variations in attachment relationships are better described as qualitative differences (e.g., secure vs. insecure) (Cassidy, 2016). Correspondingly, Ainsworth (Ainsworth, 1989) sees Hinde's (1979) concept of "penetration" – describing the centrality of one person in another person's life – as a suitable framework: Considering the natural change of a child's attachment during development, an increased autonomy and separation from the attachment figure consequently does not have to be seen as a "weakening" of the attachment bond. It can more appropriately be described as fewer aspects of the child's life being penetrated by that relationship (Cassidy, 2016).

In line with Bowlby's theory (e.g., 1982), early empirical observations showed that during their first year, most children form an attachment to more than one person (Ainsworth, 1967).

However, there rarely seem to be more than four attachment figures (Grossmann & Grossmann, 1991). In addition, these attachment figures are not equivalent or interchangeable for the child but form an attachment hierarchy where one principal attachment figure is usually preferred by the child (Cassidy, 2016). This “monotropy” (Bowlby, 1982) might be the result of “reciprocal hierarchical bonding, in which the child matches an attachment hierarchy to the hierarchy of the caregiving in his or her environment” (Cassidy, 2016, p. 16).

While early attachments usually develop with close family members, new attachments can also be formed later in life, and although the attachment bond to primary caregivers typically persist a lifetime, those later attachments (e.g., to sexual partners, friends) often become the most important ones in adulthood (Cassidy, 2016). Studies on similarities (i.e., concordance) in quality across an individual’s attachments have yielded inconsistent results: While a high similarity across attachments could be theorized to lead to a corresponding similarity in internal working models, it is yet not fully clear how distinctly different experiences with different attachment figures are translated into internal working models and whether those models are consequently integrated (Cassidy, 2016). Furthermore, there is as yet very little research on how differences between a child’s attachments relate to its development and functioning. The available studies suggest that when secure as well as insecure attachments have been formed by a child, this child functions more competently when it is securely attached to the mother instead of to another attachment figure, while the best-functioning children have two secure attachment bonds (for an overview, see Cassidy, 2016).

Dynamics of Attachment

To integrate the results of recent studies with established attachment theories (Ainsworth & Bowlby, 1991; Bowlby, 1982; Cassidy & Kobak, 1988; Fraley & Shaver, 2000), Shaver and Mikulincer (2002) formulated a model of the dynamics in the attachment system that links the functioning of this system with strategies for emotion regulation.

This model is defined by three major components (Mikulincer, Shaver, & Pereg, 2003):

1. The monitoring and appraisal of physical or psychological threats regulates the activation of proximity seeking (i.e., the primary attachment strategy). Importantly, this includes the notion of both external as well as internalized attachment figures and therefore either actual or symbolic proximity seeking.
2. The monitoring and appraisal of whether an attachment figure is available regulates the development and activation of security-based strategies. This component marks the individual differences in attachment security or insecurity.

3. The monitoring and appraisal of the usefulness of the primary attachment strategy results in the development of individual secondary attachment strategies (i.e., hyperactivating strategies or deactivating strategies) (Mikulincer et al., 2003).

Factoring in the effects of the recurrent use of secondary attachment strategies, the extended version of this model also includes inhibitory and excitatory pathways that in turn influence the first and second components (i.e., monitoring of threat and the availability of the attachment figure) (Mikulincer et al., 2003).

While continued development can be assumed to increase the ability to rely on symbolic (inner representations) attachment figures, some reliance on actual others remains throughout the lifespan (Bowlby, 1982, 1988; Mikulincer et al., 2003). In line with this, the first component of the model (i.e., the primary attachment strategy) has been demonstrated to be relevant in children (e.g., Ainsworth, 1991) as well as in adults (e.g., Fraley & Shaver, 1998). Furthermore, even minimally threatening situations seem to already activate thoughts related to internalized attachment figures and proximity seeking (Mikulincer, Birnbaum, Woddis, & Nachmias, 2000; Mikulincer, Gillath, & Shaver, 2002).

Security-Based Strategies

When the availability of an actual or symbolic attachment figure can be established, a sense of attachment security is accompanied by security-based strategies that reduce the experienced distress and enable resilience as well as personal growth through the increased internalization of secure attachment models. In detail, these strategies enable individuals with a secure attachment history to extent their internal resources while also increasing their willingness and ability to rely on actual attachment figures (Mikulincer et al., 2003).

Security-based strategies therefore include procedural as well as declarative knowledge (e.g., optimistic beliefs, a sense of self-efficacy as well as trust) (Hazan & Shaver, 1994) about emotion regulation, others and the self (Mikulincer et al., 2003). The procedural knowledge includes “emotion-focused coping” (Lazarus & Folkman, 1984) that enables the acknowledgement and expression of feelings as well as the seeking of emotional support, so that distress can be reduced. This in turn enables the successful use of “problem-focused coping” and therefore creates a constructive way of coping (S. Epstein & Meier, 1989) instead of maladaptive coping strategies (e.g., rumination, withdrawal, primitive defence mechanisms) that would distort perception and consequently generate interpersonal problems (for an overview, see Mikulincer & Shaver, 2003).

When this sense of attachment security is disrupted or inhibited, the activation of other important behavioural systems (e.g., exploration, caregiving, sociability) is also impaired (Bowlby, 1982) as insecure attachment (momentarily or enduring) focuses the available resources on the experienced distress. Conversely, secure attachment – and therefore the existence of a “*secure base*” (Bowlby, 1982) – facilitates autonomy, individuality, and self-actualization (Mikulincer et al., 2003).

Secondary Attachment Strategies

When the availability of an actual or symbolic attachment figure cannot be established, the individual remains in a state of distress and attachment insecurity. This forces the individual to decide (consciously or unconsciously) whether the primary attachment strategy (i.e., proximity seeking) can still be seen as a viable option (Shaver & Mikulincer, 2002).

The direction of this decision consequently leads to different secondary attachment strategies: When the focus remains on proximity seeking, the attempts to reach that goal are intensified via hyperactivating strategies (Cassidy & Kobak, 1988). These strategies result in constant concern, vigilance and effort, which is visible in an intensive approach orientation towards the attachment figure, including strong attempts (e.g., clinging and controlling) to obtain proximity, care and affection (Shaver & Hazan, 1993). Therefore, hyperactivating strategies reflect a compromise between the anger directed at unavailable attachment figures and the intense need to be close to them (Cassidy & Kobak, 1988). Often, these attachment figures are inconsistent in their behaviour (Ainsworth, Blehar, Waters, & Wall, 1978). Furthermore, these strategies may focus beyond physical proximity, on increased intimacy and self-other similarity (i.e., “*oneness*”) (Mikulincer et al., 2003).

As individuals who apply these hyperactivating strategies perceive themselves as incompetent (e.g., at emotion regulation) and helpless (Mikulincer & Florian, 1998), they also develop an overdependence on their attachment figure (Shaver & Hazan, 1993). Furthermore, the excitatory pathways involved in these strategies lead to hypervigilance regarding possible threats to the self and the unavailability of the attachment figure, which in turn results in a self-amplifying, chronic cycle of distress, with intensified negative emotional responses and undifferentiated mental models (Mikulincer et al., 2003).

When proximity seeking can no longer be considered a viable option, the primary attachment strategy can be deactivated. The resulting deactivating strategies (Cassidy & Kobak, 1988) aim to avoid the distress and frustration caused by the unavailability of the attachment figure. Therefore, they inhibit the seeking of support and focus on self-reliance.

Attachment needs are consequently denied, closeness, intimacy, and dependence on others are avoided. Furthermore, continued and generalized distancing (symbolical as well as literal) from distress is achieved through an active inattention to vulnerabilities and threats, including the suppression and inhibition of related memories or thoughts (Shaver & Mikulincer, 2002). Deactivating strategies can consequently be defined as either “pre-emptive” (Fraley, Garner, & Shaver, 2000), when they are directed towards the preferred avoidance of distress and vulnerability, or as “post-emptive”, when perception could not be avoided and has to be minimized (Mikulincer et al., 2003). While (negative) emotions are no longer visible, high levels of unconscious unresolved distress remain (Shaver & Mikulincer, 2002). This conscious and unconscious emotional down-regulation (Cassidy & Kobak, 1988; Mikulincer & Shaver, 2003) is not as reliable or thorough as more secure approaches to emotion regulation and therefore vulnerable to disruption by competing mental processes (e.g., Mikulincer, Dolev, & Shaver, 2004).

Attachment Styles

Attachment theory (Bowlby, 1973, 1980, 1982) differentiates between a secure attachment style that is established through a sensitive, supportive and caregiving environment as well as insecure attachment styles that are the result of an inconsistent, insensitive or rejecting attachment figure. However, since the foundation of attachment theory, different – but mostly overlapping – approaches to operationalize and measure attachment styles have emerged (Bakermans-Kranenburg & van IJzendoorn, 2016).

To illustrate the development of attachment styles, drawing a parallel to the development of language seems useful: While every individual is born with the capacity to learn a language, the specific environment determines what kind of language is learned (Bakermans-Kranenburg & van IJzendoorn, 2016).

Attachment Dimensions

In line with the above described dynamics of attachment, Mikulincer and Shaver (e.g., 2007) differentiate between two basic attachment dimensions – anxious attachment and avoidant attachment – that correspond to the use of either hyperactivating strategies (in anxious attachment) or deactivating strategies (in avoidant attachment).

Accordingly, secure attachment (low anxious attachment and low avoidant attachment, application of security-based strategies) allows the individual to deal with stressful experiences by relying upon mental representations of previously received support or by actively seeking support in the present (Mikulincer et al., 2003).

These individuals with secure attachment belief in their ability to manage distress, they have positive views of themselves and others, and are consequently able to maintain their effective functioning and their mental health through periods of distress (e.g., Collins & Read, 1994; Mikulincer & Florian, 1998). Furthermore, they are willing and able to acknowledge and communicate their emotions (Fuendeling, 1998) and to revise their cognitive representations according to new information (Mikulincer, 1997; Mikulincer & Arad, 1999). Finally, individuals with secure attachment also seem to be more empathetic towards help-seeking others and less hostile towards member of other groups (Mikulincer, Hirschberger, Nachmias, & Gillath, 2001; Mikulincer & Shaver, 2001).

Individuals with high levels of anxious attachment, characterised by the use of hyperactivating strategies, actively demand support although they feel unworthy of love (Mikulincer & Shaver, 2007). Their negative self-view is paired with an exaggerated appraisal of threats that in turn leads to pessimistic or even catastrophic expectations regarding everyday interactions with others and the environment (Bartholomew & Horowitz, 1991; Mikulincer & Florian, 1998). While an actual stressful event leads to intensive distress in these individuals, their constant threat-related rumination (for an overview, see Mikulincer & Florian, 1998) allows the negative emotions aroused by a distressing memory to spread and taint others (Mikulincer & Orbach, 1995). Consequently, attachment-related worries are independent of an actual external threat (Mikulincer et al., 2002).

Individuals with high levels of avoidant attachment, characterised by the use of deactivating strategies, are often unaware that they are suppressing or denying their needs for protection and support as well as their painful attachment-related memories and thoughts (Cassidy & Kobak, 1988). Instead, they pride themselves on their self-reliance which in turn leads to a denial of personal imperfections and weaknesses (Mikulincer, 1995). Consequently, negative self-representations are often not cognitively accessible but rather projected on others, intimacy and emotional involvement are avoided, painful and fear-arousing thoughts, emotions and memories are suppressed (e.g., Mikulincer, 1995; Mikulincer & Orbach, 1995).

Attachment Types

The above described dimensions also fit with the presently most widely accepted categorical conceptualization of adult attachment proposed by Bartholomew (e.g., Bartholomew & Horowitz, 1991): It differentiates between one secure and three insecure (preoccupied, dismissing, and fearful) attachment styles.

While Mikulincer and Shaver (2007) defined attachment through the dimensions of anxious attachment and avoidant attachment, Bartholomew and colleagues (e.g., Bartholomew & Horowitz, 1991) based their categorization on the dimensions of self and others, with the self-dimension describing the individual's view on his or her own worthiness and lovability (i.e., cognitive representations of the self) and the others-dimensions describing the individual's expectation regarding the availability of an attachment figure (i.e., cognitive representations of others).

Accordingly, secure attachment is defined by low levels of anxious attachment and avoidant attachment as well as a positive model of self and others. As described above, these individuals see themselves as worthy of being loved and are capable to have a mutually supportive intimate relationship. They deal with stressful experiences by relying upon mental representations of previously received support or by actively seeking support in the present (Bartholomew & Horowitz, 1991; Mikulincer & Shaver, 2007). In comparison, preoccupied attachment (also known as anxious-ambivalent attachment) is defined by high levels of anxious attachment and low levels of avoidant attachment as well as a negative model of self and a positive model of others. Individuals with this attachment style tend to be very demanding but simultaneously expect to be abandoned as they do not see themselves worthy of being loved (Bartholomew & Horowitz, 1991; Mikulincer & Shaver, 2007).

Individuals with a dismissing attachment style, defined by low levels of anxious attachment and high levels of avoidant attachment as well as a positive model of self and a negative model of others, tend to avoid intimate relationships and mutual support. They need to establish a high level of self-confidence as they feel that they can only rely on themselves (Bartholomew & Horowitz, 1991; Mikulincer & Shaver, 2007). Lastly, individuals with fearful attachment, defined by high levels of anxious attachment and avoidant attachment as well as a negative model of self and others, tend to have little self-worth as well as a high distrust of others. Therefore, it takes them a long time to allow emotional closeness. However, as they are also afraid of being alone, they tend to passively remain in relationships even if they are exploited or abused (Bartholomew & Horowitz, 1991; Mikulincer & Shaver, 2007).

Fearful/Disorganized Attachment

While “normal” samples mostly contain individuals with secure attachment (about 70%; Granqvist, 2010), individuals with extremely high scores on both anxious attachment and avoidant attachment (i.e., fearful attachment) are most likely to be found in abused or clinical samples (for an overview, see Shaver & Clark, 1994). Therefore, the consideration of fearful attachment is especially important in research on psychopathology and its treatment.

To date, empirical studies indicate that individuals with fearful attachment are the most troubled and least trusting of adults (Shaver & Clark, 1994), showing highly negative representations of their romantic partners (Mikulincer & Arad, 1999), uncommonly closed and rigid cognitions (Mikulincer, 1997) as well as very little empathy for distressed others (Mikulincer, Gillath, et al., 2001). Furthermore, they show the poorest mental health during stressful periods (Berant, Mikulincer, & Florian, 2001a, 2001b) and can often be diagnosed with severe personality disorders (Brennan & Shaver, 1998).

Fearful attachment can furthermore be described as disorganized, as individuals with this attachment style seem unable to decide whether proximity-seeking is a viable option (Simpson & Rholes, 2002) and therefore, whether to rely on hyperactivating or deactivating strategies (e.g., Mikulincer et al., 2003).

According to Simpson and Rholes (2002), these individuals “may enact both strategies in a haphazard, confused, and chaotic manner (...) their behaviour under stress may be an incoherent blend of contradictory, abortive approach/avoidance behaviours or perhaps paralyzed inaction or withdrawal” (p. 224). This behaviour has a close resemblance to the “disorganized” attachment visible in some infants during the strange situation paradigm (Main & Hesse, 1990).

The dynamics detailed by Simpson and Rholes (2002) can also be incorporated into the above described dynamics of attachment (e.g., Mikulincer et al., 2003) as an additional path that is activated when primary attachment strategies as well as secondary attachment strategies have failed. This failure might occur when the experience of traumatic events cannot be handled with an individual’s preferred (attachment) strategies (Mikulincer & Shaver, 2003). In line with this, individuals with fearful attachment often report to have experienced physical and/or sexual abuse as well as other attachment-related traumata that cannot be dismissed or denied (Brennan & Shaver, 1998; e.g., Shaver & Clark, 1994). Therefore, “fear without solution” can be seen as the defining dilemma leading to this form of attachment (DeKlyen & Greenberg, 2016).

Circling back to the question of types versus dimensions, it is important to clarify that the dynamics described above only apply to individuals with extremely high scores on anxious attachment and avoidant attachment, while a purely categorical approach relying on self-description (e.g., Bartholomew & Horowitz, 1991) sets a much lower hurdle for the classification of fearful attachment, which in turn leads to discrepancies between social-psychological work based on “normal” samples and clinical work focused on disorganized attachment (Mikulincer & Shaver, 2003).

Attachment Over the Lifespan

Studies have shown that internal working models are able to change considerably between early childhood and late adolescence (Booth-Laforce et al., 2014; Haydon, Roisman, Owen, Booth-Laforce, & Cox, 2014; Sroufe, 2005). This supports Bowlby's theory (1988) that internal working models become more complex and more resistant during this age-span: As natural changes are inevitable during the development of cognitive, communicative, and social skills (Bretherton & Munholland, 2016), a changing internal working model can consistently enable accurate predictions and internal simulations (Bowlby, 1988).

This also implies a growing ability to take another individual's perspective (i.e., to gain insights into their motives and feelings) (Bretherton & Munholland, 2016). Furthermore, the need for physical proximity of the attachment figure gradually evolves towards a desire for psychological proximity (i.e., "felt security") (Sroufe & Waters, 1977).

With the onset of adolescence, the functions of attachment are gradually transferred from the primary attachment figures (i.e., adult-child attachment) to peers (i.e., friends and romantic partners) (Furman & Simon, 1995). Parallel to this, the evolutionary process of reproduction becomes more obvious and direct (Simpson & Belsky, 2016). However, its integration with the mating and caregiving system (Shaver, Hazan, & Bradshaw, 1988) complicates the interpretation of attachment styles in adulthood (Simpson & Belsky, 2016).

Furthermore, while some studies indicate that a person's attachment style might vary considerably dependent on the relationship (La Guardia, Ryan, Couchman, & Deci, 2000), there still seems to exist a relatively stable higher-order attachment style (Fraley, 2002; Fraley, Vicary, Brumbaugh, & Roisman, 2011). In line with this, the most comprehensive and extensive study on the developmental consequences of early attachment – the Minnesota Study of Risk and Adaption from Birth to Adulthood (Sroufe, 2005; Sroufe, Egeland, Carlson, & Collins, 2005) – revealed connections between early attachment security and several personality characteristics (e.g., self-esteem, social competence, ego resilience, positive affect).

Furthermore, several studies have linked early secure attachment to better cognitive, social and emotional competences as well as fewer problem behaviours in later life (for an overview, see Kerns & Brumariu, 2016).

Attachment and Personality Structure

Describing the long-lasting effects of attachment across the life span, Bowlby (1977) already named early attachment experiences as an important factor influencing personality structure.

In line with this and with the categorization of attachment styles by Bartholomew and colleagues (e.g., Bartholomew & Horowitz, 1991) based on the dimensions of self and others (described in detail above), Blatt and colleagues (e.g., Blatt, 1991; Blatt & Blass, 1990) formulated a model of personality development that includes two fundamental and parallel lines of development, ideally evolving in a reciprocal manner (one line cannot develop without the other): Firstly, the relatedness line allows the formation of mutually satisfying and increasingly mature relationships with others. Secondly, the introjective line allows the formation of a realistic, differentiated and essentially positive self-identity (e.g., Blatt, 1991; Blatt & Blass, 1990).

Combining psychoanalytic theory with cognitive developmental theory (Piaget, 1950; Werner, 1948), Blatt and colleagues (e.g., Blatt & Auerbach, 2001) furthermore suggest an epigenetic development of representations of self and others, defined by affective and cognitive components that become increasingly accurate and complex. Consequently, higher levels of representations (defined by increased differentiation, flexibility and hierarchic organization) are more effective than the lower (more global, diffuse and fragmented) levels they evolve and extend from.

According to Kernberg (e.g., 1976) the degree of differentiation, integration and affective valence of these representations has important implications for the individual's overall personality organization. His prominent psychodynamic conceptualization of personality organization defines three levels of increasing impairment (i.e., structural deficits): Neurotic, borderline and psychotic (Kernberg & Caligor, 1996).

The amount of structural deficits results from the amount of

1. Impaired reality testing (i.e., the “capacity to differentiate self from non-self, intrapsychic from external stimuli and to maintain empathy with ordinary social criteria of reality” (Kernberg & Caligor, 1996, p. 120),
2. Primary defence mechanisms (e.g., projection, denial, dissociation, or splitting), and
3. Identity diffusion (i.e., poorly integrated concepts of self and others) (Kernberg & Caligor, 1996).

Conversely, higher levels of representations allow an integration of negative and positive components as well as a higher tolerance for contradictory and ambivalent feelings about the self and others (Kernberg & Caligor, 1996).

Essentially, while the internal working models defined by attachment theory have a strong focus on the content and behavioural consequences of mental representations, the concept of personality structure extends this model by adding the complexity of their structural organization and integration. Therefore, individuals with similar attachment patterns might vary regarding the level of integration and differentiation of their internal working models (D. Diamond & Blatt, 1994; Levy, Blatt, & Shaver, 1998). In general, however, more insecure attachment patterns seem to be associated with lower levels of structural integration (Schauenburg, 2000).

As an extension of Kernberg's model (e.g., 1976), the Operationalized Psychodynamic Diagnosis System (OPD; OPD Task Force, 2008) defines personality structure as including four basic functions that are linked to the internal world of an individual as well as the external world (i.e., mental representations of the self and others):

1. Perception/Cognition of the self and others,
2. Regulation of the self and relationships,
3. Communication with the internal and external world, as well as
4. Attachment to internal and external objects.

The attachment system is therefore seen as defining one component of the personality structure. As each of the four basic functions is assessed in relation to the internal as well as the external world, with the resulting eight dimensions each containing three clinically meaningful subdimensions, this model allows a very differentiated assessment of an individual's personality structure (OPD Task Force, 2008).

For the basic function of attachment to internal and external objects the subdimensions are as follows: Attachment to internal objects is defined by "Internalization", "Use of Introjects", and "Variability of Attachment Patterns", while Attachment to external objects is defined by "Capacity of Attachment", "Accepting Help" and "Detaching from Relationships" (OPD Task Force, 2008).

As the four basic functions of personality structure are assumed to be highly interconnected, a global assessment for impairments in personality structure can be generated (OPD Task Force, 2008): Consequently, a good structural integration is defined by a relatively autonomous self that shows stability as well as flexibility when adequately processing impulses, emotions and conflicts. The central fear in relation to others is to lose their affection or love. A moderate structural integration is defined by a restricted ability for regulation that tends towards overcontrolling as well as an increased occurrence of self-destructive and self-devaluative impulses. Here, the central fear is to lose the (needed) others (OPD Task Force, 2008).

A low structural integration is defined by severely impaired regulatory functions which leads to repetitive flooding with intense negative affect as well as an increased occurrence of (self-)destructive impulses. Due to the very limited understanding for the self and others, interpersonal relationships are often used to enact internal conflicts while the central fear is to be harmed or destroyed by introjections or others (OPD Task Force, 2008). Lastly, a disintegrated structure is defined by fragmentations and psychotic tendencies, with the central fear being that the sense of self vanishes due to a symbiotic merging of the self and objects (OPD Task Force, 2008).

Consequently, patients with a low level of structural integration seems to be more likely to experience psychotic symptoms (Uzdawinis et al., 2010), to have a longer duration of mental illness (Rudolf, Grande, Oberbracht, & Jakobsen, 1996) and to be indicated for psychiatric instead of psychotherapeutic treatment (G. Schneider, Lange, & Heuft, 2002). Conversely, both patients and therapist rate a higher level of structural integration as advantageous for the success of treatment and a change in symptoms (e.g., Müller, Kaufhold, Overbeck, & Grabhorn, 2006; Rudolf et al., 1996).

Assessment of Attachment

In general, two traditions for the assessment of attachment have emerged: Self-report questionnaires and interviews. These forms of measurement are not only defined by different strengths and limitations (as detailed below), they also often capture attachment in different ways (i.e., types versus dimensions). The description here can only give a short overview of a few different approaches on the measurement of adult attachment. An extensive chapter on the measurement of individual differences in adult attachment can be found in the Handbook of Attachment (Chapter 27; Crowell, Fraley, & Roisman, 2016), while a more comprehensive description of different measures currently used in empirical studies can also be found in the review by Ravitz and colleagues (2010).

Types versus Dimensions

While the first theories on adult attachment used categorical models, taxometric research on attachment (Fraley & Waller, 1998) initiated a gradual transition towards dimensional definitions. However, categorical models continue to have a strong influence on attachment research (Ravitz et al., 2010).

For example, several researchers addressed the “types versus dimensions” question by using both categorical and dimensional approaches (e.g., McWilliams & Asmundson, 2007; Meredith, Strong, & Feeney, 2006) or by defining categories based on dimensional measures (e.g., Conradi & de Jonge, 2009; Kaitz, Bar-Haim, Lehrer, & Grossman, 2004; Schmitt et al., 2004).

Initially, Fraley and Waller (1998) strongly recommended continuous attachment measures, as the use of categorical measures makes it harder to describe mixed attachment types as well as changes in attachment patterns. More recently, however, Fraley and colleagues (2015) argued that changing the preferred method for assessing attachment does not clarify whether individuals vary continuously or categorically in their attachment patterns. Furthermore, they hypothesized that the “types versus dimensions” question might have to be answered differently depending on the level of specificity on which attachment is assessed: They argue that the categorical approach mostly applies in the context of a specific relationship (e.g., to the mother or romantic partner), while the dimensional approach is more suitable in the context of general, more abstract representations of others (Fraley et al., 2015).

However, to date the “types versus dimensions” debate regarding adult attachment has not been fully resolved. To further clarify the question, future research should try to determine which kind of assessment is better suited to predict attachment-relevant outcomes (e.g., well-being, coping abilities, relationship satisfaction) (Fraley et al., 2015).

Overall, as the various measures in use to assess adult attachment are based on different conceptualizations of attachment (i.e., defining three categories, four categories or two dimensions of attachment), the results of different studies are often hard to compare or to summarize (Mikulincer & Shaver, 2003).

Interviews

The most prominent example for the assessment of attachment with an interview is the *Adult Attachment Interview* (AAI), developed by Main and colleagues (e.g., George, Kaplan, & Main, 1985, 1996; Main, Kaplan, & Cassidy, 1985). This interview – currently containing 20 questions (George et al., 1996) and taking approximately one hour – assesses the attachment history and consequently differentiates between several attachment styles in adult individuals: Secure/Autonomous, Dismissing, Enmeshed/Preoccupied and Unresolved/Disorganized. Furthermore, there is the possibility of describing the attachment style as “cannot classify” when contradictory attachment patterns are displayed (George et al., 1996).

The Secure/Autonomous attachment style is defined by a structured narrative, a free expression of emotions as well as a balanced (i.e., both positive and negative experiences are described) and realistic description of early relationship experiences and their influence on development (George et al., 1996).

A Dismissing attachment style is defined by a portrayal of attachment relationships as either unimportant or idealized, despite the lack of concrete examples. In contrast, the Enmeshed/Preoccupied attachment style is defined by a free but often confused and incoherent expression of experiences and feelings. Lastly, the Unresolved/Disorganized attachment style is defined by a description of implausible causes and consequences, memory loss, confusion or silence regarding attachment-related traumata (George et al., 1996).

One often mentioned strength of the Adult Attachment Interview – in comparison to self-report questionnaires – is the effect of “surprising the unconscious into revelation” (George et al., 1985, 1996) and therefore its ability to include unconscious representations (Shaver & Mikulincer, 2002; Stein, Jacobs, Ferguson, Allen, & Fonagy, 1998). Furthermore, it allows an individual to elaborate upon, contradict or fail to support previous descriptions of attachment experiences (George et al., 1996). However, the time required for the training of sufficiently qualified interviewers as well as for the administration and scoring of the interviews far exceeds the requirements of self-report measures.

Offering those same advantages and disadvantages, the *Adult Attachment Projective Picture System* (AAP; George, West, & Pettem, 1999) is another interview designed to assess adult attachment. Here, the individual is shown seven pictures of scenes designed to activate the attachment system (i.e., depictions of illness, maltreatment, separation, solitude, and death) and asked to tell stories about each one.

Consequently, each story is coded for Content and Defence (George & West, 2011): While Content comprises the aspects “Agency of Self”, “Connectedness”, and “Synchrony” (i.e., balance and mutuality), Defence can be described through “Deactivation” (i.e., reducing the need for attachment), “Cognitive Disconnection” (i.e., separating emotions from situations or individuals), or “Segregated Systems” (i.e., fearful or traumatizing contents that are suppressed from consciousness).

Similar to the Adult Attachment Interview, an individual’s attachment style is consequently characterized as Secure, Dismissing, Preoccupied, or Unresolved. The AAP showed excellent psychometric properties (e.g., George & West, 2001).

Self-Report Measures

To date, several well-established self-report questionnaires exist to assess various aspects of adult attachment (Ravitz et al., 2010). The subsequently described versions have been used in numerous studies and are – among other translations – available in English as well as in German. Furthermore, these questionnaires have been used in one or more of the studies detailed in the later section on original research.

The *Attachment Style Questionnaire* (ASQ; Feeney, Noller, & Hanrahan, 1994; German Version: Hexel, 2004) is a 40-item questionnaire that assesses five dimensions of adult attachment (relationship focus: close relationships): “Confidence in Self and Others” (15 items), “Discomfort with Closeness” (8 items), “Relationships as Secondary” (7 items), “Need for Approval” (4 items) and “Preoccupation with Relationships” (6 items). All Items are rated on a 6-point Likert scale. Cronbach’s alpha were .90 for “Confidence in Self and Others”, .81 for “Discomfort with Closeness”, .65 for “Relationships as Secondary”, .69 for “Need for Approval” and .65 for “Preoccupation with Relationships” for the German version (Hexel, 2004).

The *Adult Attachment Scale* (AAS; Collins & Read, 1990; German version: Schmidt, Strauss, Höger, & Brähler, 2004) assesses three subscales of adult attachment (relationship focus: partner): Anxiety about being rejected or unloved (Anxiety), comfort with closeness (Closeness) as well as intimacy and comfort depending on others (Dependence). The German version of this questionnaire (Schmidt et al. 2004) contains of 15 items (5 items per sub-scale) that are rated on a 5-point Likert scale. Cronbach’s alpha were .79 for Closeness, .72 for Dependence and .78 for Anxiety (Schmidt et al. 2004).

The *Experience in Close Relationships - Revised* (ECR-RD; Fraley, Waller, & Brennan, 2000) assesses adult attachment on two dimensions (18 items per scale, rated on a 7-point Likert scale): Anxious Attachment and Avoidant Attachment. Cronbach’s alpha were .91 for Anxious Attachment and .92 for Avoidant Attachment for the German version (Ehrental, Dinger, Lamla, Funken, & Schauenburg, 2009).

In general, self-report measures are thought to be limited in their ability to assess all areas of attachment patterns, as they solely rely on conscious attitudes and behaviours and “cannot detect when defences distort responses” (Ravitz et al., 2010, p. 420). However, they are also considered to be more focused on current attachment patterns in various relationships, while the Adult Attachment Interview (George et al., 1996) solely focuses on the relationship with the parents. Most notably, it has been argued that self-report measures are less likely to detect avoidant attachment patterns, as individuals with this attachment pattern are prone to normalise and to avoid negative self-attributions (Stein et al., 1998).

Attachment Disruptions and Psychopathology

As “adaptations to early experiences set the stage for negotiating later experiences” (Stovall-McClough & Dozier, 2016), the development of adult psychopathology has to be considered in light of the interactions between earlier experiences, the resulting adaptation and current contextual parameters (Carlson, Egeland, & Sroufe, 2009).

The consideration of the relationship between a child and its parents as an important influence on the child’s personality development has a long tradition (Bowlby, 1982; Erikson, 1963; A. Freud, 1965). Furthermore, most theories of development include the fundamental concept that social relationships both influence and are influenced by the development of psychopathology: Therein, secure attachment is generally thought to act as a protective factor, while insecure attachment is thought to increase the vulnerability for psychopathology (for an overview, see DeKlyen & Greenberg, 2016). Importantly, however, the possible influence of attachment always has to be considered in the context of other risk factors (Cicchetti & Rogosch, 1996; Mark T. Greenberg, Speltz, Deklyen, & Jones, 2001; Keller, Spieker, & Gilchrist, 2005) as pathology is unlikely to be caused by a single risk factor (Mark T. Greenberg, Speltz, & DeKlyen, 1993). In line with this, multiple pathways may lead to and from pathology (Cicchetti & Rogosch, 1996), with different risk factors potentially leading to the same pathology (i.e., equifinality), while a specific risk factor potentially contributes to various forms of pathology (i.e., multifinality) (DeKlyen & Greenberg, 2016).

Considering life-long development, risk factors may differ in their impact depending on the developmental period, with attachment thought to have the most influence in early development (Fraley, 2002). Conversely, protective factors possibly also act in different ways: They may, for example, prevent or buffer the influence of risk factors or directly decrease dysfunctions (Coie, 1993). In line with this, Bowlby (1977) already noted that insecure attachment patterns can help to explain “the many forms of emotional distress and personality disturbances, including anxiety, anger, depression, and emotional detachment, to which unwilling separations and loss give rise” (p. 201). He further stated that the attachment style formed in childhood influences the “later capacity to make affectional bonds as well as a whole range of adult dysfunctions”, including “marital problems and trouble with children, as well as ... neurotic symptoms and personality disorders” (p. 206).

While confidence in the attachment bond can normally be restored after a short-term unavailability or unresponsiveness of the attachment figure, more prolonged denial of availability and responsiveness can lead to attachment disruptions or injuries. When they cannot be repaired, these disruptions or injuries increase an individual’s vulnerability for psychopathology (for an overview, see Kobak, Zajac, & Madsen, 2016).

Accordingly, insecure attachment patterns have been extensively discussed as contributing to different facets of personality pathology (Brennan and Shaver 1998; Nakash-Eisikovits et al. 2002) as well as a large number of other psychiatric diseases, including affective disorders as well as Substance Use Disorders (Zellner, Watt, Solms, & Panksepp, 2011).

Phases in Disrupted Attachment

The first description of mechanisms connecting disruptions in attachment to psychopathology consists of three phases – protest, despair and detachment (Bowlby, Robertson, & Rosenbluth, 1952): During the initial phase of protest, the child signals his or her separation distress and is focused on signals of the attachment figures return. This phase typically lasts between a few hours to more than a week, with fear, distress and anger (needed to mobilize and sustain attachment behaviour) being the dominant emotions (Kobak et al., 2016). After protest has been deemed unfruitful, increased hopelessness and sadness mark the despair phase that Bowlby (1973) compared to deep mourning. He further emphasized that inactivity and withdrawal during this phase should not be misinterpreted as recovery from distress (Kobak et al., 2016). Finally, in the detachment phase, the child starts to actively turn attention to the environment and to accept alternative caregivers. Should the attachment figure return during this phase, the child likely responds with a mixture of distress (e.g., crying), apathetic behaviour (e.g., expressionless face) and clinging (Kobak et al., 2016).

These phases also provide a prototype for emotional responses to attachment disruptions later in life and numerous studies have shown that interpersonal difficulties and emotion dysregulation due to severe threats to an attachment figure's availability increase the risk for psychopathology (e.g., Carlson et al., 2009; Kobak, Little, Race, & Acosta, 2001). While, with increased age, a prolonged physical separation from an attachment figure is less likely to be experienced as a threat to the attachment bond, such disruptions might still occur with the death of the attachment figure or the inability to establish contact in extremely distressing situations (Kobak et al., 2016).

A second possibly pathogenic attachment disruption lies in the breakdown of the caregiving system through frightening or threatening behaviour of the attachment figure: While the attachment figure remains physically available, he or she no longer provides protection and safety (Kobak et al., 2016). However, while both the consequences of attachment disruptions as well as the reasons for these disruptions are likely to contribute to psychopathology, the consideration of the caregiving environment has to date lagged behind the consideration of attachment styles in empirical studies (Kobak et al., 2016).

Regarding the experience of loss in adult life, Bowlby (1980) extended and modified the phases described before (Fraley & Shaver, 2016): The frequent occurrence of initial disbelief led to the addition of the numbing phase and the last phase was renamed “reorganization”, as it is often characterised by a reorganisation of mental representations allowing a continuing bond to the lost attachment figure as well as an adjustment to the new circumstances (Bowlby, 1980). Furthermore, Bowlby (1980) emphasized that seemingly “immature” or irrational reactions to the experience of loss (e.g., anger, searching, disbelief) have to be interpreted from an evolutionary or ethological perspective: While the manifestation and ritualization of grief varies considerably across cultures, the basic principles of emotional and behavioural responses to loss seem to hold across cultures (for an overview, see Fraley & Shaver, 2016). Although Bowlby expected most individuals to experience all aforementioned phases, he suggested that disordered forms can be found on a conceptual dimension from “chronic mourning” to “prolonged absence of mourning” (Bowlby, 1980, p. 138). Interestingly, chronic mourning is often found in adults with anxious attachment (Parkes & Weiss, 1983), while Bowlby (1980) linked a prolonged absence of mourning to a “compulsive self-reliance” that is formed through the discouragement of emotions in early attachment experiences. Furthermore, “compulsive caregiving” (Bowlby, 1980) might be an additional form of disordered grief (for an overview, see Fraley & Shaver, 2016). Importantly, Bowlby associated the described phases mostly with different functions rather than rigid stages: An individual might move in and out of different phases and different individuals may vary in their response to loss (Fraley & Shaver, 2016).

Hyperactivating and Deactivating Strategies

Interestingly, the influence of attachment styles is not limited to psychological health but seems to extend to a large variety of disorders (McWilliams & Bailey, 2010).

Maunder and Hunter (2001) summarize the influence of hyperactivating and deactivating strategies (i.e., secondary attachment strategies, as described in more detail above) as a general vulnerability factor for pathology with three mechanisms: First, insecure attachment is accompanied by a heightened susceptibility to and a more pronounced physiological response to stressful events. Second, it is accompanied by less efficient methods for emotion regulation, including a preferred use of external methods (e.g., substance use). Third, it is accompanied by less effective and less frequent help-seeking behaviour. Conversely, secure attachment appears to have a protective effect against various risk beliefs and problematic behaviours (Lac, Crano, Berger, & Alvaro, 2013).

In detail, avoidant attachment (accompanied by deactivating strategies) seems to be primarily associated with conditions defined by (chronic) pain (e.g., severe headaches, back or neck problems), while anxious attachment (accompanied by hyperactivating strategies) seems to be associated with a considerable range of conditions, especially involving the cardiovascular system (McWilliams & Bailey, 2010). Overall, anxious attachment seems to be more strongly associated with poor health. However, more research regarding the specific mechanisms with which attachment influences (mental) health is still needed (McWilliams & Bailey, 2010).

The Role of Traumatic Experiences

As mentioned above, abused and clinical samples are often characterized by a high prevalence of fearful/disorganized attachment, defined by extremely high scores on anxious as well as avoidant attachment (for an overview, see Shaver & Clark, 1994).

Individuals with this attachment style – that is thought to develop in response to extremely traumatic (early) experiences – show the poorest mental health during stressful periods (Berant et al., 2001a, 2001b) and can often be diagnosed with severe personality disorders (Brennan & Shaver, 1998). Conversely, childhood maltreatment (i.e., neglect as well as physical, emotional, or sexual abuse) seems to create various vulnerabilities including fearful/disorganized attachment (for a meta-analytic review, see Cyr, Euser, Bakermans-Kranenburg, & Van Ijzendoorn, 2010). It can consequently be linked not only to low self-worth and low relationship quality but also to externalizing (e.g., delinquency, substance use) as well as internalizing (e.g., depression, anxiety) symptoms in later life (Flynn, Cicchetti, & Rogosch, 2014).

Furthermore, childhood maltreatment is associated with a higher amount of negative peer relationship qualities (e.g., aggression, rejection) (Alink, Cicchetti, Kim, & Rogosch, 2012; Kim & Cicchetti, 2010). In line with this, adolescents treated in residential psychiatric settings reported an extremely high amount of trauma and loss as well as unresolved mourning in their childhood history, with the pathogenic effects being most pronounced in the case of cumulative traumata (Wallis & Steele, 2001). Furthermore, childhood maltreatment seems to increase the vulnerability for psychosis directly as well as indirectly through insecure attachment (Goodall, Rush, Grünwald, Darling, & Tiliopoulos, 2015).

Interestingly, both the diagnosis of PTSD (Post Traumatic Stress Disorder) and fearful/disorganized attachment are associated with dissociative symptoms (e.g., numbing) as well as hyperarousal (e.g., angry outbursts, irritability) (DeKlyen & Greenberg, 2016).

Substance Use Disorders

Definition and Diagnostic Criteria

In the theoretical and empirical literature on Substance Use Disorders, various terms are used to describe the relation between a psychotropic substance and its user. Historically, definitions of physical dependence were the first to appear with Himmelsbach (1943; as cited in Koob & Le Moal, 2006) defining it as “an arbitrary term used to denote the presence of an acquired abnormal state wherein the regular administration of adequate amounts of a drug has, through previous prolonged use, become requisite to physiologic equilibrium. Since it is not yet possible to diagnose physical dependence objectively without withholding drugs, the *sine qua non* of physical dependence remains the demonstration of a characteristic abstinence syndrome” (p. 4).

In an attempt to include not only physical but also behavioural aspects in the definition, psychical dependence was later described as a state in which the use of a psychotropic substance produces “a feeling of satisfaction and a psychic drive that require periodic or continuous administration of the drug to produce pleasure or to avoid discomfort” (Eddy, Halbach, Isbell, & Seevers, 1965, p. 723).

However, dependence – defined through the appearance of withdrawal symptoms when the use of a psychotropic substance is discontinued – is only one component of the diagnosis for Substance Use Disorders, that are more equivalent to “addiction” (Koob & Le Moal, 2006). While current definitions of addiction include a combination of physical and psychological dependence, the emphasis lies mostly on the psychological or motivational components of withdrawal. A comprehensive description by Nelson and colleagues (1982) states the following:

“Addiction from the Latin verb ‘addicere’, to give or bind a person to one thing or another. Generally used in the drug field to refer to chronic, compulsive, or uncontrollable drug use, to the extent that a person (referred to as an ‘addict’) cannot or will not stop the use of some drugs. It usually implies a strong (Psychological) Dependence and (Physical) Dependence resulting in a Withdrawal Syndrome when use of the drug is stopped. Many definitions place primary stress on psychological factors, such as loss of self-control and overpowering desires; i.e., addiction is any state in which one craves the use of a drug and uses it frequently. Others use the term as a synonym for physiological dependence; still others see it as a combination (of the two).”

Consequently, Substance Use Disorders can be described as chronic, relapsing disorders defined by

1. The compulsive seeking and taking of psychotropic substances,
2. A loss of control regarding these behaviours as well as
3. The emergence of withdrawal symptoms including negative emotions (e.g., irritability, anxiety) when these behaviours are unfruitful.

In contrast, a limited, recreational and occasional use of psychotropic substances does not include the before described behaviours (Koob & Le Moal, 1997).

Interestingly, different psychotropic substances are associated with different patterns of addiction, emphasizing different components of the addiction cycle (Koob, Arends, & Le Moal, 2014): While, for example, opioids – as a classic substance of addiction – are associated with intense initial intoxication, a development of extensive tolerance, followed by an escalation in consumption and preoccupation as well as withdrawal symptoms of intense dysphoria and physical discomfort, alcoholism is associated with a somewhat different pattern, including a less intense initial intoxication and an often binge-like consumption. While psychostimulants – such as amphetamines and cocaine – also often follow a pattern with binge-like consumptions, cannabinoids tend to be consumed in a pattern similar to opioids, often resulting in a chronic intoxication during waking hours (Koob et al., 2014).

The diagnostic criteria for Substance Use Disorders in the DSM (Diagnostic and Statistical Manual of Mental Disorders) and ICD (International Statistical Classification of Diseases and Related Health Problems) have evolved with every edition published: While initial descriptions focused on the criteria of tolerance and withdrawal, recent descriptions are more focused on compulsive use (Koob et al., 2014). While similar criteria for Substance Use Disorders can be found in DSM-IV (American Psychiatric Publishing, 1994) and ICD-10 (World Health Organization, 1992), conceptual and diagnostic changes have been made in the DSM-V (American Psychiatric Publishing, 2013): Here, the criteria for substance abuse and substance dependence have been merged into one continuum of Substance Use Disorders, ranging from mild to moderate to severe, based on the number of criteria met. Interestingly, “committing illegal acts” has been removed as a criterion in DSM-V, while a “craving” has been added to the list already used in the previous edition.

As the original research presented later is based on the diagnostic criteria for Substances Use Disorders in ICD-10, this diagnostic system is explained in more detail: In ICD-10, Substances Use Disorders are organized in the chapter on “mental and behavioural disorders due to psychoactive substance use” in the following order (World Health Organization, 1992):

- | | |
|---------------------------|--|
| F10. – Alcohol | F16. – Hallucinogenics |
| F11. – Opioids | F17. – Tobacco |
| F12. – Cannabinoids | F18. – Volatile solvents |
| F13. – Sedative Hypnotics | F19. – Multiple drug use and use of other
psychoactive substances |
| F14. – Cocaine | |
| F15. – Other stimulants | |

In addition, four- and five-character codes (e.g., F19.20 for dependence syndrome with current abstinence) can be applied to specify the clinical conditions. Four-character codes – among others – include:

- | | |
|----------------------------|-----------------------------|
| F1x.0 – Acute intoxication | F1x.2 – Dependence syndrome |
| F1x.1 – Harmful use | F1x.3 – Withdrawal state |

Furthermore, a dependence syndrome can be present either for a specific substance (e.g., diazepam), a class of substances (e.g., hallucinogenic) or a larger variety of substances (e.g., if the use of substances varies according to their current availability). While the ICD-10 acknowledges that the use of several substances is common among drug users, it encourages the classification of the disorder under the most important substance (i.e., the substance causing the disorder or the substance most frequently used). The diagnosis for F19. should only be used if the pattern of using diverse substances is indiscriminate and chaotic and if the contributions of different substances cannot be separated (World Health Organization, 1992).

Poly Drug Use Disorder

Poly drug use is common among recreational and regular drug users worldwide (United Nations Office on Drugs and Crime, 2014). It is especially important to increase the understanding of this pattern of use, as it invalidates the established profile and characterization of the user of a specific, single substance (United Nations Office on Drugs and Crime, 2014). In line with this, most individuals in treatment for Substance Use Disorders report a Poly Drug Use Disorder. Interestingly, while opioids are common main drugs of choice, relatively few report alcohol as their main drug of choice (Weigl, Anzenberger, Busch, Horvath, & Türscherl, 2015). As previous studies have suggested numerous differences between Poly Drug Use Disorder and Mono Substance Use Disorder regarding personality (e.g., impulsivity) as well as etiological (e.g., emotional neglect in childhood) factors (Martinotti et al., 2009), it has been suggested that individuals with Poly Drug Use Disorder might need different treatment settings (Weigl et al., 2015).

Regarding the development of a Poly Drug Use Disorder, developmental progression may not only apply to the stages of use – ranging from occasional use to dependence – but also across substances: For example, individuals often seem to progress from “gateway” substances (e.g., tobacco, alcohol) to the use of other psychotropic substances (Kandel, Yamaguchi, & Chen, 1992). This progression might be attributed to several factors, including a common propensity to use psychotropic substances, a sensitization for the use of other substances due to the use of a previous substance or a connection to a social network that promotes the use of several substances (Kandel, Yamaguchi, & Klein, 2006; MacCoun, 2006). This possible developmental progression across the use of various substances has important implications for research on Substance Use Disorders, as it suggests that the possibility of co-occurring use of other substances should always be taken into consideration, even when only the use of one particular psychotropic substance is the focus of a study (Chassin et al., 2013).

Development of Substance Use Disorders

Substance Use Disorders are a complex phenomenon: Diverse pathways and multiple, interacting processes may lead to dependence, with the individuals abusing or dependent on one or more of these substances consequently representing a highly heterogeneous group: Differences might be present for example in social development, comorbidity, neurobiological processes and genetics (Chassin et al., 2013). Importantly, only a small percentage of individuals progresses from the initial use of legal psychotropic substances to the use of illegal psychotropic substances and to a dependence on these substances. Therefore, various psychological, physiological, social and environmental parameters may also act as protective factors against the development of Substance Use Disorders (Chassin et al., 2013).

The importance of applying a developmental perspective to the study of Substance Use Disorders is underlined by various aspects: Epidemiological data reveal characteristic age-related trajectories for Substance Use Disorders, progressing from the typical onset of substance use and Substance Use Disorders during adolescence to peak rates in young adults (ages 18–25) and to a decline in later life (Masten, Faden, Zucker, & Spear, 2008). However, the time that it takes to progress through the developmental stages of substance use varies for different individuals and substances (Chassin et al., 2013).

As this variability depends on several parameters, e.g., gender or family history of Substance Use Disorders (Hussong, Bauer, & Chassin, 2008; Ridenour, Lanza, Donny, & Clark, 2006), “the speed of progression may itself be an important phenotype to study in order to understand the aetiology of addiction” (Chassin et al., 2013, p. 8).

In line with this, substance use outcomes and Substance Use Disorders in adults can be predicted through parameters related to early childhood (Caspi, Moffitt, Newman, & Silva, 1998; Masten et al., 2008). While early onset of use – whether it is tobacco, alcohol use or an illegal substance (Breslau & Peterson, 1996; Dawson, Goldstein, Chou, Ruan, & Grant, 2008; Grant & Dawson, 1998) – can be linked to a greater likelihood for the development of a Substance Use Disorder, there are various possible interpretations for this connection, ranging from underlying high-risk phenotypes to the high vulnerability of the central nervous system in early development: For example, adolescence might be a particular high-risk period due to the combination of increased (peer-)reward seeking and an incompletely developed cognitive top-down control systems (Casey, Jones, & Somerville, 2011; Forbes & Dahl, 2010; Steinberg, 2010). Importantly, the often-described role of early adversity in the development of Substance Use Disorders makes it methodologically challenging to establish causal inferences in related empirical studies: While early adversity can be randomized in animal studies, it is inherently interconnected with other risk factors in human studies. For example, parental use of psychotropic substances may be connected to both a heritable risk for such behaviour as well as early aversive experiences (Chassin et al., 2013).

Different Perspectives on Development

Biopsychosocial Pathways and the Developmental Psychopathology Perspective

In line with the above described complexity, Sher (1991) described three interconnected biopsychosocial pathways to Substance Use Disorders:

1. A deviance proneness pathway,
2. A stress and negative affect pathway and
3. An enhanced reinforcement pathway.

The deviance proneness pathway describes how adolescents, who are exposed to insufficient caregiving and who developed poor emotion regulation and executive functioning, are more likely to affiliate with deviant peers that encourage the use of psychotropic substances (Sher, 1991).

The stress and negative affect pathway suggests that adolescents with poor emotion regulation and coping skills are more likely to self-medicate when exposed to increased levels of environmental stress. Lastly, the enhanced reinforcement pathway suggests that individuals who experience fewer negative effects and/or more positive effects after using a substance have a higher risk of developing a Substance Use Disorder. Importantly, inherent to all three pathways is the assumption that the use of psychotropic substances is more likely when positive effects are expected (Sher, 1991).

While Sher's model (1991) demonstrates the key aspects of a developmental psychopathology perspective on Substance Use Disorders, Chassin and colleagues (2013) state that this perspective can be further defined by the recognition that

- An interplay between risk and protective factors operates on multiple levels of analysis;
- Various pathways can lead different individuals to the same outcome (i.e., equifinality);
- Not all individuals with the same level of initial risk may develop a certain disorder (i.e., multifinality);
- Early risk exposure may decrease an individual's potential to deal with later risk exposure;
- Risk might generalize over several domains, thereby leading to deeper and broader levels of dysfunction;
- Individuals have an active role in creating and selecting their environments.

Regarding environmental influences, Bronfenbrenner (1979) established an "Ecology of Human Development Theory" that describes an interaction of parameters inherent to the individual with three levels of environments: While interpersonal interactions in specific settings (e.g., family, friends) are defined as microsystems, the mesosystem is defined by the interactions (e.g., competitions for influence) between these microsystems. Lastly, the exosystem includes all larger social systems as well as their values, beliefs and policy (Chassin et al., 2013).

The Psychiatric Perspective

From a psychiatric perspective, Substance Use Disorders can be conceptualized through a cycle of addiction: This cycle describes a progression from impulsivity to compulsivity through three stages that feed into each other and continually increase in intensity (Koob & Le Moal, 1997):

1. Binge/intoxication
2. Withdrawal/negative affect
3. Preoccupation/anticipation

This increase in intensity is associated with allostatic changes in the brain stress and reward systems, as the shift from impulsiveness – defined by an increasing tension or arousal before the act, pleasure or relief experienced while committing the act and the possible experience of guilt, regret, or self-reproach after the act – to compulsiveness – defined by stress and anxiety before the act and the experience of relief while committing the act – implies a shift from positive reinforcement – where the presentation of a stimulus increases the probability of a behaviour – to negative reinforcement – where the removal of an aversive state increases the probability of a behaviour (Koob, 2004).

The inability to suppress behavioural impulses (i.e., impulsivity) is not only considered an important risk factor for the development of Substance Use Disorders but is associated with a large number of disorders – including antisocial and borderline personality disorder – that show a high amount of comorbidity with Substance Use Disorders (Grekin, Sher, & Wood, 2006; Trull, Waudby, & Sher, 2004). Furthermore, the transmission of impulsivity has been implicated in the heritability of Substance Use Disorders by genetic studies (for a review, see Lejuez et al., 2010). Importantly, longitudinal studies found that impulsivity often precedes the development of Substance Use Disorders (Caspi et al., 1998; Littlefield, Sher, & Steinley, 2010; Schuckit, 1998).

The Psychodynamic Perspective

The current psychodynamic perspective on Substance Use Disorders formulated by Khantzian and colleagues (1985, 1990, 1997) focuses on developmental difficulties leading to an increased vulnerability for this form of psychopathology: As a modern self-medication hypothesis, this model includes two critical parameters (disordered self-care and disordered emotions) as well as two contributory parameters (disordered relationships and disordered self-esteem) that lead individuals to use psychotropic substances to cope with a dysregulated affective state.

These dysregulated affective states can range from threatening, painful, overwhelming and unbearable emotions to a painful sense of emptiness, including the inability to access and express feelings or to differentiate them from physical sensations (Koob & Le Moal, 2006).

Consequently, a specific psychotropic substance might be used depending on whether an individual attempts to diminish, control or express certain feelings (e.g., Khantzian, 1997): For example, while opioids might be used to reduce feelings of rage and violent anger, psychostimulants might be used to counteract anhedonia and alcohol might be preferred by individuals that are otherwise unable to express their feelings. The specific substance can therefore be seen as a “replacement for a defect in the psychological structure” of such individuals (Kohut, 1971). However, the same substance will later – paradoxically – lead to a perpetuation of the dysregulated affective state that it was meant to medicate, thereby ensuring a continued need for self-medication (e.g., Khantzian, 1997).

This psychodynamic perspective – unlike classic psychoanalytic models – does not emphasize the regressive and pleasurable aspects of substance abuse but integrates well with clinical practice and the neurobiology of Substance Use Disorders (Koob & Le Moal, 2006). However, while the growing empirical support for a critical role of dysregulated brain reward and stress systems can be linked with this perspective, the neurobiology of Substance Use Disorders also recognizes the possible influences of the direct effects produced by psychotropic substances on the perpetuation and even the creation of psychological dysfunction (Koob & Le Moal, 2006).

The Role of Attachment

As an increased prevalence of insecure attachment in patients diagnosed with Substance Use Disorders has been consistently reported in the relevant literature (Flores, 2001; Schindler et al., 2005), Substance Use Disorders have consequently been prominently conceptualized as an “Attachment Disorder” (Flores, 2011).

Furthermore, the definition of Substance Use Disorders as “Attachment Disorders” is supported by studies reporting the use of psychotropic substances as a result of disrupted attachment in early childhood (Flores, 2006; Höfler & Kooyman, 1996), to compensate for an alienated sense of self (Khantzian, 2011) and to aid in the regulation of emotions (Flores, 2011).

This association between attachment and the use of psychotropic substances has been reported by studies using interviews (Allen, Hauser, & Borman-Spurrell, 1996; Caspers, Cadoret, Langbehn, Yucuis, & Troutman, 2005; Caspers, Yucuis, Troutman, & Spinks, 2006; Fonagy et al., 1996; Schindler, Thomasius, Petersen, & Sack, 2009) as well as self-report measures (De Rick, Vanheule, & Verhaeghe, 2009; Fowler, Groat, & Ulanday, 2013; Kassel, 2007; Thorberg & Lyvers, 2006, 2010; Vungkhanching, Sher, Jackson, & Parra, 2004; Wedekind et al., 2013) to assess attachment. However, the use of psychotropic substances does not seem to be related to one specific form of insecure attachment (Caspers et al., 2005) as anxious attachment (Fonagy et al., 1996; Fowler et al., 2013) as well as avoidant attachment (Caspers et al., 2006; Schindler et al., 2009) and disorganized attachment (De Palo, Capra, Simonelli, Salcuni, & Di Riso, 2014; Fonagy et al., 1996; Riggs & Jacobvitz, 2002) have been reported in relevant samples. This indicates that the deprivation of developmental needs can result in vulnerabilities that in turn lead to misguided attempts at self-repair, leaving the individual “constantly searching for something ‘out there’ that can be substituted for what is missing ‘in there’” (Flores, 2011, p. 7). This coincides with the psychodynamic point of view that substance abuse “represents a failure to negotiate the transition from helplessness to competence in the social world” (Zellner et al., 2011, p. 2004).

Importantly, the conceptualization of Substance Use Disorders as an “Attachment Disorder” does recognize that Substance Use Disorders are not a one-dimensional phenomenon: While substance abuse is initially used by the individual to deal with difficulties in interpersonal relationships, it consequently gradually increases the impairments in “an already fragile capacity for attachment” (Flores, 2011, p. 2). In line with this, a diminished attachment security as well as several other known risk factors for the development of a Substance Use Disorder (e.g., impairments in behavioural control and cognitive abilities) seem to be premorbid personality characteristics connected to early childhood traumata (Ersche et al., 2012; Laux, 2009; Narvaez et al., 2012).

Transgenerational Effects

Regarding the transgenerational transmission of attachment (Fonagy, Gergely, Jurist, & Target, 2005), the caregiver’s capacity for reflective functioning (Fonagy, Steele, Steele, Moran, & Higgit, 1991; Slade, 2005) has been suggested to be of key importance for the ability to adequately care and protect a child.

An impaired capacity for reflective functioning – that is associated with insecure attachment and seems to be highly prevalent in substance-using women (Porreca, De Palo, Simonelli, & Capra, 2016; Schuman, McMahon, DeCoste, Castiglioni, & Luthar, 2009) – might reduce the caregiver’s ability to recognize a child’s feelings and behaviours in terms of mental states (Pajulo, Schuman, Kalland, & Mayes, 2006), thereby constituting a risk factor for the child’s psychosocial development. In line with this, women diagnosed with a Substance Use Disorder seem to be less capable of performing caregiving tasks that require interpersonal connection and affective attunement but better suited for tasks oriented towards activation and excitement (Hans, Bernstein, & Henson, 1999).

However, transgenerational effects can already be observed in the prenatal stage, as pregnant women who use psychotropic substances (e.g., methadone, cigarettes, marijuana) often have mixed feelings regarding the foetus (e.g., guilt, discomfort) and are less able to form an optimal attachment to the foetus (Magee et al., 2014; Shieh & Kravitz, 2006). In line with this, early maternal withdrawal (combined with a low nonverbal IQ in childhood) seems to predict substance abuse in young adulthood (Pechtel, Woodman, & Lyons-Ruth, 2012).

While prenatal exposure to alcohol as well as prenatal stressful life events have been linked to fearful/disorganized attachment in infants (Bergman, Sarkar, Glover, & O’Connor, 2008; Hay, Payne, & Chadwick, 2004), postnatal secure attachment experiences seem to be able to attenuate these effects (Bergman et al., 2008; Bergman, Sarkar, Glover, & O’Connor, 2010).

Comorbidity

With his longitudinal study, Vaillant (1983) contradicted the earlier view of Substance Use Disorders as resulting from psychological instability, by concluding that “most of psychopathology seen in the alcoholic is the result, not the cause of alcohol abuse. Put differently, alcoholism is the horse, not the cart of mental illness” (p. 317).

However, a more recent extensive review (Center of Substance Abuse Treatment, 1994) of the connection between psychiatric symptoms and substance abuse concludes that there is a great variability in comorbidity, as mental disorders increase the risk for Substance Use Disorders and vice versa. Consequently, substance abuse might cause, mimic or mask other psychiatric symptoms (Center of Substance Abuse Treatment, 1994).

The resulting heterogeneity of patients and problems accompanying Substance Use Disorders makes it very improbable “that a one-treatment-for-all, cookie-cutter approach will work for all patients” (Flores, 2011, p. 24). Consequently, a thorough screening of mental health symptoms should be routine, as even low levels of psychological problems can have a substantial impact on overall functioning. As comorbid disorders not only occur in a primary-secondary relationship but often show various interactions and overlap that may vary over time, retrospective and repeated assessments are often necessary (Kavanagh & Connolly, 2009). While the rates of comorbid disorders for Substance Use Disorders vary slightly across different surveys, they consistently demonstrate that the risk of other psychiatric diagnosis increases significantly with the presence of a Substance Use Disorders (for an overview, see Kavanagh & Connolly, 2009).

Internationally, this high risk of co-occurrence appears in both directions: While between 40% and 50% of individuals with a Substance Use Disorder also have at least one other psychiatric diagnosis (with the strongest associations being present with affective disorders, anxiety disorders and personality disorders), other psychiatric diagnosis also show a high rate of comorbid Substance Use Disorders (e.g., with rates as high as 50% – excluding tobacco dependence – in individuals with schizophrenia) (for an overview, see Kavanagh & Connolly, 2009).

In line with this, stressful early experiences and insecure attachment can be linked to various aspects of psychopathology: According to Bowlby (1980), the development of depression can most likely be traced to the hopelessness and despair felt by the child after the traumatic event of a parent’s death, the experience of the self as a failure resulting from the inability to establish secure and lasting relationships with caregivers as well as the experience of the self as unlovable and others as unloving. In line with Seligman’s theory of learned helplessness (e.g., Seligman, Maier, & Geer, 1968), these circumstances all include a sense of uncontrollability in the child. While there is ample empirical support for the centrality of these circumstances in the development of depression (Stovall-McClough & Dozier, 2016), studies have also demonstrated that subsequent adverse experiences with other caregivers further increase the risk for depression (e.g., Nickerson, Aderka, Bryant, Hinton, & Hofmann, 2013).

The most frequent dual diagnosis in clinical contexts involves the co-occurrence of Substance Use Disorders and personality disorders, especially antisocial personality disorder and borderline personality disorder (Chapman & Cellucci, 2007; James & Taylor, 2007; McGlashan et al., 2000; Shorey, Anderson, & Stuart, 2014).

This dual diagnosis seems to be associated with impairments in all three dimensions of personality organization according to Kernberg (Di Pierro, Preti, Vurro, & Madeddu, 2014).

Apart from a notably unstable sense of self (American Psychiatric Publishing, 1994, 2013), borderline personality disorder is marked by undeveloped and unstable representations of others (including both idealization and devaluation) that often lead to emotional volatility. Abandonment by the idealized other becomes the central fear as the unstable self depends on its validation. Together with the often tumultuous and intense interpersonal relationships, these factors highlight the probable influence of attachment on the aetiology of this personality disorder: Mental representations of inconsistently available and incompetent caregivers as well as of an inconsistently valued self are as central to anxious attachment as to the diagnosis of borderline personality disorder (Agrawal, Gunderson, Holmes, & Lyons-Ruth, 2004). In line with this, the evidence for the relevance of problematic family conditions (e.g., early abuse, prolonged separations, emotional neglect) in the development of this disorder is compelling (for an overview, see Cassidy, 2016).

However, it is important for treatment to distinguish between a Substance Use Disorder leading to character pathology (e.g., through the toxicity of the abused substances), a personality disorder leading to substance abuse and a common factor leading to both Substance Use Disorder and personality disorder. This distinction may only be possible after the individual has been abstinent for some time (Flores, 2011).

Multiple Addictions and Cross-Addiction

Until the capacities for attachment and interpersonal affect regulation are developed, the individual remains vulnerable to cross-addiction (i.e., substituting one addiction for another), especially when their primary addiction is interrupted. Consequently, abstinent individuals with a Substance Use Disorder may for example unconsciously turn to eating disorders, sexual addiction or gambling (Flores, 2011).

All these obsessive-compulsive behaviours are sought out as a distraction from the internal discomfort and emptiness that result from the individual's impaired abilities to form lasting, positive attachments and emotional closeness with others (Flores, 2011).

Only “when the last door on their last addictive behaviour is closed”, do they “instinctually move through a previously unseen and often-painful portal into the true transformational experience that AA calls recovery” (Flores, 2011, p. 5). This reasoning also explains why abstinence has to be a crucial part of recovery.

However, not only the interruption of the primary addiction can lead to the development of new addictive behaviours: There are various dynamics that can lead to the presence of multiple addictions, for example “Masking” (the second addiction excuses or masks the first one), “Numbing” (the second addiction numbs the shame felt about the first one) or “Intensification” (the second addiction intensifies the first one or these addictions intensify each other) (Flores, 2011).

Treatment

While there have been significant advances in the development and validation of psychosocial treatment strategies for Substance Use Disorders in the last decades, the parameters for the success of these approaches have yet to be fully explored. A meta-analytic review by Dutra and colleagues (2008) – including contingency management, relapse prevention, general cognitive behaviour therapy and treatments combining cognitive behaviour therapy and contingency management – found moderate effect sizes for psychosocial treatments, but these effect sizes vary considerably dependent on the Substance Use Disorder and the treatment strategy under study: While individuals with Cannabis Use Disorder appear to profit considerably from psychosocial interventions, individuals with Poly Drug Use Disorder appear to profit the least. Drop-out rates were high (around one third) across all psychosocial interventions but approximately the same percentage of participants achieved posttreatment and/or clinically significant abstinence (Dutra et al., 2008).

While the completion of treatment is closely linked to favourable treatment outcome, it is more likely for a patient to drop-out of treatment than to complete it: According to a systematic review by Brorson and colleagues (2013), the most consistent risk factors for drop-out were cognitive deficits, younger age, personality disorders and low treatment alliance. Conversely, the effects of treatment are dose related: While more and longer treatment usually lead to a better outcome, disruptions in attachment to the program or the clinical staff increase the likelihood of relapse and drop out (Flores, 2004).

Opioid Substitution Treatment

Since the establishment of opioid substitution in the 1960s, this treatment strategy for Opioid Use Disorder went hand-in-hand with psychosocial interventions. Accordingly, international clinical guidelines list psychosocial rehabilitation as crucial in this area (Day & Mitcheson, 2017). However, while several randomized controlled trials and systematic reviews conclude that opioid substitution is just as effective or even more effective when provided on its own, some large outcome studies have concluded that treatment providers with a higher frequency and a higher quality of psychosocial interventions are able to achieve better outcomes (for an overview; see Day & Mitcheson, 2017).

Therefore, future research might focus on identifying which sub-groups might do best with a certain level of opioid substitution, psychosocial intervention or a combination of the both. Furthermore, the included outcome measures for treatment effectiveness might strongly influence the research results. The most commonly used outcome measures for opioid substitution, i.e., treatment retention and abstinence from the primary psychotropic substance (Amato, Minozzi, Davoli, & Vecchi, 2011), might not be able to fully assess the effects psychosocial interventions, especially if these target areas only indirectly related to drug use, e.g., symptoms of depression and anxiety, social skills, or employability (Day & Mitcheson, 2017). Here, additional outcome measures, such as compliance, psychiatric symptoms, or quality of life, should be considered to avoid an underestimation of the effects of psychosocial interventions (Day & Mitcheson, 2017).

Attachment and Treatment

Most specialists for the treatment of Substance Use Disorders (intuitively) recognize the importance of attachment in addiction, independent of whether interpersonal problems are the cause or the consequence of drug use (Flores, 2011). However, before an attachment to treatment (e.g., a therapeutic alliance) can be established, individuals with a Substance Use Disorder must first become detached from the substances they abuse (Flores, 2011).

Attachment influences the therapeutic process in three different areas (Schuengel & van IJzendoorn, 2001):

1. All involved individuals bring their mental representations of current and previous attachment relationships to the treatment.
2. These representations influence expectancies as well as interactions and therefore the extent to which a therapeutic alliance can be established and maintained.

3. Consequently, the outcome of the treatment is likely influenced either in a positive or negative way by attachment.

These influences of course apply to therapeutic processes in general and are not limited to the treatment of Substance Use Disorders alone (Schuengel & van IJzendoorn, 2001).

According to Bowlby (1988), the goal of individual therapy with adults is to provide a “secure base”, so that unconscious painful interpersonal expectancies can be accessed and so that their validity can be tested in current experiences. The linking of present symptomatic emotional expressions (e.g., of anger or fear) to past disruptions in attachment relationships allows the gaining of control over symptoms. However, a revision of internal working models is often hindered by the negative expectancies integrated in these models and their distortion by well-established defensive strategies. These defences (e.g., denial, self-deception, misattribution) lead to inconsistencies and confusions and often make it harder for the internal working models to be revised (Bretherton & Munholland, 2016) and for the therapist to recognize the individual’s attachment related feelings and needs (Kobak et al., 2016).

However, while the revision of no longer useful internal working models can be an arduous task, especially when internalised (superego) representations forbid a reappraisal (Bowlby, 1980), the automated application of internal working models is an advantage in well-adapted individuals (Bretherton & Munholland, 2016). Here, a heightened awareness of the appraisals performed by the internal working models allows an individual to monitor his or her current state, situation and urges (Bretherton & Munholland, 2016).

Importantly, for the treatment approach and recovery, the distinction between impaired attachment as cause or as consequence of substance abuse is irrelevant (Flores, 2011). Furthermore, the consideration of attachment theory in the treatment of Substance Use Disorders highlights the importance of the therapeutic alliance (Flores, 2004): While numerous studies underline that the therapist’s ability to establish such an alliance and to stay connected is invaluable for treatment success, this is not accomplished by clinging to the patient, but rather by empathic understanding as well as a negotiation of give and take (Flores, 2004, 2011).

Contrary to the classic psychodynamic developmental model, attachment-oriented treatment does not equate mental health and maturity with independence (Flores, 2004, 2011). In line with Bowlby (1980), normal development is seen as a movement from immature dependence towards mature interdependence and mutuality (Flores, 2004).

While the experience of mutuality instead of alienation and isolation is a long-term goal in treatment, maintaining a sense of separateness is equally important, so that the polarity between attachment and autonomy can be established (Flores, 2004, 2011).

In line with this, group therapy has been an important component of the treatment for Substance Use Disorders ever since the establishment of Alcoholics Anonymous in the 1930s (Flores, 2004). This can be attributed to the interpersonal conception of group therapy (human beings are always considered as social and as being situated in relation to others) that is more likely to promote attachment than other treatment strategies (Flores, 2004).

As an extension of group therapies, therapeutic communities were established in the 1960s as long-term (several months) residential programs for individuals with Substance Use Disorders (De Leon, 2013). According to their conceptual groundings, the extent of impairments in psychological dysfunction and social deficits is more important than a certain pattern of drug use. Notably, most residents are characterised by educational problems, immaturity and antisocial dimensions (De Leon, 2013). Considering “community as method”, the most important psychological treatment goals are to restructure the negative patterns of behaviour, thinking and feeling using self-help, mutual self-help and social learning. The daily operation of the community is managed by the residents under supervision of a comparatively small staff, with work being both education as well as therapy and peers (De Leon, 2013). A long term stay within this caregiving, abstinence promoting environment should promote alternative emotional experiences and, consequently, stimulate a kind of subsequent maturation of former inadequate attachment patterns (Flores, 2011).

Treatment and Comorbidity

The question of how co-occurring psychiatric disorders influence the participation and outcome of treatment in Substance Use Disorders has not yet been fully answered (Hesse, 2009). Regarding affective disorders, numerous studies indicate that symptoms of depression increase the risk of relapse after treatment (Compton, Cottler, Jacobs, Ben-Abdallah, & Spitznagel, 2003; Curran, Flynn, Kirchner, & Booth, 2000; Curran, Kirchner, Worley, Rookey, & Booth, 2002; Hesse, 2006; Matzger, Kaskutas, & Weisner, 2005; Rounsaville, Kosten, Weissman, & Kleber, 1986), while a few others indicate that symptoms of depression are associated with lower rates of continued use of psychotropic substances during or after treatment (Charney, Paraherakis, Negrete, & Gill, 1998; Rao, Broome, & Simpson, 2004).

Furthermore, there is some indication that individuals with co-occurring depression profit more than others from highly structured treatment settings, while they profit less than others in less structured treatment settings (Carroll et al., 1994; G. Gonzalez, Feingold, Oliveto, Gonsai, & Kosten, 2003; Thornton et al., 2003).

Overall, treating co-occurring affective and personality disorders as diagnoses in their own right generally seems to lead to better outcomes than only treating Substance Use Disorders and an integrated treatment approach can therefore be considered evidence based (Hesse, 2009).

A Neuro-Evolutionary Perspective

“By looking at drug addiction from an evolutionary perspective, we may understand its underlying significance and evaluate its three-fold nature: biology, psychology, and social influences.” (Saah, 2005, p. 1)

As natural psychotropic substances can be traced back to our ancestral environment (R. J. Sullivan & Hagen, 2002), a co-evolution of these plants and the mammalian brains can be assumed (Saah, 2005). However, the effects of psychotropic plants were used by indigenous civilizations to increase fitness (e.g., by offering nutritional value, decreasing fatigue or increasing the tolerance to thermal conditions) and not to allow recreation (i.e., inebriation) (Saah, 2005). As the distribution of these plants was often limited, there was likely no need to develop a salience regulating system in the cortico-mesolimbic dopaminergic system (Lende & Smith, 2002; Nesse & Berridge, 1997) and environmental as well as genetic risk factors for substance abuse were likely of no consequence (Saah, 2005). In line with this, we may not yet have developed the required internal control to adept to a modern environment offering an excessive amount of salience, which increases our vulnerability for the development of Substance Use Disorders (Saah, 2005).

By connecting (neuro)-biology, developmental psychology (e.g., attachment) and social/environmental influences, evolutionary theory may therefore inform the biopsychosocial approach to Substance Use Disorders through adaptationist thinking and through the exploration of the mechanism by which natural selection influenced the determinants underlying Substance Use Disorders (Lende & Smith, 2002). Furthermore, evolutionary principles offer a conceptual common ground that enables the integration of the theories and findings in psychoanalysis, psychology and neuroscience (Polan & Hofer, 2016).

While many attachment theorists have emphasized the regulatory function of social bonding and attachment through the provision of security and the alleviation of distress (i.e., negative affect and arousal) (e.g., Bowlby, 1973; Mikulincer et al., 2003), evolutionary theorists – dating back to Darwin (1872/1998) – have extended this model by arguing that emotional responding in all mammals evolved in a social environment, which makes social and emotional behaviours virtually inextricable (Buss & Kenrick, 1998). In line with this, it has been argued that “significant future advances in attachment theory and research are likely to rest on the successful and complete integration of attachment theory into a modern evolutionary perspective“ (Simpson & Belsky, 2016, p. 111).

Attachment Theory as an Evolutionary Theory

While Darwin already emphasized the impact of selection pressure on human social nature, Bowlby – who was one of Darwin’s biographers and admired his work – build his attachment theory on this foundation and the fundamental principles of evolution (Simpson & Belsky, 2016). However, Darwin’s (1859/2004) original theory – predating the understanding of genes and their inheritance – was understandably incomplete and Bowlby’s attachment theory was also established before several significant theories on evolution (Simpson & Belsky, 2016). Therefore, apart from stating that attachment behaviour evolved through natural selection and enables the infant’s survival in the environment of evolutionary adaptedness – attachment theory has in many aspects not managed to keep up with the developments in evolutionary biology (Simpson & Belsky, 2016).

Furthermore, in its beginnings, attachment theory was based on the erroneous assumption that most rearing environments would favour the development of secure attachment and that this attachment style was therefore “species-typical” (Ainsworth, 1979; Main, 1981). However, it can be argued that different attachment styles represent adequate responses to specific environments and consequently all serve the goal of improving reproductive fitness (Simpson & Belsky, 2016), as the attachment figure is thought to provide important information about the quality and nature of the larger present – and perhaps even future – environment (Belsky, 1997; Chisholm, 1996; Frankenhuis, Gergely, & Watson, 2013). Furthermore, the formation of attachment bonds is critical, as the infant’s survival is totally dependent upon the caregiver – regardless of the quality of the care (Simpson & Belsky, 2016). Therefore, the ability to distinguish the caregiver from strangers within hours after birth (Decasper & Fifer, 1980) as well as the following preference of the familiar, are a matter of survival throughout evolutionary time (Coan, 2016).

Among the hierarchy of evolutionary theories, attachment theory can be attributed to the middle-level theories that also include sexual selection, parental investment, parent-offspring conflict and reciprocal altruism (Trivers, 1971, 1972, 1974). Consequently, it can be allocated below the inclusive fitness theory that includes fitness due to direct (i.e., children) and indirect (e.g., grandchildren, nieces) reproduction (Simpson & Belsky, 2016). Furthermore, life history theory (Charnov, 1993; Kaplan & Gangestad, 2004) integrates and connects the middle-level theories, as it describes how finite resources should be allocated across the lifespan in response to the various problems connected to survival, development and reproduction.

Depending on the individual's circumstances, resources would consequently be directed at somatic effort (i.e., health and strength of the individual's own body), mating effort, reproductive effort or parenting effort (Simpson & Belsky, 2016).

Like all other middle-level theories (Simpson, 1999), attachment theory has a small set of basic components that form the next lower level: While the normative component of attachment theory allows predictions regarding relatively stable and universal patterns of behaviours in response to distress-eliciting situations (Bowlby, 1982), the individual-differences component allows predictions about the origins, the development and the adaptiveness of different attachment styles (Simpson & Belsky, 2016). Although all middle-level theories focus on a specific range of adaptive problems, their implications for social behaviours often overlap and sometimes lead to different predictions for a given outcome (Simpson & Belsky, 2016).

A middle-level evolutionary theory with great importance for attachment theory is parent-offspring conflict theory (Trivers, 1974), as it states that children and their parents diverge in their evolutionary interests (i.e., what is good for the parents is not always good for the child and vice versa). Attachment theory rather tends to idealize and romanticise parent-child relationships instead of fully recognizing these diverging interests (Simpson & Belsky, 2016). For example, parental investment appears to be lower when families are poor, when birth-spacing is too short, when mothers are very young or when fathers question their paternity (Daly & Wilson, 1988; Hrdy, 1999). These conditions and the consequent low parental investment could in turn lead to more insecure attachment styles in the child (Simpson & Belsky, 2016).

In line with this, Belsky and colleagues (1991) propose a five-stage model that links

1. Contextual conditions in and around the family (e.g., financial resources, spousal harmony) to
2. The experiences in early childhood (e.g., behaviour of the attachment figures). These in turn affect
3. Behavioural and psychological development (e.g., attachment style),
4. Somatic development (e.g., time of sexual maturation) as well as later
5. Mating and parenting behaviour.

This model has been supported by numerous studies (for an overview, see Simpson & Belsky, 2016).

In an extension of this model, Chisholm (1996) drew attention to the influence of local mortality rates – a direct indicator for the harshness of an environment and the quality of caregiving – on the speed of human development (e.g., sexual maturation) and reproductive strategies: Therein, parental indifference and insensitivity should serve as a cue for high mortality rates and consequently promote insecure attachment, favouring behaviour that would increase fitness in this environment (Simpson & Belsky, 2016). Interestingly, Chisholm (1996) also differentiated between parental inability and unwillingness to invest in the child: While ability and willingness to invest promote secure attachment, inability can be related to anxious attachment and unwillingness to avoidant attachment (Simpson & Belsky, 2016).

Furthermore, individuals raised in insecurity-inducing environments should prefer immediate rewards even when significantly better ones can be expected later, as waiting for the delayed reward would be considered too risky (e.g., it might prevent the individual from leaving descendants). Chisholm (1999) called this phenomenon “time preference”.

Nature versus Nurture

Following the application of evolutionary bet-hedging theory, Belsky and colleagues (Belsky, 1997; Belsky & Ellis, 2005; Belsky & Pluess, 2009; Ellis, Boyce, Belsky, Bakermans-Kranenburg, & Van IJzendoorn, 2011) theorized that siblings should differ in their susceptibility to the influence of primary caregivers, as this would increase overall adaptiveness if the primary caregiver’s “preparation” efforts are misguided due to the inherent unpredictability of future environmental conditions.

These differences in susceptibility could also explain gaps in intergenerational transmission (Simpson & Belsky, 2016). Interestingly, most twin studies on attachment in children found that monozygotic and dizygotic twins did not differ regarding attachment similarity (Bakermans-Kranenburg, van IJzendoorn, Bokhorst, & Schuengel, 2004; Bokhorst, Bakermans-Kranenburg, Fearon, Fonagy, & Schuengel, 2003; Finkel, Wille, & Matheny, 1998; O’Connor & Croft, 2001; Roisman & Fraley, 2008): As about 50% of the variation in attachment security could be attributed to the shared environment (leading to similarity) and unique influences (leading to dissimilarity), respectively, genetic parameters seemed to have no influence. However, with increasing age genetics seem to gain more influence on several traits (e.g., cognitive development) (Bakermans-Kranenburg & van IJzendoorn, 2016).

Accordingly, a large twin study on adolescents (Fearon, Shmueli-Goetz, Viding, Fonagy, & Plomin, 2014) found similarities in the attachment security of monozygotic twins to be about twice as high as in dizygotic twins which led the researchers to conclude a heritability of about 40 % as well as a negligible influence of the shared environment. However, when interpreting these results, the difficulty of measuring attachment in adolescence – potentially due to the development of independence from the parents which in turn seem to lead to a temporary overrepresentation of dismissing attachment (Bakermans-Kranenburg & van IJzendoorn, 2009) – has to be taken into account (Bakermans-Kranenburg & van IJzendoorn, 2016).

On the level of molecular genetics, only relatively few studies on attachment have been conducted to date: For example, a small study (Lakatos et al., 2000) following the candidate gene approach (i.e., focusing on one gene of interest) reported a strong association between infant disorganized attachment and DRD4 (the dopamine receptor D4 gene) that had previously already been marked as a “risk” genotype for attentional problems, impulsivity and addiction (Bakermans-Kranenburg & van IJzendoorn, 2016). While these findings could not be replicated by later research (for an overview, see Bakermans-Kranenburg & van IJzendoorn, 2016), there is some indication for a link between DRD4 and the infant’s susceptibility to anomalous parental behaviour as well as parental unresolved loss (Van IJzendoorn & Bakermans-Kranenburg, 2006).

In general, the study of the role of genetics in attachment is a relatively recent undertaking (Bakermans-Kranenburg & van IJzendoorn, 2016). However, although attachment theory has a strong focus on environmental (and especially parental) influences, Bowlby (1982) already argued that “just as area is a product of length multiplied by width so every biological character (...) is a product of the interaction of genetic endowment and environment” (p. 38). While it already seems safe to conclude that genes cannot account for the gap in intergenerational transmission of attachment, an interaction effect of genes and environment seems plausible (for an overview, see Bakermans-Kranenburg & van IJzendoorn, 2016): Accordingly, genetic differential susceptibility might make certain infants more vulnerable to development of an insecure attachment style in an unsupportive environment while at the same time allowing them to better profit from a supportive environment. This general openness for parenting influences could consequently also influence the possible effectiveness of attachment-based clinical interventions (Bakermans-Kranenburg & van IJzendoorn, 2016).

In addition to these plastic strategies, temperament might be another (largely underappreciated) influence on attachment development (Fearon & Belsky, 2016). For example, some studies have shown that infants and toddlers defined by a highly negative emotionality are especially susceptible to the influence of rearing on the development of self-control and socioemotional abilities (for an overview, see Belsky, 2005).

Cross-Cultural Aspects of Attachment

As research has already found evidence for the influence of culture on childhood development (Gardner & Kosmitzki, 2002), the dynamics of romantic relationships (Hatfield & Rapson, 1996) as well as the attitudes formed about the self and others (Markus & Kitayama, 1991), it is very likely that an influence of culture on the internal working models of (romantic) adult attachment can also be assumed (Schmitt et al., 2004). For example, the argument by Markus and Kitayama (1991) that the self-evaluation of Japanese individuals would largely depend on whether others collectively value the self consequently led to the notion that East Asian individuals in general might be especially likely to develop anxious (i.e., preoccupied) attachments defined by the need for approval by highly valued others in order to allow self-acceptance (You & Malley-Morrison, 2000).

In detail, parameters of the early (cultural) environment influence reproductive patterns along two pathways: While high levels of stress – generated by inconsistent or insensitive caregivers, economic hardship, or harsh physical environments – likely lead to insecure attachment patterns that can be linked to short-term reproductive strategies (Belsky et al., 1991; Kirkpatrick, 1998; Schmitt, 2003), low levels of stress – generated by capable caregivers in cultures with enough resources – likely lead to secure attachment patterns that can be linked to long-term reproductive strategies (Belsky, 1997). These associations generate the optimal mating strategy for the respective environment, as early and frequent reproduction (associated with short-term strategies) is more beneficial in cultures with scarce resources, while continued investment in a small number of offsprings (associated with long-term strategies) is more beneficial in cultures with ample resources (Chisholm, 1996, 1999).

Some cultural variations in the prevalence of different attachment patterns might also stem from cultural variations in the meaning of showing sensitivity (Rothbaum, Weisz, Pott, Miyake, & Morelli, 2000) and the meaning of different parenting techniques.

While parental acceptance seems to have an universal, positive impact (Khaleque & Rohner, 2002), parental control seems to be viewed as constraining by adolescents in individualistic cultures but as supporting by adolescents in collectivistic cultures (Rohner & Pettengill, 1985; Trommsdorff, 1999).

However, despite these possible cultural influences, a large cross-cultural study by Schmitt and colleagues (2004) supports the universality of an internal working model of the self and others by showing correlations between the model of self and self-esteem as well as correlations between the model of others and agreeableness in numerous cultural regions. This also supports the consideration of an internal working model of the self and others as a fundamental component of human psychology (Bowlby, 1988). Interestingly and in support of its normative nature, secure attachment was the most prevalent style in almost 80% of cultural regions included in the study of Schmitt and colleagues (2004), while anxious attachment was especially prevalent in large parts of Asia in accordance with the above mentioned theory. This pattern closely resembles the cultural differences found in childhood attachment (van IJzendoorn & Sagi, 2008).

Furthermore, the data gathered by Schmitt and colleagues (2004) supports Christholm's theory on reproductive strategies (1996, 1999), as nations with higher rates of insecure attachment also reported higher fertility rates. However, within most cultures, no association was found between attachment patterns and socioeconomic status (Schmitt et al., 2004). In line with this, inter-cultural differences in attachment patterns generally seem to be smaller than intra-cultural differences (van IJzendoorn & Sagi, 2008). Furthermore, cultural differences in attachment patterns should be separated from the effects of poverty (van IJzendoorn & Bakermans-Kranenburg, 2010), as poverty appears to largely mediate the influence of ethnicity on caregiver sensitivity and infant attachment (e.g., Bakermans-Kranenburg, van IJzendoorn, & Kroonenberg, 2004).

Primary and Higher Emotions

According to evolutionary theory, emotions can be seen as indicators of fitness formed by the evolution of chemical signals in the brain (Buss, 2000; Nesse, 1998; Nesse & Berridge, 1997; Panksepp, Knutson, & Burgdorf, 2002). Consequently, emotions are thought to influence behaviour and physiology towards increased Darwinian fitness (Saah, 2005).

However, as negative emotions can be seen as motivators to escape danger (Nesse, 1999), their down-regulation due to a decreased ability to suffer (e.g., to experience pain) may leave the individual unprepared to manage (e.g., through behavioural and/or physiological defences) more detrimental problems than the warning emotion (Saah, 2005).

Connecting evolutionary theory and neuroscience, affective neuroscience focuses on distinct emotional circuits underlying six primary emotions (SEEKING, SADNESS, FEAR, ANGER, CARE and PLAY) that are hypothesized to influence personality and attachment security (Davis & Panksepp, 2011; Zellner et al., 2011). A seventh primary emotion, LUST, is mostly excluded from empirical studies due to measurement difficulties (as frank answers would be doubtful) and the hypothesis that this emotion is of little relevance for human personality (Davis & Panksepp, 2011). Therefore, it is at this point unfortunately impossible to fully determine if and to what extent LUST might contribute to development of higher emotions (e.g., spirituality) and personality parameters.

The subcortical systems underlying these primary emotions enable humans (as well as other mammals) to anticipate various survival concerns and are therefore of great evolutionary importance (Panksepp & Biven, 2012). Panksepp (1998) theorized a continuity of these systems as well as their interaction: At the foundation, activation of the SEEKING system (associated with the ventral tegmental area and dopamine release) underlies exploration, curiosity and expectancy, while its down-regulation – initiated by isolation, loss of love or social rejection – promotes activation in the panic-grief system coinciding with activations of FEAR and ANGER. In contrast, PLAY and LUST work together with activations of SEEKING and promote social joy (Panksepp & Biven, 2012).

Spirituality

Spirituality has been proposed by Davis and Panksepp (2011) to be one of the highest human emotions and furthermore, as an important variable in studies on personality and mental health. In line with this, an evolutionary perspective would suggest that the experience of spirituality is linked to the same neural developments underlying the need to socialize and create communities (Kirkpatrick, 2005).

Regarding the universality of spiritual values, Maslow (1964) stated they “have naturalistic meaning, that they are not the exclusive possession of organized churches, that they do not need supernatural concepts to validate them, that they are well within the jurisdiction of a suitably enlarged science, and that, therefore, they are the general responsibility of all mankind” (p. 33).

In line with this, religious beliefs in a higher power – ranging from spiritual forces to a personal God – play an important role in practically every past or present human culture (Atran & Norenzayan, 2004; Boyer, 2001; Tylor, 1958). However, Maslow (1964) also believed that spiritual experiences are always interpreted in relation to the language and symbols inherent to an individual’s cultural, religious and personal belief system. In line with this, Vaughan (1991) states that “from a psychological perspective, spirituality is a universal experience, not a universal theology. Spirituality may be theistic as in Judaism, Christianity and Islam, non-theistic as in Buddhism, or polytheistic as in Hinduism” (p. 116).

The relationship between believers and a higher power (e.g., God or other divine figures) frequently fulfils the criteria of an attachment bond and can consequently be assumed to enable similar psychological advantages (Kirkpatrick, 2005). For example, proximity to the higher power (that is viewed as omniscient and omnipotent) seems to be established and maintained through prayer, the higher power seems to represent a “safe heaven” in times of distress as well as a “secure base” from which one can explore the world (Kirkpatrick, 2005). Thereby, spirituality – most prominently described as “the search for significance in ways related to the sacred” (Pargament, 1999, p. 4) – and attachment security can be connected in two ways (Kirkpatrick, 2005; Kirkpatrick & Shaver, 1990):

1. Correspondence hypothesis – based on Bowlby’s (1973) notion that internal working models generalize over different attachment relationships – states that this generalization could also extend to the perceived relationship with a higher power. Consequently, securely attached individuals are more likely to perceive a higher power as positive and reliable, enabling them to form an enduring connection (Kirkpatrick, 2005).
2. Compensation hypothesis – based on Ainsworth’s (1985) writings about surrogate attachments in children – suggests that insecurely attached individuals might develop a relationship to a higher power as a surrogate for positive human attachment figures.

These two hypotheses represent two pathways to as well as two ways of being religious (Granqvist & Kirkpatrick, 2016). Furthermore, the compensation hypothesis implies that secure attachment could be learned even after childhood and without the help of another human individual. To accomplish this task higher-order distress regulation strategies are needed (Granqvist & Kirkpatrick, 2016). Accordingly, parental religiousness acts as a moderator between attachment security and religiousness (Granqvist, 1998, 2005; Kirkpatrick & Shaver, 1990).

Especially adolescence – where the importance of early attachment figures gradually decreases through the development of additional attachment bonds with peers as friends or romantic partners – is a period in life marked by uncertainty and turbulence (Mikulincer & Shaver, 2007). Coinciding with “the age of religious awakening” (Argyle & Beit-Hallahmi, 1975), it is also associated with an increased likelihood for religious conversion as well as apostasy (i.e., the loss of faith).

Importantly, fluctuation in spiritual beliefs – that seem to coincide with distressing life events where emotional support is needed (Granqvist & Hagekull, 2003) – seem to be relatively small in securely attached individuals, while insecurely attached individuals are more prone to major fluctuations, including conversions (Granqvist, 2002). In later adulthood, spiritual development seems to be especially prevalent in individuals who managed to overcome personal sorrow and pain by transforming it into a deeper understanding of life (Wink & Dillon, 2002). This seems to be attributable to a heightened reflectiveness that allows for the use of spiritual resources to construct meaning out of stressful experiences (Park, 2005).

As the sense of having a secure attachment bond with a higher power is associated with higher spiritual well-being (Diaz, Horton, & Malloy, 2014), spirituality can be conceptualized as the “ability to experience and integrate meaning and purpose in existence through a connectedness with self, others or a power greater than oneself” (Unterrainer, Ladenhauf, Wallner-Liebmann, & Fink, 2011, p. 117). Based on earlier work (Ellison, 1983), this conceptualization includes both an immanent kind of existential well-being as well as a transcendent kind of religious well-being (Unterrainer, Lewis, & Fink, 2014). While existential well-being is not connected to a specific higher power but rather includes life satisfaction as well as a conviction that life is meaningful, religious well-being is strongly connected to the relationship with a specific higher power (Ledbetter, Smith, Fischer, & Vosler, 1991).

Consequently, a multifactorial expansion of these two dimensions – the Multidimensional Inventory for Religious/Spiritual Well-Being (MI-RSWB; Unterrainer, Huber, Ladenhauf, Wallner-Liebmann, & Liebmann, 2010) – defined three sub-dimensions for each area: “Hope Immanent”, “Forgiveness” and “Experiences of Sense and Meaning” have been proposed to form Existential Well-Being, while “Hope Transcendent”, “General Religiosity” and “Connectedness” for have been proposed to form Religious Well-Being (Unterrainer, Huber, et al., 2010).

Connections to Personality

Regarding connections to personality (most prominently described through the Big Five: Extraversion, Neuroticism, Openness, Conscientiousness and Agreeableness) (e.g., McCrae & Costa, 1997; McCrae & John, 1992), notable connections appear to exist between SEEKING and Openness, PLAY and Extraversion, CARE and Agreeableness as well as ANGER, FEAR, SADNESS and Neuroticism (Davis & Panksepp, 2011). The strong association between Neuroticism and negative primary emotions also underlines the importance of these variables in psychopathology in general as well as affective disorders in particular (Lang, Lütke, & Asendorpf, 2001; McCrae & John, 1992; Panksepp & Biven, 2012). Only Conscientiousness seems not to be connected to any primary emotion (see also Abella, Panksepp, Manga, Bárcena, & Iglesias, 2011; Barrett, Robins, & Janata, 2013). In the context of Darwinian “continuity”, primary emotions therefore seem to underlie the development of personality (Bouchard & Loehlin, 2001; Davis & Panksepp, 2011; Nettle, 2006; Panksepp & Watt, 2011) that is thought to be influenced by gene expressions as well as environmental factors (Goldberg, 1990).

Furthermore, the notion within the field of personality research to view spirituality as a sixth factor added to the classic Big Five personality factors (MacDonald, 2000; Piedmont, 1999; Unterrainer, Ladenhauf, Moazedi, Wallner-Liebmann, & Fink, 2010) draws support from studies finding positive associations between various aspects of spirituality and Agreeableness, Conscientiousness, Openness as well as Extraversion (Saroglou, 2010; Unterrainer, Ladenhauf, et al., 2010; Unterrainer et al., 2014).

While Panksepp and colleagues initially also included a scale of spirituality in the framework of Affective Neuroscience (e.g., Davis & Panksepp, 2011), this scale has been excluded from consequent versions, as it “is secondary to the neurobiologically justified core dimensions of the ANPS” (Barrett et al., 2013, p. 829).

Conversely, the multidimensional concept of Religious/Spiritual Well-Being (Unterrainer, Huber, et al., 2010) includes more facets than the purely emotional form of spirituality. Consequently, it seems to be more strongly connected to the primary emotions and the Big Five personality facets (Hiebler-Ragger et al., 2018) than Panksepp’s conceptualization (e.g., Davis & Panksepp, 2011).

Emotion Regulation

Various forms of Substance Use Disorders – e.g., poly drug use as well as the abuse of alcohol, cannabis, cocaine, opioids, methamphetamine, amphetamine and opiates – have been linked to impairments regarding the cognitive control of emotions (for an overview, see Jarmolowicz et al., 2013). Most prominently, the negative reinforcement model of Substance Use Disorders posits that the reduction or avoidance of negative affective states is the motivational basis for drug abuse (T. B. Baker, Piper, McCarthy, Majeskie, & Fiore, 2004). While these processes of negative reinforcement already seem to be relevant for the initiation of substance use, when individuals try to reduce negative affective states (Eissenberg, 2004), they are further increased as the abstinence from a substance leads to symptoms of psychological and/or physical withdrawal (e.g., anxiety, stress, irritability, depression) that have to be counteracted by continued substance use (T. B. Baker et al., 2004). In line with this, Russel (1976; as cited in Le Moal & Koob, 2007) stated that “the notion of dependence on a drug, object, role, activity or any other stimulus-source requires the crucial feature of negative affect experienced in its absence. The degree of dependence can be equated with the amount of this negative affect, which may range from mild discomfort to extreme distress, or it may be equated with the amount of difficulty or effort required to do without the drug, object, etc.” (p. 385).

In line with this, low distress tolerance – the inability to experience and endure negative emotional states (Simons & Gaher, 2005) – is associated with a higher frequency of substance use in adolescence (Daughters, Reynolds, et al., 2009; MacPherson et al., 2010) and into adulthood (Howell, Leyro, Hogan, Buckner, & Zvolensky, 2010; Marshall et al., 2008; Simons & Gaher, 2005) as well as with early relapse in patients with Substance Use Disorders (Abrantes et al., 2008; Brown et al., 2002, 2009). Furthermore, low distress tolerance can be connected to greater self-reported coping motives for alcohol, marijuana and cocaine use (Howell et al., 2010; Simons & Gaher, 2005; Zvolensky et al., 2009).

However, it is as yet unclear whether the mechanisms of distress tolerance apply to psychological and physical distress in the same way, as most studies on Substance Use Disorders have only focused on psychological distress after acute physiological withdrawal (Magidson, Ali, Listhaus, & Daughters, 2013). Furthermore, barely any research exists on neural and biological parameters of distress tolerance (Magidson et al., 2013):

While there is evidence for a dysregulated stress response of the hypothalamic-pituitary-adrenal axis in Substance Use Disorder (Daughters, Richards, Gorka, & Sinha, 2009; Sinha, 2011), these findings have yet to be linked to distress tolerance. Regarding neural parameters, distress tolerance seems to be associated with reduced functioning in the prefrontal and anterior cingulate cortex as well as a weak connectivity within the cortico-striatal-limbic circuit (Li & Sinha, 2008).

Importantly, deficiencies in emotion processing and regulation are a known “liability spectrum that underlies many different mental disorders” (Kret & Ploeger, 2015, p. 154). However, while the improvement of emotion regulation abilities is of central importance in the treatment of Substance Use Disorders (Larimer, Palmer, & Marlatt, 1999), only few studies to date have examined the role of different emotion regulation strategies and their neural correlates in Substance Use Disorders (Aldao, Nolen-Hoeksema, & Schweitzer, 2010) as well as their connection to attachment and personality structure.

Emotion and Attachment

As already shortly mentioned above, emotions and their regulation have been in the focus of attachment theory since its beginnings. For example, Bowlby (1980) stated that “many of the most intense emotions arise during the formation, the disruption, and the renewal of attachment relationships. The formation of a bond is described as falling in love, maintaining a bond is loving someone, and losing a partner as grieving over someone. Similarly, the threat of loss arouses anxiety and actual loss gives rise to sorrow; whilst each of these situations is likely to arouse anger. The unchallenged maintenance of a bond is experienced as a source of joy” (p. 130). Furthermore, affective states cannot be completely regulated by individuals themselves as “we all are emotional regulators of each other” (Flores, 2004, p. 8). Developing the capacity for healthy interpersonal affect regulation requires the development of a secure attachment style, as individuals with secure attachment are willing and able to acknowledge and communicate their emotions (Fuendeling, 1998). In line with this, the importance of secure attachment for the ability to regulate emotions is apparent (neurobiologically and behaviourally) from infancy on (Thompson, 2016). While early functions of attachment are obvious, as human infants are unable to survive without adequate caregiving, the primary function of adult attachment relationships may be seen in the social regulation of emotions (Mikulincer & Shaver, 2016). In detail, the influence of social (attachment) relationships on the primary perception systems seems to regulate emotional activation (Coan & Sbarra, 2015; E. B. Gross & Proffitt, 2013).

Development of Emotion Regulation

The caregivers' acceptance of the child's emotions as well as their ability and willingness to openly communicate about them, encourages emotional awareness and self-regulation in the child. In line with this, mothers of securely attached children are not only more sensitive to their child's emotions (Waters et al., 2010), they also tend to communicate with their child in a richer and more elaborative manner (Laible & Thompson, 2000; Ontai & Thompson, 2002) and to be more supportive and validating towards the child's point of view while actively coaching emotion regulation (Raikes & Thompson, 2008). Thereby, they encourage the child to develop a better understanding of the psychological mechanisms (including the role of emotions) in human interactions and other everyday experiences (Thompson, Laible, & Ontai, 2003) which allows the child to develop a greater social competence (Thompson, 2016). Conversely, critical, punitive or dismissive behaviours in the caregivers – associated with insecure attachment – lead to poorer emotion regulation abilities in the child (Thompson, 2016).

Furthermore, Kochanska (2002) proposed that the wish to maintain the positive relationship with the attachment figure also contributes to the development of conscience. This notion is supported by studies that found secure attachment to be associated with greater cooperation and compliance (Kochanska, Aksan, & Carlson, 2005; Laible & Thompson, 2000) as well as by studies that link the ability to understand emotions (nurtured by the attachment figures focus on feelings and needs instead of rules) to conscience development (for an overview, see Thompson, 2016).

Emotion and Cognition

The moderating influence of attachment strategies on the link between affect and cognition has been described in detail by Mikulincer, Shaver and Pereg (2003): In the confrontation with negative affect, individuals with a secure attachment style tend to show a mood-incongruent pattern of cognitions, as negative emotional priming seems to lead to fewer negative cognitions than neutral priming. In contrast, individuals with a more anxious attachment style tend to show a mood-congruent pattern, while the cognitions of individuals with a more avoidant attachment style tend not to differ in response to either negative or neutral emotional priming. Furthermore, individuals with a secure attachment style seem less inclined to attribute a negative event to global or stable causes, while individuals with a more anxious attachment style seem overly inclined to do so (Mikulincer et al., 2003).

Although attachment strategies are mostly directed at the regulation of distress, they also seem to influence the link between positive affect and cognition (Mikulincer & Sheffi, 2000): Accordingly, the induction of positive affect only seems to have a positive influence on the creative problem solving abilities in individuals with secure attachment, while individuals with more anxious attachment seem to even be impaired by induced positive affect. This may either be due to previous experiences that were initially positive but turned out negative or due to generalized emotion dysregulation that makes any emotion aversive and unmanageable (Mikulincer et al., 2003). As with negative affect, individuals with more avoidant attachment do not seem to be influenced by induced positive affect (Mikulincer & Sheffi, 2000) which suggests a generalized defensive exclusion of affect related stimuli in these individuals (Mikulincer et al., 2003).

Social Emotion Regulation

The regulation of emotions through social interactions is a key function of the attachment system, as the quality of the attachment bond – and most importantly the attachment figure’s status as a “secure base” – influences emotional functioning and regulation capabilities as well as styles of interpersonal relating from childhood on into adulthood (Beckes & Coan, 2015; Coan, 2016).

These regulatory effects of attachment are either immediate – when the attachment figure influences emotional responding directly (e.g., by hugging a crying child) – or more generalized – when mental representations of the attachment figure are used (Coan, 2011). These mental representations manifest through immediate experiences either as internal working models (that rely on semantic and procedural memory) or as explicitly recalled situations (declarative memory) (Coan, 2016). Consequently, attachment as well as familiarity and physical contact influence the magnitude of social regulation effects (S. Cohen, 2004; S. Cohen, Janicki-Deverts, Turner, & Doyle, 2015) that reduce the physiological and psychological impact of everyday stress on several levels (e.g., friends, family) (Coan, 2016). In line with this, the attachment style also seems to be an important moderator in the social regulation of pain (Krahé, Springer, Weinman, & Fotopoulou, 2013).

According to social baseline theory (Coan & Sbarra, 2015) – that relies on the “economy of action” principal, stating that an organism needs to consume more energy than it expends in order to survive and reproduce (Proffitt, 2006) – social interaction is used to regulate affect because of the efficiency and cost-effectiveness of doing so (Coan, 2016):

Through the proximity to and interaction with conspecifics, humans are able to economize their energy expenditure in several areas, e.g., in the raising of children (Burkart, Hrdy, & Van Schaik, 2009). The absence of conspecifics (especially social isolation), on the other hand, increases the estimated cost of interacting with the (threatening) environment (Coan & Sbarra, 2015).

Therefore, social baseline theory might be able to supply information on the mechanisms underlying the dynamics of attachment by describing more abstract and generalized ecological and neural principles (Coan, 2016). For example, social baseline theory describes mechanisms of how the presence of conspecifics decreases the cost of engagement with the environment: Firstly, “risk distribution” – or “safety in numbers” – implies that the effort associated with threat vigilance as well as the actual threat to a single individual decrease when group size increases, so that more energy can be attributed to other purposes (Coan, 2016). On a neural level, this also translates into less energy (metabolic resources) needed for attention and vigilance so that more energy can be attributed to other areas (Dietrich, 2009). Secondly, the distribution of the effort required to perform a certain task among several individuals is referred to as “load sharing”. This mechanism underlines that an attachment figure may enhance the individual’s safety and health through several behaviours (e.g., acquisition of resources, caring) thereby reducing the (metabolic) effort the individual has to provide (Coan, 2016).

The sensitivity of human brains to this mechanism in attachment bonds has been demonstrated in several studies, where securely attached individuals had to invest less in the down-regulation of negative affect and were less responsive to cues of possible harm (Coan, Kastle, Jackson, Schaefer, & Davidson, 2013; Coan, Schaefer, & Davidson, 2006; Robles & Kiecolt-Glaser, 2003). While “risk distribution” depends primarily on the number of individuals involved, “load sharing” (similar to attachment security) is “likely to develop as the brains of individuals in a relationship become familiar with one another, especially in the context of coping with adversity or sharing goals” (Coan, 2016, p. 258). As a consequence, the attachment figure becomes literally (even at a neural level) part of the individual’s strategy for emotional regulation and response (Coan, 2016). In line with this, studies have shown that threats towards friends, but not strangers, are encoded in the brain like threats to the self (Beckes, Coan, & Hasselmo, 2013). This suggests that the subjective feeling of familiarity stems from an incorporation of familiar others into the neural representation of the self and that the self – defined as something the brain does – has some flexibility including the ability to expand or collapse (Coan, 2016).

Neuroscience

While the neurobiological research on Substance Use Disorders addresses several different aspects, the most important goal is to establish an understanding of how neuropharmacological and neuroadaptive processes within specific neurocircuits influence the transition from occasional, recreational drug use to the loss of control over drug-seeking and finally to chronic substance dependence (Koob & Le Moal, 1997).

Several studies using Magnetic Resonance Imaging (MRI) techniques have reported altered brain morphology in various Substance Use Disorders (for an overview, see Yang et al., 2011): Regarding grey matter, impairments have in particular been reported in the frontal lobes, the amygdala and the insula. Regarding white matter, impairments have in particular been reported in the genu and the corpus callosum as well as in prefrontal regions. In general, these impairments seem to be relevant for various cognitive dysfunctions relevant in Substance Use Disorders (e.g., increased impulsivity and impaired executive functions) (for an overview, see Yang et al., 2011). However, there is still some debate as to how and to what extent Substance Use Disorders are connected to impairments in white matter integrity (S. T. E. Baker, Yücel, Fornito, Allen, & Lubman, 2013; Batalla et al., 2013). For example, impairments in self-regulation and executive functions, connected to dysfunctions or pathologies in the frontal lobes, represent a risk factor not only for Substance Use Disorders but several psychiatric disorders (Dawes, Tarter, & Kirisci, 1997). Consequently, it has yet to be determined if neuroimaging can identify which individuals have an increased vulnerability for or resilience against the development of a Substance Use Disorder after recreational use. The identification of such vulnerabilities might be beneficially for prevention and early intervention programs (Yang et al., 2011).

Regarding white matter tracts, a healthy development is necessary for an efficient communication between brain regions, higher order cognitive functioning as well as several complex behaviours (Jacobus et al., 2013). Consequently, substance abuse is likely particularly harmful during adolescence, when white matter is still developing (S. T. E. Baker et al., 2013; Bava et al., 2010; Clark, Chung, Thatcher, Pajtek, & Long, 2012; Lubman, Yucel, & Hall, 2007). While impairments in white matter can be connected to deficits in cognitive ability as well as psychological dysregulations in Substance Use Disorder (Clark et al., 2012), white matter integrity also seems to be connected to the duration of abstinence during treatment (Bell, Foxe, Nierenberg, Hoptman, & Garavan, 2011; Xu et al., 2010).

Motivation and Emotion

According to Damasio (2000), „emotions“ can be defined as consistent and specific patterns of physiological responses in the brain (include the brainstem, hypothalamus, basal forebrain, amygdala, ventromedial prefrontal cortex and cingulate cortex) triggered by a specific stimulus. Conversely, „feelings“ can be seen as the private experience of an emotion, i.e., the mental state arising from certain neural representations (Damasio, 2000).

As one of the most important brain structures associated with emotion (Johansen, Cain, Ostroff, & Ledoux, 2011), the amygdala reacts to both unconditioned and conditioned signs of threat (Coan, 2016) and is highly sensitive to facial social signals (Benuzzi et al., 2007; Rolls, 2007). Furthermore, amygdala activity is crucial for the consolidation of emotionally salient information in the long-term memory. Together with the hippocampus, who is involved in the formation of associations between internal states and environmental stimuli (Brasted, Bussey, Murray, & Wise, 2003), the amygdala consequently enables the identification and consolidation of important interactions with attachment figures as well as emotionally salient situations (Coan, 2016).

Incentive motivation is involved in several attachment processes (e.g., proximity seeking): The intensity of this motivation is based on the magnitude of the reward (e.g., what kind of food is offered) as well as the state of the individual (e.g., how extensive the hunger is) (Coan, 2016). Incentive motivation – including the reinforcement of stimuli, goal-directed behaviour and the experience of pleasure – has been closely linked to the dopamine projection system of the ventral tegmental area and its major terminus, the nucleus accumbens (for an overview, see Coan, 2016). Interestingly, the ventral tegmental area also responds to unconditioned stimuli that naturally and automatically trigger a response and either reinforce (positive stimuli, e.g., sleep or touch) or punish (negative stimuli, e.g., social deprivation or pain) behaviours (Rolls, 2007).

Strongly connected to all these brain structures, the prefrontal cortex also plays an important role in motivation as well as emotion regulation (Coan, 2016; Coan & Allen, 2004; R. D. Ray & Zald, 2012). While “automatic” forms of emotion regulation (e.g., conditioning or extinction learning) seem to be connected to the ventromedial and medial orbital prefrontal cortex (Milad et al., 2005; Quirk & Beer, 2006), “effortful” forms of emotion regulation (e.g., reappraisal), that require cognitive operations such as attention or working memory (Sheppes, Catran, & Meiran, 2009), seem to be connected to lateral – especially dorsolateral – portions of the prefrontal cortex (Coan, 2016).

Therefore, the prefrontal cortex seems to be connected to attachment through the encoding of “automatic” (conditioned through threat related stimuli) responses to the attachment figures as well as the “effortful” modulation of cognitive operations involving the attachment figures (Coan, 2016).

Regarding Substance Use Disorders (as well as other psychiatric diagnosis associated with dysregulated motivational systems), an allostatic model of the brain motivational systems can be used to describe the continuous changes in motivation associated with the vulnerability to relapse (Koob & Le Moal, 2006). Therein, allostasis can be defined as the mechanism of maintaining apparent stability in reward functioning through changes in brain reward mechanisms. However, this chronic deviation may not be observable as long as an individual actively consumes a substance (Koob & Le Moal, 2001). Fuelled by the dysregulations in reward and stress response circuits, this chronic elevation of the thresholds for reward is associated – among others – with decreases in the function of dopamine, serotonin and opioid peptides as well as dysregulation of the corticotropin-releasing factor. As this pathology in neurocircuitry persists long into abstinence, it also forms the motivational background for relapse (Koob & Le Moal, 2006).

Behavioural Systems and Neural Circuits of Attachment

Although numerous neurobiological studies during the past few decades focused on attachment (or related constructs such as caregiving or social bonding) in nonhuman animals, such research in humans is relatively limited (Coan, 2016). Consequently, possible neural circuits underlying attachment and its different styles are as yet relatively unknown (Coan, 2010). During the first two years of life, attachment styles are formed in the context of the extensive neural development (Coan, 2016), where patterned and repetitive activations have a considerable influence on neural organization (Posner & Rothbart, 2007). For example, the immature neonatal amygdala might not be (fully) capable to allow aversive conditioning (R. M. Sullivan, 2003) but only able to distinguish stimuli as familiar or not (Coan, 2016). As the pathway linking the amygdala to the hippocampus as well as various areas of the prefrontal cortex are not yet fully developed in neonatal infants (Herschkowitz, 2000), the influence of prefrontal regions in neonatal learning is likely limited (Coan, 2016). Therefore, the formation of attachment bonds during this sensitive period of learning is likely rapid and unconditional in the infant, while the caregiver can be seen as a surrogate prefrontal cortex guiding the infant’s neural development and consequently her or his emotion regulation throughout life (Gee et al., 2014; Tottenham, 2012).

In detail, as plastic changes in response to early experiences appear to be persistent, the resulting individualized model of the social world likely includes specific strategies for engaging or avoiding social stimuli as well as for regulating emotions. However, new experiences in later development can reinforce or alter this model to a certain extent (Coan, 2016).

In addition, when approaching attachment as a neural construct, one has to keep in mind that the attachment behavioural system is highly unlikely to be related to a singly, dedicated attachment circuit, as this higher-order construct makes use of multiple subsystems (e.g., emotion, memory, perception, motivation) (Coan, 2016). Fortunately, several of these subsystems as well as their neurobiological background have been the target of extensive research (Hane & Fox, 2016; Polan & Hofer, 2016). In light of these multiple subsystems involved in attachment, it may even be suitable to “think of the entire human brain as an attachment system” (Coan, 2016, p. 244).

Importantly, a strict distinction has to be made between behavioural systems, defined as a set of behaviours whose activation by a specific causal antecedent leads to the deactivation of the system (e.g., the attachment behavioural system), and neural circuits, as there are rarely one-to-one relationships (Coan, 2016). Accordingly, different attachment styles can likely be linked to different activation patterns in neural systems underlying emotion and its regulation, social cognition and threat assessment (Vrtička & Vuilleumier, 2012).

Based on a survey of functional Magnetic Resonance Imaging (fMRI) studies on social attachments, Feldman (2017) furthermore describes three interconnected neural systems responsible for the establishment, integration and maintenance of affiliative bonds:

1. The “reward-motivation” system – including striatum, amygdala, ventral tegmental area, orbitofrontal cortex, ventromedial prefrontal cortex and anterior cingulate cortex – employs dopamine and oxytocin pathways and supports several motivational behaviours related to attachment (e.g., social orientation and seeking or maintenance of contact across extended periods).
2. The “embodied simulation/empathy” system – including insula, anterior cingulate cortex, inferior frontal gyrus, inferior parietal lobule and supplementary motor area – underlies automatic interoception and internal representations.

3. Lastly, the “mentalizing” system – including several frontotemporal-parietal structures (e.g., the superior temporal sulcus, the medial prefrontal cortex and the temporal lobe) – supports the interoceptive system through higher-order cognitive processes allowing the individual to take multiple perspectives, including the goals, motives, concerns and values of others (for an overview, see Feldman, 2017).

However, while these findings allow important insights into the neurobiology of attachment, it has yet to be explored whether they can further our understanding of the “neurobiology of reparation” (Feldman, 2017), i.e., what mechanisms allow an individual to overcome disrupted early attachments and whether certain individuals are better prepared to do so.

Attachment and Social Elements

“Social influences on the regulation of affect are sufficiently powerful and unconditioned to suggest that the brain’s first and most effective approach to affect regulation is via social proximity and interaction.” (Coan, 2016, p. 256)

As mentioned above, attachment as well as familiarity and physical contact influence the magnitude of social regulation effects (S. Cohen, 2004; S. Cohen et al., 2015). For example, while even the supportive touch of an unfamiliar person leads to a decrease in threat-related neural activation, a higher current relationship quality as well as higher perceived mutuality (i.e., shared interests, goals and feelings) further increase this effect (Coan et al., 2013, 2006).

Interestingly, the actual presence of the attachment figure is not necessary to achieve regulatory effects, as even viewing images of the attachment figure (Eisenberger et al., 2011; Younger, Aron, Parke, Chatterjee, & Mackey, 2010) or simple reminders of secure attachments (Karremans, Heslenfeld, van Dillen, & Van Lange, 2011) lead to reduced neural activations related to distress. Furthermore, proximity seeking can be motivated either by positive affect and reward or in response to cues of threat or punishment (Depue & Morrone-Strupinsky, 2005). While both motivations might lead to identical behaviour, they likely involve shared as well as distinct neural circuits (Coan, 2016). Depue and Morrone-Strupinsky (2005) even argue, that – by promoting contextual associative memory networks – consummatory pleasure associated with proximity is linked to social bonding as well as the regulatory effects of attachment relationships.

The release of endogenous opioids – often following the activation of oxytocin receptors – seems to be strongly associated with these socio-affective regulatory processes (Coan, 2016).

As proximity seeking in times of distress is a major function of the attachment system, it seems reasonable to hypothesize that the ability to detect threats coevolved with the attachment behavioural system (Bowlby, 1973, 1982). Therefore, the mechanisms of distress alleviation likely influence the formation of attachment bonds (Beckes & Coan, 2015) while – conversely – the attachment system can be viewed as an important part of the brain's overall stress response (Taylor et al., 2000, 2004). While even subliminally presented threatening stimuli seem to activate attachment-related cognitions and to direct attention towards potentially supportive individuals (Beckes, Coan, & Morris, 2013; Beckes, Simpson, & Erickson, 2010), the extent of proximity seeking is dependent on the extent of attachment security (i.e., the individual attachment style) (Coan, 2016).

In line with this, Hofer (2006) formulated a model that links early interactions with caregivers – via the immediate regulatory influence on the neural systems underlying nutritional, thermal and sensomotory functions – to the formation of the internal working models that define the extent of attachment security. Therein, the expression of emotions is first used to acquire the caregiver's support for the regulation of physiological needs and later transformers in the regulation of emotions per se (Hofer, 2006). Accordingly, internal working models represent conditioned and relative stable connections between external cues of threat, internal needs and the proximity/availability of an attachment figure that engage the nucleus accumbens, the amygdala, the hippocampus and parts of the prefrontal cortex (Coan, 2016).

While secure attachment is generally thought to be associated with less reactivity to distress, insecure attachment seems to be connected to increased neural activation throughout the brain under conditions of distress (e.g., pain or threat) (Coan, 2016). In detail, avoidant attachment seems to be associated with increased prefrontal activation, indicating an increased focus on emotion regulation due to either a greater emotional burden or regulatory inefficiency (Vrtička, Bondolfi, Sander, & Vuilleumier, 2012).

As there is some indication that avoidant attachment leads to an overestimation of potential threat, a greater emotional burden seems the more likely explanation. Furthermore, individuals with avoidant attachment seem less able to profit from the presence of others in times of distress but rather tend to perceive them as an additional burden (Coan, 2016).

Anxious attachment, on the other hand, has been linked to increased activation in the amygdala, the hippocampus and especially the dorsal anterior cingulate cortex (Buchheim et al., 2006; DeWall et al., 2012; Gillath, Bunge, Shaver, Wendelken, & Mikulincer, 2005; Vrtička et al., 2012).

Unfortunately, most studies investigating the connections between early experiences, neural development and their impact on emotional functioning in later life only included populations defined by abuse, neglect and low social status (Coan, 2016). The effects of such environments – e.g., increased anxiety, depression, stress reactivity and social deviance – reach well into adulthood (M. Z. Gonzalez, Beckes, Chango, Allen, & Coan, 2014; Teicher, Samson, Polcari, & McGreenery, 2006). Especially social isolation can be linked to numerous psychosocial, physiological and neurodevelopmental problems – including an increased vulnerability to traumatic events (e.g., Barber, Eccles, & Stone, 2001; Cacioppo & Cacioppo, 2014; Kawachi & Berkman, 2001; Norman, Hawkey, Ball, Berntson, & Cacioppo, 2013).

In line with this and as described above, social baseline theory describes how the presence of others reduces the strain on the individual (Coan, 2016). Studies based on this theory – using an fMRI paradigm that combined the threat of electric shock with supportive touch – suggest that individuals in high-quality relationships (marriage or platonic friends) show lower threat-related brain activation than individuals in poor relationships while holding their partners hand. Conversely, all individuals showed the lowest threat-related brain activation in this condition compared to stranger hand-holding or being alone (Coan et al., 2013, 2006).

Among these processes, social affect regulation can be seen as a bottom-up mechanism, while affect regulation without support from others can be seen as a top-down mechanism. These top-down mechanisms include effortful cognitive and attentional emotion regulation strategies, such as suppression or cognitive reappraisal, that rely heavily on the prefrontal cortex (Coan, 2016).

Importantly, different attachment styles might lead to different assumptions regarding the metabolic cost and function of social support in the regulation of affect (Bar-Kalifa & Rafaeli, 2015) as well as the cost-effectiveness of potential attachment figures (Coan, 2010). In addition, they consequently might lead to different strategies regarding the use of neural resources or the dependence on others (Coan, 2016).

Brain Development in Adolescents

While brain development is generally influenced by the social context (Blakemore & Mills, 2014; R. Epstein, 2007), the rapidity of brain development during adolescence leads to an increased susceptibility, including risky decision making and manifesting psychopathology (Blakemore & Mills, 2014; Steinberg, 2010; Wetherill & Tapert, 2013).

Starting in early adolescence, substantial changes in brain structure determine how information is processed, perceived and coded into memory (Blakemore & Mills, 2014; Wetherill & Tapert, 2013). This development primarily concerns executive functions, e.g., information processing, perception, or emotional response (Getov, Kanai, Bahrami, & Rees, 2015; Gilaie-Dotan et al., 2014). Especially the development of the prefrontal cortex – the regulatory control centre for various brain functions including attention control and critical thinking (A. Diamond, 2013; Hofmann, Schmeichel, & Baddeley, 2012) – occurs during adolescence (Blakemore & Mills, 2014; Steinberg, 2010; Wetherill & Tapert, 2013). In particular, the pruning of seldom used connections in the prefrontal cortex facilitate stronger connections to structures relevant for emotion regulation (Broderick & Frank, 2014; Wetherill & Tapert, 2013). However, as the reward system (i.e., the mesocorticolimbic region) develops earlier than the prefrontal cortex (Steinberg, 2010; Wetherill & Tapert, 2013), adolescents are, more than adults, prone to reward-seeking behaviour instead of applying rational thought and emotion regulation (Casey, Jones, & Hare, 2008; Steinberg, 2010). Rewards are consequently overestimated and risky decisions are more exciting (Feldstein Ewing, Tapert, & Molina, 2016; Steinberg, 2010).

This rapid development during adolescence also implies an increased vulnerability for complications in neural and psychological development, especially in combination with stressful and traumatic life events (de Kloet et al., 2006; Perry & Hambrick, 2008; Teague, 2013; Van der Kolk, 2005). This vulnerability underlines that adolescent development is defined by unique neurobiological, cognitive and social needs (Blakemore & Mills, 2014; Feldstein Ewing et al., 2016; Wetherill & Tapert, 2013) that may not correspond to proven approaches for the modification of adult behaviour (Feldstein Ewing et al., 2016; Steinberg, 2010).

However, while risk for psychopathology is especially high during adolescence (Blakemore & Mills, 2014; Fine & Sung, 2014), this period is also defined by an increased potential for neuroplasticity (Steinberg, 2010, 2012).

Original Research

Research Aims

Based on the afore described theoretical models and empirical research, seven studies were conducted. Following a neuro-evolutionary perspective, their aim was to further explore the relevance of attachment and related parameters in Poly Drug Use Disorder and its treatment. In detail, the following areas were investigated:

1. Connections between Attachment, Spirituality and Mood Pathology

Two studies aimed at further exploring the mechanisms linking attachment, spirituality and mood pathology in young adults. As spirituality is considered to be helpful in the treatment of Substance Use Disorders (Davis & Panksepp, 2011), where it may support secure attachment experiences that in turn increase the ability to deal with adversity (Unterrainer, Lewis, Collicutt, & Fink, 2013), it is important to better understand the mechanisms linking parameters of attachment, spirituality and psychopathology.

2. Attachment and Personality Structure in Substance Use Disorders

Two additional studies aimed at exploring parameters of attachment and personality structure in patients at the beginning of treatment for Substance Use Disorders. Given the high rates of drop-outs (e.g., Dutra et al., 2008) and the often-discussed differences between Substance Use Disorders (e.g., Weigl et al., 2015), the results of these studies may help improve treatment adherence and consequently treatment outcomes.

3. Neural Parameters and Attachment in Poly Drug Use Disorders

Given the close connection (neurobiologically and behaviourally) between attachment and emotion regulation (Thompson, 2016), three studies using (f)MRI aimed at further exploring these connections in Poly Drug Use Disorder. In detail, two studies focused on the relevance of potential impairments in white matter integrity, while one study explored neural activation patterns during a novel emotion regulation task. The results may offer new insights into the bio-psycho-social interactions underlying Substance Use Disorders.

As the results of all the described studies have already been published or submitted for publication, this section will only give a short overview regarding the aim, methods, results, methodological considerations and discussion of these studies. Their integrated conclusions and a corresponding outlook will then be part of the last section of this thesis.

1. Connections between Attachment, Spirituality and Mood Pathology

Background

Based on previous research regarding the connection between attachment and mood pathology (Fuller-Iglesias, Webster, & Antonucci, 2015; Unterrainer, Schoeggel, Fink, Neuper, & Kapfhammer, 2012), we examined the influences of spirituality and attachment on mood pathology in young adults: While the first study (Hiebler-Ragger, Falhansl-Scheinecker, Birnhuber, Fink, & Unterrainer, 2016) focused on young adults with a Roman Catholic upbringing and a Western socialization, the second study (Hiebler-Ragger, Kamble, Aberer, & Unterrainer, submitted) examined the cross-cultural validation of our findings by focusing on Indian young adults with a Hindu upbringing.

While insecure attachment was assumed to be connected to higher levels of mood pathology, higher existential as well as religious well-being were assumed to be connected to lower levels of mood pathology. Furthermore, in line with the theory of a correspondence pathway (Granqvist & Kirkpatrick, 2016), we assumed that more secure attachment would be connected to higher existential as well as religious well-being. In line with the theory of a compensation pathway (Granqvist & Kirkpatrick, 2016), however, we additionally assumed that existential as well as religious well-being would be connected to lower levels of mood pathology – even when attachment has been controlled for.

Both attachment and spirituality are theorized to be of cross-cultural importance but to be influenced by culture, religion or personal beliefs: As it is “a universal experience” (Vaughan, 1991, p. 116), spirituality can be found in the theism of Christianity as well as in the polytheism of Hinduism or even the non-theistic Buddhism (Vaughan, 1991).

Furthermore, intra-cultural variability in attachment styles generally seems to be more extensive than inter-cultural variability (e.g., van IJzendoorn & Bakermans-Kranenburg, 2010) with secure attachment being the most prevalent style in almost 80% of cultural regions (Schmitt et al., 2004).

Study 1.1

The results of this study were published in the following article:

Hiebler-Ragger, M., Falhansl-Scheinecker, J., Birnhuber, G., Fink, A., & Unterrainer, H.-F. (2016). Facets of Spirituality Diminish the Positive Relationship between Insecure Attachment and Mood Pathology in Young Adults. *PLoS ONE*, *11*(6), 1–9. <https://doi.org/10.1371/journal.pone.0158069>

Methods

A sample of 481 students and post-graduates (between 18 and 30 years of age) participated in this study. As previous research suggests that religious orientations are associated with different levels of mood pathology (Gearing & Lizardi, 2009; Loewenthal, Cinnirella, Evdoka, & Murphy, 2001), only individuals with a Roman Catholic upbringing (the most common religious orientation in Austria) were included. Ethical approval for this study was granted by the Ethics Committee of the University of Graz, Austria.

The participants completed the *Experience in Close Relationships - Revised* (ECR-RD; Ehrental et al., 2009) (described in more detail above) as well as the following questionnaires:

The *Multidimensional Inventory for Religious/Spiritual Well-being* (MI-RSWB; Unterrainer, Huber, et al., 2010) consists of 48 items forming 6 sub-dimensions (8 items per subscale, rated on a 6-point Likert scale): Hope Immanent, Forgiveness and Experience of Sense and Meaning are part of a total score for Existential Well-Being, while Hope Transcendent, General Religiosity and Connectedness are part of a total score for Religious Well-Being. A total amount of Religious/Spiritual Well-Being can be calculated by summing up Existential Well-Being and Religious Well-Being. Cronbach's alpha was at least at .72 for each sub-dimension and .89 for Religious/Spiritual Well-Being (Unterrainer & Fink, 2013).

The *Brief Symptom Inventory-18* (BSI-18; Franke et al., 2011) is a short version of the well-established Symptom-Checklist SCL-90-R. The amount Somatization, Depression and Anxiety is assessed with 18 items (6 per scale, rated on a 5-point Likert scale) for the preceding seven days. Over all items a Global Severity Index can be generated. Cronbach's alpha was at least at .79 for each sub-dimension and .91 for the Global Severity Index (Franke et al., 2011).

Results

In line with previous studies (Luna, Horton, Newman, & Malloy, 2016), more insecure attachment was connected to lower Religious/Spiritual Well-Being ($r = -.28$ to $-.38$, all $p < .01$), while more mood pathology was connected to more insecure attachment ($r = .24$ to $.43$) and lower Religious/Spiritual Well-Being ($r = -.27$; all $p < .01$).

When attachment and Religious/Spiritual Well-Being were considered together in regression analyses, Anxious Attachment – however, not Avoidant Attachment – positively predicted all dimensions of mood pathology (see Table 1).

Interestingly, Existential Well-Being – however, not Religious Well-Being – was an additional negative predictor for Depression, but not for Anxiety or Somatization, which suggests a mediating influence of Existential Well-Being on the positive connection between insecure attachment and mood pathology (see Table 1).

Table 1. Hierarchical regression analyses predicting mood pathology.

Step and predictor variable	Anxiety			Depression			Somatization			GSI		
	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β
1	.01	.01		.00	.00		.03**	.03**		.02**	.02**	
Sex			-.12			-.03			-.18**			-.12**
2	.11**	.10**		.22**	.22**		.08**	.05**		.20**	.19**	
Sex			-.11			-.01			-.18**			-.11**
AX			.28**			.42**			.18**			.38**
AV			.07			.10			.08			.10
3	.12**	.01		.29**	.07**		.08**	.00		.23**	.03**	
Sex			-.11			-.03			-.19**			-.12**
AX			.25**			.35**			.16**			.33**
AV			.04			.02			.06			.05
EWB			-.11			-.33**			-.06			-.23**
RWB			.03			.10			.01			.06

Notes. ** $p < .01$, Sex: 1 = male, GSI = Global Severity Index (BSI-18), AX = Anxious Attachment (ECR-RD), AV = Avoidant Attachment (ECR-RD), EWB = Existential Well-Being (MI-RSWB), RWB = Religious Well-Being (MI-RSWB).

Adapted from „Facets of Spirituality Diminish the Positive Relationship between Insecure Attachment and Mood Pathology in Young Adults” by Hiebler-Ragger, M., Falhansl-Scheinecker, J., Birhuber, G., Fink, A., & Unterrainer, H.-F., 2016, *PLoS ONE*, 11(6), 1–9. CC BY 4.0. (<http://creativecommons.org/licenses/by/4.0/deed.de>)

Methodological Considerations

While the detailed investigation of religious and existential well-being is a strength of this study, the focus on young adults with Roman Catholic upbringing may limit the generalizability of the results for young adults with different religious backgrounds. Furthermore, some research suggests that past experiences, as opposed to the current attachment style, might be a stronger predictor of religiosity (Granqvist, Ivarsson, Broberg, & Hagekull, 2007).

Lastly, non-ignorable non-response (e.g., the unwillingness of depressed individuals to participate due to their depression) may have led to an overrepresentation of individuals with a low level of mood pathology in this sample. Therefore, further studies in a clinical setting are recommended.

Study 1.2

The results of this study will be published in the following article:

Hiebler-Ragger, M., Kamble, S. V., Aberer, E., & Unterrainer, H.-F. (submitted). The Corrective Function of Existential Well-Being on Mood Pathology in Indian Young Adults with Attachment Deficits: A Cross-Cultural Validation Study.

Methods

Data from 443 students and post-graduates (age between 18 and 30 years) with a Hindu upbringing – the most common religious orientation in India – were analysed in this study. Ethical approval was granted by the Ethics Committee of Karnatak University, Dharwad, India. As in the first study described above, participants completed the *Experience in Close Relationships - Revised* (ECR-RD; Ehrental et al., 2009), the *Multidimensional Inventory for Religious/Spiritual Well-being* (MI-RSWB; Unterrainer, Huber, et al., 2010) and the *Brief Symptom Inventory-18* (BSI-18; Franke et al., 2011).

Results

Compared to young adults with Roman Catholic upbringing in a Western socialization (Hiebler-Ragger, Falhansl-Scheinecker, et al., 2016), Indian participants were slightly younger ($F_{(1,922)} = 30.66, p < .01, \eta^2 = .03$) and predominantly female (67%; $\chi^2 = 175.76, p < .01$). Controlling for these variables, Indian young adults showed higher levels of Avoidant Attachment ($F_{(1,920)} = 145.57, p < .01, \eta^2 = .14$) and mood pathology (GSI: $F_{(1,920)} = 35.10, p < .01, \eta^2 = .04$) as well as Religious Well-Being ($F_{(1,920)} = 352.59, p < .01, \eta^2 = .28$), while no differences were found in Anxious Attachment ($p > .01$) and Existential Well-Being ($p > .01$).

Correlation analyses showed that more insecure attachment was connected to lower Religious/Spiritual Well-Being ($r = -.24$ to $-.37$, all $p < .01$), while more mood pathology was connected to lower Religious/Spiritual Well-Being ($r = -.15$) and more Anxious Attachment ($r = .38$; both $p < .01$) but not to Avoidant Attachment ($p > .05$). In hierarchical regression analyses (see Table 2), Anxious Attachment – however, not Avoidant Attachment – positively predicted all dimensions of mood pathology. Furthermore, Existential Well-Being – however, not Religious Well-Being – was an additional trend-significant negative predictor for Depression and Anxiety.

Table 2. Hierarchical regression analyses predicting mood pathology.

		Anxiety			Depression			Somatization			GSI		
Step and predictor variable		R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β
1		.00	.00		.00	.00		.00	.00		.00	.00	
	Sex			.04			.01			-.01			.02
2		.09**	.09**		.16**	.16**		.08**	.08**		.15**	.15**	
	Sex			.09			.09			.04			.09
	AX			.29**			.41**			.28**			.40**
	AV			-.05			.01			.04			.00
3		.10**	.01		.18**	.02 ⁺		.08**	.00		.16**	.01	
	Sex			.10			.10			.05			.10
	AX			.28**			.39**			.28**			.39**
	AV			-.06			-.02			.03			-.02
	EWB			-.12 ⁺			-.12 ⁺			-.03			-.11 ⁺
	RWB			.07			-.01			.01			.03

Notes. ⁺ $p < .05$, ** $p < .01$, Sex: 1 = male, GSI = Global Severity Index (BSI-18), AX = Anxious Attachment (ECR-RD), AV = Avoidant Attachment (ECR-RD), EWB = Existential Well-Being (MI-RSWB), RWB = Religious Well-Being (MI-RSWB).

From "The Corrective Function of Existential Well-Being on Mood Pathology in Indian Young Adults with Attachment Deficits: A Cross-Cultural Validation Study" by Hiebler-Ragger, M., Kamble, S. V., Aberer, E., & Unterrainer, H. F. (submitted).

Methodological Considerations

While it is beyond the scope of this study to take all possible interconnections between culture, religion and socialization into account, the similarity in results between this study and our previous study on young adults with Roman Catholic upbringing in a Western socialization (Hiebler-Ragger, Falthansl-Scheinecker, et al., 2016) supports the notion of a universal connection between attachment, spirituality and mood pathology.

In line with this, a recent study by McClintock and colleagues (2016) underlines a universal relationship between love, interconnectedness and a decreased risk for psychopathology. Furthermore, with certain current models of happiness and well-being still relating to ancient (Indian) texts (e.g., Gotise & Upadhyay, 2018), future research could also benefit from considering possible cross-cultural similarities and differences in these models. Lastly, as the use of English questionnaires could have had an impact on the results, the establishment of appropriate translations and a consequent replication of this study with these questionnaires should be an aim for future research.

Discussion

In line with previous research (e.g., Luna et al., 2016), both studies (Hiebler-Ragger, Falthansl-Scheinecker, et al., 2016; Hiebler-Ragger, Kamble, et al., submitted) showed secure attachment as to be connected with a higher amount of Religious/Spiritual Well-being, while insecure attachment and lower Religious/Spiritual Well-being were connected with higher levels of mood pathology. This was especially apparent for Depression. Furthermore, when attachment style and Religious/Spiritual Well-being were considered simultaneously, Existential Well-Being served as an additional negative predictor of mood pathology independent of Anxious Attachment. This indicates that Existential Well-Being has a corrective influence on insecure attachment and consequently a positive influence on mental health. Conversely, in both studies, Avoidant Attachment as well as Religious Well-Being appeared to be of less importance regarding mood pathology than Anxious Attachment and Existential Well-Being (Hiebler-Ragger, Falthansl-Scheinecker, et al., 2016; Hiebler-Ragger, Kamble, et al., submitted).

The different connections of Anxious Attachment and Avoidant Attachment to mood pathology might be based on the contrasting coping strategies underlying these attachment dimensions: While hyperactivating strategies likely support the relationship between Anxious Attachment and mood pathology, the deactivating strategies underlying Avoidant Attachment might explain the missing connection between Avoidant Attachment and mood pathology. In detail, the “segregated” mental systems (Bowlby, 1980) associated with deactivating strategies imply an exclusion of upsetting cognitions (e.g., related to personal deficiencies) from consciousness. In line with this, hyperactivating strategies have been shown to mediate the connection between Anxious Attachment and mood pathology, while results for deactivating strategies in this regard are mixed (Malik, Wells, & Wittkowski, 2014) and will need to be explored in more detail in future research.

Importantly, while the relation between lower Religious/Spiritual Well-being and more insecure attachment supports the correspondence pathway, Existential Well-Being seems to supply a certain amount of protection against mood pathology independent of attachment. This is in line with the notion that the relationship to a higher power can (to some extent) compensate an insecure attachment to other individuals (i.e., compensation pathway).

2. Attachment and Personality Structure in Substance Use Disorders

Background

As there is still some debate about whether various forms of Substance Use Disorders differ regarding their association with insecure attachment (e.g., Schindler et al., 2009) and impairments in personality structure (e.g., Khantzian, 1997), we examined these parameters in inpatients with either a Poly Drug Use Disorder or an Alcohol Use Disorder in comparison to a non-drug using control group. In line with research reporting extensive differences between poly- and mono-substance dependent individuals regarding personality (e.g., impulsivity) as well as etiological (e.g., childhood emotional neglect) parameters (Martinotti et al., 2009), we expected the clinical groups to differ in attachment styles as well as parameters of personality structure.

Building on this study (Hiebler-Ragger, Unterrainer, Rinner, & Kapfhammer, 2016), we explored the relevance of attachment for treatment adherence in patients with Substance Use Disorder. To date, studies exploring a possible connection between attachment and treatment adherence (Bennett, Fuertes, Keitel, & Phillips, 2011; Ciechanowski, Katon, Russo, & Walker, 2001) suggest that insecure attachment is associated to less compliance and worse treatment outcome as it may contribute to difficulties in the relationship between patients and caregivers. Concerning the effect of attachment on treatment adherence in patients with Substance Use Disorder, previous research found negative associations between treatment adherence and comorbid psychiatric diagnoses, cognitive deficits and age (Brorson et al., 2013; Oslin, Slaymaker, Blow, Owen, & Colleran, 2005). Importantly, our study (Fuchshuber, Hiebler-Ragger, Ragger, et al., 2018) focused the role of attachment in treatment adherence during the first six weeks of a residential treatment program.

Study 2.1

The results of this study were published in the following article:

Hiebler-Ragger, M., Unterrainer, H.-F., Rinner, A., & Kapfhammer, H.-P. (2016). Insecure Attachment Styles and Increased Borderline Personality Organization in Substance Use Disorders. *Psychopathology, 49*(5), 341–344. <http://doi.org/10.1159/000448177>

Methods

The total sample of 237 participants included 66 inpatients diagnosed for Alcohol Use Disorder (AUD), 57 inpatients diagnosed with Poly Drug Use Disorder (PUD) as well as 114 non-drug using control subjects (CS).

52% of AUD inpatients and 32% of PUD inpatients were diagnosed with a comorbid mental disorder and 50% of AUD as well as 40% of PUD inpatients received psychotropic medication. The study was approved by the ethics committee of the University of Graz, Austria.

In addition to the *Attachment Style Questionnaire* (ASQ; Feeney et al., 1994; German Version: Hexel, 2004) (described in detail above), participants completed the *Borderline Personality Inventory* (BPI) (Leichsenring, 1999). This 53-item questionnaire assesses, with yes/no answers, four dimensions of personality organization (Identity Diffusion, Primitive Defences, Impaired Reality Testing and Fear of Fusion) as well as the total amount of borderline personality pathology.

Results

Compared to CS, inpatients with AUD or PUD showed higher levels in every facet of borderline personality organization (BPI; all $p < .01$) and the attachment facet “Relationships as Secondary” (ASQ; $p < .01$) as well as lower levels in every other facet of attachment (ASQ; all $p < .05$). These differences were especially distinctive in the area “Confidence in Self and Others” ($\eta^2 = .22$) which indicates secure attachment and in the total amount of borderline pathology ($\eta^2 = .30$) respectively. No differences could be observed between AUD and PUD inpatients ($p > .05$). Separate correlation analyses revealed that attachment and personality organization were unrelated in each group ($p > .01$).

Methodological Considerations

Our findings are mainly limited by a rather small sample size, self-reported measures as well as just a single-point of measurement. However, this highly explorative study was conducted in order to gather initial data. Longitudinal research designs are highly desired to learn more about personality development during the treatment for Substance Use Disorder. According to the conceptual groundings of the therapeutic community (De Leon, 2000), a long term stay within a caregiving, drug-free surrounding might facilitate alternative emotional experiences and, consequently, stimulate a kind of subsequent maturation of former inadequate attachment patterns (Flores, 2011).

Study 2.2

The results of this study were published in the following article:

Fuchshuber, J., **Hiebler-Ragger, M.**, Ragger, K., Rinner, A., Kapfhammer, H. P., & Unterrainer, H.-F. (2018). Increased Attachment Security is Related to Early Therapy Drop-Out in Substance Use Disorders. *BMC Research Notes*, 11(1), 141. <http://doi.org/10.1186/s13104-018-3251-7>

Methods

A total sample of 122 inpatients (34 female), diagnosed with Alcohol Use Disorder (AUD; $n = 66$) or Poly Drug Use Disorder (PUD; $n = 57$), were tested at treatment entry. After six weeks, the 47 inpatients remaining in treatment were tested for a second time. The study was approved by the ethics committee of the University of Graz, Austria.

At treatment entry and after six weeks (if still in treatment), participants completed the *Attachment Style Questionnaire* (ASQ; Feeney et al., 1994; German Version: Hexel, 2004) (described in detail above).

Results

Using all ASQ subscales, agglomerative cluster analysis on the total sample suggested a two-cluster solution: Cluster I was defined by higher scores in “Confidence in Self and Others” ($\eta^2 = .63$) compared to Cluster II ($p < .01$), while Cluster II was defined by higher scores in “Need for Approval” ($\eta^2 = .11$) and “Relationships as Secondary” ($\eta^2 = .10$) compared to Cluster I (both $p < .01$). Further analyses showed that inpatients in Cluster I were more likely to drop out of treatment during the first six weeks ($p < .001$).

Interestingly, inpatients that had remained in treatment showed less “Confidence in Self and Others” ($p < .05$) after the first six weeks of treatment. No changes were found in the other dimensions (all $p > .05$). In hierarchical regression analyses predicting treatment adherence, with the control variables sex at Step 1 ($B = 0.95$, Nagelkerke $R^2 = .05$, $p < .05$) and psychiatric comorbidity at Step 2 ($B = -1.05$, Nagelkerke $R^2 = .12$, $p < .01$), attachment security (Cluster I vs Cluster II) added approximately 6% of variance at Step 3 ($B = -1.10$, Nagelkerke $R^2 = .18$, $p < .01$).

Methodological considerations

A rather small sample size and the use of a self-report measure for adult attachment styles are the most significant limitations of this study. Furthermore, the focus was only on the short treatment period of the first of six weeks.

Consequently, further research is needed to explore possible long-term treatment effects within a therapeutic community setting. To better understand the role of attachment styles in treatment adherence, future studies might also focus on attachment based therapeutic interventions.

Discussion

While the results of the first study (Hiebler-Ragger, Unterrainer, et al., 2016) confirm that Substance Use Disorders are linked to deficient attachment (Schindler et al., 2009; Unterrainer et al., 2016) and increased borderline pathology (Di Pierro et al., 2014; Unterrainer et al., 2016), they furthermore indicate that impairments in those areas are similar for Alcohol Use Disorders and Poly Drug Use Disorders. However, although psychodynamic theory closely links early attachment experiences to personality structure (Bowlby, 1977), no distinctive link between impairments in those areas could be observed. Interestingly, inpatients with a Substance Use Disorder showed lower levels in several facets of attachment deficiencies (e.g., Need for Approval) than healthy controls (Hexel, 2004). However, we argue that lower and higher than average levels in these areas could be considered problematic as they might indicate rigid patterns in interpersonal experiences. Correspondingly, from a psychodynamic perspective one of the major therapeutic aims is described as “greater flexibility in interpersonal relationships and an enhanced capacity to meet interpersonal needs” (Shedler, 2010 p. 99). The increased borderline pathology we detected in inpatients with a Substance Use Disorder (Hiebler-Ragger, Unterrainer, et al., 2016) suggests that deficiencies in personality organization can be present independent of comorbid personality disorders. In line with research on the dual diagnosis of Substance Use Disorders and personality disorders (Di Pierro et al., 2014), we therefore support a dimensional approach in the study and treatment of personality pathology in with a Substance Use Disorder.

Furthermore, the results of the second study (Fuchshuber, Hiebler-Ragger, Ragger, et al., 2018) indicate that self-reported secure attachment might be linked to lower treatment adherence in patients with Substance Use Disorders. This unexpected finding might be attributed to the influence of self-reflection, with a lower ability for self-reflection resulting in more secure self-appraisal but also to an increased likelihood of treatment drop-out. In line with this, self-report measures of adult attachment – in comparison to attachment interviews – are considered to be more likely influenced by distorted self-images while insufficiently assessing repressed information (Ravitz et al., 2010).

Consequently, self-reported attachment security may be attributed to an idealized self-view defined by primitive defence mechanisms (e.g., splitting or denial) (Fuchshuber, Hiebler-Ragger, Ragger, et al., 2018). Furthermore, our findings potentially reflect a unique attribute of therapeutic communities (De Leon, 2000) that threatens such narcissistically distorted self-appraisals: In patients with this form of self-appraisal, the high amount of group cohesion potentially leads to increased cognitive dissonances that consequently increases the likelihood of treatment drop-out (Chiesa & Fonagy, 2010). The reduction of narcissism in the therapeutic community might also explain the decrease in Confidence in Self and Others after six weeks of treatment (Fuchshuber, Hiebler-Ragger, Ragger, et al., 2018). This is also part of the concept of the therapeutic community, as patients are encouraged to explore their interpersonal deficits (De Leon, 2000). Furthermore, the decrease in Confidence in Self and Others likely also mirrors the decline of an initial euphoria experienced when entering treatment and being sober after severe substance use (Fuchshuber, Hiebler-Ragger, Ragger, et al., 2018).

3. Neural Parameters and Attachment in Poly Drug Use Disorders

Background

As this form of use invalidates the established profile and characterization of the user of a specific, single substance (United Nations Office on Drugs and Crime, 2014), it has been suggested that individuals with a Poly Drug Use Disorder might need different treatment settings than individuals with other Substance Use Disorders (Weigl et al., 2015). Therefore, we dedicated three studies to the exploration of attachment and related parameters in inpatients with Poly Drug Use Disorder. Interestingly, previous studies indicated that a drug substitutes (e.g., Methadone) could artificially alter the attachment status, so that insecure individuals would appear to be secure (Panksepp et al., 2002; Zellner et al., 2011). However, this alteration may not only prevent actual progress in personality and attachment based development, it could also support the maintenance of the Substance Use Disorder (Zellner et al., 2011). Furthermore, maintenance treatment seems to aggravate, not ameliorate, the white matter impairment (Lin et al., 2012).

In the first study (Unterrainer et al., 2016), we therefore aimed to explore whether inpatients with Poly Drug Use Disorder, that were either abstinent or in maintenance treatment, differed regarding white matter structure (assessed by means of diffusion tensor imaging) as well cognitive ability, attachment style and personality/mood pathology.

In the second study (Unterrainer, Hiebler-Ragger, Koschutnig, et al., 2017), we interpreted Substance Use Disorders as an existentially threatening disease, defined by a reduced sense of meaning as well as a reduced connectedness to the self, other people and the environment (Nicholson, Higgins, Turner, James, & et al, 1994; Wiklund, 2008). Based on the results of the first study (Unterrainer et al., 2016), we hypothesized that a lower amount of spiritual well-being might correlate with insecure attachment, impaired personality development as well as deficient white matter integrity in inpatients with Poly Drug Use Disorder. Regarding white matter tracts, we focused on the superior corona radiata and the superior longitudinal fasciculus, as deficiencies in these tracts have been linked to Substance Use Disorders in several studies (S. T. E. Baker et al., 2013; Bell et al., 2011; Unterrainer et al., 2016). In addition, we hypothesized that higher amounts of existential fear and despair would be connected to more insecure attachment and decreased spiritual well-being in inpatients with Poly Drug Use Disorder (Unterrainer et al., 2013). Furthermore, following the concept of a severity continuum in Substance Use Disorders (American Psychiatric Publishing, 2013), we differentiated between non-drug using controls, recreational drug-using controls and inpatients with Poly Drug Use Disorder.

In the third study (Hiebler-Ragger, Perchtold, et al., submitted), we examined possible connections between insecure attachment, impaired personality structure and impaired emotion regulation in inpatients with Poly Drug Use Disorder. In detail, we aimed to generate new information regarding impaired emotion regulation abilities in Substance Use Disorders by the exploratory use of an fMRI paradigm focusing on cognitive reappraisal. According to Lazarus and others (e.g., 1993), the cognitive appraisal (concerning significance and meaning) of a situation – and not the situation itself – influences the quality and intensity of an emotional reaction. In line with this, cognitive reappraisal refers to a deliberate re-interpretation in order to modulate emotional impact (Lazarus & Folkman, 1984). This strategy is thought to be very effective (Webb, Miles, & Sheeran, 2012) and to positively influence psychological well-being (J. J. Gross & John, 2003). Based on other studies on cognitive reappraisal in psychiatric settings (Dillon & Pizzagalli, 2013; Johnstone, van Reekum, Urry, Kalin, & Davidson, 2007), we hypothesized that inpatients with Poly Drug Use Disorder would show an attenuated prefrontal activation during cognitive reappraisal.

Study 3.1

The results of this study were published in the following article:

Unterrainer, H.-F., **Hiebler, M.**, Ragger, K., Froehlich, L., Koschutnig, K., Schoeggl, H., ... Fink, A. (2016). White Matter Integrity in Polydrug Users in Relation to Attachment and Personality: A Controlled Diffusion Tensor Imaging Study. *Brain Imaging and Behavior*, 10(4), 1096–1107. <http://doi.org/10.1007/s11682-015-9475-4>

Methods

The sample of 49 right-handed males included inpatients with a Poly Drug Use Disorder (PUD) that were either abstinent (PUDa; $n = 18$) or undergoing maintenance therapy (PUDm; $n = 15$) as well as a control group of healthy students (CG; $n=16$). Opioids were the main drug of choice for both PUDa and PUDm. The study was approved by the local ethics committee of the University of Graz.

Imaging data was acquired on a 3T Siemens Skyra (Siemens Medical Systems, Erlangen, Germany) using a 32-channel head coil. For diffusion weighted images a single-shot echo planar imaging sequence was used. A total acquisition time of 9 minutes 40 seconds was required.

In addition to the *Adult Attachment Scale* (AAS; Collins & Read, 1990; German version: Schmidt et al., 2004) and the *Brief Symptom Inventory* (BSI-18; Franke et al., 2011) (both were described in detail above) participants completed the following questionnaires:

The Big Five personality factors (Extraversion, Agreeableness, Conscientiousness, Neuroticism, Openness to Experience) were assessed with the *Neuroticism Extraversion Openness Five Factor Inventory* (NEO-FFI; Borkenau & Ostendorf, 1993). It consists of 60 items (12 items per factor) that are rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Cronbach's alpha were .85 for Neuroticism, .80 for Extraversion, .71 for Openness to Experience, .71 for Agreeableness and .85 for Conscientiousness (Borkenau & Ostendorf, 1993).

The *16-Item Inventory of Personality Organization* (IPO-16; Zimmermann et al., 2013) was used to assess the amount of impairments in personality structure. It is comprised of 16 items (Identity Diffusion: 6 items, Primitive Defence: 5 items, Reality Testing: 5 items) rated on a 5-point Likert scale ranging from 1 (never) to 5 (always). Cronbach's alpha was .85 for the total mean score (Zimmermann et al., 2013).

Lastly, the *Wonderlic Personnel Test* (WPT) was used as a rough screening instrument for intelligence (Wonderlic, 1999). It is comprised of 50 items with increasing difficulty. The total score is generated from the number of correct responses.

Results

Regarding the personality characteristics, we found substantial differences between PUD and CG: For instance, PUD showed a higher amount of insecure attachment, defined by lower amounts of Closeness ($\eta^2 = .24$) and Dependency ($\eta^2 = .28$), paralleled by a higher amount of Anxiety ($\eta^2 = .26$; all $p < .01$) in relationships. Furthermore, PUD showed a higher total amount of impairments in personality structure ($\eta^2 = .26$; $p < .01$), indicating a higher risk for personality disorders (Zimmermann et al., 2013). Lastly, PUD also reported a higher amount of Neuroticism ($\eta^2 = .25$) as well as a lower amount of Agreeableness ($\eta^2 = .37$; both $p < .01$).

Regarding white matter integrity, group differences in FA and RD were generally more pronounced between CG and PUDa than between CG and PUDm, with both clinical groups showing widespread reductions in FA (see Table 3) and increases in RD (see Table 4) in mainly the same white matter tracts (see Figure 1): Differences to CG were most pronounced in the superior corona radiata and the superior longitudinal fasciculus of the right hemisphere.

Table 3. Clusters with decreased FA in PUDm and PUDa in comparison to CG.

No.	R/L	Region	Voxel	1-p	X (mm)	Y (mm)	Z (mm)
CG > PUDm							
1	R	Superior corona radiata; Superior longitudinal fasciculus; Body of corpus callosum	970	0.961	69	108	114
CG > PUDa							
1	R	Superior corona radiata; Superior longitudinal fasciculus; Anterior corona radiata	959	0.958	62	109	107

Notes. Only Clusters with a size more than 200 voxel are presented. FA = Fractional Anisotropy, PUDa = Abstinent polydrug users, PUDm = Polydrug users in maintenance treatment, CG = Control group, CG > PUDm = Decreased FA in PUDm in comparison to CG, CG > PUDa = Decreased FA in PUDa in comparison to CG, No. = Number, Region = Included regions according to JHU ICBM-DTI-81 White-Matter Labels, R = Right. L = Left, Voxel = Number of voxels per cluster, 1-p = Statistical peak-value for each cluster, X - Y - Z (mm) = Peak-coordinates for each cluster.

Adapted from „White Matter Integrity in Polydrug Users in Relation to Attachment and Personality: A Controlled Diffusion Tensor Imaging Study” by Unterrainer, H.-F., Hiebler, M., Ragger, K., Froehlich, L., Koschutnig, K., Schoeggel, H., ... Fink, A., 2016, *Brain Imaging and Behavior*, 10(4), 1096–1107. Copyright 2016 by Springer Nature. Reprinted with permission.

Table 4. Clusters with increased RD in PUDm and PUDa in comparison to CG.

No.	R/L	Region	Voxel	1-p	X (mm)	Y (mm)	Z (mm)
PUDm > CG							
1	R	Superior longitudinal fasciculus	279	0.953	72	125	110
PUDa > CG							
1	R	Superior corona radiata; Superior longitudinal fasciculus; Posterior limb of internal capsule	1198	0.958	59	137	99

Notes. Only Clusters with a size more than 200 voxel are presented. RD = Radial Diffusivity, PUDa = Abstinent polydrug users, PUDm = Polydrug users in maintenance treatment, CG = Control group, PUDm > CG = Increased RD in PUDm in comparison to CG, PUDa > CG = Increased RD in PUDa in comparison to CG, No.=Number, Region = Included regions according to JHU ICBM-DTI-81 White-Matter Labels, R = Right, L = Left, Voxel = Number of voxels per cluster, 1-p = Statistical peak-value for each cluster, X - Y - Z (mm) = Peak-coordinates for each cluster.

Adapted from „White Matter Integrity in Polydrug Users in Relation to Attachment and Personality: A Controlled Diffusion Tensor Imaging Study” by Unterrainer, H.-F., Hiebler, M., Ragger, K., Froehlich, L., Koschutnig, K., Schoeggl, H., ... Fink, A., 2016, *Brain Imaging and Behavior*, 10(4), 1096–1107. Copyright 2016 by Springer Nature. Reprinted with permission.

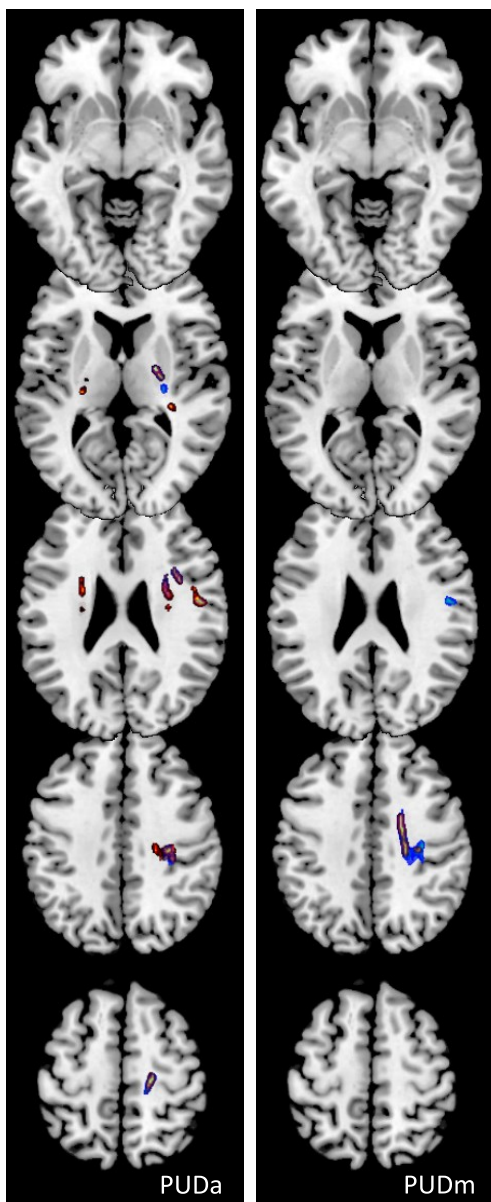


Figure 1. Clusters with reduced FA (red) and increased RD (blue) in PUDa and PUDm compared with CG.

Notes. Differences in white matter integrity between PUDa and CG included parts of the corona radiata, the superior longitudinal fasciculus, the internal and external capsule and the corpus callosum. Differences in white matter integrity between PUDm and CG included parts of the corona radiata, the superior longitudinal fasciculus and the corpus callosum. FA = Fractional Anisotropy, RD = Radial Diffusivity, CG = Control group, PUDa = Abstinent polydrug users, PUDm = Polydrug users in maintenance treatment.

Adapted from „White Matter Integrity in Polydrug Users in Relation to Attachment and Personality: A Controlled Diffusion Tensor Imaging Study” by Unterrainer, H.-F., Hiebler, M., Ragger, K., Froehlich, L., Koschutnig, K., Schoeggl, H., ... Fink, A., 2016, *Brain Imaging and Behavior*, 10(4), 1096–1107. Copyright 2016 by Springer Nature. Reprinted with permission.

Methodological Considerations

As we did not control for medication and further psychiatric comorbidity, this should be considered in future studies with larger samples. While different treatment approaches appear to influence white matter integrity (Bell et al., 2011; Lin et al., 2012), we may not have found the expected differences between the clinical groups as both attended the same therapeutic community program.

Study 3.2

The results of this study were published in the following article:

Unterrainer, H.-F., **Hiebler-Ragger, M.**, Koschutnig, K., Fuchshuber, J., Tscheschner, S., Url, M., ... Fink, A. (2017). Addiction as an Attachment Disorder: White Matter Impairment is linked to Increased Negative Affective States in Poly Drug Use. *Frontiers in Human Neuroscience*, *11*(April), 1–11. <http://doi.org/10.3389/fnhum.2017.00208>

Methods

A sample of 59 right-handed men (18 - 35 years of age) included one clinical and two non-clinical groups: The clinical group included inpatients diagnosed with Poly Drug Use Disorder (PUD; $n = 19$), while the non-clinical control groups included students with recreational drug use (RUC; $n = 20$) as well as non-drug using students (NUC; $n = 20$) who reported either no experience with illegal substances or to have tried them just a few times in their life. The study was approved by the ethics committee of the University of Graz, Austria. Imaging data were attained from a 3T Siemens Skyra (Siemens Medical Systems, Erlangen, Germany) with a 32-channel head coil. The total acquisition time for these two scans was 7 minutes.

In addition to the *Adult Attachment Scale* (AAS; Collins & Read, 1990; German version: Schmidt et al., 2004), the *Multidimensional Inventory for Religious/Spiritual Well-Being* (MI-RSWB; Unterrainer, Huber, et al., 2010) and the *Wonderlic Personnel Test* (WPT; Wonderlic, 1999) (all were described in detail above), the participants completed the *Brief Affective Neuroscience Personality Scale* (BANPS; Barrett et al., 2013). This questionnaire assesses the primary emotions SEEKING, SADNESS, FEAR, ANGER, CARE and PLAY (Panksepp, 1998) with 33 items rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Each subscale of the BANPS showed at least a Cronbach's α of .70 (Barrett et al., 2013).

Results

Regarding behavioural parameters, PUD showed higher levels of attachment related Anxiety than NUC and RUC ($\eta^2 = .21$; $p < .01$) as well as higher levels of negative primary emotions than NUC ($\eta^2 = .14$ to $.15$; all $p < .05$).

No differences were found regarding the other variables. To explore possible connections between the behavioural parameters and white matter integrity, a Regions-of-Interest (ROI) analysis including the superior longitudinal fasciculus (SLF) and the superior corona radiata (SCR) of both hemispheres focused on fractional anisotropy (FA), the most widely used DTI parameter (Smith et al., 2006). Here, PUD showed a lower FA compared to NUC and RUC in the right and left SLF ($\eta^2 = .15$ and $.22$; both $p < .05$) as well as a lower FA compared to NUC in the right and left SCR ($\eta^2 = .14$ and $.26$; both $p < .05$).

Table 5. Correlations of behavioural measures with FA in the selected ROIs for PUD.

Measures	ROI			
	SLF_R	SLF_L	SCR_R	SCR_L
AAS				
Dependence	.13	.14	.58**	.41 ⁺
Closeness	.07	-.14	.22	-.07
Anxiety	-.02	.09	-.39 ⁺	-.08
BANPS				
SEEKING	.04	.19	.13	.26
ANGER	-.09	-.20	.21	.23
SADNESS	-.18	-.01	-.40 ⁺	-.22
FEAR	-.44 ⁺	-.25	-.46*	-.38
CARE	.28	.50*	.30	.23
PLAY	-.25	-.39 ⁺	-.19	-.31
MI-RSWB				
EWB	.44 ⁺	.44 ⁺	.06	.16
RWB	.06	.02	-.15	-.06
RSWB	.27	.24	-.08	.04

Notes. ⁺ $p < .11$, * $p < .05$, ** $p < .01$, ROI = Regions of Interest, FA = Fractional Anisotropy, PUD = Inpatients with Poly Drug Use Disorder, SLF = Superior longitudinal fasciculus, SCR = Superior corona radiata, L = Left, R = Right, AAS = Adult Attachment Scale, BANPS = Brief form of the Neuro-Affective Personality Scale, MI-RSWB = Multidimensional Inventory for Religious and Spiritual Well-Being, EWB = Existential Well-Being, RWB = Religious Well-Being, RSWB = Religious/Spiritual Well-Being.

Adapted from "Addiction as an Attachment Disorder: White Matter Impairment is linked to Increased Negative Affective States in Poly Drug Use. *Frontiers in Human Neuroscience*" by Unterrainer, H.-F., Hiebler-Ragger, M., Koschutnig, K., Fuchshuber, J., Tscheschner, S., Url, M., ... Fink, A., 2017, *Frontiers in Human Neuroscience*, 11(April), 1–11. CC BY 4.0. (<http://creativecommons.org/licenses/by/4.0/deed.de>)

Furthermore, for PUD the correlations between the FA in the ROIs and behavioural measures (see Table 5) were generally medium ($r > .30$) to large ($r > .50$) (Cohen, 1988). This pattern appears to be unique for PUD, as it could not be found in RUC or NUC. However, as these correlations are based on a very small sample, the results can only be seen as highly exploratory.

Methodological Considerations

While no differences in white matter integrity were found between RUC and NUC, these non-clinical groups should be assessed more precisely by validated measures of life time substance use (Czermak et al., 2005). Furthermore, with this small sample size, controlling for socio-anamnestic variables, total brain volume, or data processing methods was not possible. Lastly, our highly explorative findings will need to be confirmed in future research.

Study 3.3

The results of this study will be published in the following article:

Hiebler-Ragger, M., Perchtold, C.M., Unterrainer, H.-F., Fuchshuber, J., Koschutnig, K., Nausner, L., Kapfhammer, H.-P., Papousek, I., Weiss, E. M., & Fink, A. (submitted). Lower Cognitive Reappraisal Capacity is Related to Impairments in Attachment and Personality Structure in Poly-Drug Use: An fMRI Study.

Methods

34 right-handed men, divided in one clinical inpatient group (PUD; $n = 18$) diagnosed with Poly Drug Use Disorder and one group of healthy controls (HC; $n = 16$) who reported no or very little experience with illegal substances, were tested. The study was approved by the ethics committee of the University of Graz, Austria. Cognitive reappraisal capacity was assessed outside the scanner with the Reappraisal Inventiveness Test (RIT; Weber, Loureiro de Assunção, Martin, Westmeyer, & Geisler, 2014) as well as with the similar Reappraisal Generation Task (RGT) during fMRI: In each test, subjects are instructed to empathize with anger-eliciting situations and to consequently generate different reappraisals in order to downregulate anger. For example, subjects are confronted with the following event: “You arrive at your apartment after having been on a long vacation. You had asked a friend of yours to water your plants while you were gone. Now you see that most of your plants have died. You call your friend. She tells you that the distance to your apartment was too long for her to water your plants as agreed.” (Weber et al., 2014, p. 360).

RIT items are rated for Fluency (i.e., number of generated, non-identical reappraisals) and Flexibility (i.e., number of categorically different reappraisals). Furthermore, subjects had to rate their amount of induced anger (7-point scale from 0 “not angry at all” to 6 “extremely angry”). Specifically designed for fMRI, the RGT allows a detailed analysis of reappraisal answers as well as the control for adherence to the reappraisal instructions (i.e., rated effectivity), which is still rare in studies on emotion regulation (Demaree, Robinson, Pu, & Allen, 2006). For effectivity, ratings may range from 1 (“reappraisal not effective at all”) to 4 (“reappraisal highly effective”). Regarding fMRI, imaging was performed on a 3T MRI scanner MAGNETOM Skyra (Siemens Medical Systems, Erlangen, Germany) using a 32-channel head coil. Data analysis was performed using SPM 12 software (v6906; Wellcome Department of Imaging Neuroscience, London, UK), which ran in a MATLAB 2015b environment (Mathworks Inc., Natick MA, USA). Images were corrected for geometric distortions by the use of the FieldMap toolbox (Hutton et al., 2002). All task-related effects are corrected for multiple comparisons at the voxel level by means of the conservative FWE (family wise error) procedure implemented in SPM 12. Thus, activations passing a height threshold of $p < .05$ (for contrasts against implicit baseline and for contrasts between the groups) were considered significant.

In addition to cognitive reappraisal, the following parameters were assessed:

To complement the assessment of emotion regulation, the *Emotion Regulation Questionnaire* (ERQ; J. J. Gross & John, 2003), German version by Abler and Kessler (2009), was used. Its 10 items, 6 for Reappraisal and 4 for Suppression, are rated on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). Abler and Kessler (2009) report Cronbach’s alphas of .74 for Reappraisal and .76 for Suppression.

Personality Structure was assessed with the *OPD Structure Questionnaire* (OPD-SQ; Ehrental et al., 2012). The OPD-SQ assesses the amount of structural disintegration with four dimensions (Kessler, Stasch, & Cierpka, 2013) that each comprise a self-related and an object-related subdomain: (1) Perception; (2) Regulation; (3) Communication; (4) Bonding. These 8 subscales as well as a total score of Structural Disintegration are assessed with 95 items rated on a 5-step Likert scale ranging from 0 (totally disagree) to 4 (totally agree). Cronbach’s alphas for the subscales ranged from .72 to .91 (Ehrental et al., 2012).

Furthermore, participants completed the *Adult Attachment Scale* (AAS; Collins & Read, 1990; German version: Schmidt et al., 2004), the *Brief Symptom Inventory* (BSI-18; Franke et al., 2011) and the *Wonderlic Personnel Test* (WPT; Wonderlic, 1999); (all described in detail above).

Results

Group comparisons revealed several differences with generally large ($\eta^2 > .14$) effect sizes (J. Cohen, 1988) between PUD and HC (see Table 6).

Table 6. Group differences in cognitive reappraisal capacity and other behavioural measures.

Measures	HC		PUD		F _(1,34)	η^2
	M	SD	M	SD		
OPD-SQ						
Self-perception	.67	.43	1.68	.70	24.61**	.44
Object perception	.99	.42	2.03	.48	44.77**	.58
Self-regulation	.92	.48	1.86	.60	25.34**	.44
Regulation of relationships	1.18	.57	2.01	.68	14.78**	.32
Internal communication	.72	.33	1.75	.59	38.05**	.54
External communication	1.28	.50	1.81	.53	9.04**	.22
Attachment to internal objects	1.13	.71	2.07	.67	16.00**	.33
Attachment to external objects	1.47	.60	2.18	.48	14.61**	.31
Structural Disintegration	1.04	.40	1.92	.44	36.37**	.53
AAS						
Closeness	2.98	.89	1.94	.89	10.53**	.25
Dependence	3.53	.53	2.41	.67	28.15**	.47
Anxiety	1.96	.94	2.42	.82	2.32	.07
BSI						
Global Severity Index	9.19	6.16	16.72	10.64	6.17*	.16
ERQ						
Suppression	2.83	.93	3.88	1.84	4.21*	.12
Reappraisal	5.07	1.06	4.24	1.00	5.51*	.15
RIT						
Anger	3.17	.83	3.94	1.07	5.43*	.15
Fluency	4.41	1.02	2.94	1.24	13.94**	.30
Flexibility	4.19	.97	2.86	1.12	13.40**	.30
RGT						
Effectivity	2.52	.32	2.16	.43	7.43*	.19

Notes. * $p < .05$, ** $p < .01$, HC = Healthy controls, PUD = Inpatients with Poly Drug Use Disorder, OPD-SQ = OPD Structure Questionnaire, AAS = Adult Attachment Scale, BSI = Brief Symptom Inventory, ERQ = Emotion Regulation Questionnaire, RIT = Reappraisal Inventiveness Test, RGT = Reappraisal Generation Task.

From „Lower Cognitive Reappraisal Capacity is Related to Impairments in Attachment and Personality Structure in Poly-Drug Use: An fMRI Study” by Hiebler-Ragger, M., Perchtold, C.M., Unterrainer, H.-F., Fuchshuber, J., Koschutnig, K., Kapfhammer, H.P., ... Fink, A. (submitted).

Concerning personality structure, PUD reported higher levels of structural disintegration in all subscales (all $\eta^2 > .30$; $p < .01$). Concerning attachment, PUD reported lower levels of Closeness ($\eta^2 = .25$) and Dependence ($\eta^2 = .47$; both $p < .01$) but not of Anxiety ($p > .05$). Furthermore, PUD reported a higher GSI ($\eta^2 = .16$; $p < .05$). Concerning emotion regulation, PUD reported a less frequent use of Reappraisal ($\eta^2 = .15$) than HC but a more frequent use of Suppression ($\eta^2 = .12$; both $p < .05$). In detail regarding cognitive reappraisal, PUD showed lower Fluency and Flexibility of ideas (both $\eta^2 = .30$; $p < .01$) as well as more induced Anger ($\eta^2 = .15$; $p < .05$) than HC. In line with this, their reappraisals during fMRI were rated as less effective than those of HC ($\eta^2 = .19$; $p < .05$). Regarding the reappraisal-related neural activation, remarkably similar patterns were observed for both PUD and HC (see Figure 2): They included a rather left-lateralized network of inferior, superior and middle frontal gyri, supplemental motor areas as well as pre- and postcentral gyri.

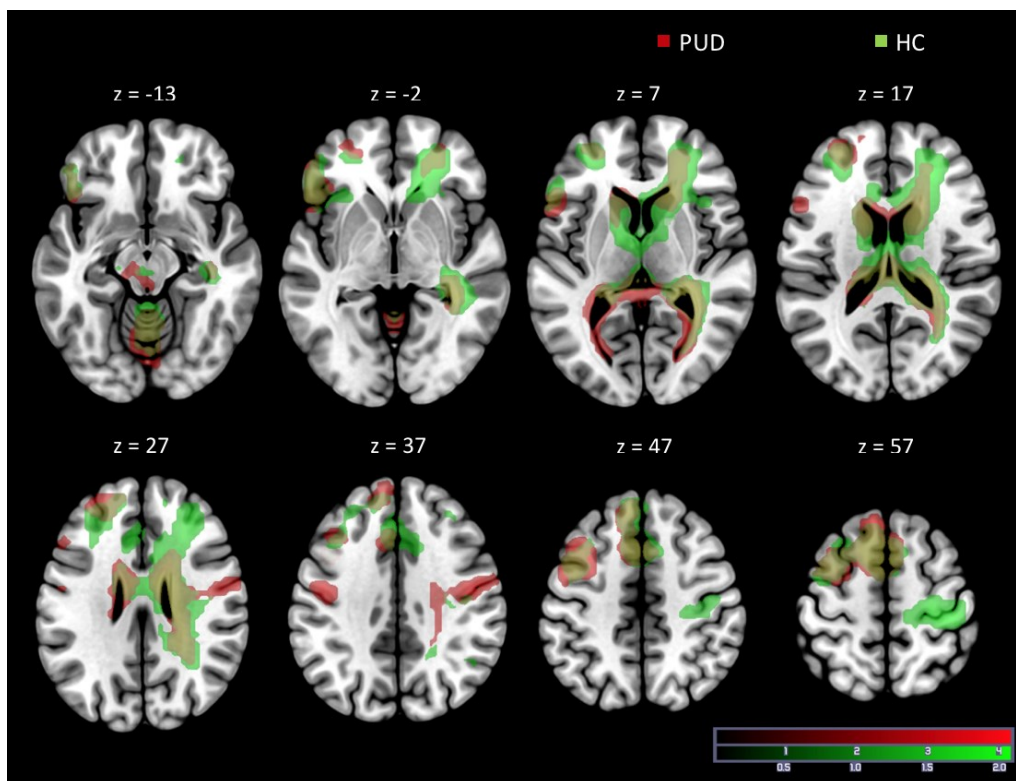


Figure 2. Overlap in brain activation between PUD and HC.

Whole brain analysis (T maps) of brain activation during RGT for PUD and HC relative to implicit baseline (all effects at voxelwise $p < .05$ FWE corrected, $k > 50$). Both PUD (red) and HC (green) showed significant brain activation in a large, rather left-lateralized frontal network including the superior, middle and inferior frontal gyri as well as supplemental motor areas and pre- and postcentral gyri.

(HC = Healthy controls, PUD = Inpatients with Poly Drug Use Disorder, RGT = Reappraisal Generation Task)

From „Lower Cognitive Reappraisal Capacity is Related to Impairments in Attachment and Personality Structure in Poly-Drug Use: An fMRI Study” by Hiebler-Ragger, M., Perchtold, C.M., Unterrainer, H.-F., Fuchshuber, J., Koschutnig, K., Kapfhammer, H.P., ... Fink, A. (submitted).

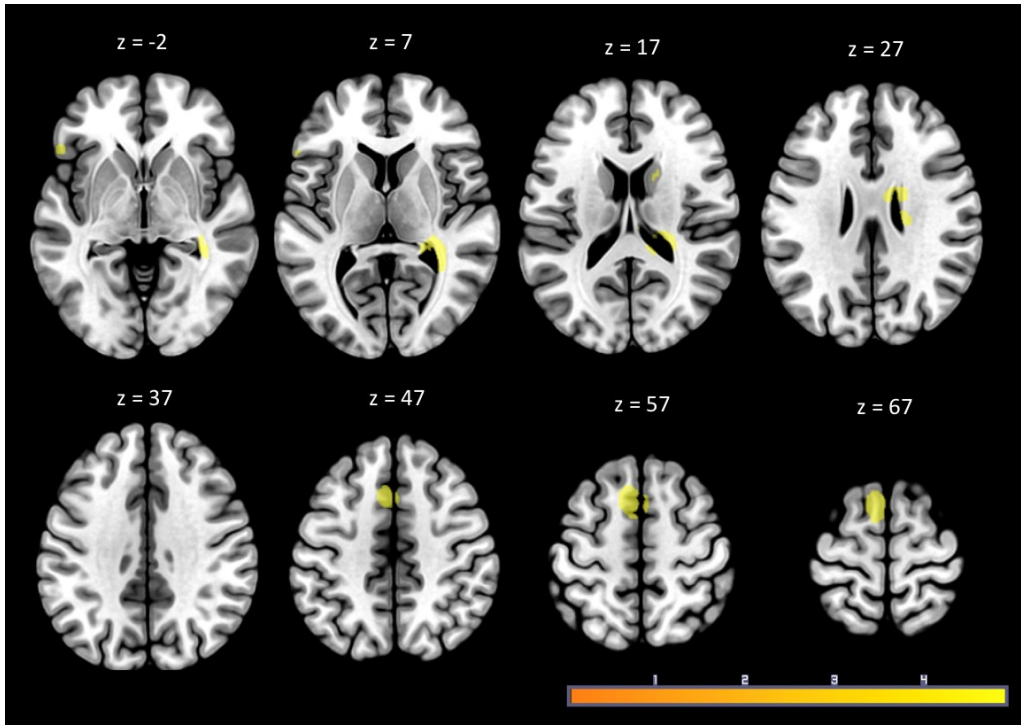


Figure 3. Conjunction analysis of RGT activation in PUD and HC.

Whole brain analysis (T maps) of active voxels in both groups during the RGT by means of conjunction analysis (all effects at voxelwise $p < .05$ FWE corrected, $k > 50$). RGT-activation in both PUD and HC is associated with activation in the right cerebellum, the left superior and inferior frontal gyrus as well as supplemental motor areas and the right middle temporal cortex.

(HC = Healthy controls, PUD = Inpatients with Poly Drug Use Disorder, RGT = Reappraisal Generation Task)

From „Lower Cognitive Reappraisal Capacity is Related to Impairments in Attachment and Personality Structure in Poly-Drug Use: An fMRI Study” by Hiebler-Ragger, M., Perchtold, C.M., Unterrainer, H.-F., Fuchshuber, J., Koschutnig, K., Kapfhammer, H.P., ... Fink, A. (submitted).

Table 7. Overview of significant activation clusters for the conjunction analysis of reappraisal-related brain activation shared by PUD and HC.

Location	MNI peak coordinate	k	t-max
<i>Conjunction PUD and HC</i>			
L sup frontal G, L med frontal G, L/R SMA	-6, 9, 60	223	8.29
R cerebellum	39, -57, -30	208	7.12
R mid temp G, R sup temp G	60, -15, -18	68	6.70
L inf frontal G	-54, 24, 0	54	6.65

Note. Voxelwise $p < .05$ FWE corrected, $k > 50$; Coordinates are reported in MNI space as given by SPM 12 and correspond only approximately to the Talairach and Tournoux (1988) space. Anatomical labels are based on the AAL (automated anatomical labelling) atlas (Tzourio-Mazoyer et al., 2002). Location, MNI peak coordinates, cluster size k and maximum t-value of the significantly activated clusters. The first label represents the location of the peak activation; additional labels denote further brain areas covered to at least 20% by the activation cluster. (HC = Healthy controls, PUD = Inpatients with Poly Drug use Disorder, L = left hemisphere, R = right hemisphere, inf = inferior, mid = middle, med = medial, G = gyrus, SMA = supplemental motor areas)

From „Lower Cognitive Reappraisal Capacity is Related to Impairments in Attachment and Personality Structure in Poly-Drug Use: An fMRI Study” by Hiebler-Ragger, M., Perchtold, C.M., Unterrainer, H.-F., Fuchshuber, J., Koschutnig, K., Kapfhammer, H.P., ... Fink, A. (submitted).

A consequent conjunction analysis on voxels significantly activated in PUD and HC showed in more detail that both groups activated the left inferior and superior frontal gyri, the right cerebellum as well as the right middle temporal cortex (see Figure 3). Table 7 contains the coordinates of regional peak activations for this conjunction analysis. No group differences in neural activation were found.

Methodological Considerations

Although the reappraisal tasks we used in this study have several advantages over other methods to assess reappraisal (e.g., the control for adherence to the instructions), this approach is still a relatively new for clinical research (Papousek et al., 2016). Consequently, future studies will have to explore in more detail what relevance the reappraisal inventiveness concept might have in clinical groups. Furthermore, future research could expand our approach by using EEG instead of, or in addition to fMRI, as EEG would allow a more time-sensitive analysis of the reappraisal process (e.g., Kalisch, 2009).

Lastly, while highlighting the relationship between insecure attachment, impaired personality organization and impaired emotion regulation abilities in inpatients with Poly Drug Use Disorder, we did not include a comparison of different forms of insecure attachment and impaired personality organization, although these different forms likely differ regarding their influence on an individual's chosen modus of dealing with distress (Shaver & Mikulincer, 2007).

Discussion

As it has been suggested that individuals with Poly Drug Use Disorder differ from individuals with other Substance Use Disorders (United Nations Office on Drugs and Crime, 2014) and that they consequently may need different treatment settings (Weigl et al., 2015), we dedicated three studies to the exploration of attachment and related parameters in inpatients with Poly Drug Use Disorder. The results of the first study (Unterrainer et al., 2016) indicate that impairments in white matter structure are present in inpatients with Poly Drug Use Disorder and that these impairments are paralleled by a higher amount of mood and personality pathology. In line with the conceptualization of Substance Use Disorders as "Attachment Disorders" (Flores, 2001) and in accordance with previous work (Schindler et al., 2009), substituted inpatients with Poly Drug Use Disorder seem to show the highest amount of anxious attachment.

Contrary to our assumptions, no significant differences in white matter integrity between abstinent and substituted inpatients with Poly Drug Use Disorder were found. However, differences in white matter parameters were more pronounced between abstinent inpatients with Poly Drug Use Disorder and healthy controls than between substituted inpatients with Poly Drug Use Disorder and healthy controls (Unterrainer et al., 2016). This may indicate that white matter integrity deteriorates more under abstinence, as the brain struggles to regain homeostasis (Unterrainer et al., 2016). As impairments in the superior corona radiata and the superior longitudinal fasciculus have also been observed in adolescent substance abusers, they may be partly premorbid or a very early occurrence in Substance Use Disorders (S. T. E. Baker et al., 2013). Furthermore, impairments in the superior corona radiata and the superior longitudinal fasciculus appear to be linked with impaired decision making (Bechara, 2005), while impairments in the superior corona radiata also can be linked to higher risk taking in adolescents (Jacobus et al., 2013).

While the second study (Unterrainer, Hiebler-Ragger, Koschutnig, et al., 2017) also supports the presence of white matter impairments and insecure attachment in inpatients with Poly Drug Use Disorder, some additional insights could be gathered, as increased levels of certain primary emotions also seem to be connected to diminished white matter integrity. As in previous research (Moeller et al., 2005; Schindler & Bröning, 2015), inpatients with Poly Drug Use Disorder in this study demonstrated a higher amount of ANGER, FEAR and SADNESS compared to non-using controls (Unterrainer, Hiebler-Ragger, Koschutnig, et al., 2017). However, no differences were found regarding SEEKING, which previously has been theorized to be pathologically abridged in Substance Use Disorders (Alcaro & Panksepp, 2011; Wright & Panksepp, 2012). This may be attributed to the fact that the inpatients with Poly Drug Use Disorder in this study were enrolled in a therapeutic community (Chiesa & Fonagy, 2010; De Leon, 2000) during data acquisition. This treatment approach is theorized to act like a substitution drug, thereby balancing the abridged SEEKING dimension that would otherwise heighten drug craving and the possibility of relapse (Alcaro & Panksepp, 2011; Drummond, 2001). In addition, the high level of SADNESS in inpatients with Poly Drug Use Disorder may underline the close connection between Substance Use Disorders and depression (Zellner et al., 2011). The tentative connections between attachment, primary emotions, religious/spiritual well-being and white matter integrity in inpatients with Poly Drug Use Disorder we found in this study (Unterrainer, Hiebler-Ragger, Koschutnig, et al., 2017), are in line with the notion of including religious/spiritual aspects in addiction treatment.

As stated before, this may allow for more secure attachment experiences and could consequently increase the ability for emotion regulation (De Leon, 2000; Flores, 2011; Unterrainer et al., 2013).

Consequently, the results of the third study (Hiebler-Ragger, Perchtold, et al., submitted) not only underline our previous findings of insecure attachment and impaired personality structure in Substance Use Disorders but also highlight the prevalence of impaired emotion regulation abilities in Poly Drug Use Disorder. Although we did not find the expected differences in neural activation patterns during cognitive reappraisal between inpatients with Poly Drug Use Disorder and healthy controls, the pattern of neural activation assessed for both groups highlights the crucial role of the frontal cortex and therefore of executive functions in this emotion regulation strategy (Rowland et al., 2013; Weber et al., 2014). Considered together with the poorer behavioural results in cognitive reappraisal in inpatients with Poly Drug Use Disorder, the discrepancy between neural and behavioural results may point towards a third parameter connecting these two levels (Hiebler-Ragger, Perchtold, et al., submitted): As our previous two studies (Unterrainer et al., 2016; Unterrainer, Hiebler-Ragger, Koschutnig, et al., 2017) found extensive white matter impairments in inpatients with Poly Drug Use Disorder, efforts in cognitive reappraisal could generate the required activation in grey matter structures in inpatients with Poly Drug Use Disorder, but white matter impairments may prevent an adequate interaction between these grey matter structures which could result in a lower capacity for cognitive reappraisal. In addition, as the contrary strategies underlying different types of insecure attachment—hyperactivating strategies in anxious attachment and deactivating strategies in avoidant attachment (Shaver & Mikulincer, 2005) – appear to be connected to different or contrary patterns of neural activation during emotion regulation (Vrtička et al., 2012), a mixture of these patterns could mask possible difference to healthy controls (Hiebler-Ragger, Perchtold, et al., submitted). Importantly, the various possible mechanisms of cognitive reappraisal in Substance Use Disorders need to be explored in more detail in future studies, as reappraisal may be directed at the meaning or the self-relevance of a potentially emotion-eliciting situation in order to increase or decrease negative or positive emotions (J. J. Gross, 2015). Furthermore, there is some indication that cognitive reappraisal is only adaptive when dealing with uncontrollable stress (where the only option is self-regulation) but not controllable stress (where the situation can be influenced) (Troy, Shallcross, & Mauss, 2013).

Conclusion and Outlook

Following a neuro-evolutionary perspective on the conceptualization of Substance Use Disorders as “Attachment Disorders”, this thesis aimed at generating new insights into the mechanisms linking insecure attachment to psychopathology in general and Substance Use Disorders in particular. While the application of attachment theory always implies a developmental approach, this thesis focused on the basis from which individuals diagnosed with a Substance Use Disorders might progress towards recovery. Importantly, for the treatment of and recovery from Substance Use Disorders, it is irrelevant whether insecure attachment and the connected interpersonal problems are a cause or a consequence of substance abuse (Flores, 2011). Furthermore, the effects of treatment are dose-related: While more and longer treatment usually lead to a better outcome, disruptions in attachment to the program or the clinical staff increase the likelihood of relapse and drop out (Flores, 2004). Consequently, especially the characteristics and treatment requirements connected to Poly Drug Use Disorders need to be addressed in more detail, as this diagnosis is highly common in individuals seeking treatment while simultaneously being associated with poor treatment success (e.g., Weigl et al., 2015).

Several important conclusions regarding Substance Use Disorders – particularly Poly Drug Use Disorder – and their treatment can be drawn from the original research presented in this thesis:

1. Connections between Attachment, Spirituality and Mood Pathology

As spirituality is considered to be a helpful factor in the treatment of Substance Use Disorders (Davis & Panksepp, 2011), two studies on the connections between attachment, spirituality and mood pathology were included in this thesis (Hiebler-Ragger, Falthansl-Scheinecker, et al., 2016; Hiebler-Ragger, Kamble, et al., submitted). Furthermore, the question of how co-occurring psychiatric disorders influence the participation and outcome of treatment in Substance Use Disorders has not yet been fully answered (Hesse, 2009). These studies on non-clinical samples of young adults underline the cross-cultural connection between insecure attachment and mental health problems while also highlighting a potentially corrective effect of spirituality – and especially existential well-being – on this connection (Hiebler-Ragger, Falthansl-Scheinecker, et al., 2016; Hiebler-Ragger, Kamble, et al., submitted).

Furthermore, the results not only inform future studies on the importance of spiritual development across the span of adult life (R. E. Ray & McFadden, 2001), they also support the notion that considering parameters of spirituality may be helpful in the treatment of Substance Use Disorders (Davis & Panksepp, 2011), as they may support secure attachment experiences that in turn increase the ability to deal with adversity (Unterrainer et al., 2013).

2. Attachment and Personality Structure in Substance Use Disorders

Contrary to the hypothesis that Poly Drug Use Disorders do not follow established profiles and characterizations of other Substance Use Disorders (e.g., United Nations Office on Drugs and Crime, 2014), the study comparing inpatients with Poly Drug Use Disorder and Alcohol Use Disorder found no group differences in parameters of insecure attachment and borderline personality pathology (Hiebler-Ragger, Unterrainer, et al., 2016). While this suggests that the “drug(s) of choice” cannot always be interpreted as an indicator for the extent of insecure attachment and impairments in personality structure, they might also be attributed to the effects of the treatment setting: In detail, all participants in this study (Hiebler-Ragger, Unterrainer, et al., 2016) were enrolled in a therapeutic community (De Leon, 2000) at the time of data acquisition. This long-term residential treatment concept for Substance Use Disorders was established in the 1960s as a self-help alternative to existing treatments and has consequently been adapted for various populations and settings (De Leon, 2013). As the clinical characteristics of admitted individuals often centre around antisocial dimensions and immaturity, the assessment of psychological and social functioning is more important than the assessment of specific drug use patterns (De Leon, 2013). This is in line with the current trend to treat individuals diagnosed with different Substance Use Disorders in the same residential setting (Weigl et al., 2015).

By using “community as method”, residents in the therapeutic community are encouraged to engage in and use the community as a social learning setting for self-change (De Leon, 2013). A long term stay within this surrounding should therefore facilitate and encourage alternative emotional experiences and, consequently, stimulate the generation of more secure attachment patterns (Flores, 2011). Consequently, this developmental process of recovery should include changes in negative patterns of feeling, thinking and behaviour that will lead to changes in personal and social identity (De Leon, 2013).

As participants in several of the described studies were enrolled in a therapeutic community at the time of data acquisition (Fuchshuber, Hiebler-Ragger, Ragger, et al., 2018; Hiebler-Ragger, Unterrainer, et al., 2016; Hiebler-Ragger, Perchtold, et al., submitted; Unterrainer et al., 2016; Unterrainer, Hiebler-Ragger, Koschutnig, et al., 2017), this may have influenced the results in various areas: As described above, the decline in reported attachment security after the initial treatment phase (Fuchshuber, Hiebler-Ragger, Ragger, et al., 2018), the similarities in attachment, personality structure and neural parameters between abstinent inpatients and inpatients in maintenance treatment (Unterrainer et al., 2016) as well as the comparatively normal level of SEEKING in inpatients with a Substance Use Disorder (Unterrainer, Hiebler-Ragger, Koschutnig, et al., 2017), could also – at least partly – be attributable to this treatment approach. This attribution is supported by the often reported effectiveness of the therapeutic community for the treatment of Substance Use Disorders, especially concerning individuals with severe social and psychological problems (for an overview, see De Leon, 2013). However, to date hardly any empirical studies have investigated the role of attachment theory and related parameters (e.g., therapeutic alliance) for the conceptual framework and success of the therapeutic community (e.g., Janeiro, Ribeiro, Faísca, José, & Miguel, 2018). Consequently, further research following a neuro-evolutionary perspective is very much needed to explore these mechanisms.

3. Neural Parameters and Attachment in Poly Drug Use Disorders

The described studies highlight, that insecure attachment and other behavioural impairments in inpatients with Poly Drug Use Disorders are paralleled by extensive impairments in white matter integrity (Unterrainer et al., 2016; Unterrainer, Hiebler-Ragger, Koschutnig, et al., 2017), most notably in tracts connected to facets of emotion regulation (e.g., impaired decision making and higher risk taking behaviour) (Bechara, 2005; Jacobus et al., 2013). Consequently, a potential neuroplasticity during the treatment of Substance Use Disorders in general – and the long-term stay in a therapeutic community in particular – should be explored. Therein, especially the influence of attachment-based interventions on emotion regulation abilities should be considered. While the study exploring neural activation during emotion regulation (Hiebler-Ragger, Perchtold, et al., submitted) focused on cognitive reappraisal, an explicit emotion regulation strategy, the inclusion of implicit, i.e., automatic and largely unconscious, emotion regulation strategies may be of relevance, as they are likely more closely connected to the mental representations of self and others included in attachment and personality structure (Mikulincer & Shaver, 2003).

During the last decades, only a few original research studies have focused on exploring attachment parameters in individuals with Substance Use Disorders (for a systematic review, see Unterrainer, Hiebler-Ragger, Rogen, & Kapfhammer, 2017). Therefore, the original research presented in this thesis generated valuable new insights that may inform future studies on Substance Use Disorders and their treatment.

In detail, the presented results underline the conceptualization of Substance Use Disorders as “Attachment Disorders” as well as the value of following a neuro-evolutionary perspective in this research area. Furthermore, they highlight the importance of considering higher emotions (i.e., spirituality) as well as emotion regulation in the treatment of Substance Use Disorders. Lastly, the results of the above described studies suggest that future research on the treatment for Substance Use Disorder would profit from the assessment of personality structure and related psychodynamic interventions. Therein, Kohut’s (1971) theory that a specific substance can be seen as a “replacement for a defect in the psychological structure”, matches with the widespread impairments in personality structure found in inpatients with Poly Drug Use Disorder (e.g., Hiebler-Ragger, Perchtold, et al., submitted). Furthermore, impairments in personality structure seem to mediate the influence of traumatic experiences in childhood on the amount of addictive behaviours displayed in young adulthood (Fuchshuber, Hiebler-Ragger, Kresse, Kapfhammer, & Unterrainer, 2018).

As the influence of attachment always has to be considered in the context of other risk factors (DeKlyen & Greenberg, 2016), exploring and integrating the clinical characteristics of individuals with different Substance Use Disorders is of vital importance for future research on treatment approaches. In this, attachment theory offers the great advantage of not only informing our understanding of the development of psychopathology but also of the development of mental health and well-being.

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