



Keeping Mind in Mind

Parental Reflective Functioning and Executive
Functioning in Mothers with Substance Use Disorder

Ulrika Håkansson
Doctoral dissertation
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Keeping Mind in Mind
Parental Reflective Functioning
and Executive Functioning in Mothers
with Substance Use Disorder

Ulrika Håkansson
Doctoral thesis submitted
for the degree of PhD

Inland Norway University of Applied Sciences - INN University

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SUMMARY

There is a consensus that having a substance use disorder may adversely affect caregiving capacities. Parental reflective functioning (PRF) and executive functioning (EF) are both important capacities for sensitive parenting as well as often being impaired in SUD mothers. Although there are increasing interest in cognitive components underlying mentalizing capacities, no studies have previously investigated associations between PRF and EF in SUD mothers. Therefore, the first aim of this study (Paper I) was to investigate if PRF was associated with EF. We controlled for mental health status and IQ, factors known to associate with both PRF and EF. Our findings supported an association between PRF and EF, but the significant association was diminished after introducing mental health status as a control variable. However, when the group of mothers were divided in two based on PRF level, mothers with adequate PRF exhibited significantly better working memory, cognitive flexibility and planning capacities compared to mothers with poor PRF, even after controlling for mental health status and intelligence (IQ). In addition, mothers with poor PRF started using substances and developed a dependency significantly earlier than mothers with adequate PRF. These findings elucidate the association between particular EF components and PRF in mothers with SUD.

Compromised EF and PRF are both known to be associated with heightened stress levels. Mothers with SUD exhibit high levels of stress, as well as difficulties in stress-regulation. The second aim of the study (Paper II) was therefore to investigate how EF components (working memory, inhibition and cognitive flexibility) associated with different forms of stress (parental stress, general life stress and psychological distress), and if PRF mediated the association between EF and stress. Results demonstrated that cognitive flexibility significantly contributed to variance in parental stress, while working memory contributed to variance in psychological distress. PRF mediated the relationship between EF and parental stress, while the association between EF and psychological distress was partially mediated by PRF. As far as we know, this study is the first to demonstrate the mediating effect of PRF between EF and experience of stress. The result indicate that a well-functioning PRF and reflection around the experience of stress might heighten access to EF in SUD mothers.

Dysregulated levels of stress in adulthood have been associated with experiences of adversity in childhood. Adaptive childhood experiences, on the other hand, are known to enhance resilience. Mothers with SUD have a heightened likelihood of having experienced different types of adversity during childhood and adolescence, and often report low levels of adaptive childhood experiences. The third aim of this study (Paper III) was therefore to explore how different types of adversity (emotional, physical and sexual abuse and neglect) and adaptive experiences (safety and competence) in different developmental phases (early childhood, latency and adolescence) were associated with

PRF, when we controlled for mental health status and EF. Results showed that only adaptive experiences in early childhood significantly explained variance in PRF. Mental health status also contributed to variance in PRF, indicating that mothers with more adaptive experiences in early childhood had better mental health status in adulthood, which in combination related to higher PRF. Mothers who reported absence of substantial adaptive experiences in early childhood exhibited lower PRF. Amongst the types of adversities, experiences of emotional abuse during childhood and adolescence stood out as contributing to deficits in PRF more than other types of adversities. In addition, EF contributed significantly to variance in PRF. The results indicated that mothers with less experience of emotional abuse had better EF, which in combination related to higher PRF. Moreover, compared to mothers with negative to low PRF, mothers with adequate PRF had more adaptive and less adverse experiences in the different developmental phases assessed. Our results indicate that PRF might have developmental trajectories. The results in this study may give further knowledge about possible intergenerational risk and resilience.

Findings in these studies indicate that development of effective interventions for mothers with SUD should have a dual focus on PRF and EF when targeting stress, dynamic intergenerational risk factors, and sensitive caregiving capacities. The considerable heterogeneity in the group of mothers stresses the importance of individually adjusted interventions in accordance with capacities and vulnerabilities to better target capacities important for sensitive caregiving.

ABBREVIATIONS

ADHD	Attention Deficit Hyperactivity Disorder
CPS	Child Protective Services
D-KEFS	Delis-Kaplan Executive Function System
DSM-V	Diagnostic and Statistical Manual of Mental Disorders - 5 th revision
EF	Executive Functioning
EUROP-ASI	European Addiction Severity Index
GAD	General Anxiety Disorder
HSCL-10	Hopkins Symptom Checklist, 10 items
ICC	Intra-Class Correlation
ICD-10	International Statistical Classification of Diseases and Related Health Problems. Mental and Behavioural Disorders: Diagnostic Criteria for Research
IQ	Intelligence Quotient
MANOVA	Multivariate Analysis of Variance
M.I.N.I.MINI	International Neuropsychiatric Interview Plus version 5.0.0
NAS	Neonatal Abstinence Syndrome
PCA	Principal Component Analysis
PDI-R2	Parental Development Interview
PDI-RF	Parental Development Interview, Reflective Functioning
PRF	Parental Reflective Functioning
PRFQ	Parental Reflective Function Questionnaire
PSI	Parenting Stress Index
PTSD	Post-Traumatic Stress Disorder
RF	Reflective Functioning
SD	Standard Deviation
SPSS	Statistical Package for Social Sciences
SUD	Substance Use Disorder
TAQ	Traumatic Antecedents Questionnaire
ToM	Theory of Mind
WASI	Wechsler Abbreviated Scale of Intelligence

LIST OF PAPERS

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Content

Aknowledgements

Abbreviations

List of papers

1. Introduction	1
1.1 Child Development	1
1.2 Mothers with Substance Use Disorder and Risk for Compromised Parenting Practices	2
1.3 Mentalizing, Parental Reflective Functioning, Parenting and Substance Use Disorder	3
1.4 Executive Functioning, Parenting and Substance Use Disorder	5
1.5 Stress, Parental Reflective Functioning, Executive Functioning, parenting and Substance Use Disorder	7
1.6 Adaptive and Adverse Childhood Experiences in mothers with Substance Use Disorder	8
1.7 Associations between Parental Reflective Functioning and Executive Functioning	10
2. Aims and Objectives	11
2.1 Paper I	11
2.2 Paper II	11
2.3 Paper III	12
3. Material and Methods	13
3.1 Design	13
3.2 Participants	13
3.2.1 Socio-Demographic Background Data.	14
3.2.2 Substance Use.	14
3.2.3 Mental Health.	15
3.3 Procedures	15
3.4 Materials and Measures	16
3.4.1 Socio-Demographic Variables and Use of Psychoactive Substances ..	16
3.4.2 Mental Health Status	17
3.4.3 Parental Reflective Function (PRF)	17
3.4.4 Executive Functions	18
3.4.4.1 Working memory	18
3.4.4.2 Cognitive inhibition	18

3.4.4.3 Cognitive flexibility	18
3.4.4.4 Verbal fluency	18
3.4.4.5 Planning	19
3.4.4.6 General cognitive functioning (IQ)	19
3.4.5 Stress	19
3.4.6 Adaptive and adverse experiences	20
3.5 Statistical Analyses	20
3.5.1 Statistical considerations	21
3.5.1.1 Missing data	21
3.5.1.2 Causality.	21
3.5.1.3 Small sample size and statistical power	21
3.5.1.4 Representativeness of the sample	22
4. Summaries of papers	23
4.1 Paper I: Parental Reflective Functioning and Executive Functioning in Mothers with Substance Use Disorder	23
4.2 Paper II: The association between Executive Functioning and Parental Stress and Psychological Distress is mediated by Parental Reflective Functioning in Mothers with Substance Use Disorder	24
4.3 Paper III. Adverse and Adaptive Childhood Experiences are Associated with Parental Reflective Functioning in Mothers with Substance Use Disorder	25
5. Discussion	27
5.1 Interpretation and Discussion of the Findings	27
5.1.1 The Association between Parental Reflective Functioning and Executive Functioning	27
5.1.2 Q, Parental Reflective Functioning and Executive Functioning	33
5.1.3 Mental Health Status, Parental Reflective Functioning and Executive Functioning	33
5.1.4 Substance Abuse, Parental Reflective Functioning and Executive Functioning	34
5.1.5 Parental Stress, Parental Reflective Functioning and Executive Functioning	36
5.1.6 Adaptive and adverse childhood experiences, PRF and EF	38
5.2 Methodological Considerations	42
5.2.1 Advantages	42
5.2.2 Cross-sectional design	42
5.2.3 Sample Size and Characteristics	43

5.2.4 Representativeness, Participation and Selection Bias	43
5.2.5 Possible confounding variables	44
5.2.6 Cross-cultural considerations	44
5.2.7 Objectivity in observations and assessments	45
5.3 Ethical Considerations	45
5.4 Clinical Implications	48
6. Future directions	51
7. Conclusions	53
References	55
The papers	
Appendix	

1. Introduction

Mothers with Substance Use Disorder (SUD) are considered a high-risk group with compromised parenting capacities (Salo & Flykt, 2013; Siqveland & Moe, 2014; Suchman, McMahon, Slade, & Luthar, 2005; Suchman & Luthar, 2001). To be able to provide effective and targeted interventions for this group, further research is required to enhance our understanding of the mechanisms underlying adequate as well as vulnerable parenting capacities seen in SUD mothers. Research indicates that parental reflective functioning (PRF) and executive functioning (EF) are important for sensitive caregiving and are capacities that are often impaired in mothers with SUD (Gonzalez, 2015; Pajulo, Suchman, Kalland, & Mayes, 2006). Furthermore, it is important to consider the myriad of risk and resilience factors that could affect parenting capacities. Amongst others, these aspects include sociodemographic risk factors (Kaltenbach, 2013; Suchman & Luthar, 2000; Suchman, McMahon, Zhang, Mayes, & Luthar, 2006), adversity during childhood (De Bellis, 2002; Ford & Smith, 2008), resilience factors (Holmes, 2017), mental health issues (Espinosa, Beckwith, Howard, Tyler, & Swanson, 2001; Hans, Bernstein, & Henson, 1999; Paris, Herriott, Holt, & Gould, 2015), and stress (Nair, Schuler, Black, Kettinger, & Harrington, 2003). The associations between PRF and EF are unclear, and to date there are no studies that have investigated the associations between the two concepts in a high-risk population such as SUD mothers. Therefore, the main aim of this thesis is to investigate whether there are associations between PRF and EF in SUD mothers, and how mental health status, SUD-related aspects, parental stress as well as adverse and adaptive childhood experiences might influence the possible presence or lack of association between PRF and EF.

1.1 Child Development

The quality of the interaction between a child and its caregiver is essential for emotional and social development. According to the transactional model, child development is based on an ongoing bidirectional dynamic transaction between the child and its environment (Sameroff, 2009). The process that takes place during the caregiver-child interaction shapes the neural connections and architecture of the brain in the child and in the caregiver (Schore & Schore, 2008). Parental sensitivity, which is the parent's ability to perceive the child's signals accurately and to respond to them promptly and adequ-

ately, is considered essential for development of attachment security as well as trust in significant others (Bowlby, 1970; Steele & Steele, 2017; Velderman, Bakermans-Kranenburg, Juffer, van IJzendoorn, 2006). In addition, parental mental representations of attachment (i.e. perception of own childhood attachment experiences) is showed to influence current psychosocial functioning and sensitivity to the child's attachment signals (van IJzendoorn, 1995), hence affecting the child's attachment pattern (Meins, 2013). Although the developmental outcome of a child is dependent on a complex interplay between the family system, genetic, biological and environmental factors (Bronfenbrenner, 2006), the effect of the proximal system (i.e. the caregiving environment) have been shown to mediate the relationship between environmental risk and developmental outcome in the child (Trentacosta, Hyde, Shaw, Dishion, Gardner, Wilson, 2008).

1.2 Mothers with Substance Use Disorder and Risk for Compromised Parenting Practices

Maternal SUD has been suggested to pose a threat to the quality of sensitive caregiving, essential for a healthy development of the infant brain and biological system, and consequently the development of physical, emotional, and cognitive capacities in the child (Salo & Flykt, 2013; Shonkoff et al., 2012; Siqveland, Haabrekke, Wentzel-Larsen, & Moe, 2014). Dyadic interaction between mothers with SUD and their infants have been characterized by less sensitivity, lower emotional involvement, less attention and responsiveness and poor attunement compared to other dyadic interactions, including during maternal abstinence/sobriety (Pajulo et al., 2001; Siqveland et al., 2014; Strathearn & Mayes, 2010). It has been suggested that SUD alters brain functioning related to parental behavior (Rutherford, Potenza, & Mayes, 2013). It is known that substance abuse can cause alterations in biological processes and responses to infant sensory stimuli, which could lead to a cycle of inappropriate maternal behavior (Newman, Harris, & Allen, 2011; Rutherford et al., 2013). For example, it has been demonstrated that there is reduced activation in reward regions of the brain in SUD mothers, who experience observing their children as more stressful and less gratifying than healthy mothers (Kim, Iyengar, et al., 2017; Landi et al., 2011). Furthermore, parenting and addiction share neurobiological pathways known to be associated with reduced sensitivity to infant cues (Landi et al., 2011; Rutherford & Mayes, 2017; Strathearn, 2011). Moreover, studies indicate that SUD mothers have compromised mental representations of current caregiving experiences (Suchman, McMahon, et al., 2006; Torrado, Ouakinin, & Bacelar-Nicolau, 2013). Together, these findings contribute to an understanding of why young children of SUD mothers, even when the mothers are not currently using substances, are at increased risk for compromised care (Banducci, Hoffman, Lejuez, & Koenen, 2014; Lussier, Laventure, & Bertrand, 2010; Rutherford & Mayes, 2017).

1.3 Mentalizing, Parental Reflective Functioning, Parenting and Substance Use Disorder

The foundation of mentalizing is thought to be an evolutionary adaptation, and an innate cognitive faculty (Fonagy, Gergely, & Jurist, 2004; Kovács, Téglás, & Endress, 2010). Mentalizing is also a developmentally acquired skill that enables understanding of mental states in others and oneself as underlying behavioural expressions (Fonagy et al., 2004; Fonagy, Steele, Steele, Moran, & Higgitt, 1991). The capacity to form implicit and explicit representations of ongoing and prior relationships develops from the dyadic bidirectional interaction in an attachment relationship between a sensitive caregiver and a child (Bouchard et al., 2008; Fonagy & Target, 1997; Sharp & Fonagy, 2008, Fonagy & Target, 1997; Fonagy & Target, 2002). These relational experiences are theorized to contribute to comprehension of oneself and others in terms of mental state constructs, for example feelings, beliefs, intentions and desires (Allen, 2006). A mother's mental representations of caregiving are therefore partly influenced by her own experiences of being cared for (Fonagy, 2010; Huth-Bocks, Muzik, Beehly, Earls, & Stacks, 2014; Suchman, McMahon, et al., 2006). As a dynamic capacity, mentalizing is continuously influenced by subsequent relational experiences (e.g. being parented, or being a parent) and by different contexts throughout life (Luyten, Nijssens, Fonagy, & Mayes, 2017). While the attachment system between a child and a parent are important for mentalizing development in early in life, peers, teachers and the sociocultural context increasingly influence mentalizing capacity as the child develops (Luyten, Nijssens, Fonagy, & Mayes, 2017). Mentalizing is as such not a static trait, but subject to change due to personal arousal, stress and relational experiences from birth and throughout life.

Mentalizing is conceptually related to the concept of theory of mind (ToM), which refers to the ability to ascribe thoughts, feelings, intentions, and ideas to others (Baron-Cohen, 1995; Baron-Cohen, Leslie, & Frith, 1985; Premack & Woodruff, 1978). Both constructs are founded on metacognition, and the ability to reflect that behavior is driven by mental states. However, there are significant differences between the two concepts. ToM refers to cognitive-perceptual knowledge of mind, while the ability to mentalize requires activation of relational and emotional representations (Górska & Marszał, 2014; Kalbe et al., 2007). ToM primarily focuses on exploring attribution in terms of thoughts and intentions, while mentalizing focuses on understanding interpersonal processes in terms of regulating emotional experiences (Pajulo et al., 2006). Early mirroring and other caregiver related experiences are considered essential for mentalizing development, while ToM has been described as having innate neurocognitive foundations (Abu-Akel & Shamay-Tsoory, 2011). Moreover, ToM and mentalizing theory has been developed in two different disciplines even though they are linked developmentally. Developmental theorists have focused primarily on the cognitive underpinnings of perspective taking, whereas psychodynamic theorists, in addition to cognition emphasise the caregiver-in-

fant relationship as equally, if not more critical, to the development of mentalizing.

Reflective functioning (RF) is the manifestation of the capacity to mentalize, and is referred to as the ability to understand, anticipate, and interpret one's own and other's behaviors in light of underlying mental states (Fonagy, Steele, Steele, Moran, & Higgitt, 1991). RF provide individuals with the ability to represent the internal experiences and mental states of others, thus allowing anticipation and interpretation of behaviors, rather than just responding to behaviors in isolation (Fonagy & Target, 2002). The ability to understand how mental states affect behaviors is the core of RF, and might be particularly important in parenting young children.

Parental reflective functioning (PRF) is the operationalization of mentalizing in an attachment relationship, meaning the caregiver's capacity to interpret behavior of oneself and the child in terms of mental states (Fonagy & Target, 1997; Slade, 2005). RF and PRF are related capacities; however, they seem to capture slightly different aspects of mentalizing (Luyten et al., 2012, 2017; Steele et al., 2008). Parental reflective capacities can vary. For instance, parents with average PRF tend to have a well-integrated model of the mind in which behavior is conceptualized in terms of mental states. Others, who have high or sophisticated PRF, can recognize that mental states can be complex, dimensional, transactional and dynamic. Conversely, parents with a negative to low PRF may misattribute, distort, exaggerate, or ignore mental states and their role in interpersonal exchanges. Therefore, negative to low PRF indicates not fully developed reflective capacities and adequate to high PRF indicates developed RF (Kelly, Slade, & Grienenberger, 2005; Taubner et al., 2013). Mental representations of the current, ongoing relationship also affect parental behavior (Dollberg, Feldman, & Keren, 2010; George & Solomon, 1996; Madigan et al., 2006; Slade, Belsky, Aber, & Phelps, 1999). In particular, low PRF has been associated with maternal difficulties in recognizing and processing own parenting abilities as well as their children's emotions (Luthar & Suchman, 2000).

The level of PRF has been positively associated with parental sensitivity in SUD mothers (Pajulo et al., 2012). As a group, mothers with SUD are often reported to have lower levels of PRF compared to healthy mothers (Pajulo et al., 2006; Suchman, DeCoste, Castiglioni, et al., 2010; Suchman, Decoste, Leigh, & Borelli, 2010; Suchman et al., 2005; Suchman, Ordway, de las Heras, & McMahon, 2016). In a series of studies, SUD mothers have been found to exhibit more severe deficits in self-focused mentalizing than in other-focused mentalizing. In addition, self-mentalizing predicts the level of maternal sensitivity to a larger degree than other-mentalizing (Suchman, 2016; Suchman et al., 2016; Suchman, Decoste, McMahon, Rounsaville, & Mayes, 2011; Suchman et al., 2017). Furthermore, PRF seems to have an intergenerational aspect, as it is associated with the psychosocial development and development of RF in the child (Ensink & Mayes, 2010; Sharp & Fonagy, 2008; Slade, 2005). However, pa-

renting interventions targeting PRF in SUD mothers are associated with improvements in caregiving capacities (Pajulo et al., 2012; Suchman, DeCoste, Castiglioni, Legow, & Mayes, 2008). Overall, PRF is important for sensitive caregiving, and found particularly vulnerable in SUD mothers, which makes the concept important to investigate further.

1.4 Executive Functioning, Parenting and Substance Use Disorder

Executive Functioning (EF) refers to a set of basic neurocognitive processes important for cognitive control of behavior, thoughts and emotions (Diamond, 2013). EF is necessary for self-regulation and enables complex, goal-directed behavior (Diamond, 2013; Zelazo, 2015). Although EF is generally applied as an umbrella construct, it consists of interrelated, but distinct components. There is some debate regarding which processes that are encompassed in EF. Yet, there is a general consensus that working memory, cognitive inhibition and cognitive flexibility/set-shifting are the core EF components (Best & Miller, 2010; Diamond, 2013). Working memory is the ability to keep information in mind, update and integrate current contents with new information. Cognitive inhibition is the ability to inhibit responses and selectively attend to relevant information rather than to habitual or impulsive responses. Both working memory and cognitive inhibition are developmental predecessors to cognitive flexibility. Cognitive flexibility is the ability to shift between cognitive rules and changed perspectives spatially or interpersonally (Diamond, 2013; Friedman & Miyake, 2017). Although planning is not considered one of the core EF components, it is a capacity relevant for establishing and sequencing actions to a desired goal (Valls-Serrano, Verdejo-García, & Caracuel, 2016), and as such an important executive capacity. Working memory has been related to intelligence (IQ), while cognitive inhibition and cognitive flexibility has not (Friedman & Miyake, 2017; Friedman, Miyake, Corley, Young, DeFries et al., 2006).

EF is supported by anatomically separated but cooperating networks in the brain, primarily located in the frontal lobes (Barkley, 2012; Friedman & Miyake, 2017). Areas that control affective and motivational processes are the orbitofrontal cortex, ventral striatum, and the limbic system. These areas are activated in situations with emotional salience, and functions are labelled “hot” EF. In contrast, “cold” EF is activated in affectively neutral situations with little pronounced emotional salience, and are associated with dorsolateral parts of the prefrontal cortex (Zelazo & Cunningham, 2007, Castellanos, Sonuga-Barke, Milham, & Tannock, 2006). “Cold” EF is thought to control “top-down” functioning, and is as such involved with regulation of “hot” emotional and behavioral “bottom up” reactions (Barrett & Fleming, 2011). Hence, EF impairments can arise from a range of everyday situations targeting affective, motivational or cognitive processes. Individual differences in EF are stable and consistent across the lifespan and throughout adulthood (Friedman & Miyake, 2017; Tucker-Drob & Briley, 2014) and

highly heritable (Engelhardt, Briley, Mann, Harden, & Tucker-Drob, 2015; Friedman et al., 2008), thus constituting a consistent trait-like quality. Even so, EF are considered to be plastic, and affected by social, emotional, and physical health (Diamond, 2013). That indicates that EF are trainable and thus might be improved.

There have been challenges to the concept of EF as being categorical “hot” or “cold”. A recent study suggested that individual differences in EF are dynamic, and dependent on individual capacities in allocating limited cognitive resources when facing stress (Kluwe-Schiavon, Viola, Sanvicente-Vieira, Malloy-Diniz, & Grassi-Oliveira, 2016). When there is a shift from controlled to automatic processes during emotional dysregulation, the individual ability to affect regulate is dependent on a unique capacity for adaptive use of existing EF resources (Gagnon & Wagner, 2016; Kluwe-Schiavon et al., 2016). For example, a person with an impaired EF may have poorer coping strategies, leading to heightened frustration and even more emotional dysregulation and stress. Together, this could lead to fewer opportunities to transfer learning for future similar situations.

SUD is associated with neural abnormalities in the frontal lobes, and linked to alterations in EF (Bechara et al., 2001; Moreno-López et al., 2012). Indeed, individuals with SUD are shown to have disruptions in a number of EF components, such as inhibition (Dolan, Bechara, & Nathan, 2008), working memory (Bechara, Martin, & Becker, 2004), cognitive flexibility (Cunha, Nicastrì, de Andrade, & Bolla, 2010), and planning (Valls-Serrano et al., 2016). There are deficits both during substance use and during abstinence, although to a lesser degree in abstinence (Verdejo-García et al., 2006). Furthermore, executive dysfunction has been shown to be a risk marker for SUD (Dolan, Bechara, & Nathan, 2008; Kalivas & Volkow, 2005). In addition, low EF is related to psychological distress and mental health problems (Dvir, Ford, Hill, & Frazier, 2014; Gonzalez, 2015; Leyro, Zvolensky, & Bernstein, 2010).

A growing body of research has identified mothers' EF as determinants of parenting behaviors, and specifically adequate EF is thought to regulate parenting behavior (Crandall, Deater-Deckard, & Riley, 2015). For instance, EF capacities are associated with flexible, perceptive and responsive parenting in relation to parental demands (Galinsky, 2010; Gonzalez, 2015; Kienhuis, Rogers, Giallo, Matthews, & Treyvaud, 2010), including supportive responses to children's emotions (Hughes & Gullone, 2010; Valiente, Lemery-Chalfant, & Reiser, 2007). In addition, good enough EF is thought to be prerequisites for sensitive caregiving (Chico, Gonzalez, Ali, Steiner, & Fleming, 2014; Gonzalez, Jenkins, Steiner, & Fleming, 2012). In contrast, mothers with deficits in EF are shown to be less able to manage strong emotions and are vulnerable for parental stress (Skowron & Friedlander, 1998). Furthermore, mothers with a vulnerable EF system are showed to be more reactive and express less positive parenting behavior (Deater-Deckard, Sewell, Petrill, & Thompson, 2010).

1.5 Stress, Parental Reflective Functioning, Executive Functioning, parenting and Substance Use Disorder

Stress refers to processes involved in perception, appraisal and response to challenging or threatening stimuli, and depends on both internal and external conditions, emotional states, personality factors, and individual resources (Sinha, 2008). Stress exposure may result from major life events (e.g. divorce, loss of job), daily difficulties (e.g. interpersonal conflict, socioeconomic resources, chaos in the environment), psychological distress (e.g. stress related to mental health issues, SUD), or parental stress.

Parental stress relates to the parents' appraisal of the child and to own experiences of the parental role (Abidin, 1995; Deater-Deckard, 1998). Studies have found that mothers with a positive and coherent representation of their child, engage in more positive parenting behavior, while mothers who perceive their children as having a difficult temperament show more stress and negative caregiving behavior (Mäntymaa, Puura, Luoma, Salmelin, & Tamminen, 2006; A Slade et al., 1999). An elevated stress level has also been found to affect mentalizing capacities negatively (Luyten, Fonagy, Lowyck, & Vermote, 2012). Further, adequate PRF is associated with increased tolerance of child distress (Rutherford, Goldberg, Luyten, Bridgett, & Mayes, 2013).

Individual differences in EF may influence the experience of stress and the capacity to manage stressful experiences (Williams, Suchy, & Rau, 2009). Conversely, stress is also considered one of the main aspects undermining EF and promoting automatic, uncontrolled modes of processing (Diamond, 2013). Further, neurobiological evidence shows that increased levels of stress leads to a decrease in prefrontal functioning related to EF capacities (Li & Sinha, 2008). As such, stress is found to impair EF (Schmeichel & Tang, 2014; Verdejo-García, Bechara, Recknor, & Perez-Garcia, 2006), and is associated with an increase of maternal behavior related to automatic reactions and less controlled EF (Deater-Deckard, Wang, Chen, & Bell, 2012). Moreover, stress has been linked to difficulties in exertion of control (Crandall et al., 2015; Diamond, 2013), and has been suggested to favour automatic processing (Mayes, 2000).

For mothers with multiple risk factors, parenting can be experienced as highly stressful (Nair et al., 2003). Indeed, as a group, mothers with SUD exhibit increased levels of parental stress, as well as difficulties in regulating experiences of stress (Bagner et al., 2009; Kelley, 1998; Nair et al., 2003; Tronick et al., 2005; Zvolensky & Hogan, 2013). Parenting cues, such as a child crying, has been showed to trigger stress reactivity in SUD mothers, rather than reward salience (Rutherford, Williams, Moy, Mayes, & Johns, 2011). Furthermore, mothers with SUD have been found to have a heightened stress-level regarding apperception of own parenting capacities (Thomason et al., 2014). For instance, mothers with high ratings of psychological distress are more likely

to perceive their child's behavior as stressful (Sheinkopf, Lester, LaGasse, Seifer, Bauer et al., 2005). Additionally, mothers with SUD have a heightened risk for difficulties in emotion regulation capacities (Suchman, DeCoste, Ordway, & Mayes, 2012), which in turn is related to reduction in distress tolerance (Deater-Deckard, Li, & Bell, 2016). Reduced stress tolerance is considered a central component of SUD (Li & Sinha, 2008; Tronick et al., 2005), making mothers with SUD especially vulnerable for parental stress exposure.

Children acquire their own regulatory capacities in the context of the parent-infant relationship (Jaffe et al., 2001; Schore, 2015). Dysfunctional dyadic interactions between SUD mothers and their children have been associated with elevated stress levels in the mothers (Hans et al., 1999; Nair et al., 2003). Furthermore, high stress levels in the mother can lead to increased risk for development of psychopathology in the child (Crnic & Low, 2002; Deater-Deckard, 2005).

1.6 Adaptive and Adverse Childhood Experiences in mothers with Substance Use Disorder

Adverse interpersonal traumatic experiences in childhood and adolescence can negatively affect somatic health as well as increase the risk for adult psychopathology (Heleniak, Jenness, Vander Stoep, McCauley, & McLaughlin, 2016; Shonkoff et al., 2012; Teicher, Samson, Anderson, & Ohashi, 2016). Individuals with a SUD are more likely to have experienced childhood adversity (Felitti et al., 1998; Green et al., 2010; Jansson & Velez, 2011; Norman et al., 2012; Vachon, Krueger, Rogosch, & Cicchetti, 2015). In addition, substance abuse might be conceptualized as a form of coping behaviour, where substances might function as a strategy to manage challenging emotions associated with previous traumatic exposure (Berking & Wupperman, 2012; Haller & Chassin, 2014; Leeies, Pagura, Sareen, & Bolton, 2010; Sheerin et al., 2016).

Trauma is defined as a response to an event that threatens a person's life, physical or psychological integrity whether experienced directly, witnessed or heard about (American Psychiatric Association, 2013; Rothschild, 2011). Early, recurrent and severe interpersonal trauma have been termed developmental trauma and indicate that a primary caregiver is involved in the adversity, and that core developmental capacities in the child are affected (Ford et al., 2013).

When the child-caregiver relationship is the source of adversity, the attachment relationship and development of psychological representations of the self and others may be severely compromised (Cook et al., 2005; Fonagy et al., 2004; Van der Kolk, Roth, Pelcovitz, Sunday, & Spinazzola, 2005). In particular, exposure to adversity during sensitive periods, such as early childhood and adolescence, can affect core self-regula-

tory capacities, and therefore adversity is potentially harmful for the developing child (Manly, Kim, Rogosch, & Cicchetti, 2001; Meaney & Ferguson-Smith, 2010). Furthermore, individuals exposed to adversity in childhood may be particularly sensitive to stressful experiences and prone for later psychological distress in adolescence and adulthood (Althoff, Verhulst, Rettew, Hudziak, & van der Ende, 2010; Fonzo et al., 2016; McLaughlin, Sheridan, Alves, & Mendes, 2014).

Adaptive experiences in childhood and adolescence such as safe relationships, adequate coping mechanisms, and a sense of competence and agency may contribute to resilience in adulthood (Belsky & Pluess, 2009; Block & Block, 1980; Cook et al., 2017). Resilience is defined as the ability to maintain equilibrium in the face of stressful life events (Bonanno, 2005), or a pattern of positive adaptation in the context of significant risk or adversity (Rutter, 2012). A good enough, safe attachment relationship with the caregiver, in addition to having effective coping capacities have been found to be protective factors when growing up with adversity (Luthar, 2006; Schofield, Conger, & Neppl, 2014). Adults with SUD exposed to developmental trauma often report low levels of such protective adult relationships in childhood (Brown & Shillington, 2017).

Adverse childhood experiences have been associated with long lasting effects for cognitive development and functioning, including reductions in EF (Hanson et al., 2015; Hostinar, Johnson, & Gunnar, 2015; Teicher et al., 2016; Viola, Tractenberg, Pezzi, Kristensen, & Grassi-Oliveira, 2013). Impairments in the hippocampus, prefrontal cortex (PFC), and enhanced amygdala function after early life adversity may increase emotional responses to threat detection and EF capabilities later in life (Kim et al., 2013; Loman et al., 2013; Teicher et al., 2016). Furthermore, early adversity is associated with poor mentalizing in individuals with SUD (Allen, Lemma, & Fonagy, 2012). Different forms of adversities, particularly emotional abuse and neglect have been associated with compromised PRF level (Bottos & Nilsen, 2014; Burns, Jackson, & Harding, 2010; San Cristobal, Santelices, & Fuenzalida, 2017).

Transition to parenthood is considered a period of reorganization of the self, that may trigger adaptive and adverse childhood memories and experiences (Ensink, Berthelot, Bernazzani, Normandin, & Fonagy, 2014; Fraiberg, Adelson, & Shapiro, 1975; Lieberman & Van Horn, 2011). Indeed, adults with developmental trauma are shown to be at risk for impaired parenting capacities (Belsky & Pluess, 2013; DiLillo & Damashek, 2003; Fuchs, Möhler, Resch, & Kaess, 2015; Gonzalez, 2015). Recently, there has been an expanding interest in the concept of epistemic trust and mistrust, especially in populations subjected to early life adversity (Fonagy, Luyten, & Allison, 2015; Knox, 2016). Epistemic trust is the authenticity in the interpersonal transmitted knowledge (Fonagy & Allison, 2014; Sperber et al., 2010). Initially, learning takes place in a developmental context, where the caregiver is trusted, and gives the child an opportunity for acquiring

social learning and to benefit from being in relationships with others (Fonagy, Campbell, & Bateman, 2017; Luyten, Nijssens, et al., 2017). Epistemic trust is a capacity related to resilience, whereby an individual may turn to others for support when needed, as well as continuing learning from relational experiences, in contrast epistemic mistrust hinders relational learning (Fonagy & Campbell, 2017).

1.7 Associations between Parental Reflective Functioning and Executive Functioning

To our knowledge, only four studies have previously explored the association between mentalizing and EF in mothers. In a study with a non-clinical group of 64 mothers with small children, no significant relationship between EF and PRF was found when using a projective imagination test to measure mentalizing capacity (Turner, Wittkowski, & Hare, 2008). Capstick (2008) studied a sub-clinical community sample, of 29 mothers with children aged between 9-12 years and found no significant association between EF and PRF using the Parental Development Interview (PDI-R2) (Slade et al., 2003). However, more recently two studies, found significant associations between PRF and EF. In one study, two groups of mothers with young children from a normative population ($n = 50$ and $n = 64$), were assessed for PRF by completing the Parental Reflective Function Questionnaire (PRFQ) (Luyten, Mayes, Nijssens, & Fonagy, 2017), and results found significant associations between working memory and set shifting capacity and PRF (Rutherford et al., 2017). In another study, Yatziv, Kessler & Atzaba-Poria (2017) compared mothers from a healthy population with mothers to preterm children ($N = 102$) and measured mentalizing using the dyadic interaction mind-mindedness coding instrument (Meins & Fernyhough, 2006). The results showed positive associations between updating (working memory) and mentalization in the whole group, while response inhibition and shifting were not associated with mentalizing.

PRF, EF, stress, mental health, substance use and relational childhood experiences are concepts that are well studied respectively, yet few studies have investigated the possible association between them. In addition, both PRF and EF have been highlighted as directly affecting parenting behavior. Although there is a growing interest of the relationship between the concepts, to our knowledge, no previous studies have investigated the association between them in a high-risk group as mothers with SUD represents. Improved knowledge about possible associations between PRF and EF might inform research and practice about specific aspects to focus on in interventions when trying to offer help to mothers with SUD and their children. Targeted and more effective interventions for the mother and the dyad might further positively affect the child's development.

2. Aims and Objectives

The overarching aim of this thesis was to contribute to the understanding of possible associations between PRF, EF, and stress in addition to adverse and adaptive childhood experiences in SUD mothers to small children. These factors are considered important for sensitive caregiving, and are often affected in SUD mothers. However, in research the variables are rarely assessed together in the same study. To provide improved and targeted help to mothers with SUD, it is important to identify possible relevant variables for intervention, and how these aspects may be associated.

In this study, the following aims were addressed:

2.1 Paper I

The aim of Paper I was to identify possible associations between EF and PRF in SUD mothers, controlling for IQ and mental health status, which are known variables to influence both components. More specifically, the following research questions were investigated:

1. Are there associations between EF and PRF in SUD mothers? If so, how does IQ and mental health status in the mothers affect the associations?
2. Are there differences in EF depending on if the mother is showing an adequate PRF ability or not?
3. Are there differences in SUD related components (onset age, age of having a SUD diagnosis, preference of a particular kind of substance, and multiple substance use) in mothers exhibiting adequate PRF and mothers who do not?

2.2 Paper II

The objective of Paper II was to examine associations between different types of stress (parental stress, general life stress, and psychological distress), EF (working memory, inhibition, and cognitive flexibility) and PRF in SUD mothers.

1. Are there associations between different types of stress and EF in SUD mothers?

2. Does specific EF components contribute more to variance in stress (parental stress and psychological distress), when controlled for demographic variables in SUD mothers?
3. Are there associations between PRF and stress and between PRF and EF in SUD mothers?
4. Does PRF have a mediating effect between EF and parental stress and between EF and psychological distress in SUD mothers?

2.3 Paper III

The aim of Paper III was to examine associations between PRF, EF, mental health status and different types of adaptive (safety and competence), and adverse (emotional, physical, sexual abuse, and neglect) experiences in different developmental phases (early infancy, latency, and adolescence) in the mothers.

1. Do adaptive and adverse experiences in different developmental phases associate with PRF in SUD mothers where EF and mental health status are introduced as control variables?
2. Do specific types of adversities during childhood associate with PRF in SUD mothers, when controlled for EF and mental health status?
3. Do mothers with negative to low PRF report more adverse experiences and less adaptive experiences compared to mothers with adequate PRF?
4. Are there differences in reports of having specific type of adaptive experience, or a specific type of adverse experience during childhood between mothers exhibiting adequate PRF and mothers exhibiting deficits in PRF?

3. Material and Methods

3.1 Design

The research study is a part of the overarching “Mosaic Project”, where the overall aim of the project is to generate knowledge about what kind of support is important to promote wellbeing, competence development, and participation in children of different age groups living in families with parental mental illness and/or substance abuse problems. In the present cross-sectional study, we measured dyadic and individual function in mothers with SUD and their infants aged 4 to 18 months. In this thesis, only results regarding the mothers are presented, while results regarding the dyad or variables related to the child will be interpreted later and are not presented in this thesis.

3.2 Participants

Our participants ($N = 43$) were mothers with infants, 18 months old or younger. The mothers had a recent history of substance abuse. The families were recruited either in pregnancy or early during post-partum period. Twelve families (27.9%) were recruited from outpatient clinics and six (14.0%) from municipality health nurses. Twenty-five families (58.1%) were recruited from one of eight different residential treatment institutions in Norway (Lade Treatment Centre in Trondheim, Borgestad Clinic in Skien, Rogaland A-centre in Stavanger, the Family Ambulatory in Bergen, Seljelia child and family centre in Gjøvik, Moringen Child and Family Centre in Fredrikstad, Aline Infant Centre in Oslo, and Innlandet Hospital Trust, Reinsvoll). Forty-five mothers and their infants were originally recruited in the project. One mother withdrew due to personal reasons, and one mother died early in the assessment period. Therefore, forty-three mothers were included in the study. All of the participants completed the full assessment battery. The recruitment period lasted for two years. The inclusion criteria were a SUD diagnosis of any severity and kind, whether with or without a comorbid mental illness. All the mothers were abstinent during the assessment period, but had previously been diagnosed with a SUD by a clinician based on the ICD-10 classification of mental and behavioral disorders (World Health Organization, 1993). The diagnoses were later confirmed by our assessments. The exclusion criteria were an estimated full scale IQ below 70 in the mothers, multi-parity (giving birth to twins or triplets), premature birth (< 32

weeks and < 1500g), or a severely ill or multi-handicapped child. Children with neonatal abstinence syndrome (NAS) were not excluded to take part in the assessments. At assessment, the age of the target child ranged from four to eighteen months ($M = 8.6$, $SD = 3.8$). There were fifteen girls (34.9%), and twenty-eight boys (65.1%). Eleven (25.6%) of the children were born with NAS and received medical intervention for the condition.

3.2.1 Socio-Demographic Background Data

On average, participants were educated for 11.5 years (range seven to eighteen years). Two participants (4.7%) did not complete primary school, and twenty-two (51.2%) started but did not complete high school. Six participants (14.0%) had a graduate or professional degree beyond high school. Twenty-two mothers (51.2%) did not have a partner and thirteen (30.2%) had a cohabitant. One participant (2.3%) was married and seven (16.3%) had a partner who was not a cohabitant. Twenty-four mothers (55.8%) reported that the father of the child had an ongoing substance abuse problem, and fifteen (34.9%) reported a previous, but currently abstinent substance abuse problem in the father. Four mothers (9.3%) reported that the father never had a substance abuse problem. For the majority of the mothers ($N = 27$), the target child was their first child. Although sixteen of the mothers (37.2%) had older children, only one (2.3%) had custody of the older sibling of the target child. Siblings were either living in foster care or with their father. During the inclusion period, twelve of the mothers (27.9%) lost daily custody of the target child.

3.2.2 Substance Use

The mothers in our study qualified for several potential SUD diagnoses according to ICD-10 (World Health Organization, 1993). Twenty-eight (65.1%) of the mothers had one or more diagnosis for mental health problems in addition to the SUD diagnosis. Eight (18.6%) of the mothers qualified for F10 (mental and behavioural disorders due to the use of alcohol), twenty-four (55.8%) qualified for F11, (mental and behavioural disorders due to the use of opioids). Whereas twenty-seven (62.8%) of the mothers qualified for F12 (mental and behavioural disorders due to use of cannabinoids), twenty-five (58.1%) had a diagnosis of mental and behavioural disorders due to the use of other stimulants, specifically amphetamines. None of the mothers qualified for any of the other SUD diagnoses in ICD-10. Although thirty-seven (86%) of mothers reported multi-substance use, all of the respondents could define a preferred substance. The most commonly preferred substances among the mothers were central stimulants and opioids. Twenty-two mothers (51%) reported injecting substances intravenously, thereby indicating a substantial substance use problem in the group. The majority of the mothers, twenty-nine (67%) reported having had one or more serious overdoses. Eleven of the mothers (25.6%) were receiving medically assisted rehabilitation and were

prescribed either Methadone or Buprenorphine, and four mothers (9.3%) mothers were prescribed medication for Attention Deficit Hyperactivity Disorder (ADHD). Eight mothers (18.6%) reported regularly using other types of prescribed medications, including anxiolytics, sedatives or anti-depressants. The majority of the mothers reported alcohol to be the first substance they used. When investigating onset-age, forty-two mothers (98%) reported having used alcohol and cannabis, with an average onset-age of 13.1 years for alcohol and 16.2 years for cannabis. Thirty-seven mothers (86%) reported using prescribed medication illegally, with an average onset-age of 18.1 years. The average onset-age for the use of stimulants was 17.8 years, and thirty-eight mothers (88.4%) reported having used the substance at one point in time. Twenty-five mothers reported previous usage of opioids (58%). The onset-age for opioid usage was somewhat older compared to onset age of other substances, with an average age of 20.3 years. The majority of mothers in our sample, (86.0%), reported multi-substance use.

3.2.3 Mental Health

The mothers in our study qualified for numerous mental health diagnoses. During assessment with the MINI International Neuropsychiatric Interview plus version 5.0.0, Norwegian version (Mordal et al., 2010) (MINI), sixteen (37.2%) of the women reported an ongoing depression. Two (4.7%) were diagnosed with bipolar affective disorder. Twenty-six (60.5%) mothers had a panic disorder and twelve (27.9%) had agoraphobia, while twenty-one mothers (48.8%) had social phobia. Twenty-three (53.5%) of the mothers qualified for a generalized anxiety disorder (GAD). None of the women had a schizophrenia diagnosis, while sixteen (37.2%) of the women reported having an eating disorder, either anorexia, bulimia, overeating or a combination of these. Sixteen mothers (37.2%) had symptoms of a post-traumatic stress disorder (PTSD). Four (9.3%) of the mothers reported having an Attention Deficit Hyperactivity Disorder (ADHD). As a group, the mothers reported an average score of 2.5 on the Hopkins Symptom Checklist, 10 items (HSCL-10), indicating a high level of current psychological distress.

3.3 Procedures

A large battery of assessments, including measurements of the dyadic relationship, and variables related to child development were administered in this study. Only selected results are presented in this thesis though. We examined all the participants in their own home or in the treatment facility where they were currently living. To confirm or establish mental health diagnoses, including the SUD according to ICD-10 (World Health Organization, 1993), mothers were interviewed with European Addiction Severity Index (EuropASI) (McLellan et al., 1992), Norwegian version (Lauritzen & Ravndal, 2004) to assess for SUD and the Diagnostic interview MINI plus version 5.0.0 (M.I.N.I) (Sheehan et al., 1998), Norwegian version (Mordal, Gundersen, & Bramness, 2010),

to assess for mental health diagnoses. Furthermore, we interviewed the mothers with Parent Development Interview-Revised (PDI-R2) (Slade et al., 2003), Norwegian version (Söderström, 2011) and completed neuropsychological assessments. Mothers also completed questionnaires concerning mental health status and psychological distress; HSCCL-10 (Strand, Dalgard, Tambs, & Rognerud, 2003), stress; Parenting Stress Index (PSI), full version (Abidin, 1990) and adverse and adaptive experiences: Traumatic Antecedents Questionnaire (TAQ) (van der Kolk, 2003), Norwegian version. If the mothers experienced difficulties in completing the questionnaires, they were given an option of receiving help by having the questions read by the researcher. Mothers met with the researcher on three to six separate occasions to complete the assessments, with each session lasting between one and two hours. On average, the total time collecting the data was approximately seven hours per family. In addition, the majority of the families met with the researcher after the assessment to receive feedback and discuss possible clinical implications from the results.

The PhD candidate (UH) collected the majority of the data material, including administering the PDI-R2 interview. However, for six participants the PDI-R2 were conducted by the principal clinician in contact with the mother. Collection and interpretation of the neuropsychological assessments were administered by UH and supervised by a specialist in clinical neuropsychology (Merete Gløenn Øie).

Participation was voluntary and no payments or reimbursements were offered.

3.4 Materials and Measures

The measures presented are part of a larger test battery, and only instruments used in the thesis are presented here.

3.4.1 Socio-Demographic Variables and Use of Psychoactive Substances

Substance use was registered with the EuropASI (McLellan et al., 1992), Norwegian version (Lauritzen & Ravndal, 2004; G. O. Lauritzen, 2010). The EuropASI is a semi-structured clinical interview and consists of questions related to legal and illegal substance use and medication in addition to different areas of functioning, such as physical and mental health, family and social relationships, education, employment and support status, family and social relationships, and criminal offences. Besides thoroughly investigating diverse aspects of the SUD it is possible to obtain an ASI-score to indicate the severity of the SUD. However, the measure requires active substance use for the last year before the assessment. The mothers in our study reported to have been abstinent during parts of the pregnancy and the post-partum period, and the majority of the mothers reported not having used substances during the last year. Therefore we did not use the ASI score as an assessment for SUD severity. Reliability and validity for the Europ-ASI

has been reported to be satisfactory (Carise, McLellan, Gifford, & Kleber, 1999; Kessler et al., 2012; Kokkevi & Hartgers, 1995).

3.4.2 *Mental Health Status*

Mental health status was measured with the M.I.N.I (Sheehan et al., 1998), Norwegian version (Mordal et al., 2010), which is related to do the diagnostic criteria in Diagnostic Manual of Mental Disorders, 5th edition, (American Psychiatric Association, 2013) and ICD-10 classification of mental and behavioral disorders (World Health Organization, 1993). In addition HSCL-10 (Strand et al., 2003), a self-administered 10-item questionnaire, was used to measure general mental health status/psychological distress in the mothers. HSCL-10 is a shortened version of the HSCL-90 (Derogatis, Lipman, Rickels, Uhlenhuth, & Covi, 1974), and has satisfactory validity and reliability (Haavet, Sirpal, Haugen, & Christensen, 2010; Strand, Dalgard, Tambs, & Rognerud, 2003).

3.4.3 *Parental Reflective Function (PRF)*

To assess PRF, we used the PDI-R2 (Fonagy, Target, Steele, & Steele, 1998; Slade, Aber, Berger, Bresgi, Kaplan et al., 2003), Norwegian translation (Söderström, 2007). PDI-R2 is a 20-question semi-structured interview designed to elicit narratives of different aspects of parenting and of being parented. The interview addresses various themes concerning feelings, thoughts and intentions in the caregiving relationship and focuses on how these aspects might influence behaviour and mental processes in the person reflected upon (i.e. oneself or one's child). The PDI-R2 interview was recorded, transcribed and rated in accordance with guidelines for RF assessment (Fonagy et al., 1998) by an independent reliable coder who was not familiar with the respondents. In addition, 25% of the interviews were double-coded by a second coder for reliability purposes. There was a strong intra-class correlation (ICC) between the coders ($r = .96$). When there was a disagreement between the coders, we used the assessment from the first coder. In accordance with the manual, interviews were scored for PRF on an 11-point scale from -1 to 9, with higher scores reflecting higher PRF (Slade, Bernbach, Grienberger, Levy, & Locker, 2005). Score of 5 or above indicate a clear PRF in a normal population (Slade, 2005), in a stressed or vulnerable population; a score of 4 would constitute the average capacity (Kelly et al., 2005; Levy et al., 2001; Taubner et al., 2013). Therefore, a distinction between a negative to low PRF was set at a score of 3 or below and an average to high PRF was set at a score of 4 or above in our sample of mothers. Validity for the PDI-RF is reported as being satisfactory in non-clinical populations (Slade, 2005; Slade et al., 1999), and in populations of parents with a SUD (Levy & Truman, 2002).

3.4.4 Executive Functions

A neurocognitive test battery was used to assess executive sub-functions in the mothers. We measured the following EF domains:

3.4.4.1 Working memory

The Letter-Number Sequencing test from the Wechsler Adult Intelligence Scale 4th Edition (Wechsler, 2014) was used as a measure of working memory in Paper I, II and III. Participants were orally presented with increasingly longer series of mixed letters and numbers at one-second intervals, and the researcher asked the mother to recall the numbers in ascending order and the letters in alphabetical order. Total correct recalled trials were examined. Lower scaled scores indicated difficulties with the task. The test shows satisfactory reliability and validity (Wechsler, 2014), however the Letter-Number Sequencing sub-test mainly measures auditory/verbal working memory and not spatial/visual working memory (Egeland, 2015).

3.4.4.2 Cognitive inhibition

The Colour-Word Interference Test, Condition 3 from the Delis-Kaplan Executive Function System (D-KEFS) (Delis et al., 2001) was used as a measure of cognitive inhibition in Paper I, II, and III. The instrument assesses the participant's ability to inhibit an overlearned verbal response when naming the ink colour in which the words are printed as quickly as possible. Completion time in seconds, in addition to frequency of errors was examined. Lower scaled scores indicated difficulties with the task. The D-KEFS has exhibited satisfactory validity and reliability measuring cognitive inhibition (Delis, Kramer, Kaplan, & Holdnack, 2004; Homack, Lee, & Riccio, 2005).

3.4.4.3 Cognitive flexibility

The inhibition-switching task in the Colour-Word Interference Test, Condition 4 from the D-KEFS (Delis et al., 2001) was used as a measure of cognitive flexibility in Papers I, II and III. The participant is required to switch back and forth between naming the dissonant ink colours and reading the colour word. Completion time in seconds, and the number of errors committed during the task were examined. Lower scaled scores indicated difficulties with the task. The test is reported to have satisfactory validity and reliability for measuring cognitive flexibility (Delis et al., 2004).

3.4.4.4 Verbal fluency

Two categories (Letter Fluency, and Category Fluency) from the Verbal Fluency test from the D-KEFS (Delis, Kaplan, & Kramer, 2001), were used to assess verbal fluency in Papers I, and III. The tasks included three 60-second trials each. In the Letter Fluency

condition, participants were required to say as many words as possible that started with a specific letter ('F', 'A', and 'S'). Completion of the Category Fluency condition required participants to first say as many animals as possible, and then as many boys' names as possible. The number of correct answers was examined and lower scaled scores indicated difficulties with the task. The two sub-tests are reported to have satisfactory validity and reliability in measuring verbal fluency (Delis et al., 2004; Shunk, Davis, & Dean, 2006).

3.4.4.5 Planning

The Tower Test (Delis et al., 2001) was used as a measure of planning abilities in Papers I, and III. Participants were asked to construct target towers by placing discs of varying sizes across three pegs in the fewest number of moves as possible. There is an increasing complexity of the test as it progressed from starting with two discs and ending with five discs. The participant was allowed to move only one disk at a time, and not to place a larger disk over a smaller disk. Total achievement scores within the time limit were examined. Lower scaled scores indicated difficulties with the task. Taking a longer time to complete the task, as well as a high frequency of errors gave lower scaled scores. The validity and reliability of the Tower Test has been reported to be satisfactory (Delis et al., 2004).

3.4.4.6 General cognitive functioning (IQ)

The Wechsler Abbreviated Scale of Intelligence (WASI) (Wechsler, 1999, 2014) was administered to estimate the participants' average estimated full scale IQ, verbal IQ and non-verbal IQ.

3.4.5 Stress

The Parental Stress Index 3rd Edition (Abidin, 1995) is a self-administered 120-item inventory that measures three major sources of stress and was used in Paper II. The instrument measures: (1) child characteristics and the parent's appraisal of them (child domain), (2) parental characteristics and family context variables that can compromise parenting (parent domain) and (3) stressful circumstances beyond the parent's control (general life stress). A total parental stress score may be derived from the sum of child and parent domain. General life stress was separately indexed in the questionnaire. The majority of items are rated on a 5-point Likert Scale (*Strongly Agree, Agree, Not Sure, Disagree, and Strongly Disagree*). A few items are rated *Yes/No* according to whether they are present or absent. The manual provides percentile cut-offs indicating adequate stress level (< 80th percentile), and high-risk clinical stress level (\geq 80th percentile). This PSI has adequate test-retest reliability and good internal consistency (Abidin, 1995).

3.4.6 *Adaptive and adverse experiences*

Adaptive and adverse experiences in different age periods were assessed by the self-report questionnaire, Traumatic Antecedent Questionnaire (TAQ) (Van der Kolk, Spinazzola, & Hopper, 1995) and were presented in Paper III. TAQ is a 41-item instrument that gathers information about experiences in early childhood (0-6 years), latency (7-12 years), adolescence (13-18 years), and adulthood. Adaptive and adverse experiences are gathered in 10 domains: (1) Competence, (2) Safety, (3) Neglect, (4) Separation, (5) Emotional Abuse, (6) Physical Abuse, (7) Sexual Abuse (8) Witnessing, (9) Other Traumas (i.e., natural disaster, serious accident), and (10) Exposure to Familial or Personal Alcohol or Illicit Drug Use. It is possible to calculate summary scores for each of the individual domains, and across the developmental periods measured. Higher scores on the two adaptive domains represent greater levels of adaptive functioning, while higher scores on the eight adverse domains represent greater levels of accumulated risk. To counteract the dilemma of multiple comparisons and the risk of incorrectly rejecting a null hypothesis, we selected what we considered the theoretically most relevant variables. We chose to explore the two adaptive domains (competence and safety), and four adverse domains (emotional, physical, and sexual abuse and neglect). Validity and reliability for the TAQ is considered satisfactory (Luxenberg, Spinazzola, & Van der Kolk, 2001; Spinazzola, Ford, & van der Kolk, 2005).

3.5 **Statistical Analyses**

All statistical analyses were carried out using IBM Statistical Package for Social Sciences (SPSS) (versions 22/23/24), IBM Corp. Released 2016. IBM SPSS Statistics for Windows, version 24.0. Armonk, NY: IBM Corp. All cases ($N = 43$) were included in the analyses, and there were no missing data. All analyses were two-tailed with a significance level of 0.05. Descriptive statistics were used to analyse the sample characteristics, and correlations between variables were explored with Pearson's r (Papers I, II, and III).

A Principal Component Analysis (PCA) was conducted on the measured EF, and a factor score of the extracted dimensions were calculated. One major EF-factor was extracted accounting for 56.9% of the unrotated variance (Eigenvalue = 3.4). The EF-factor was used in a hierarchical ordinary least square regression analyses to test how much variance in PRF the EF-factor accounted for controlling for IQ and mental health status (Paper I). In addition, the EF-factor was used as a control variable in two multiple regression analysis when we investigated how much variance in PRF different types of adaptive and adverse experiences in different developmental phases accounted for when we controlled for mental health status and EF (Paper III). Furthermore, we carried out a two multiple regression analyses to see how much variance in parental stress and in psychological distress different EF components (working memory, inhibition

and cognitive flexibility) accounted for when we controlled for education (Paper II).

To test differences in reported preference for particular substances depending on exhibiting a negative to low PRF ($N = 32$) or an adequate to high PRF ($n = 11$), we used a chi-square test (Paper I). We conducted several multiple analyses of variance (MANOVA) to test differences between a group of mothers exhibiting negative to low PRF and a group of mothers exhibiting adequate to high PRF. Differences were tested on onset age of substance use, and onset age of dependency qualifying for a SUD, controlling for IQ and mental health status (Paper I). In addition, differences in working memory, cognitive inhibition, cognitive flexibility, verbal fluency, and planning, controlling for IQ and mental health status on PRF level in the mother were tested with a MANOVA (Paper I). Furthermore, differences between mothers depending on PRF level were also tested with MANOVA's on types of adaptive (safety and competence) and adverse (emotional, physical, and sexual abuse, and neglect) experiences, as well as adaptive and adverse experiences in different developmental phases (early childhood, latency, and adolescence), controlling for EF and mental health status (Paper III). In addition, we conducted mediation analyses according to Baron and Kenny's approach (1986) to investigate if PRF mediated the relationship between EF (working memory, inhibition and cognitive flexibility) and stress (parental stress and psychological distress). The Sobel's test (1982) was applied to calculate the indirect effects and its significance using the Indirect. sbs tool, version 2.0 Beta, added to the IBM SPSS 25 (Paper II). The statistical analyses used in the study are described in more detail in the three Papers.

3.5.1 Statistical considerations

3.5.1.1 Missing data

We had no missing data in neither of the analyses.

3.5.1.2 Causality

The study was a non-experimental design and therefore we cannot determine causality between variables. Although we aimed to control for possible confounding factors, it is possible that components not included in the analyses might have affected the results.

3.5.1.3 Small sample size and statistical power

Although comparable to other studies of mothers with SUD (Pajulo et al., 2012; Suchman et al., 2012), our sample was quite small. The sample size leads to some statistical limitations in performing complex analyses and limiting statistical power. Furthermore, significant effects and group differences are more difficult to detect in small samples, increasing the risk of committing type II errors. Thus, it is possible that some of the non-significant results could have been significant with a larger sample.

3.5.1.4 Representativeness of the sample

The mothers were recruited based on having a SUD diagnosis, however, the in-group diversity regarding psychiatric comorbidity, socio-demographic factors (as age, parity, education and marital status), and factors related to the SUD (e.g. onset age, substance preference, severity in dependency) led to heterogeneity in the sample. The diversity of participants with SUD in our study could be clinically representative; however, heterogeneity of the sample might have affected the analyses, and a more homogenous sample might have yielded different results.

4. Summaries of papers

4.1 Paper I: Parental Reflective Functioning and Executive Functioning in Mothers with Substance Use Disorder

Aims

Our first aim was to investigate the association between parental reflective functioning (PRF) and executive functioning (EF) controlling for IQ and mental health status in mothers with SUD. Our second aim was to investigate possible differences in maternal EF and factors related to the SUD (onset age, SUD onset, substance preference, and multiple substance use) depending on either exhibiting a negative to low PRF, or exhibiting an adequate to high PRF, controlling for IQ and mental health status.

Method

The mothers ($N = 43$) were interviewed using the PDI-R2, the M.I.N.I and the EuropASI, and assessed with the neuropsychological test battery (measuring working memory, cognitive inhibition, cognitive flexibility, verbal fluency, and planning). In addition, they completed the self-administered questionnaire HSCL-10. Correlation and regression analyses were used to measure associations between PRF and EF, and Chi-Square analyses and MANOVA's were used to test differences between groups.

Results

There were significant associations between PRF and EF, but when controlled for with IQ and mental health status, the relationship was no longer significant. However, mental health status showed a significant negative association with PRF. Separating the group in two based on PRF-level mothers with negative to low PRF ($PRF \geq 3$) had significantly lower scores in working memory, cognitive flexibility and planning compared to mothers with adequate to high PRF ($PRF \leq 4$) even after controlling for IQ and mental health status, highlighting the possible association between PRF and EF. Mothers with adequate to high PRF showed EF capacities expected in a normal population on all the EF components. Furthermore, mothers with negative to low PRF reported an onset age of substance use and acquired a SUD diagnosis significantly earlier compared to mothers with adequate to high PRF. In addition, mothers with negative to low PRF reported

a multi-substance-abuse significantly more often. There were no significant differences between mothers with negative to low PRF and mothers with adequate to high PRF regarding substance preference.

Conclusion

Our findings suggested that the association between PRF and an EF were significantly affected by mental health status in the mother. Mothers with adequate PRF exhibited EF comparable to normative populations, while mothers with negative to low PRF had significantly more deficits in cognitive flexibility, working memory and planning. Furthermore, mothers with negative to low PRF had a significantly earlier onset of substance use, in addition to meeting a dependency criteria earlier compared to mothers with adequate PRF. The results have implication for how interventions targeting SUD mothers may be individually customized.

4.2 Paper II: The association between Executive Functioning and Parental Stress and Psychological Distress is mediated by Parental Reflective Functioning in Mothers with Substance Use Disorder

Aims

The study aimed to investigate how the experience of stress (parental stress, general life stress and psychological distress) was associated with core Executive Functioning (EF) (working memory, inhibition and cognitive flexibility), controlling for sociodemographic variables (age, education and marital status) in mothers with substance use disorder (SUD). In addition, the study aimed to explore the possible mediating effect of parental reflective functioning (PRF) between EF (working memory, inhibition and cognitive flexibility) and stress (parental stress and psychological distress).

Method

The mothers ($N = 43$) were assessed for EF with a neuropsychological test battery. Two self-administered questionnaires, the PSI full version for parental stress and general life stress, and HSCL-10 items for psychological distress were completed. In addition, the mothers were interviewed and rated for PRF with PDI-R2. They were also interviewed with the EuroropASI for demographic variables and variables concerning the SUD. Correlations and regression analyses were used to test associations between the variables of interest. The mediation analyses were conducted according to Baron and Kenny's approach (1986), and the Sobel's test (1982) was applied to calculate the significance of the mediation.

Results

Parental stress and psychological distress were positively associated with all the EF components (working memory, inhibition and cognitive flexibility), while general life stress did not associate with any of the EF components. Cognitive flexibility made a unique contribution to variance in parental stress, while working memory contributed uniquely to variance in psychological distress. PRF mediated the relationship between EF and parental stress and partially mediated the relationship between EF components (inhibition and cognitive flexibility, but not working memory) and psychological distress.

Conclusion

The results suggest that mothers with SUD as a group are vulnerable for stress. EF, and particularly cognitive flexibility associates with parental stress level, and PRF mediates the relationship between EF and parental stress, indicating that capacity to reflect around the stressful experience affects how a mothers accesses EF capabilities. In addition, EF and particularly working memory associate with psychological distress. PRF had a partially mediating effect between EF components (inhibition and cognitive flexibility) and psychological distress. The results indicate that other variables in addition to PRF influences the association between EF and experience of psychological distress. However, working memory seems to affect psychological distress directly, without PRF as a mediator. Results have implication for interventions targeting regulation of parental stress and psychological distress, EF and PRF in mothers with SUD.

4.3 Paper III. Adverse and Adaptive Childhood Experiences are Associated with Parental Reflective Functioning in Mothers with Substance Use Disorder

Aims

The first aim was to investigate the association between parental reflective functioning (PRF) and adaptive (safety and competence) and adverse (emotional, physical, and sexual abuse, and neglect) in three developmental phases (early infancy, latency, and adolescence), controlled for executive functions (EF) and mental health status in mothers with a substance use disorder (SUD). Secondly, the study aimed to investigate in-group differences in particular types of adaptive or adverse experience, and by having adaptive or adverse experiences in a specific developmental phase, depending on exhibiting either a negative to low PRF or an adequate to high PRF, controlling for EF and mental health status.

Methods

The mothers ($N = 43$) were assessed for PRF with Parent Development Interview-Revised (PDI-R2) and completed the self-administered questionnaires: Traumatic Antece-

dents Questionnaire (TAQ) and Hopkins Symptom Checklist, 10 items (HSCL-10). In addition, to assess EF the mothers completed a battery of neuropsychological tests. Correlations and linear regression analyses were used to test associations between PRF and adaptive and adverse experiences. Multiple analyses of variance (MANOVA's) were used to test differences on adverse and adaptive experiences depending on mothers either exhibiting negative to low PRF, or exhibiting adequate to high PRF.

Results

Adaptive experiences in early childhood had a significantly positive association with PRF, while emotional abuse had significantly negative associations with PRF, after controlling for EF and mental health status. Mothers with negative to low PRF had significantly more adverse experiences, and less adaptive experiences, compared to mothers with adequate to high PRF, controlled for EF and mental health status. Furthermore, mothers with adequate to high PRF had significantly more experience with safety and competence, and less experience with emotional, physical, and sexual abuse, and neglect compared to mothers with negative to low PRF.

Conclusion

Our findings infer that the experience of emotional abuse and early childhood adaptive experiences affect the development of PRF. Furthermore, mothers with negative to low PRF have significantly more adverse experiences and less adaptive experiences. The results have implications for intergenerational transmission of risk and development of interventions.

5. Discussion

5.1 Interpretation and Discussion of the Findings

To the best of our knowledge, the current study is the first to examine the relationship between PRF and EF in SUD mothers with small children. In addition to PRF and EF, we explored mental health status, including the SUD, parental stress as well as adaptive and adverse experiences throughout childhood and adolescence in the mothers. The main findings of the study are discussed.

5.1.1 The Association between Parental Reflective Functioning and Executive Functioning

The key finding of this thesis is that we found an association between EF and PRF in SUD mothers. In Paper I, we found moderate to strong positive correlations between a number of EF subcomponents (working memory, cognitive inhibition, cognitive flexibility, and planning) and PRF. Our results are congruent with recent research investigating the association between EF and mentalizing capacities in mothers to small children. For instance, working memory and cognitive flexibility have been associated with PRF, measured with PRFQ in a group of healthy mothers (Rutherford et al., 2017). Another study found positive associations between working memory and mentalizing, while inhibition and cognitive flexibility were not associated with mentalizing (Yatziv et al., 2017). In our study, we used the PDI-RF to measure mentalizing and this measure is considered “gold standard” assessment of PRF (Slade, 2005). Multiple studies have confirmed the validity and reliability of the instrument in different populations, including SUD mothers (Levy & Truman, 2002; Slade, 2005; Slade et al., 1999; Slade, Bernbach, Grienberger, Levy, & Locker, 2005). Our results of an association between the two concepts are strengthened by those findings in different populations other than mothers with SUD. Contrary to our results, other research has not found significant associations between EF and mentalizing. One study measuring mentalizing with a projective test in a normative group of mothers to infants, found no association between EF and mentalizing (Turner et al., 2008). Another study that used PDI-RF in a group of mothers of children aged 9-12 years of age, did not find associations between PRF and EF either, even after controlling for substance abuse and mental health (Capstick, 2008). The lack of

associations in both these studies could have been related to methodological choices. For example, using the PDI-RF on older children might not have captured the essence of the instrument, which is originally developed for younger children. Likewise, it is possible that projective tests did not necessarily target PRF but other parts of mentalizing.

We used a major EF-factor constituted of all six EF-components in Papers I and III. When we controlled for IQ and mental health in Paper I, there was no significant contribution of the EF-factor on PRF, even if we found multiple strong correlations between individual EF components and PRF. There could be several explanations for these non-significant findings. Mental health status, but not IQ showed a significant unique effect in variance in PRF. Indeed, mental health issues have been negatively associated with both PRF (Camoirano, 2017; Slade, 2007) and EF (Gonzalez, 2015), supporting our results of mental health status as an important component in the association between PRF and EF. In Paper I and Paper III we used EF as a unitary construct. It is possible that only specific EF sub-components associated with PRF, not EF as a unitary construct. Previous research has shown that EF skills are only moderately correlated with each other, in addition to being sub-served by different brain regions (Friedman & Miyake, 2017; Marceau, Kelly, & Solowij, 2018; Miyake et al., 2000). It is possible that certain sub-components of EF could associate with PRF regardless of mental health status, while others are more sensitive for mental health. Furthermore, the overall PRF score was used in our analyses. Specific PRF sub-components (e.g. self-focused mentalizing or other-focused mentalizing), could have been significantly associated with the EF-factor, while the overall PRF was not after we controlled for mental health status. Moreover, although previous studies have found associations between PRF and general RF, the associations are unclear (Luyten, Nijssens, et al., 2017; Steele, Steele, & Busch, 2008). For instance, certain EF components, such as cognitive flexibility might be particularly important for parenting and as such associate strongly with PRF. Other EF skills might associate with more general RF and lower the association when EF is measured as a unitary construct. Indeed, when we divided the group of mothers in two, based on having an adequate or a negative to low PRF, there were significant between-group differences on several EF components but not on all. For example, mothers with negative to low PRF exhibited significantly poorer working memory, cognitive flexibility and planning compared to mothers with adequate PRF. There were no significant differences between the groups on inhibition or verbal fluency, though. Therefore, it seems that certain EF components might target PRF more than others. Results indicate that cognitive flexibility is particularly important for adequate PRF in mothers with SUD.

In our results, we found that SUD mothers had on average a low PRF score, which indicated that the mothers might have a poorly integrated capacity to keep a mental model of herself and the child in mind (Slade, 2005). There was a large in-group variation

in the PRF level, and we were interested to see if there were differences in EF depending on having an adequate PRF level or not. Adequate PRF provides the mother with a capacity to distinguish inner from outer reality, pretend from real modes, and mental processes from the physical reality (Luyten, Nijssens, et al., 2017). Deficits in PRF may indicate problems with abstraction and difficulties in moving beyond what is immediately observable. This process might lead to difficulties in attending to mental states as underlying behavior in oneself, or in the child (Fonagy & Target, 2002). Furthermore, adequate PRF involves the capacity of decoding others' mental states based on observation of cues, and reasoning about those as a way of understanding or predicting behavior (Hynes, Baird, & Grafton, 2006; Sabbagh, Moulson, & Harkness, 2004). PRF score of 3 or below indicates deficits in PRF and compromised abstraction ability, while PRF score of 4 indicates a conception of the mind (Fonagy, Target, Steele, & Steele, 1998; Katznelson, 2014). A cut-off at score 4 is considered average in a vulnerable or stressed population (Kelly, Slade, & Grienenberger, 2005; Levy, Truman, & Mayes, 2001).

We found that particularly cognitive flexibility, but also working memory and planning were significantly weaker in mothers with negative to low PRF compared to mothers with adequate PRF, even after controlling for mental health status and IQ. Interestingly, mothers who had an adequate PRF exhibited EF similar to what could be expected in a healthy sample (Shunk et al., 2006). A mother requires a good-enough working memory capacities to understand her own and her child's mind in an on-going interaction (Gonzalez, 2015). At the same time, she needs to be aware of, and update changes in herself, the child and the dyad to be able to appropriately relate to mental states (Meins, Fernyhough, Fradley, & Tuckey, 2001; Slade, 2005; Yatziv et al., 2017). Moreover, a mother needs capacity to plan, to prepare and organize for future events and outcomes, in addition to keep a focus and simultaneously keep mental states in mind. Indeed, planning has been suggested as an essential skill for making effective reflections about oneself and others (Carlson, Claxton, & Moses, 2015; Carlson, Moses, & Claxton, 2004). Cognitive flexibility may contribute to a parent/mothers capacity to be able to look at a situation from her own perspective, and then reflect on the same situation from her child's point of view. That requires a capacity to shift back and forth between mental sets. Parenting also requires shifting between tasks while simultaneously caring for the child (Gonzalez, 2015; Rutherford et al., 2017). In a recent study, individual differences in cognitive flexibility have been suggested to be a regulatory capacity associated with perspective taking (Long, Horton, Rohde, & Sorace, 2018). A mother who has difficulties in cognitive flexibility might be more likely to either focus on own mental state or the child's mental state without the capacity for shifting. Alternatively, the mother may solely focus on behaviour without having the capacity to shift between what is observable and its mental counterpart. It could be that cognitive flexibility requires high levels of mental capacity (i.e. cognitive effort). Alternatively, PRF and EF might share

a common underlying function that is impaired in mothers with SUD. Adequate RF has been labelled as 'adaptive flexibility' (Allen, Fonagy, & Bateman, 2008). In line with this, our results indicate that having elasticity in capacity for abstraction and especially in shifting modes is essential for adequate PRF. A recent review highlights the negative effect of SUD on orbitofrontal cortex, the area of the brain that promotes flexible motivated behavior (Moorman, 2018). In addition, the orbitofrontal cortex is shown to be related to both cognitive and emotional perspective taking (Hynes et al., 2006; Powell, Lewis, Dunbar, García-Fiñana, & Roberts, 2010). Together, these findings suggest that PRF and EF share common functions / processes and hence could be dependent of or related to each other.

Several dimensions of mentalizing have been described. These polarities have been characterised as: self/other, internal/external, automatic/controlled and cognitive/affective processes (Fonagy & Luyten, 2012; Luyten et al., 2012; Luyten, Nijssens, et al., 2017; Slade, 2005). Our findings of mothers who have a compromised EF and low PRF might display a rigidity in adapting to mental and behavioural circumstances along these dimensions, while mothers with adequate PRF and a well-functioning EF may display more flexibility in the four dimensions.

The ability to differentiate between aspects of oneself and the child (self/other-dimension), and having a capacity to shift focus back and forth in a flexible manner are core features of adequate PRF (Luyten, Nijssens, et al., 2017). Mothers with deficits in PRF and EF in our study might have difficulties in either reflecting about herself, about her child, or both. Parents with SUD have been shown to display difficulties in conceptualizing and processing their own emotions while simultaneously reflecting about the mental state of their child (Neger & Prinz, 2015; Slade, Grienemberger, Bernbach, Levy, & Locker, 2005). This could mirror a lack of mental capacity (i.e. cognitive effort) leading to deficits in both PRF and EF. Moreover, deficits in perspective taking have been negatively associated with difficulties in cognitive flexibility (Carlson et al., 2015; Stuss & Knight, 2002; Wunderli et al., 2016). One study found that the shift from 'oneself' to 'the other' is cognitively more demanding than the opposite (Bradford, Jentsch, & Gomez, 2015), indicating the need for effortful control, and understanding of the 'self' as a prerequisite for understanding of the 'other'. A series of studies have highlighted the presence of a self-reflective and an interpersonal component in PRF in SUD mothers (Suchman, 2016; Suchman et al., 2012; Suchman, DeCoste, Borelli, & McMahon, 2018; Suchman et al., 2017). In these studies, self-focused mentalizing (i.e. the mothers ability to mentalize primarily about own emotions and their impact on her child) was associated with maternal contingent behavior and maternal sensitivity, while child-focused mentalizing (i.e. the mother's capacity to mentalize about her child's emotions and their impact on herself) was not. The ability to understand oneself is therefore sug-

gested a prerequisite to understand other's perspectives and the ability to flexibly shift back and forth. Results from our study of PRF being associated with EF, might expand on this research by delineating possible components underlying PRF. That is, deficits in EF, especially cognitive flexibility might shed light on difficulties in PRF, especially vulnerabilities in perspective taking.

In adequate mentalizing, cognitive and affective mental states interact (Fonagy & Luyten, 2012). Mothers with weak EF and difficulties in PRF could be easily overwhelmed by emotional cues, with difficulties in integrating cognitive reflections with affective experiences (Blatt, 2008; Fonagy & Luyten, 2012). In Paper II, mothers with difficulties in cognitive flexibility were found to be particularly vulnerable for parental stress, which might play out as difficulties in integrating cognitive and affective mental states. It is also possible that others might lack an affective experience, although they display a cognitive understanding (Blatt, 2008). Mothers with poor EF and PRF might have had difficulties in integrating cognitive interpretation of emotional experiences, which are fundamental aspects of alexithemia (Bermond, Vorst, & Moormann, 2006; Lysaker et al., 2017). A compromised capacity for attention and cognitive flexibility has been associated with difficulties to attribute complex emotional and motivational states in self and others (Decety & Sommerville, 2003). Hence, mothers in our study with deficits in PRF and EF might display difficulties in balancing cognitive and emotional experiences by giving excessive weight to one or the other. In Paper II, results showed that parental stress was particularly associated with cognitive flexibility, and that PRF mediated the association between EF and parental stress. Level of stress is related to emotion regulation capacity in mothers (Deater-Deckard et al., 2016). It is possible that a group of mothers had mentalizing difficulties along the cognitive-emotional dimension, possibly contributing to regulation difficulties, and an experience of higher parental stress. Supporting our suggestions, recent research found associations between EF and emotion regulation in women with SUD (Marceau et al., 2018), and between distress tolerance and PRF (Rutherford, Booth, Luyten, Bridgett, & Mayes, 2015).

Mentalizing might also vary on a dimension of internal and external features (Fonagy & Luyten, 2012). Adequate mentalizing can include the capacity to shift focus between external visible features (e.g. behaviour) and internal counterparts (e.g. thoughts, feelings and experiences) in both in self and in others' (Fonagy & Luyten, 2012). Mothers with limited PRF and EF in our study might have had difficulties in interpreting external behavior as internally driven, or as understanding that internal feelings, thoughts and motivation might display behaviourally. It is suggested that compromised mirroring of affective states in early childhood might lead to difficulties in understanding internal states from external features, in adulthood (Fonagy & Luyten, 2012). Moreover, mirroring in infancy is considered critical for development of later affect regulation capacities

as well as development of mentalizing (Bernier, Carlson, & Whipple, 2010; Gergely & Watson, 1996; Gross, 2013). In Paper III, we highlighted the significance of adaptive experiences in early childhood and experience of emotional abuse for capacity of PRF. It is possible that mothers with experiences of emotional abuse and lack of adaptive early childhood experiences could have experienced inadequate mirroring of internal states, which could have led to rigidity in mentalizing along the internal/external dimension in adulthood seen in a group of mothers in our study. On the other hand, mothers with presence of adaptive experiences in early childhood likely had more contingent mirroring, hence possibly leading to a more flexible PRF.

Controlled, explicit mentalizing is conscious, and as such, a relatively slow process that requires effort and attention, whereas automatic mentalizing is a fast implicit process (Allen et al., 2008; Satpute & Lieberman, 2006). Mothers who experience themselves as being in a secure context when relating to their child tend to rely more on implicit mentalizing (Bartels & Zeki, 2004), but with the ability to shift to explicit mentalizing in more demanding situations (Fonagy et al., 2004). For instance, if it is difficult for a mother to soothe her baby, it is necessary with explicit reflections to try to make sense of possible reasons for the baby's discomfort. Impairments in EF and PRF might as such display as either relying on implicit impulses in situations that requires cognitively explicit reflections, or by leaning heavily on explicit mentalizing in situations that could have been processed implicitly. Both make the cognitive system less effective. In Paper III, we highlighted the importance of adaptive and adverse childhood experiences for PRF. Individuals that have been subjected to early relational adversity are prone for implicit automatic reactions to stimuli that are only subtly reminiscent of the original stimuli (Cook et al., 2005; Perry, 2009). As such, relational stress could potentially reduce the flexibility between implicit and explicit mentalizing (Scheeringa & Zeanah, 2001). As seen in Paper II, mothers with poor EF experienced high levels of parental stress although PRF mediated the association. Mothers with poor EF in addition to low PRF were hence at risk for parental stress dysregulation. It is possible that these dynamics are related to a tendency of reacting implicitly on relational demands although an explicit reflection would have been appropriate, which could reflect a difficulty in shifting from implicit to explicit mentalizing when needed.

Our study did not allow us to determine directionality of the association between PRF and EF, and it is possible that the association between PRF and EF is bidirectional. Based on results from Paper I, we suggest that it is likely that higher capacities in EF provide more cognitive resources for PRF. We therefore suggest a well-functioning EF system, and particularly cognitive flexibility, to be a prerequisite of adequate PRF. In Paper II however, PRF mediated the association between EF and stress (parental stress and psychological distress). The results indicate that a well-functioning PRF might allow for

EF resources when a mother is in need for them. Meaning, if mothers have an adequate capacity to reflect around a stressful situation it might be easier for her to access the EF capacities she needs to handle the situation. As such, our results from Paper I and Paper II suggests that EF and PRF might work in a bi-directional manner.

5.1.2 Q, Parental Reflective Functioning and Executive Functioning

In Paper I, we introduced general IQ as a control variable when we investigated the association between PRF and EF. Previous studies have demonstrated moderate positive associations between PRF and IQ (Steele et al., 2008), while others did not find such an association (Grienberger & Slade, 2002). Several studies have shown an association between EF and IQ (Diamond, 2013; Friedman & Miyake, 2017), although there are differences in how IQ relates to different EF components. It seems that working memory is associated with IQ, but not inhibition or cognitive flexibility (Friedman et al., 2006). As presented in Paper 1, IQ did not significantly contribute to variance in PRF in our group. Throughout this thesis, the EF sub-component cognitive flexibility has been particularly associated with PRF. It is possible that lack of association between IQ and cognitive flexibility seen in previous studies (Friedman et al., 2006) highlighted why IQ did not contribute to variance in PRF in our study as cognitive flexibility seemed particularly important for PRF in SUD mothers.

5.1.3 Mental Health Status, Parental Reflective Functioning and Executive Functioning

We included mental health status in all three Papers. Poor mental health is associated with compromised PRF (Allen & Fonagy, 2002; Bouchard et al., 2008; Camoirano; Fischer-Kern et al., 2013) and poor EF (Friedman & Miyake, 2017; Gonzalez, 2015; Snyder, 2013). However, mental health issues do not necessarily imply low PRF (Pawlby et al., 2010; Rigby, Conroy, Miele-Norton, Pawlby, & Happé, 2016). Therefore, we were interested in how mental health affected the relationship between PRF and EF. In Paper I, introducing mental health status as a control variable diminished the significant association between PRF and EF, which highlighted the importance of mental health status for the relationship between PRF and EF as a general construct. The results indicated that mothers with increased mental health problems experienced more severe difficulties in PRF if EF was low. It is possible that capacities for both PRF and EF were reduced because of emotional difficulties. Indeed, mental health issues are known to exhaust emotion regulation capacities, which in turn decrease both EF and PRF (Fonagy et al., 2004; Heim, Shugart, Craighead, & Nemeroff, 2010; Hofmann, Schmeichel, & Baddeley, 2012; Rutherford, Booth, Crowley, & Mayes, 2016; Schmeichel & Tang, 2014). Specifically, mental health status affects flexible thinking and attention by decreasing the capacity to adequately attend to own and others perspectives (Allen &

Fonagy, 2002). These impairments have negative implications for self-organization and affect-regulation, and are at the core of many mental health problems (Fonagy & Target, 2002; Gergely & Unoka, 2008). When we investigated mental health status (termed psychological distress in Paper II), it was associated to poor working memory. PRF did not mediate the relationship between working memory and psychological distress. In a recent study, weak working memory was shown to negatively associate with difficulties in emotion regulation strategies in mothers to small children (Rutherford et al., 2016). Emotion regulation deficits have been associated with psychological distress, both in normative samples and in mothers with SUD (Daughters, Lejuez, Kahler, Strong, & Brown, 2005; Deater-Deckard et al., 2016; Leyro et al., 2010). Our results indicate that there might be a more direct association between poor working memory and psychological distress, without the mediating effect of PRF. There might be other mediating components, though. For instance, it is possible that education level could have mediated the effect between working memory and psychological distress. In our results, psychological distress was strongly associated with education while the other forms of stress (parental stress and general life stress) were not. In addition, working memory is known to be sensitive to IQ, while inhibition and cognitive flexibility are not (Friedman et al., 2006). However, PRF partially mediated the association between inhibition and psychological distress as well as between cognitive flexibility and psychological distress partially. To have adequate capacities in inhibition and cognitive flexibility and an ability to reflect, are likely to diminish the risk of heightened psychological distress. However, other variables in addition to PRF are likely needed to explain mediation.

Based on results from Papers I, and II, we were further interested in investigating possible dynamic aspects of our previous findings in Paper III. It is well documented in research that adverse and adaptive interpersonal experiences during childhood and adolescence affects adult mental health (Belsky & Pluess, 2009; Fonagy & Campbell, 2017; Heleniak et al., 2016; Shonkoff et al., 2012; Teicher et al., 2016). Results in our study were congruent with these studies, showing that mothers with adaptive experiences in early childhood also had better mental health status, which combined contributed to a higher PRF level. Furthermore, results also suggested that mothers with few adaptive experiences in early childhood had poorer mental health and lower PRF. Findings in all three Papers indicate that mental health status is important to take into consideration when focusing on PRF and EF.

5.1.4 Substance Abuse, Parental Reflective Functioning and Executive Functioning

Empirical literature has documented the effects of substance abuse on cognitive functioning, both during active use and during abstinence (Mintzer, Copersino, & Stitzer, 2005; Mintzer & Stitzer, 2002; Moreno-López et al., 2012; Verdejo-García et al., 2006).

Mothers in our study showed considerable heterogeneity in terms of drug preference, frequency of use, and how early they met the criteria for SUD. Previous studies have demonstrated a link between preferred substance and successful interventions targeting PRF (Pajulo et al., 2012) and between substance preference and social cognition (Quednow, 2017), which is a capacity known to be related to mentalizing (Górska & Marszał, 2014; Nolte et al., 2013). Results from these studies indicate an association between type of substance preference and PRF. Contrary to these studies, and our expectations, findings in Paper I suggests that there were no significant differences between preferred substance based on having an adequate PRF level or not. Mothers with negative to low PRF significantly more often reported polysubstance-abuse compared to mothers with adequate PRF, though. We hypothesize that a chaotic use of substances might have reflected an impaired PRF level more than any particular type of substance preference in our group of mothers. Confirming our results, polysubstance abuse has been associated with deficits in ToM (Sanvicente-Vieira et al., 2017), and with more difficulties in EF than single use dependency (Domínguez-Salas, Díaz-Batanero, Lozano-Rojas, & Verdejo-García, 2016; Schmidt, Pennington, Cardoos, Durazzo, & Meyerhoff, 2017). Our group of mothers appeared particularly vulnerable to stress, and this was associated with compromised EF and PRF (Paper II). Mothers with polysubstance abuse might have had particular difficulties in regulating complex affective states as stress, hence the need to use many substances simultaneously for regulation. It is also possible that mothers with weaker EF had reduced capacity for recollection while using, hence the chaotic substance use pattern. Together, our results and previous research indicate a possible association between PRF, EF and polysubstance use in SUD mothers.

Mothers with negative to low PRF in our study, reported significantly earlier onset age of substance use, and age of meeting the dependency criteria compared to mothers with adequate PRF. Importantly, these mothers also exhibited significantly more deficits in EF compared to mothers with adequate PRF. Consistent with our results, early onset of substance use has been associated with low PRF (Suchman, McMahan, et al., 2006). Interestingly, mothers in our study with low PRF were diagnosed with SUD in adolescence, while mothers with adequate PRF acquired a SUD diagnosis during adulthood. Multiple studies have suggested early substance use to adversely impact the brain development, especially prefrontal functions particularly during cognitive demanding tasks (Andersen, 2016; Koob & Volkow, 2016; Lubman, Yücel, & Hall, 2007; Nguyen-Louie et al., 2018). Furthermore, early onset of substance use heightens the likelihood of later dependency (Bechara, Martin, & Becker, 2004; Rutherford, Gerig, Gouillard, Potenza, & Mayes, 2015). A recent study highlights the importance of ventromedial prefrontal cortex as facilitating development of identity and cognitive control related to adolescence as a period that foster autonomy and connectedness (Pfeifer & Berkman, 2018). It is possible that early substance use and substance dependency

compromised important developmental tasks in mothers who reported early use and dependency, hindering adequate development of PRF and EF. Moreover, prefrontal cortex has also been found to be important for parenting functioning (Bridgett, Kanya, Rutherford, & Mayes, 2017; Gonzalez, 2015), EF (Davidson, 2001; Tekin & Cummings, 2002) and PRF (Frith & Frith, 2006; Powell et al., 2010). A recent review highlights the negative effects of substance abuse on orbitofrontal cortex, an area in the brain that promotes flexible motivated behaviour (Moorman, 2018). Early onset of substance use and SUD could have affected normal neuropsychological development, possibly leading to deficits in both PRF and EF, particularly cognitive flexibility. Together, our results and previous research, leads us to suggest that cognitive flexibility is particularly important for PRF in SUD mothers.

A lack of social and emotional experiences normally present in adolescence might have contributed to heightened levels of emotional dysregulation and stress related both to PRF (Rutherford et al., 2015), and EF (Zelazo & Cunningham, 2007). It is possible that results in Paper II which depicted a general high stress level in the mothers could be partially explained by early substance use. Multiple studies have found that weak EF is associated with onset age of substance use (Kim-Spoon et al., 2017; Peeters et al., 2015). Early onset is suggested to be a precursor of severe substance abuse and mental health problems (DeWit, Adlaf, Offord, & Ogborne, 2000; Jordan & Andersen, 2017; Richmond-Rakerd et al., 2016). Mental health status has already been discussed as an important factor related to the association between PRF and EF, and we suggest that early substance use also might play a part / be a contributing factor.

5.1.5 Parental Stress, Parental Reflective Functioning and Executive Functioning

Previous studies suggest that impairments seen in parenting in SUD mothers could be secondary to dysregulated stress (Rutherford & Mayes, 2017). Therefore we were interested in investigating parental stress and its relation to EF and PRF. SUD mothers have been found to often experience emotion dysregulation in response to parental stress (Skowron, Kozlowski, & Pincus, 2010; Suchman et al., 2012). In addition, individual differences in EF may influence subjective experience of stress, and is suggested to be central in regulation of stressful experiences (Williams et al., 2009). Congruent with these findings, mothers in our study experienced stress close at a clinical lever (parental stress) or within a clinical level (general life stress and psychological distress).

Decreased PFC functions, related to EF are associated with increased stress (Li & Sinha, 2008) and are known as a vulnerability for substance abuse (Sinha, 2008). In addition, EF serves self-regulation across a variety of cognitive, emotional and behavioural responses to the experience of stress (Miyake & Friedman, 2012). Based on

this, we expected selected EF components (e.g. working memory, cognitive inhibition and cognitive flexibility) to associate with parental stress. Based on results from Paper I, we particularly expected cognitive flexibility and working memory to correlate strongly with parental stress. Congruent with our hypothesis, all the EF components correlated with parental stress, but only cognitive flexibility contributed uniquely to the variance, highlighting the particular importance of capacities and deficits of cognitive flexibility in this group of mothers. Several studies have previously highlighted the association between deficits in cognitive flexibility and stress (Alexander, Hillier, Smith, Tivarus, & Beversdorf, 2007; Plessow, Fischer, Kirschbaum, & Goschke, 2011; Shields, Szma, & Yonelinas, 2016). A recent study found that impairments in cognitive flexibility is related to emotion dysregulation in women with SUD (Marceau et al., 2018), known to relate to stress in mothers with small children (Deater-Deckard et al., 2016).

When we introduced PRF as a mediator between the EF components and parental stress, PRF had a mediating effect according to Baron & Kenny's approach (1986). Our results indicate that PRF had a regulating or a dysregulating function on the experience of parental stress, depending on it being adequate or poor. Mothers with good enough PRF might have had enhanced capacities to access EF, and particularly cognitive flexibility when subjected to relational demanding situations because they were able to reflect upon them. On the other hand, mothers with poor PRF could have had less access to EF capabilities, making the experience of stress more dysregulating. Because PRF mediates the relationship between EF and parental stress, it is possible that a group of mothers were particularly vulnerable to EF deficits in regards of heightened parental stress, while others were not. Supporting our results, a recent study found that low PRF heightens stress sensitivity in mothers with mental health problems (Krink, Muehlhan, Luyten, Romer, & Ramsauer, 2018). PRF is a dynamic, non-static capacity, and a person under stress has a tendency to fall back on automatized behaviour, indicating less flexibility and a diminished capacity for explicit reflection (Yu, 2016). It is possible that a rigidity in PRF could have heightened stress sensitivity leading to an automatized parental stress response when reflective capacities were not there to help. Perspective taking is a core element of PRF (Slade, 2005), and mentalizing has previously been suggested as essential in regulating strong emotions (Fonagy & Bateman, 2016; Rutherford et al., 2015). Together, previous research supports our suggestion that PRF might function as a buffer between EF and the experience of parental stress, or as a risk factor, that heightens the experience of parental stress. Mothers with adequate stress regulation might have had access to cognitive flexibility via the capacity to reflect, while mothers with poor PRF might have had fewer abilities to access EF regulation strategies thereby affecting parental stress level more. Individual capacities in allocating EF under stress are suggested to work in a dynamic process (Kluwe-Schiavon, Viola, Sanvicente-Vieira, Malloy-Diniz, & Grassi-Oliveira, 2016). Some mothers in our study might have had higher tolerance for

stress through a better functioning PRF, and therefore were able to access EF capabilities. Other mothers could have become easily dysregulated when facing stress and therefore had less access to EF (Kluwe-Schiavon et al., 2016). In support of this suggestion, recent neuropsychological evidence infers that EF is placed on a continuum, rather than being either “hot” or “cold” and that different EF capacities are used in a more dynamic fashion than previously suggested (Nejati, Salehinejad, & Nitsche, 2018). Mothers with more effective and adaptive EF might have had more developed capacities to adjust and use EF when faced with stress. We suggest that it might be due to a higher capacity for PRF and an ability to explicitly reflect around the situation.

It is also possible that EF could have affected PRF (as suggested in Paper I), so that poor EF weakened PRF and accordingly heightened the experience of parental stress. In line with this possibility, previous studies have suggested that shifts in PRF capacity partly depends on level of stress (Fonagy, Luyten, & Strathearn, 2011).

The etiological underpinnings to parental stress are likely to be multidimensional. For example, impairments in hippocampus, PFC and enhanced amygdala functions after early life adversity may increase stress responses later in life (Kim et al., 2013; Loman et al., 2013; Teicher & Samson, 2016; Teicher et al., 2016). Early adversities may disrupt development of effective emotion regulation and interpersonal capacities needed for parenting, making the demands and cues from the child potentially overwhelming (Burns et al., 2010; Cicchetti & Rogosch, 2009). Furthermore, recent research has identified maternal trauma to affect the amount of stress a mother experiences in relation to her child (Pointet et al., 2018). Impairments in mentalizing often occur under conditions of high emotional arousal, particularly under circumstances where an individual's attachment needs are activated (e.g. loss, closeness). In the absence of the capacity to mentalize, an individual is more likely to confuse internal and external signals in an effort to self-regulate (Fonagy & Target, 2002). Moreover, excessive arousal may become sensitized and the threshold for shifts in PRF and EF capacities may therefore be limited (Kluwe-Schiavon et al., 2016; Mayes, 2000). Overall, adverse childhood and adolescence adversity may make a particular group of mothers more vulnerable for a number of difficulties, e.g. parental stress and weaker EF and PRF capacities. Therefore, we wanted to further investigate early adversity and adaptive experiences and possible associations with PRF and EF in Paper III.

5.1.6 Adaptive and adverse childhood experiences, PRF and EF

Multiple studies have identified early adversity as a common experience in SUD populations (Anda et al., 2006; Conway, Raposa, Hammen, & Brennan, 2018; Kim, Kwok, et al., 2017). Therefore, we expected that the mothers in our studies would report a high degree of adverse childhood experiences, and few adaptive experiences. Confirming our

hypotheses, the results in Paper III identified that the group of mothers as a whole, reported prolonged experiences of multiple interpersonal adversities, as neglect, emotional, physical and sexual abuse throughout early childhood, latency and adolescence. Exposure to adversity is known to be harmful for the developing child, and increases risk for mental health problems, including SUD in adulthood (Briere, Kaltman, & Green, 2008; Cook et al., 2005; B. A. Van der Kolk et al., 2005).

Emotional abuse, above other forms of abuse and neglect significantly explains variance in PRF in the mothers in our study. Childhood emotional abuse has previously been found to negatively affect PRF (Bottos & Nilsen, 2014). Fundamental aspects of self-development are known to be targeted (Barlow, Turow, & Gerhart, 2017; Fonagy, Gergely, & Target, 2007). Having a caregiver who demeans, threatens or ignores the child, may impair the possibility to create a coherent narrative and a well-functioning inner working model of a self, as well as a self in relation to others for the developing child (Schmeichel, Volokhov, & Demaree, 2008). In addition to presence of adversities, mothers in our study as a group reported few adaptive experiences throughout childhood and adolescence. Lack of resilience enhancing experiences such as access to safety in attachment relationships, or experience of competence related to agency and self-development might have exacerbated the negative effects of growing up in an adverse environment in our group of mothers. Emotional abuse might further have reduced second-order cognitive appraisal to develop affect regulation capacities and social-cognitive skills (Bram & Gabbard, 2001; Fonagy et al., 2007; Gergely & Unoka, 2008), which might eventually have affected PRF. PRF involves an ability to appreciate the inner world of oneself and others, hence emotional abuse could be linked to self-conception and development of self-identity. It has been hypothesized that early adversity in attachment relationships leads to a 'fear of minds', reflecting possible difficulties with boundaries between self and others (Bromberg, 2008; Brown, 2005; Fonagy et al., 2004; Fonagy, 2010; Levine, 2008). Mothers who experienced childhood emotional abuse could have experienced an elevated persistent experience of fear, known to represent a risk factor for development of regulation capacities and tolerance of distress (Egeland, 2009; Hart, Binggeli, & Brassard, 1997). These studies in addition to our results in Paper III may help inform our results regarding experience of parental stress and psychological distress (mental health status) in Paper II.

The EF-factor (constituting of working memory, inhibition, cognitive flexibility, verbal fluency and planning) contributed significantly to the variance in PRF. EF was in turn negatively associated with emotional abuse. Several studies have highlighted the association between adversities in childhood and impairments in adult EF (Hanson et al., 2015; Hostinar, Stellern, Schaefer, Carlson, & Gunnar, 2012; Viola et al., 2013). We expand on this knowledge by highlighting that SUD mothers with increased le-

vels childhood emotional abuse had a weaker EF system in addition to a lower PRF.

Recent research identifies that there are specific vulnerabilities when an individual has experienced multiple forms of relational trauma over time, without presence of adaptive experiences (Cecil, Viding, Fearon, Glaser, & McCrory, 2017), such as safety and agency. Our results indicated that a group of mothers, who reported experiencing multiple forms of adversities throughout childhood and adolescence, also reported fewer adaptive experiences. Another group of mothers in our study reported presence of adaptive experiences throughout childhood and adolescence and reported fewer adverse experiences. Yet another group reported presence of both adverse and adaptive experiences. Interestingly, only presence or absence of adaptive experiences (safety and competence) in early childhood (0-6 years) were uniquely associated with variance in PRF level, even after controlling for EF and mental health status. Our results suggest that having, or not having adaptive experiences early in life was significantly more important than presence or absence of adversity throughout childhood and presence of adaptive experiences later in life for PRF.

Safe positive relationships and a sense of agency are showed to represent protective resilience factors for children growing up in adversity (Luthar, 2006; Shonkoff et al., 2012; Stein, 2006), although the severity of adversity weakens the strengthening effects of resilience factors (Holmes, 2017). Furthermore, safe regulatory relational experiences in early childhood are essential for development of adult emotion regulation capacities (Dunn, Nishimi, Gomez, Lott, & Bradley, 2017; Schore, 2015). It is possible that consequences of lack of adaptive experiences in early childhood seen in the analyses in Paper III, play out as stress-related regulation difficulties in a group of mothers with low PRF seen in Paper II. Indeed, development of effective regulation capacities in childhood has been associated with resilience and adult capacity of tolerating distress (Friston, 2010; Holmes, 2017; Schore & Schore, 2008; Tronick, 2007). Adaptive experiences in early childhood might have allowed for better regulation capacities in adulthood accessing EF and PRF capacities in a more adaptable manner compared to mothers who lacked such experiences in early childhood.

Adaptive experiences might also make it easier for a person to relate to others in a trusting manner. In contrast to episodic memories, which makes conscious recollection of the actual experience possible to reflect upon, experiences in early childhood are mainly procedural and implicit (Fonagy & Campbell, 2017). As such, they are not necessarily accessible for explicit reflection without conscious effort, which results in some memories remaining unconscious and therefore not accessible. Early experiences are suggested to lead the child to encode bodily, affective and relational experiences as a means to develop a sense of self (Critchley, Mathias, & Dolan, 2001; Fonagy et al., 2004; Gergely & Unoka, 2008). The potential emotional charge of experiences (adapti-

ve and adverse) may thereby become embodied and implicit, rather than explicit. These experiences could then potentially be manifested in later relationships, including with one's child (Shai & Belsky, 2011; Shai & Belsky, 2017). It has previously been suggested that early adversities might be transferred to the next generation through implicit ways of relating to a child (Fraiberg et al., 1975). Our study expands on this knowledge by highlighting the particular importance of presence or absence of adaptive early childhood experiences as essential for PRF.

When our group of mothers were divided in two based on PRF level (adequate or low), mothers with adequate PRF had significantly more adaptive experiences (safety and competence) and less adverse experiences (emotional, physical, sexual abuse and neglect) throughout childhood and adolescence, after controlling for EF and mental health status. We suggest that the results seen in Paper III may have implication for the parent-child relationship and may also affect how accessible a mother is for receiving clinical interventions. In addition to affecting attachment and emotion regulation capacity, early life relational experiences affect the capacity for epistemic trust (Knox, 2016). Research has primarily focused on how children develop epistemic trust (Fonagy & Campbell, 2017), and how they develop epistemic mistrust or vigilance (Fonagy et al., 2015; Knox, 2016; Sperber et al., 2010). In addition, there has been a focus on how presence or absence of epistemic trust has consequences for therapeutic relationships and change (Fonagy & Allison, 2014; Fonagy & Campbell, 2017; Fonagy et al., 2017). Risk for epistemic mistrust accompanied with a diminished capacity to learn from relational experiences are prevalent after adverse childhood experiences (Fonagy & Campbell, 2017; Knox, 2016). It is possible that epistemic trust and mistrust affects the quality of the dyadic relationship between mother and child. Having a child provides the mother opportunities to learn about her maternal self, the child and the dyadic relationship by being a mother (Stern, 1995). It is possible that mothers who had few adaptive experiences and exhibited poor PRF capacities found relational learning from the dyadic relationship more challenging compared to mothers with more adaptive childhood experiences and higher PRF. Previous studies have showed that PRF level is associated with parental behavior (Pajulo et al., 2012; Stacks et al., 2014; Suchman et al., 2017). It is possible that our findings of presence of adversity and lack adaptive experiences as significantly more common in mothers with negative to low PRF could relate to epistemic mistrust in the dyadic relationship. Exploring the relationship between epistemic trust and dyadic relationships could be an area for future studies to investigate.

5.2 Methodological Considerations

5.2.1 *Advantages*

The results in our study increase and deepen an understanding of cognitive mechanism underlying PRF in in SUD mothers. To our knowledge, this is the first study to investigate the association between PRF and EF in SUD mothers with small children. To strengthen our design we introduced a number of additional processes known as relevant for development and maintenance of SUD, including mental health status, stress and adaptive and adverse childhood experiences. By combining observations, clinical assessments, interviews, and self-report questionnaires, in addition to using a comprehensive and psychometrically sound research battery, the study contributes to accumulated evidence of the association between PRF and EF, and as well as its complexity and multifaceted quality. An important factor is that all the mothers completed the full test battery, which increases validity of our analyses.

Parental SUD is associated with intergenerational transmission of risk. In addition, mothers with SUD are considered a difficult group to offer appropriate, individually customized interventions that has long-term effects (Luthar, D'Avanzo, & Hites, 2003). Results from this study could help strengthen our knowledge on how to develop more effective, individually targeting clinical interventions to offer to parents with SUD and their children. It is still important to be aware of methodological challenges in interpreting the results in this study, and these are discussed below.

5.2.2 *Cross-sectional design*

The study had a cross-sectional design, and we predominately conducted correlations and regression analyses. Therefore, the possibility of determining causality between the variables was limited, and we were not able to infer directionality.. For example, having pre-existing difficulties in EF and PRF might heighten vulnerability for adverse childhood experiences. It is possible that EF is a prerequisite for PRF, as we suggested in Paper I. It is also possible that PRF is a mediator in how EF associates with others variables as shown in Paper II. PRF could also be a consequence of dynamic factors as suggested in Paper III. By conducting MANOVA's in Paper I and Paper III, and mediation analyses in Paper II, we attempted to delineate possible directions as far as possible. In addition, we used PRF, EF, mental health and IQ as control variables in the different analyses. However, as this was not an experimental treatment design with a randomized sample or a healthy control group, causation cannot be inferred. Instead, we aimed to explore the relationship between what we considered relevant variables and suggested possible interpretations of the results in the Papers and in this thesis. Future research with prospective or longitudinal designs could determine the direction and temporal order of relationships among the variables.

5.2.3 Sample Size and Characteristics

We had a total sample of 43 respondents with notable heterogeneity. Although the number of participants were well within the norm for similar studies of parents with SUD (Pajulo et al., 2012; Suchman, Pajulo, DeCoste, & Mayes, 2006), the sample size posed some statistical limitations or might have impeded the quality of the analyses. For example, with a small sample, the number of covariates we were able to enter into the analyses were limited. Controlling for, or demonstrating possible relationships with other variables were therefore not always possible. Although we conducted mediation analyses in Paper II, the sample size makes it necessary to replicate the study with a larger sample. Especially non-significant findings must be considered with caution. It is possible that more group differences could have been detected in a larger sample when we compared different groups of mothers in the Chi-squares and the MANOVA's. In addition, when we divided the group of mothers in two based on PRF level, the number of participants in each group were skewed. Although the division was clinically meaningful (adequate or low PRF) and is likely to be representative for mothers with SUD, it might have created methodological limitations. Even so, the use of dichotomised data appeared useful, and should be adopted in future studies. A replication study with a larger amount of participants is therefore needed for confirmation of our results.

5.2.4 Representativeness, Participation and Selection Bias

The mothers were recruited from outpatient clinics, municipality nurses, and residential treatment institutions over large parts of Norway from both small and large cities. We therefore considered the sample to consist of a representative diversity of SUD mothers as they display in Norway. Even so, the mothers lacked unifying characteristics except for being a recent mother and being diagnosed with a SUD at a point in time. Indeed, demographic variables and diagnostic characteristic were highly diverse in nature. As all the participants had a SUD, the mothers were predominately drawn from clinical populations, although there were great diversity concerning periods of abstinence, heavy use, occasional use and intravenous substance use. Even so, our population was mainly represented by mothers who had been seeking, or been willing to accept help. It is possible that a group of parents, who have substance use problems, do not have contact with treatment facilities. It may be that having other inclusion criteria with lower thresholds and possibilities to recruit outside clinical facilities could have affected the results in our analyses, as well as being more representative.

Clinicians at residential treatment facilities and outpatients clinics, and municipality nurses were in charge of the recruitment of families. The selection bias was considered as small, as only five mothers who were asked to participate declined. Although the inclusion and exclusion criteria were clearly delineated, it is possible that some mothers

that would have been eligible were not informed about the study and asked to participate due to clinical evaluation from the recruiter. The recruiters could have had different thresholds for whom to ask to participate or not, which may have affected representativeness. Recruitment bias is therefore important to bear in mind when generalizing from the results.

As UH was involved in the recruitment, and conducted the large majority of the assessments, it was important to ensure objectivity in coding and in interpretation of the data. This was especially important in coding of the PDI, where knowledge about the mother's performance in other parts of the test battery could have influenced interpretation and scoring of PRF. Therefore, we had reliable coders independent to the study for rating of interviews.

5.2.5 Possible confounding variables

It is impossible to control for all variables known to affect the variables in a research study as this. There are a myriad of confounding variables that have the potential to contribute to capacities and difficulties in SUD mothers (Choi & Ryan, 2007; N Suchman & Luthar, 2000). In an attempt to solve this limitation we included some of the variables frequently mentioned as associated with parental SUD, which likely gave us a better understanding of the associations between PRF and EF. For example, it is known that IQ is an important confounding factor when assessing particularly EF and to some extent PRF. Therefore, IQ was controlled for in the study design in Paper I. The main findings in the study remained significant even after controlling for IQ, suggesting that IQ did not confound the main results of associations between EF and PRF. Therefore, we did not include IQ in Paper II or III. Mental health status is another possible confounding variable in assessing EF and PRF. We found mental health status to contribute significantly to the variance in association between PRF and EF in Paper I. Therefore, we chose to further investigate mental health status (psychological distress) in relation to PRF and EF in Paper II, and used it as a control variable in Paper III. Moreover, it remains unclear whether the effects seen in our analyses were a product of the SUD or if comorbid or pre-existing factors contributed to the variations seen in the associations between PRF and EF. Recent studies that confirm associations between EF and PRF in parents without SUD (Rutherford et al., 2017; Yatziv et al., 2017) suggest that our results could be generalized to other clinical groups of parents and normative parents, although that needs to be investigated further.

5.2.6 Cross-cultural considerations

As a Norwegian population study, whenever possible, we preferred to use Norwegian norms on the instruments. For the majority of the instruments

used in this study Norwegian norms were not available, and therefore, consequently American and British norms were applied. Therefore, it is important to take into consideration that results with Norwegian norms could have been slightly different.

5.2.7 Objectivity in observations and assessments

The main outcome variables were quite time demanding, and possibly emotionally challenging for some of the mothers. Therefore, conditions during the assessments were adjusted so that mothers would not feel overwhelmed when completing the measures. Although we aimed to create equal conditions for each family, some mothers needed more breaks during and between the assessments compared to other mothers. Furthermore, it was not practically possible, or ethically advisable to implement the whole test battery at the same occasion. Even so, that might have posed some methodological challenges. Multiple environmental stressors and situational factors could have affected the measures. This was especially relevant considering the PDI-R2 and the neuropsychological test-battery. EF and PRF are both known to be affected by stress (Shields et al., 2016; Slade, Bernbach, et al., 2005), and mothers tested during particularly stressful periods might have performed lower than their potential on both measures. It is also possible that having a regulating interviewer could have affected the results in a positive direction, showing higher capacities than normally present. Nevertheless, even if the assessments were not implemented at the same occasion, the significant associations between the measures indicate that there are some degree of stability in these variables. Moreover, retrospective recall of detailed information is a potential source of bias, as recollection could have been subject to distortion over time. In our study, this was particularly relevant in the recall of adverse and adaptive experiences. Although self-report could potentially be affected by recall bias, longitudinal follow-up of adults have demonstrated that reports for childhood abuse and neglect are often underestimated (Hardt & Rutter, 2004). We may therefore suspect that reports in our study represent a minimum of what is an objective estimate.

5.3 Ethical Considerations

The study was conducted in accordance with the Helsinki Declaration of the World Medical Assembly (2004), approved by the Norwegian Regional Committee for Medical Research Ethics in Eastern Norway (REK-Ost), reference number: 2012/1370, and by the Norwegian Social Science Data Service (NSD). All the information collected during the study was treated confidentially according to the approved criteria of REK-Ost and NSD. Standardized, context-independent procedural ethical considerations were considered and agreed upon before collection of data. Even so, a more context dependent reflection around ethical dilemmas has to be considered throughout the re-

search process, especially when conducting research with a vulnerable group, as SUD mothers and their children (Blok, 2014).

All the mothers signed an agreement of participation (see Appendix 1), with the opportunity to withdraw for any reason at any time, and opportunity to decline certain parts of the assessment without having to explain reasons why. Mothers were also asked to consider if the researcher could contact them at a later point for the possibility to take part in a follow-up study, and those who agreed signed consent. In addition, fathers with parenting rights gave their written approval of their child's participation in the assessment. Since the children were not able to give informed consent to participate, it was of importance to ensure that their interests were protected. In cases where children were foster placed, the Norwegian Child Protective Services (CPS) considered whether it was advisable for the child to participate along with the mother in the assessment. Conditions that might have reduced a participant's ability to give informed consent, such as an ongoing substance use were included as exclusion criteria. At recruitment point, all the mothers were abstinent and had been so during parts of the pregnancy and postpartum period. However, some of the mothers had started using substances again at the time they were given feedback on the assessments. In addition, several of the fathers were intoxicated when they were supposed to sign the consent agreement. Being under the influence while receiving feedback or consenting of participation poses an ethical dilemma (McCrary & Bux Jr, 1999). The researcher evaluated the condition of the mother (and the father) and if she (or he) was under the influence of substances or being affected by recent intoxication, no feedback or consent signing took place, but a later meeting was arranged.

Oral information about the project was initially given by recruiters, and later in the first meeting with the researcher. Written information about the purpose of the study procedure and potential distress was formulated in an easy to read short folder (see Appendix 2), as well as in a more detailed information sheet written in a clear, concise and understandable manner (see Appendix 3). It was explicit, both verbally and in writing that the mothers could withdraw from the project at any time. All participants were encouraged to ask questions and raise potential concerns before, during, and after assessments. As an important ethical aspect of the project, the mothers had an opportunity to receive individual feedback of the test results, and advice on possible clinical implications after the assessment was finished. Thirty-five of the mothers (81.4%) received feedback. Of those, twenty-three (65.7%), agreed on receiving feedback accompanied with their therapist or other clinician as an opportunity to use the results in ongoing treatment. Furthermore, based on experiences of the mothers as a group having a vulnerable executive system, some mothers were offered a short written document of the results.

It is important to respect the potentially challenging life situation mothers with

SUD are in. The disadvantages for participants in a research project should be avoided, or kept at a minimum (Grady, 2017; Health & Services, 2013). When we initially developed the project protocol, we evaluated the potential side effects of the study to be modest or transient. In addition, studies highlighting components important for parenting capacities in high-risk populations are sought for in the development of effective treatment methodology. Therefore, this kind of research should be highly prioritized. The research methods used in the present study were established, highly relevant for the purpose of the study, considered appropriate for mothers with SUD, and had been approved by REK-Ost: Even so, we expected that some of the mothers could experience the comprehensive and rather time-consuming assessments as stressful and or tiring to some degree. To prevent negative effects, duration and breaks needed during the assessments varied and depended on each mother's needs. Furthermore, mothers were encouraged to ask questions and raise potential concerns. Mothers who had difficulties filling out the questionnaires had the opportunity for the researcher to help read the questions. After each segment, the researcher investigated the experience of the testing, and the mothers had an opportunity for debriefing.

Based on initial information, some of the mothers could be considered more vulnerable than others and it would have been possible to exclude them from parts of the assessments. However, the vulnerability concept is debated as stereotypical and excluding (Levine et al., 2004). Furthermore, excluding certain mothers based on severity of difficulties would also have affected validity and reliability (Smith, 2008).

Participation in the study was voluntary, and despite the fact that parental SUD may constitute a risk factor for sensitive caregiving, the results of the assessments were not intended to have negative consequences for the mothers, but rather contribute to receiving adequate interventions if needed. The balance between assessments and the findings not having negative consequences for the mothers are often difficult to implement in high-risk populations. In the first meeting with the mother, the researcher routinely reviewed the information sheet with the mother, highlighting the duty to report to CPS under certain circumstances according to the Child Welfare Act. Particularly, it was clarified that results from the assessments were confidential to others than the researcher and the mother herself. According to the Health Research Act, Chapter 7 § 32; "research using personal health data may not be used for purposes that are incompatible with the original objective without the consent of the research participant, unless otherwise laid down in law".

5.4 Clinical Implications

Maternal SUD is a significant concern for mothers and their children. Although resilience studies highlight the importance of individually customized interventions to address maternal functioning in clinical populations (Luthar, 2006), mothers with SUD and their families are considered difficult to offer appropriate interventions. Based on results from this study, it is of great importance to highlight that ‘mothers with SUD’ are a heterogeneous group constituting of individuals with different needs. They are different from each other, both concerning capacities and difficulties, and hence the interventions should mirror that. Easily accessible methods for early identification of individual capacities and deficits should therefore be available for clinicians in contact with families with small children to be able to develop appropriate interventions.

Mentalization-based interventions are considered effective treatment approaches for parents with SUD (Kalland, Fagerlund, von Koskull, & Pajulo, 2016; Sadler et al., 2013; Suchman et al., 2008; Söderström & Skårderud, 2009); However, there are considerable variation in whether parents benefit from the interventions. PRF is critical to sensitive parenting as it enables parents to reflect and empathically respond to their child’s inner experience (Luyten, Nijssens, et al., 2017; Slade, 2005). As seen in this study, when PRF is compromised, it is likely to be accompanied with certain EF deficits. With difficulties in both EF and PRF, interventions targeting mentalizing capacities in mothers might be less effective. Therefore, it would be relevant to develop interventions that have a dual focus on both PRF and EF. To improve certain EF, especially cognitive flexibility but also working memory, inhibition and planning might provide the cognitive foundation for the development of a more flexible and elastic PRF. For some of the mothers, the capacity for abstraction may be severely compromised and the ability to develop adequate PRF might be poor. However, strengthening of EF capabilities with cognitive training or adjusting the surroundings might nevertheless prove effective as a regulating intervention in preparing a mother for receiving support that targets concrete parenting behavior.

As shown in this thesis, mothers with SUD often presents with complex needs, and therefore understanding the associations between PRF and EF are not straightforward. Possible influence of mental health status should always be considered, as it seems to have an important role in the association between PRF and EF. Targeting and improving mental health and psychological distress status could heighten PRF and EF directly. Alternatively, improvement of mental health might lay a foundation for a subsequent focus on EF and PRF. Furthermore, activation of parental stress seemed central in understanding the association between EF and PRF. A main goal must therefore be to increase the ability for cognitive flexibility and explicit mentalizing in the face of stressful situations. Interventions offering explicit regulation training would therefore be a useful prerequisite when trying to heighten capacities for perspective taking.

It seemed methodologically and clinically meaningful to divide the group of mother into two groups based on exhibiting an adequate or low PRF. Therefore, clinicians should have access to instruments that coarsely assess PRF level. In mothers with adequate PRF and high EF capabilities, intact cognitive capacities might be used in immediate clinical interventions for improvement in PRF and caregiving behavior. We found that mothers with negative to low PRF exhibited more deficits in EF, started using substances and developed a dependency significantly earlier. In addition, they had significantly poorer mental health status compared to mothers with adequate PRF. Furthermore, the group of mothers with low PRF reported more adversity and less adaptive childhood experiences. It is likely that interventions targeting parental capacities should be more complex and long-term for this subgroup of mothers. Considering the importance of presence or lack of early childhood adaptive experiences for PRF level in our study, an intervention focusing on establishment of epistemic trust before trying to heighten EF and PRF might prove useful. To our knowledge, no instruments measuring epistemic trust or mistrust exist today, and therefore we forward a suggestion on how it might affect SUD mothers. Furthermore, offering trauma therapy, including both explicit psychotherapy and embodied interventions, would be advisable as mothers with negative to low PRF have a significantly larger presence of adverse childhood experiences, which are considered to relate to relational traumatization and implicit embodied memories.

To conclude, a richer understanding of the factors related to capacities and difficulties seen in SUD mothers may help develop individually targeted interventions. Advances in treatment could be more efficacious in terms of timing and resources, but more importantly, specialist treatment could be experienced as more relevant and meaningful for the mothers and their children.

6. Future directions

In future studies, addressing some of the limitations outlined will provide further knowledge about the associations between PRF and EF in SUD mothers, in addition to how they might display in real-life.

First, this study had a cross-sectional design, and we were not able to assume directionality or infer causality, although we suggested some hypotheses. It would therefore be useful to use the same variables in a longitudinal design to allow for more casual and temporal inferences regarding the interactions seen in our study. Likewise, including participants other than mothers with SUD would be relevant. Mothers with mental health difficulties, but without SUD should be included. In addition, mothers from a normative sample are required for a comparison sample. It would also be relevant to include fathers with and without SUD. With a more heterogenic sample, it would help to determine if the effects seen in our study generalizable to other populations or if they are specific for mothers with SUD.

Furthermore, to support our results this study should be replicated with a larger sample. The disadvantage with heterogeneity could be controlled for in a larger sample and by including a control group. Increased number of respondents and data would allow to perform more complex statistical analyses than we were able to do in this study.

In this study, we offer hypotheses about how deficits in PRF and EF might manifest in clinical settings. Based on our results, we suggest that mothers with compromised PRF and EF need an approach where these difficulties are taken into consideration. It was not part of the study to investigate how mothers profited on treatment as usual (TAU), which would be interesting for future studies to investigate. Furthermore, an intervention program targeting EF and PRF in SUD mothers should be developed and piloted. Comparing TAU and PRF and EF intervention program could investigate if targeted interventions are more effective for a particular group of SUD mothers with pronounced deficits in PRF and EF.

There are multiple neurobiological, psychological, social, and environmental factors that may affect PRF and EF in SUD mothers. Although we included variables hypothesized to be important for these components, future research should take additi-

onal factors into considerations. For instance, it would be interesting to expand findings in this study to include different clinical control variables as personality variables, more socio-demographic factors in addition to specified assessments of particular mental health disorders. Furthermore, it is well documented that mothers with SUD are at high risk for social stressors, such as poverty, lack of social support, strained relationship with child protective services, domestic violence and unstable living conditions (Choi & Ryan, 2007; N Suchman, McMahon, et al., 2006). These factors have been found to affect maternal sensitivity and should be considered as control variables for future studies (Huth-Bocks et al., 2014; Siqveland, Smith, & Moe, 2012; Suchman, McMahon, et al., 2006).

Mother and a child reciprocally affect each other (Sameroff, 2009). In this study, we highlighted maternal variables, and hypothesized on how they might affect caregiving behavior. Even so, a child with its own congenital or acquired characteristics might either be easily distressed, hard to read or difficult to care for. A child may also be even-tempered and clearly cueing, hence easier to read and care for. Child-related factors might affect the role in the association between PRF and EF in the mothers. Future studies should consider including child variables to get a deeper understanding of associations between maternal PRF and EF in a dyadic context. There are data concerning the children available in the extended study, and they will be used for furthering knowledge on how PRF and EF associates with child-related factors.

Future studies should consider investigating online PRF by focusing on dyadic interactions between the mother and the child. As children in this study are under the age of 18 months, and mainly preverbal, it would be interesting to focus on kinaesthetic, non-verbal moment-to-moment changes in mode, body movements during parent-infant interaction patterns that focus on implicit mentalizing as described in Parental Embodied Mentalizing (PEM) (Shai & Belsky, 2011; Shai, Dollberg, & Szepsenwol, 2017), an instrument that is included in the extended study. Moreover, future studies should qualitatively investigate representational aspects in the narratives of the mothers (Isosävi et al., 2016; Sleed, 2014), and how they relate to PRF and EF.

7. Conclusions

Findings from the present study suggest that PRF and EF are associated in SUD mothers. The findings have implications for understanding how maternal EF contributes to differences in PRF, as well as how PRF abilities might help or hinder access to EF capacities, which together could affect the quality of caregiving. However, associations between PRF and EF are not clear, but influenced by a number of confounding variables associated with maternal SUD. Our results demonstrate that mothers with adequate PRF have significantly better mental health status, started using substances later, and meet the criteria for dependency later in life compared to mothers with negative to low PRF. Furthermore, they exhibited EF capacities comparable to a normative sample, while mothers with negative to low PRF showed compromised EF. Moreover, mothers with adequate PRF reported less childhood adversities, and more adaptive experiences. Particularly adaptive experiences in early childhood were associated with adequate PRF. In addition, PRF mediated the relationship between EF and parental stress, and between EF and psychological distress. Of the EF components included in the study, cognitive flexibility was highly associated with PRF, which suggests that the capacity of cognitive shifting between oneself and the child is particularly important for parental mentalizing capacity.

We have significant evidence for associations between EF and PRF in this thesis, and that has implications for interventions. Mothers with adequate PRF had a well-functioning EF system, better mental health status, met criteria for substance dependency in adulthood, and had access to functioning regulation strategies when facing parental stress. In addition, they reported fewer adverse experiences and more adaptive experiences, including a sense of safety. It is likely that their capacities lead them to be more receptive to interventions targeting PRF, EF and parental capacities directly, as they are less affected by aspects related to mistrust and emotion dysregulation, which could lead to higher engagement to psychotherapeutic treatment modalities. Mothers reporting high presence of adversities throughout childhood and adolescence, with few adaptive experiences in addition to a compromised PRF and EF, increased mental health issues and clinically high parental stress that were not regulated by PRF, might need a more long-term individually customized intervention targeting epistemic mistrust and EF before focusing on and improving PRF.

This study highlights the diversity in mothers with SUD and the need for individually adjusted interventions to heighten PRF and EF, which can possibly lead to improvements in parenting abilities.

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Paper 1

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Parental reflective functioning and executive functioning in mothers with substance use disorder

Ulrika Håkansson^a, Kerstin Söderström^{a,b}, Reidulf Watten^a, Finn Skårderud^c and Merete Glenne Øie^{d,e}

^aThe Research Centre for Child and Youth Competence and Development, Innland Norway University of Applied Sciences, Lillehammer, Norway; ^bDivision Mental Health Care, Innlandet Hospital Trust, Lillehammer, Norway; ^cNorwegian School of Sport Science, University of Oslo, Oslo, Norway; ^dDepartment of Psychology, University of Oslo, Oslo, Norway; ^eResearch Division, Innlandet Hospital Trust, Lillehammer, Norway

ABSTRACT

Having a substance use disorder (SUD) may adversely affect caregiving capacities. Reflective functioning (RF) and executive functioning (EF) are both important capacities for sensitive parenting, and are often impaired in a SUD. Only a few studies have explored the possible association between the two phenomena. In this study, we used a neuropsychological test battery to assess EF, and the Parent Development Interview to assess RF in a sample of mothers with a SUD ($N = 43$). Although parental RF (PRF) was associated with EF, when controlled for intelligence (IQ) and mental health, there was no significant association between EF and PRF. Mental health, however, showed a significant negative association with PRF. Splitting the group in two based on PRF level, mothers with a negative to low PRF exhibited more severe difficulties in SUD-related aspects, as well as in several EF components, compared to mothers with an adequate to high PRF, highlighting the association between EF and PRF. The results from this study contribute to enhance our understanding of the dynamics underlying vulnerability in PRF that mothers with small children may experience. We suggest EF to be a prerequisite for adequate PRF, and for interventions to be customized accordingly regarding parents with a SUD.

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Introduction

Several studies have shown that as a group mothers with a substance use disorder (SUD) are at risk of maladaptive parenting practices (Cash & Wilke, 2003; Mayes & Truman, 2002; Walsh, MacMillan, & Jamieson, 2003) and associated with an increased risk of child neglect and abuse (Pajulo, Suchman, Kalland, & Mayes, 2006). Maternal SUD poses a threat to the quality of sensitive parenting (Siqueland, Smith, & Moe, 2012). A sensitive caregiving environment is proposed to be essential for a healthy development of the infant brain and biological system, and consequently the development of physical,

social, emotional, and cognitive capacities in the child (Atkinson et al., 2009; Shonkoff et al., 2012).

Mentalization is a fundamental part of sensitive caregiving (Slade, 2005), which involves the ability to understand others and oneself in terms of feelings, wishes, and thoughts, in addition to the capacity to interpret mental states underlying behavioural expressions (Fonagy & Target, 1997). Although there is some support for a moderate relationship between mentalizing and intelligence (IQ) (Capstick, 2008; Steele & Steele, 2008), as well as between IQ and embodied mentalizing (Shai & Belsky, 2017), others have not found such a relationship (Grienenberger & Slade, 2002). Reflective functioning (RF) is the manifestation of the capacity to mentalize, although the terms are often used interchangeably (Suchman, Ordway, de las Heras, & McMahon, 2016). RF is an innate human characteristic (Kovács, Téglás, & Endress, 2010), though it is continuously influenced by environmental experiences (Fonagy, Target, Gergely, Allen, & Bateman, 2003), and has been associated with mental health issues (Bouchard et al., 2008; Fischer-Kern et al., 2013).

Parental reflective functioning (PRF) refers to a mentalizing capacity in relation to one's child, including the caregiver's capacity to recognize the child's expression and behaviour as being linked to the inner world of mental states, and as being influenced by the parents' own mental state (Slade, 2005). As a group, mothers with a SUD are often reported to have impairments in PRF, although with individual variations (Pajulo et al., 2006; Suchman, McMahon, Slade, & Luthar, 2005).

PRF can be distinguished between being average too high or negative to low, in which the latter is related to not fully realized reflective capacities (Kelly, Slade, & Grienenberger, 2005; Taubner et al., 2013). Mothers with a negative to low PRF have been found to have difficulties in recognizing and processing their own and their infant's emotions, which could result in distorted reflections concerning their own parenting abilities and the infant's capabilities (Luthar & Suchman, 2000). Accordingly, there is a risk of disruptions in the dyadic communication between mother and infant, which heightens the risk of insensitive maternal behaviour such as disengagement, withdrawal, hostility, and intrusiveness (Kelly et al., 2005; Levy & Truman, 2002). Vulnerability in PRF is associated with poorer psychosocial infant development (Levy, Truman, & Mayes, 2001; Lyons-Ruth, Bronfman, & Atwood, 1999). PRF is also associated with both adequate and inadequate parenting behaviour (Levy & Truman, 2002), including neglect and abuse (Fonagy et al., 1995). Parenting interventions targeted towards PRF in SUD mothers are associated with an improvement in caregiving capacities (Suchman, DeCoste, Castiglioni, Legow, & Mayes, 2008).

Maternal sensitivity also involves executive functions (EFs). EFs are a multi-dimensional construct involving a number of cognitive processes, such as inhibition, working memory, cognitive flexibility, planning and regulation of attention and emotion (Pennington & Ozonoff, 1996). EFs are thought to be a higher-level cognitive functioning involved in the control and regulation of lower-level functioning such as emotional and behavioural processes (Miller & Cohen, 2001). Even though EFs are related to intelligence (IQ) (Friedman & Miyake, 2017), there is a diversity in how IQ relates to different EF components. One study has shown that working memory is associated with IQ, but inhibition and cognitive flexibility are not (Friedman et al., 2006).

Disruptions in a number of EF components are frequently described in addiction research (Kalivas & Volkow, 2005). In addition, executive dysfunction can be a risk marker for SUD (Dolan, Bechara, & Nathan, 2008). Substance use is also associated with neural abnormalities in the frontal lobes, and accordingly linked to alterations in EF (Bechara et al., 2001; Moreno-López et al., 2012).

High EFs are associated with perceptive, responsive and flexible parenting behaviour (Galinsky, 2010; Kienhuis, Rogers, Giallo, Matthews, & Treyvaud, 2010), including supportive responses to children's emotions (Hughes & Gullone, 2010; Valiente, Lemery-Chalfant, & Reiser, 2007), as well as parental sensitivity and warmth (Chico, Gonzalez, Ali, Steiner, & Fleming, 2014; Gonzalez, Jenkins, Steiner, & Fleming, 2012). Mothers with low EF are less able to manage intense emotions and tend to dysregulate in response to parental stress (Skowron & Friedlander, 1998), in addition to expressing less positive parenting behaviour (Deater-Deckard, Sewell, Petrill, & Thompson, 2010). Furthermore, weaknesses in EF are known to be related to psychological distress and mental health issues (Dvir, Ford, Hill, & Frazier, 2014; Gonzalez, 2015; Gonzalez, Atkinson, & Fleming, 2009; Leyro, Zvolensky, & Bernstein, 2010). In addition, for individuals with a previous SUD, even if there may be an improvement in EF during substance abstinence, some deficits in EF are still present, despite the actual abuse being terminated (Verdejo-García, Bechara, Recknor, & Perez-García, 2006). This implies that the etiological explanation for EF difficulties may be a consequence of a SUD (Giancola & Tarter, 1999), or they may originate before the onset of the actual addiction. Accordingly, EF difficulties in parenting practices might still exist, even when the use of substances is no longer present.

In summary, although they are distinct capacities, PRF and EF are both essential in sensitive caregiving (Barrett & Fleming, 2011; Slade, Belsky, Aber, & Phelps, 1999) and both capacities are found to be impaired in individuals with a SUD (Giancola & Tarter, 1999; Suchman et al., 2005). Understanding the possible relationship between PRF and EF is important, as it may have implications for the dynamic underlying difficulties in parenting capabilities in SUD mothers.

To the best of our knowledge, only two previous studies have explored the possible association between maternal RF and EF, and no significant correlations between the two phenomena were found when studying a group of mothers with small children in a non-clinical population (Turner, Wittkowski, & Hare, 2008). In a similar study examining urban mothers with 9- to 12-year-old children, no associations were found between EF and PRF, even after controlling for lifetime histories of depression and substance abuse (Capstick, 2008). However, several studies have identified associations between EF and a phenomenon closely related to RF, Theory of Mind (ToM) which might help to shed light on the possible relationship between EF and RF. ToM refers to the ability to comprehend and interpret thinking and feeling in another person as intentions (Frith & Frith, 2003; Premack & Woodruff, 1978). Although similar and often used interchangeably, there are important differences between RF and ToM. ToM refers to cognitive-perceptual "cold" knowledge of mind, whereas the ability to mentalize (i.e. RF) additionally requires the activation of relational and emotional "hot" representations (Górska & Marszał, 2014; Kalbe et al., 2007). A positive association between ToM and EF has been found in non-clinical populations of children (Austin, Groppe, & Elsner, 2014; Carlson, Claxton, & Moses, 2015), adolescents (Vetter, Altgassen, Phillips, Mahy, & Kliegel, 2013), and adults

(Apperly, Samson, & Humphreys, 2009; Bull, Phillips, & Conway, 2008), showing that a well-functioning EF system is related to an effective ToM.

Several clinical studies have demonstrated a relationship between deficits in ToM and deficits in EF. An association between ToM and EF has been shown in autism disorders (Baron-Cohen, 1995; Fisher & Happé, 2005), maternal mental illness (Rigby, Conroy, Miele-Norton, Pawlby, & Happé, 2016), and in SUD populations (Sanvicente-Vieira et al., 2017; Verdejo-Garcia, López-Torrecillas, de Arcos, & Pérez-Garcia, 2005). Although there are few studies that have explored the explicit relationship between RF and EF, several studies make implicit inferences of possible associations, which lead us to suggest a relationship between the capacities. For example, a low capacity of self- and other-reflections (i.e. RF) is associated with deficits in affect regulation and flexibility (i.e. EF) in mothers with a SUD (Suchman, Pajulo, DeCoste, & Mayes, 2006). Furthermore, abilities in affect regulation (i.e. EF), and maternal stress tolerance (Rutherford, Booth, Luyten, Bridgett, & Mayes, 2015) are associated with stability, flexibility, and deficits in RF (Fonagy, Gergely, & Jurist, 2004). Also, neurological studies have found that the dorso-lateral prefrontal cortex is important for EF (Oldrati, Patricelli, Colombo, & Antonietti, 2016), as well as being the neural circuit partly responsible for mentalizing (Abu-Akel & Shamay-Tsoory, 2011). These studies make further investigation of the possible explicit association between PRF and EF in mothers with a SUD relevant.

The current study

The study consists of two parts. In the first part, we used a correlational design to examine associations between EF and PRF in mothers with a SUD caring for small children, controlling for IQ and psychological distress. In part 2, we split the group of mothers and investigated whether there were differences in SUD-related factors and EF, depending on the PRF level being negative to low or adequate to high. IQ and psychological distress were included as control variables.

Part 1 – We expected that EF and PRF, respectively, would gain low scores in the population of mothers in this study compared to average scores in a normal population. We based this assumption on previous studies that found these two capacities particularly affected by SUD (Deater-Deckard, 2014; Gonzalez, 2015; Suchman, Decoste, Leigh, & Borelli, 2010). We expected to find positive correlations between PRF and EF. Based on literature concerning the relationship between SUD and EF, we predicted working memory, inhibition, cognitive flexibility, planning, and fluency all to be related to low PRF (Bechara, 2005; Fernández-Serrano, Pérez-García, Perales, & Verdejo-García, 2010; Graham, 2004; Mintzer & Stitzer, 2002; Valls-Serrano, Verdejo-García, & Caracuel, 2016; Verdejo-García & Pérez-García, 2007; Vik, Cellucci, Jarchow, & Hedt, 2004). In addition, we expected IQ moderately to affect the relationship between EF and PRF (Steele & Steele, 2008). Based on earlier studies on emotion regulation (Rutherford et al., 2015), we also expected the level of experienced psychological distress to affect the relationship between PRF and EF.

Part 2 – In the second part of the study, we separated the group of mothers in two, based on PRF level. We expected to find differences depending on the mother exhibiting either a negative to low PRF or an adequate to high PRF. We hypothesized that preference for a specific type of substance would be associated with PRF

level. We expected that mothers preferring stimulants or opioids would exhibit a lower PRF than to mothers preferring alcohol or cannabis. We based these expectations on studies showing that the severity of substance abuse is associated with PRF level (Pajulo et al., 2012), and an assumption that an abuse of stimulants and opioids might reflect a more definite substantial substance abuse problem, while an abuse of alcohol and cannabis may be more diverse in its severity. We also anticipated that PRF level would be related to differences in the onset of substance use, as well as onset of the SUD. We based our hypothesis on our own expectation of an association between PRF and EF and previous research showing substance use onset age to be related to severity in EF difficulties (Gruber, Sagar, Dahlgren, Racine, & Lukas, 2012), as well as a severity in SUD (Grant & Dawson, 1998). We expected mothers with a negative to low PRF to have an earlier onset of substance use, as well as an onset of SUD, compared to mothers with an average to high PRF. Moreover, we hypothesized that mothers with a negative to low PRF would exhibit more severe deficits in EF compared to mothers with an average to high PRF.

Methods

Participants

Forty-three mothers (M age = 31 years, SD = 6.4 years, range 19–44) with a SUD were recruited during pregnancy or during the postpartum period. In total, 12 of the mothers (27.9%) were recruited from outpatient clinics, 6 (14.0%) from municipality health nurses, and 25 (58.1%) from one of seven treatment facilities specialized in caring for pregnant women and families with small children and substance abuse problems. The recruitment period lasted for 2 years. The inclusion criteria were a SUD diagnosis of any severity and kind, whether with or without a comorbid mental illness. All the mothers were abstinent during the assessment period, but had previously been diagnosed with a SUD based on the International Classification of Mental and Behavioural Disorders (ICD-10) (World Health Organization, 1993). The diagnoses were confirmed by our assessments. The exclusion criteria were a full IQ below 70, multi-parity, premature birth (<32 weeks and <1500 g), or a severely ill or multi-handicapped child, whereas children with neonatal abstinence syndrome (NAS) were not excluded. For the majority of the mothers (N = 27), the target child was their first child. Although 16 of the mothers (37.2%) had older children, only 1 (2.3%) had custody of the older sibling of the target child. Siblings were either living in foster care or with their father. At assessment, the age of the target child ranged from four to 18 months (M = 8.6, SD = 3.8). There were 15 girls (34.9%), and 28 boys (65.1%). Eleven (25.6%) of the children were born with NAS and received medical intervention. During the inclusion period, 12 of the mothers (27.9%) lost daily custody of the target child.

Socio-demographic background variables

On average, participants were educated for 11.5 years (range 7–18 years). Two participants (4.7%) did not complete primary school, and 22 (51.2%) started but did not complete high school. Six participants (14.0%) had a graduate or professional degree

beyond high school. Twenty-two mothers (51.2%) did not have a partner, and 13 (30.2%) had a cohabitant. One participant (2.3%) was married and seven (16.3%) had a partner who was not a cohabitant. Twenty-four mothers (55.8%) reported that the father of the child had an on going substance abuse problem, and 15 (34.9%) reported a previous, but currently abstinent substance abuse problem in the father. Four mothers (9.3%) reported that the father never had a substance abuse problem.

Measures

Socio-demographic variables and use of psychoactive substances

Substance use was registered with the *European Addiction Severity Index* (Europ-ASI) 5th edition (Kokkevi & Hartgers, 1995; McLellan et al., 1992), Norwegian version (Lauritzen, 2010). Europ-ASI is a semi-structured clinical interview, which consists of questions related to employment and support status, family and social relationships, and legal and illegal substance use, as well as somatic and psychological issues. Reliability and validity for the Europ-ASI has been reported to be satisfactory (Kessler et al., 2012; Kokkevi & Hartgers, 1995; McLellan et al., 1992).

Parental reflective function

To assess PRF, we used the Parent Development Interview-Revised (PDI-R2) (Fonagy, Target, Steele, & Steele, 1998; Slade et al., 2003), Norwegian translation. PDI-R2 is a 20-question semi-structured interview designed to elicit narratives of parental representations. The interview addresses various themes concerning feelings, thoughts, and intentions, both in the mother herself and in her child. The interview focuses on how these aspects might influence behaviour and mental processes in the person reflected upon (i.e. oneself or one's child). The PDI-R2 interview was recorded and transcribed from audio files, and the transcribed interviews were coded in accordance with guidelines for RF assessment (Fonagy et al., 1998) by an independent reliable coder who was not familiar with the respondents. A second independent rater coded 25% of the interviews for reliability purposes. There was a strong intra-class correlation between the coders ($r = .96$). When there was a disagreement between the coders, we used the assessment from the first coder. The interviews were scored for PRF on an 11-point scale from -1 to 9, with higher scores reflecting a higher RF (Slade, Bernbach, Grienerberger, Levy, & Locker, 2005). A score of -1 indicates a negative RF and includes a violation of coherence (bizarre) or openly hostile responses. A score of 9 indicates an exceptional RF with rich and full reflections. Although scores of 5 or above indicate a clear RF and evidence of mentalizing capacities in a normal population (Slade, 2005), in a stressed or vulnerable population, a score of 4 would constitute the average capacity (Kelly et al., 2005; Levy et al., 2001; Taubner et al., 2013). Therefore, a distinction between a negative to low PRF and an average to high PRF was set at a score of 4 in our sample. Validity for the PDI-RF is reported as being satisfactory in non-clinical populations and in populations of parents with a SUD (Levy & Truman, 2002; Slade, 2005; Slade et al., 1999).

Executive functions

Neuropsychological measures of maternal EF included an assessment of several executive sub-functions. The raw scores were converted into *t*-scores. We assessed the following EF components.

Working memory

The Letter-Number Sequencing sub-test from the Wechsler Adult Intelligence Scale 4th edition (Wechsler, 2014) was used. During this task, the participants were presented with an increasingly longer series of mixed letters and numbers at 1 s intervals. The participants were required to repeat the series back to the administrator in a manner in which the numbers were presented first in order from the lowest to the highest, followed by the letters in alphabetical order. Higher raw *t*-scores and longer spans are consistent with a high capacity of auditory working memory.

Verbal fluency

Two categories from the Verbal Fluency test from the Delis–Kaplan Executive Function System (D-KEFS) (Delis, Kaplan, & Kramer, 2001), Letter Fluency and Category Fluency, were used to assess verbal fluency. Completion of the Letter Fluency condition required participants to say as many words as possible that started with a specific letter within in a 60 s time frame, which was done with the letters “F,” “A,” and “S.” The participants were instructed that they could not use the names of people, places, or numbers, and were only allowed to use each response once. Completion of the Category Fluency condition required participants to first say as many animals as possible in a 60 s time frame, and then as many boys’ names as possible. Higher *t*-scores on these tasks are indicative of high levels of verbal fluency.

Cognitive inhibition

The Colour-Word Interference Test, Condition 3 from the D-KEFS (Delis et al., 2001), was used to assess cognitive inhibition. Participants had to inhibit themselves from reading a colour word, and instead say the name of the colour in which the word was printed as quickly as possible. A longer time to complete the task, as well as a higher frequency of errors, indicated more difficulties with inhibition and provided a lower *t*-score.

Cognitive flexibility

The inhibition-switching task in the Colour-Word Interference Test, Condition 4 from the D-KEFS (Delis et al., 2001), was used to assess cognitive flexibility. Participants were required to switch between reading the colour word and naming the colour in which the colour was printed. The time used and the numbers of errors committed during the task were measured. A longer time to complete the task, in addition to having more errors, indicated difficulties with cognitive flexibility and provided a lower *t*-score.

Planning

The Tower Test (Delis et al., 2001) measures planning, rule learning, and the ability to establish and maintain an instructional set. Participants were requested to place discs of varying sizes on a board with three vertical pegs in the same manner shown on a picture in front of them as effectively as possible, both regarding the number of movements and time usage. There is an increasing complexity of the test as it progresses from starting with two discs and ending with five discs. Taking a longer time to complete the task, as well as a high frequency of errors, indicated difficulties in planning and yielded a lower *t*-score.

Intelligence

The Wechsler Abbreviated Scale of Intelligence (WASI) (Wechsler, 1999, 2014) measured the participants average estimated full-scale IQ, verbal IQ, and non-verbal IQ scores.

Mental health

To assess mental illness, we used the diagnostic interview M.I.N.I plus version 5.0.0, Norwegian version (M.I.N.I) (Mordal, Gundersen, & Bramness, 2010). The instrument is a diagnostic interview related to the diagnostic criteria in DSM-IV (Association, 2000) and ICD-10 (World Health Organization, 1993). M.I.N.I constitutes of 16 modules and covers 27 psychiatric diagnoses. The instrument has a high inter-rater and test reliability (Rush, First, & Blacker, 2008).

We used the Hopkins Symptom Checklist (HSCL-10) to measure general mental health status. HSCL-10 is a self-administered questionnaire designed to measure symptoms of anxiety and depression. HSCL-10 is a shortened version of the HSCL-90 (Derogatis, Lipman, Rickels, Uhlenhuth, & Covi, 1974) and has satisfactory validity and reliability (Haavet, Sirpal, Haugen, & Christensen, 2010; Strand, Dalgard, Tambs, & Rognerud, 2003). The HSCL-10 consists of 10 items, in which responses ranges from 1 = not at all to 4 = very much. The average item score is calculated by dividing the total score of the number of items answered; the cut-off score of 1.85 is considered to indicate psychological distress (Strand et al., 2003).

Procedures

We examined the participants at their home or in the treatment facility where they were currently living. Participants were interviewed with Europ-ASI and M.I.N.I plus to establish and/or confirm SUD diagnoses and mental health diagnoses according to ICD-10 (World Health Organization, 1993). The mothers answered the HSCL-10 questionnaire to indicate the presence of psychological distress. They were interviewed with the PDI-R2 and also completed the neuropsychological assessments. It should also be mentioned that we collected data from a large battery of measures, and only selected results are presented in this paper. The estimated time for data collection using the larger test battery was approximately 7 h per family, and each participant met with the researcher on 3–6 separate occasions to complete the assessment. Each session lasted between 1 to 2 h. A clinical psychologist (UH) supervised by a specialist in clinical neuropsychology (MØ) collected all data, with the data collection for this particular part of the test battery lasting for approximately 4 h per respondent.

Ethics

The study was approved by The Norwegian Regional Committee for Medical Research Ethics in Eastern Norway (REK-Ost) and was conducted in accordance with the Helsinki Declaration of the World Medical Assembly.

Statistical analyses

All cases ($N = 43$) were included in the analyses and there was no missing data. In part 1 of the study, we used descriptive statistics of socio-demographic variables, substance use, PRF, and EF. In addition, we calculated Pearson product moment correlations between PRF and EF for the total sample. We also conducted a principal component analysis on the EF measures and calculated the factor scores of the extracted dimensions. The criteria for the number of factors extracted were set at eigenvalues >1 . One major factor was extracted accounting for 56.9% of the unrotated variance (eigenvalue = 3.4). The factor loadings of the six EF components were the following: inhibition: .87; working memory: .86; cognitive flexibility: .80; planning: .79; category fluency: .57; and letter fluency: .57. To further inspect the links between PRF and EF, we carried out a hierarchical ordinary least-square regression analysis, using PRF as the criterion variable, the EF factor score as predictor variable and total IQ, and mental health (HSCL-10) as control variables. Control variables and the predictor variable were entered in two blocks: the first block consisted of the control variables total IQ and HSCL-10. The second block consisted of the EF factor score. This analytic strategy allowed us to see how much additional variance in PRF the EF factor accounted for after controlling for IQ and mental health.

In part 2 of the study, analyses were carried out to test the differences between two groups of mothers differentiated based on exhibiting an adequate to high PRF or exhibiting a negative to low PRF. We used chi-square analyses to test differences in reported preference of particular substances, as well as differences in report of multiple substance use in mothers with negative to low PRF and mothers with adequate to high PRF. We conducted a multiple analysis of variance (MANOVA) to test onset age of substance use, onset age of SUD and EF, controlling for total IQ and mental health status. All statistical analyses we carried out using IBM Corp. Released 2016. IBM SPSS for Windows, version 24.0. Armonk, NY: IBM Corp. Sciences (SPSS) version 24.

Results

Results part 1

Characteristics of the respondents

Specifications for substance use, outcomes for general PRF, and the results of cognitive tests, IQ tests, and variables for mental health are presented in [Table 1](#).

As seen in [Table 1](#), although 86% of mothers ($n = 37$) reported multi-substance use, all of the respondents could define a preferred substance. The most commonly preferred substances among the mothers were central stimulants and opioids. Twenty-two mothers (51%) reported injecting substances intravenously, thereby indicating a substantial substance use problem in the group. The majority of the mothers, 67% ($n = 29$), reported having had one or more serious overdoses. Eleven of the mothers (25.6%) were receiving medically assisted rehabilitation and were prescribed either methadone or buprenorphine, and four (9.3%) mothers were prescribed medication for attention-deficit hyperactivity disorder (ADHD) Eight (18.6%) women reported regularly using other types of prescribed medications, including anxiolytics, sedatives, or antidepressants.

Table 1. Descriptive statistics of substance use, parental reflective functioning, performance on cognitive tests presented by *T*-scores, IQ, and mental health status.

Variable	<i>M</i>	<i>SD</i>	%	<i>N</i>	Range
Preferred substance ^a					
Central stimulant			37.2	16	
Opioids			32.6	14	
Alcohol			16.3	7	
Cannabis			14.0	6	
Simultaneous use of several substances ^a			86.0	37	
Injecting substances ^a			51.2	22	
Overdoses in life ^a					
0			32.6	14	
1–5			48.9	21	
>5			18.5	8	
Prescribed medications ^a					
Medically assisted rehabilitation			25.6	11	
Medication for ADHD			9.3	4	
Other			18.6	8	
Debut age of substance use and report of ever having used a specific substance for intoxication ^a					
Alcohol	13.1	2.2	97.7	42	5–19
Prescribed medications	18.1	5.8	86.0	37	2–36
Cannabis	16.2	4.4	97.7	42	12–36
Central stimulants	17.8	4.4	88.4	38	14–36
Opioids	20.3	6.0	58.1	25	12–36
Multiple substances	18.4	4.8	86.0	37	12–36
Parental reflective functioning ^b					
General RF	2.91	1.71			0–6
Performance on cognitive tests					
Working memory ^c					
Letter-number	41.2	8.8			25–65
Inhibition ^d	39.8	11.3			20–65
Cognitive flexibility ^d	35.2	11.4			20–63
Verbal fluency ^e					
Letter fluency	48.4	11.4			21–70
Category fluency	59.0	11.4			30–80
Planning ^f					
Tower	45.1	6.5			30–59
IQ ^g					
Verbal IQ	89.7	17.1			55–127
Non-verbal IQ	98.8	14.0			74–132
Total IQ	94.1	14.6			71–125
Mental health ^h					
SCL-10	2.5	0.6			1.3–3.5

^aEuropean Addiction Severity Index (Europ-ASI), 5th edition.

^bParental Development Interview – Revised, Reflective Functioning Scale.

^cLetter-Number Sequencing sub-test in the Wechsler Adult Intelligence Scale, 4th edition.

^dColour-Word Interference Test, Conditions 3 and 4 from Delis–Kaplan Executive Function System (D-KEFS).

^eVerbal Fluency test from Delis–Kaplan Executive Function System (D-KEFS).

^fTower Test from Delis–Kaplan Executive Function System (D-KEFS).

^gWechsler Abbreviated Scale of Intelligence (WASI).

^hHopkins Symptom Checklist (SCL-10).

The majority of the mothers reported alcohol to be the first substance they used. When investigating onset age, nearly all of the mothers, 98% ($n = 42$), reported having used alcohol and cannabis, with an average onset age of 13.1 years for alcohol and 16.2 years for cannabis. A majority of the mothers, 86%, also reported using prescribed medication illegally, with an average onset age of 18.1 years. The average onset age for the use of stimulants was 17.8 years, and 88.4% of the mothers reported having used the substance at one point in time. Although a majority of the mothers also reported having

tried opioids (58%), this was a minor group compared to reports of usage of other substances. The onset age for the use of opioids was also somewhat older, with an average onset age of 20.3 years. The majority of mothers in our sample, 86.0%, reported multi-substance use.

We found a large variability in PRF scores in the group of mothers. However, scores indicated that overall PRF in the group was poor, as 74.4% of the mothers scored 3 or lower, with a mean PRF score of 2.91 (SD = 1.17, skewness was $-.09$). *T*-scores identified considerable within group variability for distinct cognitive functions. Cognitive flexibility and inhibition, and to some extent working memory, stood out as being low in our sample compared to the average scores expected within a normal population. Planning capacities, letter and category fluency were close to the expected average in a normal population, however, with a large within-group variability.

The mean total IQ was 94.1, with a rather large difference between verbal IQ 89.7, and non-verbal IQ 98.8, qualifying this group of mothers on the low end of average for verbal capacities, but on average for non-verbal capacities.

The mothers in our study qualified for several SUD diagnoses, and 28 (65.1%) of the mothers had one or more diagnosis for mental health issues in addition to the SUD diagnosis according to ICD-10 (World Health Organization, 1993). Eight (18.6%) of the mothers qualified for F10 (mental and behavioural disorders due to the use of alcohol), 24 (55.8%) qualified for F11 (mental and behavioural disorders due to the use of opioids). Whereas 27 (62.8%) of the mothers qualified for F12 (mental and behavioural disorders due to use of cannabinoids), 58.1% ($n = 25$) had a diagnosis of mental and behavioural disorders due to the use of other stimulants, specifically amphetamines. None of the mothers qualified for any of the other SUD diagnoses.

The mothers in our study qualified for numerous mental health diagnoses. During assessment with the M.I.N.I plus version 5.0.0, Norwegian version (Mordal et al., 2010), 37.2% ($N = 16$) of the women reported an ongoing depression. Two (4.7%) were diagnosed with bipolar affect disorder. In total, 26 (60.5%) mothers had a panic disorder, and 12 (27.9%) and 21 (48.8%) had agoraphobia and social phobia, respectively. Twenty-three (53.5%) of the mothers qualified for a generalized anxiety disorder. None of the women had a schizophrenia diagnosis, while 16 (37.2%) of the women reported having an eating disorder that were either anorexia, bulimia, overeating, or a combination of these. Only four (9.3%) of the mothers reported having an ADHD diagnosis. Sixteen mothers (37.2%) reported having a post-traumatic stress disorder (PTSD). As a group, the mothers reported an average score of 2.5 on the HSCL-10, thus indicating a high level of current psychological distress, as shown in Table 1.

See Table 2 for a presentation of inter-correlations between general PRF, EF, IQ, and mental health status.

There were significant positive correlations between PRF and the following items: working memory ($r = .74$), planning ($r = .63$), cognitive flexibility ($r = .58$), inhibition ($r = .42$), but significant negative correlation with mental health status ($r = -.56$). We also found moderate positive correlations between PRF and total IQ ($r = .44$), verbal IQ ($r = .41$), and non-verbal IQ ($r = .33$). Additionally, we found numerous positive significant correlations between specific EF, in which the following items correlated most highly with each other: inhibition and working memory ($r = .72$), planning and working memory ($r = .65$), and cognitive flexibility and working memory ($r = .64$). There were also

Table 2. Correlation coefficients between parental reflective functioning (item 1), measures of executive functions (items 2–7), IQ (items 8–10), and mental health status (item 11).

Functions	1	2	3	4	5	6	7	8	9	10
1 Reflective functioning ^a										
2 Working memory ^b	.74**									
3 Inhibition ^c	.42**	.72**								
4 Cognitive flexibility ^c	.58**	.64**	.64**							
5 Planning ^d	.63**	.65**	.61**	.61**						
6 Letter fluency ^e	.01	.34*	.44**	.41**	.19					
7 Category fluency ^e	.03	.39*	.42**	.22	.37*	.36*				
8 Verbal IQ ^f	.41**	.62**	.45**	.47**	.44**	.48**	.38**			
9 Non-verbal IQ ^f	.33**	.60**	.51**	.47**	.53**	.46**	.34*	.56**		
10 Total IQ ^f	.44**	.69**	.56**	.55**	.54**	.59**	.41**	.90**	.83**	
11 HSCL-10 ^g	-.56**	-.61**	-.48**	-.57**	-.53**	-.10	-.26	-.29	-.38*	-.38*

^aParental Development Interview – Revised, Reflective Functioning Scale.

^bLetter-Number Sequencing sub-test from the Wechsler Adult Intelligence Scale, 4th edition.

^cColour-Word Interference Test, Conditions 3 and 4 from the Delis–Kaplan Executive Function System (D-KEFS).

^dTower Test from the Delis–Kaplan Executive Function System (D-KEFS).

^eVerbal Fluency test from the Delis–Kaplan Executive Function System (D-KEFS).

^fWechsler Abbreviated Scale of Intelligence (WASI).

^gHopkins Symptom Checklist (SCL-10).

* $p < .05$, ** $p < .01$.

Table 3. Multiple regression analyses for executive functioning predicting reflective functioning controlled for total IQ and mental health status (HSCL-10).

Variable	<i>B</i>	SE <i>B</i>	β	<i>t</i>	Sig
Total IQ	.01	.02	.07	.04	NS
HSCL-10	-.63	.29	-.33	-2.2	*
EF-factor	.39	.25	.33	1.6	NS

N = 43.

* $p < .05$.

NS: no significant results.

significant negative correlations between HSCL-10 and several EF components. There were no significant correlations between PRF and verbal fluency.

Table 3 presents the results of the multiple regression analysis.

Total IQ and mental health explained 37% of the variance in PRF ($R^2 = .37$, adjusted $R^2 = .34$, $F = 11.8$, $df = 2$, $p < .000$). Adding the EF score increased the explained PRF variance to 41% ($R^2 = .41$), i.e. an increase of only 4% ($\Delta R^2 = .04$), which was not significant ($F = 2.6$, $df = 1$, $p = .12$). Thus, controlled for IQ and mental health there was no significant association between EF and PRF. Mental health showed a significant negative association with PRF, i.e. we found that less distress was associated with higher PRF. Therefore, it was interesting to look more closely into differences between mothers who had a negative to low PRF and mothers with an adequate to high PRF. These results are described in more detail in part 2 of the study.

Results for part 2

In Table 4 we present differences in reported preference for particular substances and multiple substance use between mothers with negative to low PRF and mothers with adequate to high PRF.

Table 4. Differences in psychoactive substance use between mothers with an adequate to high parental reflective functioning and mothers with a negative to low parental reflective functioning; chi-square analyses.

Substance ^b	Adequate to high RF ^a N: 11		Negative to low RF ^a N: 32		Sig.
	N	%	N	%	
Alcohol	4	36.5	14	48.3	NS
Cannabis	7	63.6	28	87.5	NS
Central stimulants	6	54.5	25	78.1	NS
Opioids	4	36.4	16	50.0	NS
Multiple substances	5	45.5	27	84.4	**

N = 43.

^aParental Development Interview – Revised, Reflective Functioning Scale.

^bEuropean Addiction Severity Index (Europ-ASI), 5th edition.

** $p < .01$.

NS: no significant differences.

We found no significant differences between the groups based on a preference for any particular substance, except that mothers with a negative to low PRF were found to significantly report more frequent patterns of multiple substance abuse ($\chi^2 = 7.3$, $df = 1$, $p < .01$), compared to mothers with an adequate to high PRF.

Chi-square tests were conducted to test the differences in the use of prescribed medications, including buprenorphine, methadone, and medication for ADHD, anxiolytics, sedatives, or anti-depressants between mothers with adequate to high RF and mothers with negative to low RF. Results indicated there were no significant differences between the groups ($\chi^2 = .92$, $df = 1$, $p = .34$).

In Table 5, differences between mothers with a negative to low PRF and mothers with an adequate to high PRF based on substance use onset age and SUD onset age are presented:

The MANOVA analysis showed significant differences between the two groups regarding onset age concerning all substances. Mothers with a negative to low PRF had a significantly earlier onset age of substance use of the following substances: alcohol ($F = 9.1$, $df = 1$, $p < .01$), prescribed medications ($F = 11.0$, $df = 1$, $p < .01$), cannabis ($F = 8.7$, $df = 1$, $p < .01$), stimulants ($F = 6.0$, $df = 1$, $p < .01$), and opioids ($F = 7.0$, $df = 1$, $p < .01$).

We also found significant age differences between the two groups when reporting the onset of problems with a particular substance at a level qualifying for a SUD diagnosis. Mothers with a negative to low PRF developed a SUD significantly earlier than mothers with an adequate to high PRF on the following substances: alcohol ($F = 17.7$, $df = 1$, $p < .01$), prescribed medications ($F = 8.1$, $df = 1$, $p < .01$), cannabis ($F = 6.9$, $df = 1$, $p < .01$), and opioids ($F = 13.4$, $df = 1$, $p < .01$), but not to stimulants.

As seen in Table 6, there were significant differences in a number of EF components when we compared mothers with a negative to low PRF to mothers with an adequate to high PRF controlling for IQ and mental health status (HSCL-10).

Mothers with a negative to low PRF performed significantly poorer than mothers with an adequate to high PRF on the following EF: working memory ($F = 7.3$, $df = 1$, $p < .01$), cognitive flexibility ($F = 4.7$, $df = 1$, $p < .05$), and planning ($F = 5.6$, $df = 1$, $p < .05$), but not on inhibition, verbal, or categorical fluency.

Table 5. Differences in reported substance use debut age and age of SUD onset between average to high parental reflective functioning and negative to low parental reflective functioning; controlling for total IQ and mental health status (HSCL-10); multiple analysis of variance (MANOVA).

Substance ^b	Adequate-high RF ^a N: 11		Negative-low RF ^a N: 32		Sig.
	Mean	SD	Mean	SD	
Debut					
Alcohol	14.8	1.9	12.6	2.1	**
Prescribed medications	23.9	6.1	16.7	4.9	**
Cannabis	19.5	6.5	15.2	3.0	**
Central stimulants	20.8	6.6	16.9	3.1	*
Opioids	26.8	7.0	18.0	5.0	*
Multiple substances	17.0	8.1	15.2	6.7	NS
SUD					
Alcohol	24.8	7.9	15.4	2.2	**
Prescribed medications	24.0	5.5	19.0	3.4	**
Cannabis	22.6	7.0	17.8	3.5	*
Central stimulants	21.3	7.4	18.5	3.2	NS
Opioids	27.3	6.3	18.8	3.5	**
Multiple substances	23.3	7.1	18.4	3.1	*

N = 43.

^aParental Development Interview – Revised, Reflective Functioning Scale.

^bEuropean Addiction Severity Index (Europ-ASI), 5th edition.

** $p < .01$, * $p < .05$.

NS: no significant differences.

Table 6. Differences in executive functions between mothers with adequate to high parental reflective functioning and mothers with a negative to low parental reflective functioning controlling for total IQ and mental health status (HSCL-10); multiple analysis of variance (MANOVA).

Variable	Adequate-high PRF ^a N: 11		Negative-low PRF ^a N: 32		Sig.
	Mean	SD	Mean	SD	
Working memory ^b	49.1	9.3	38.4	6.9	*
Inhibition ^c	46.2	12.6	37.6	10.2	NS
Cognitive Flexibility ^c	44.7	9.8	31.9	10.1	*
Letter fluency ^d	48.6	11.3	48.3	11.6	NS
Category fluency ^d	60.3	8.6	58.6	12.3	NS
Planning ^e	50.6	5.4	43.2	5.7	*

N = 43.

^aParental Development Interview – Revised, Reflective Functioning Scale.

^bLetter-Number Sequencing sub-test from the Wechsler Adult Intelligence Scale, 4th edition.

^cColour-Word Interference Test, Conditions 3 and 4 from the Delis-Kaplan Executive Function System (D-KEFS).

^dVerbal Fluency test from the Delis-Kaplan Executive Function System (D-KEFS).

^eTower Test from the Delis-Kaplan Executive Function System (D-KEFS).

* $p < .05$.

NS: no significant differences.

In summary, the findings revealed that there were several significant associations between PRF, EF, IQ, and psychological distress. PRF was significantly associated with working memory, planning, cognitive flexibility, and inhibition, as well as with IQ. Psychological distress was negatively associated with PRF and EF, specifically working memory, planning, cognitive flexibility, and inhibition. When we controlled for mental health status and total IQ, the association between EF and PRF was no longer significant in the mothers as a group; however, mental health showed a significant negative association with PRF. We found numerous between-group differences when we

separated the group of mothers based on RF level though (negative to low vs. adequate to high), even after controlling for total IQ and mental health status. Mothers with a negative to low PRF reported a significantly earlier onset age of substance use and age of acquiring a SUD diagnosis, as well as more often reporting multiple substance abuse compared to mothers with an adequate to high PRF. Mothers with an adequate to high PRF also exhibited significantly higher scores in working memory, cognitive flexibility, and planning capacities, but not in inhibition, verbal, and category fluency compared to mothers with a negative to low PRF.

Discussion

Part 1

Mothers in this study demonstrated a lower capacity for PRF compared to what is expected in a normal population (Fonagy & Target, 1997; Slade, 2005), and in a vulnerable or stressed population (Pajulo et al., 2012; Rutherford et al., 2015; Taubner et al., 2013). Although there were variations within the group, the mothers exhibited an average PRF score lower than 3, indicating that as a group the ability to keep a mental model of oneself and the child in mind was poorly integrated, although not completely absent. In addition, in previous studies of SUD populations, including studies of mothers with SUD, deficits in EF are reported (Cuevas et al., 2014; Deater-Deckard, 2014; Koob & Volkow, 2016; Schmidt, Pennington, Cardoos, Durazzo, & Meyerhoff, 2017). These studies support our findings of impairments in cognitive flexibility, inhibition, and working memory. Contrary to our hypothesis, and previous studies in SUD populations (Fernández-Serrano et al., 2010; Verdejo-García & Pérez-García, 2007), verbal fluency and category fluency were within the normal range in the mothers in this study.

Our results partly support our main hypothesis that PRF relates positively to EF. We found moderate to strong positive correlations between PRF, working memory, planning, cognitive flexibility, and inhibition. In contrast to our results, previous studies have found no significant associations between PRF and EF in a normal population of mothers with infants (Turner et al., 2008), or in a sub-clinical group of mothers with older children (Capstick, 2008). It is possible that the association between PRF and EF was more relevant in a clinical group like ours that exhibited considerable vulnerability in both EF and PRF. When we controlled for IQ and mental health problems, the unique contribution of EF on PRF was not significant. However, psychological distress was significantly related to PRF. In accordance with our results, previous studies have reported that psychological distress may exhaust emotion regulation capacities so that it decreases the effectiveness of EF components and PRF (Heim, Shugart, Craighead, & Nemeroff, 2010; Rutherford, Booth, Crowley, & Mayes, 2016). Psychological distress could also affect the capacity for flexible thinking and attention by impairing the capacity for perspective taking (Allen & Fonagy, 2002). Supporting our results, numerous studies have demonstrated that mental health issues adversely affect RF (Borelli, West, Decoste, & Suchman, 2012; Conklin, Bradley, & Westen, 2006; Lemma, Target, & Fonagy, 2011; Luyten, van Houdenhove, Lemma, Target, & Fonagy, 2012). Our findings indicate that psychological distress significantly influences PRF capacity in mothers with a SUD and

we suggest that individual differences need to be taken into consideration for a better understanding of the association between PRF and EF.

Part 2

In the second part of the study, our aim was to investigate whether differences within the group of mothers with a SUD existed based on PRF. Contrary to our hypothesis, there were no significant differences between the type of substance used and PRF level. We expected that the use of substances commonly associated with severe substance abuse (i.e. opioids and central stimulants) would be more common in the group of mothers with a negative to low PRF. A link between preferred substance and PRF level and a link between preferred substance and successful interventions targeting PRF have previously been reported (Pajulo et al., 2012). In addition, one study found an association between type of preferred substance and social cognition (Quednow, 2017), which is considered a capacity related to RF (Humfress, O'Connor, Slaughter, Target, & Fonagy, 2002). Although we did not find any significant differences in a preferred substance based on PRF level, multiple substance abuse was significantly more frequent in mothers with a negative to low PRF. It could be that a potentially more chaotic use of substances reflected PRF level more than any particular type of substance preference. Furthermore, it seems that our results are supported by a study that found an association between usage of multiple substances and impaired ToM (Sanvicente-Vieira et al., 2017). Together, our findings suggest that the group of mothers with a negative to low PRF may have had challenges in regulating complex affective states which could have contributed to the need to use many different substances simultaneously to manage arousal.

We found between group differences in PRF depending on the onset age of substance use. Mothers with a negative to low PRF started using substances significantly earlier compared to mothers with an average to high PRF. The effect was present for all substances reported in the group (e.g. alcohol, cannabis, prescribed medication, stimulants, and opioids). Moreover, mothers with a negative to low PRF developed SUD significantly earlier when reporting an addiction to alcohol, prescribed medications, cannabis, and opioids, but surprisingly not to stimulants. Interestingly, the onset of a SUD was during adolescence for all types of substances for mothers with a negative to low PRF, whereas mothers with an adequate to high PRF developed a SUD in adulthood. Early onset of substance use has previously been associated with a low PRF (Suchman, McMahon, Zhang, Mayes, & Luthar, 2006). This supports our findings that onset age may be related to PRF capacity. Furthermore, early onset age of substance use has been suggested as a precursor of severe substance abuse, mental health problems, and psychosocial adversity (DeWit, Adlaf, Offord, & Ogborne, 2000; Jordan & Andersen, 2016; Richmond-Rakerd et al., 2016), and according to our results, possibly impaired mentalizing abilities. Multiple studies have proposed early substance use to adversely impact brain development, especially for prefrontal cortex functions (PFCs) (Andersen, 2016; Lubman, Yücel, & Hall, 2007). PFC functions are important for the development of both EF (Davidson, 2001; Tekin & Cummings, 2002) and mentalizing skills (Frith & Frith, 2003, 2006; Powell, Lewis, Dunbar, García-Fiñana, & Roberts, 2010). Taken together, these findings imply that the early onset of substance use heightens the risk of an impaired

development of PRF. Another possibility is that vulnerability in PRF and EF could have been present before the onset of substance use due to either genetic factors (Richmond-Rakerd et al., 2016) or adverse childhood experiences (Anda, Felitti, & Corwin, 2014; Bick & Nelson, 2016). Some of the mothers might have been at risk for development of diverse psychological problems, including SUD (Tarter & Horner, 2015). An early onset age of SUD may also have affected normal neuropsychological development, possibly leading to deficits in both PRF and EF. A lack of social and emotional experiences normally present in adolescence and young adulthood might have caused heightened levels of emotional dysregulation and stress, a factor known to affect both PRF (Rutherford et al., 2015) and EF (Zelazo & Cunningham, 2007).

As expected, there were significantly more deficits in a number of EF components for mothers with a negative to low PRF, even after controlling for psychological distress and IQ. Interestingly, the mothers with an adequate to high PRF performed in accordance with expected norms in a normal population on all the EF components. It appeared that when an adequate EF was present PRF and EF were well coordinated and appeared to be consistently interconnected.

Mothers with negative to low PRF exhibited significantly poorer capacities in working memory. Working memory refers to the capacity to remain emotionally regulated when processing new and unknown information, as well as integrating information from multiple sources (Schmeichel, Volokhov, & Demaree, 2008). Therefore, working memory is an important capacity in caregiving (Gonzalez, 2015) and emotion regulation (Rutherford et al., 2016). Working memory is required for complex cognitive tasks such as reasoning and problem solving (Miyake et al., 2000; Miyake & Shah, 1999), and considered an essential capacity for reflective learning in childhood (Zelazo, 2015). We suggest the same process to be essential for the development of adequate PRF.

Mothers with negative to low PRF also showed significantly more deficits in planning capacities compared to mothers with adequate to high PRF. Our results support previous research that have found SUD populations have impairments in planning (Carlson, Moses, & Claxton, 2004). Specifically, planning in low structured situations that are highly representative of everyday activities is considered particularly challenging in individuals with a SUD (Janke van Holst & Schilt, 2011; Valls-Serrano et al., 2016). Deficits in planning impair the capacity to prepare and organize for future events and outcomes, as well as the ability to focus. Although we could not find any studies investigating the explicit relationship between planning and RF, research on ToM suggests that planning is an essential skill for making effective reflections about oneself and others (Carlson et al., 2015, 2004). Based on our results, we suggest that planning is an important component for adequate PRF.

Perspective taking is an essential capacity for adequate EF (Bradford, Jentsch, & Gomez, 2015; Decety & Jackson, 2004). Our results indicate that mothers with adequate to high PRF had significantly higher cognitive flexibility capacities compared to mothers with negative to low PRF. These results support studies that have found deficits in perspective taking to be negatively related to cognitive flexibility (Carlson et al., 2015; Stuss & Knight, 2002; Wunderli et al., 2016). Individuals easily distracted by stimuli have been found to exhibit deficits in attributing complex emotional and motivational states to others (Decety & Sommerville, 2003). According to our results, the capacity to maintain attentional control and ability to shift focus are functions necessary for

adequate PRF. Indeed, the capacity to mentalize requires the individual to be regulated emotionally and attentively, in a manner that allows for perspective taking (Allen, Fonagy, & Bateman, 2008), and impairments in these regulatory capacities have been associated with deficits in EF (Hofmann, Schmeichel, & Baddeley, 2012; Zelazo & Cunningham, 2007). Difficulties in controlling and regulating emotions have also been proposed to be a core component of SUD (Schore, 2005), and in a low RF (Fonagy et al., 2004). Studies have shown that parents with a SUD struggle to conceptualize and experience their own emotions while simultaneously reflecting about the mental states of the child (Neger & Prinz, 2015; Slade, Grienenberger, Bernbach, Levy, & Locker, 2005). We suggest that psychological distress, non-reflective habitual responses, or emotional dysregulation might overrule EF, thereby having a negative effect on the PRF seen in the group of mothers with negative to low PRF in this study. Therefore, it could be that SUD mothers with adequate to high PRF may have a more sophisticated EF system.

Limitations

Although robust findings, the results should be considered preliminary due to sample size. Replication studies should include a control group and a larger number of respondents to help strengthen the power of analysis. Furthermore, as an exploratory analysis/study we predominately conducted correlations and regression analysis to analyse the data and therefore determining causality between variables is limited. It remains unclear whether the effects seen are a product of a SUD or whether pre-existing or comorbid factors explain the variation and associations between PRF and EF. Although we attempted to control for mental health by including HSCL-10 in our analyses, our results could have been due to underlying mental health issues commonly reported to be comorbid with SUD (Choi & Ryan, 2007; Miles, Svikis, Kulstad, & Haug, 2001). Mothers with SUD have a significant heightened occurrence of early childhood and lifetime trauma, including neglect and abuse (Ashley, Marsden, & Brady, 2003; Wilsnack, Vogeltanz, Klassen, & Harris, 1997), and these factors/experiences are known to affect EF (Teicher & Samson, 2016), RF (Nazarov et al., 2014), as well as SUD (Cecil, Viding, Fearon, Glaser, & McCrory, 2017). Even though we reported a high prevalence of PTSD, the dynamics underlying the possible developmental trauma is not thoroughly investigated in the current study. These issues raised should be considered for future research.

Clinical implications

Resiliency studies strongly suggest the importance of individually adjusted interventions to help address maternal functioning in clinical populations (Luthar, 2015; Rutherford et al., 2015). Based on our results, we suggest EF and PRF to be related phenomena in mothers with negative to low PRF and EF and in mothers with adequate capacities. The relationship between the two phenomena needs to be taken into consideration when trying to understand the possible challenges a certain group of mothers with a SUD may experience in parenting. The enhancement of PRF in mothers with a SUD has been found to be effective for improving parenting capabilities and preventing child neglect and abuse (Pajulo et al., 2012; Suchman, DeCoste, Ordway, & Mayes, 2012). Even so, a group of mothers with a low PRF and

deficits in EF might not benefit on commonly used intervention strategies. We suggest that the group of mothers with deficits in PRF and EF would benefit from interventions customized to improve selective executive capacities as a prerequisite to enhance poor PRF. Mothers with a SUD are a stigmatized group often considered homogenous and difficult to offer appropriate interventions. This study contributes to an understanding of the importance of individually customized interventions and how these could be carried out more effectively. It is of further interest to consider how capacities, deficits, and the relationship between PRF and EF seen in this study may affect the relationship between mother and child, and how adjustments in interventions can help strengthen these capacities.

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Paper 2

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The association between executive functioning and stress is mediated by parental reflective functioning in mothers with substance use disorder. *Stress and Health*. Submitted and under 2nd review

The association between executive functioning and parental stress and psychological distress is mediated by parental reflective functioning in mothers with substance use disorder

Ulrika Håkansson¹, Reidulf Watten¹, Kerstin Söderström^{1,2}, Merete Glenne Øie^{3,4}

¹Innland Norway University of Applied Sciences, Lillehammer, Norway. ²Division Mental Health Care, Innlandet Hospital Trust, Lillehammer, Norway. ³Department of Psychology, University of Oslo, Oslo, Norway. ⁴Research Division, Innlandet Hospital Trust, Lillehammer, Norway.

Corresponding author, Ulrika Håkansson. Email: ulrika.hakansson@inn.no

Phone number: 0047-93049312

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Competing interests

The authors declare they have no competing interests.

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Abstract

Mothers with a substance use disorder (SUD) have been found to exhibit heightened experience of stress, difficulties in stress regulation as well as deficits in executive functioning (EF). Furthermore, parental reflective functioning (PRF), a capacity underlying sensitive caregiving, has been associated with EF. Although experiences of stress, EF and PRF are important for caregiving capacities, no studies have explored associations between the phenomena in SUD mothers. This study aimed to examine the association between EF (working memory, inhibition and cognitive flexibility) and different forms of stress (parental stress, general life stress and psychological distress) in 43 SUD mothers with infants. We further aimed to investigate whether PRF had a mediating function between EF and the experience of stress. The mothers completed self-report questionnaires regarding their experiences of different types of stress. In addition, we used neuropsychological tests to assess EF, and a semi-structured interview to assess for PRF. There were negative associations between EF and parental stress and between EF and psychological distress, but no associations were found between EF and general life stress. Cognitive flexibility contributed uniquely to variance in parental stress, while working memory was a unique contributor to variance in psychological distress. PRF had a mediating function between EF and parental stress, as well as between EF and psychological distress. Theoretical and clinical implications of the results are discussed.

Keywords: Parental Stress, Psychological Distress, Executive Functioning, Parental Reflective Functioning, Substance Use Disorder, Maternal

Introduction

Studies on mothers with substance use disorder (SUD) have demonstrated that as a group, they exhibit high levels of stress (Kelley, 1998; Nair, Schuler, Black, Kettinger, & Harrington, 2003; Zvolensky & Hogan, 2013) and difficulties in stress-regulation capacities (Tronick et al., 2005). Stress refers to processes involved in perception, appraisal and response to challenging or threatening stimuli (Sinha, 2008; Sinha et al., 2005). The perception and appraisal of stress depends on both internal and external conditions, emotional states, personality factors, and individual resources (Sinha, 2008). Mothers of young children with low emotion regulation capacity have been found to exhibit reduced distress tolerance (Deater-Deckard, Li, & Bell, 2016), and in particular, mothers with SUD have a heightened risk for emotion dysregulation (Suchman, DeCoste, Ordway, & Mayes, 2012). Indeed, reduced distress tolerance is thought to be a central component of SUD (Li & Sinha, 2008; Tronick et al., 2005). Mothers with SUD may therefore be more vulnerable to stress exposure compared to mothers without SUD. Stress exposure may result from major life events (e.g. divorce, loss of job), daily difficulties (e.g. interpersonal conflict, socioeconomic resources, chaos in the environment), psychological distress (e.g. stress related to mental health issues/SUD), or parental stress. Parental stress refers to the experience of distress or discomfort arising from demands associated with parenting (Deater-Deckard, 1998). Parental stress constitutes of stress related to the parents' appraisal of the child, as well as stress related to experiences concerning the parental role (Abidin, 1995). Elevated levels of parenting stress in SUD mothers may place their children at an increased risk due to dysfunctional parent-child relationship (Hans, Bernstein, & Henson, 1999; Nair et al., 2003). Mothers with higher ratings of psychological distress are more likely to perceive their infant's behavior as stressful (Sheinkopf et al., 2005).

Research on individual differences in stress regulation has traditionally focused on phenotypic personality factors based on childhood and environmental aspects (e.g. abuse and neglect in childhood, socioeconomic factors, and substance abuse in adulthood) and genotype (Williams, Suchy, & Rau, 2009). However, a recent focus has been on elucidating the neurocognitive underpinnings of these individual differences. For instance, each of the processes involved in stress, which include exposure, reactivity, recovery, and restoration, are moderated by a set of cognitive processes known collectively as executive functioning (EF). EF is generally applied as an umbrella construct referring to a set of basic neurocognitive processes that facilitate conscious control of thoughts, actions, and emotions which together result in complex, goal-directed behaviors, such as the ability to maintain and shift focus, monitor outcomes, and alter behaviors (Diamond, 2013; Zelazo, 2015). EF includes three main processes: working memory, inhibition, and cognitive flexibility (Diamond, 2013). Working memory is the ability to keep information in mind, update and integrate current contents with new information, while inhibition is the ability to inhibit prepotent responses in order to selectively attend to relevant information, and engage in goal-directed, rather than habitual and/or impulsive actions. Cognitive flexibility is the ability to shift between cognitive rules of modes (Friedman & Miyake, 2017). These basic facets of EF are thought to underlie successful emotion regulation (Hofmann, Schmeichel, & Baddeley, 2012). Individual differences in EF may influence the experience of stress and the capacity to manage stress (Williams et al., 2009). Furthermore, EF is sensitive to socio-demographic, for instance increase in age is associated with a decline in EF, and higher education status has been found to contribute to a neuro-protective effect and increase in EF (Campanholo et al., 2017).

EF can be identified as being either “hot” or “cold”. Hot EF is influenced by emotional and motivational states, while cold EF implies cognitive processing of information that is independent of emotional involvement (Baumeister & Vohs, 2003; Peterson & Welsh, 2014).

Accordingly, EF impairments can arise from a range of everyday situations targeting affective, motivational and/or cognitive processes. A recent study has challenged the supposition that EF is categorical hot or cold. Instead, individual differences in EF are suggested to be dynamic, and dependent on individual capacities in allocating limited cognitive resources when facing stress (Kluwe-Schiavon, Viola, Sanvicente-Vieira, Malloy-Diniz, & Grassi-Oliveira, 2016). A shift from controlled EF to more automatic processes during emotional dysregulation, and the ability to affect regulate is dependent on the individuals capacity for adaptive use of existing EF resources (Gagnon & Wagner, 2016; Kluwe-Schiavon et al., 2016). The unique individual EF profile could therefore be associated with stress regulation capacities.

Disruptions in a number of EF components are commonly found in individuals with SUD (Kalivas & Volkow, 2005). In addition, substance dependency is associated with neural abnormalities in the frontal lobes, which are brain areas linked to alterations in EF (Moreno-López et al., 2012). Impairments in working memory (Bechara, Martin, & Becker, 2004), inhibition (Dolan, Bechara, & Nathan, 2008), and cognitive flexibility (Cunha, Nicastri, de Andrade, & Bolla, 2010) have been found both during substance use and during substance abstinence in individuals with SUD (Verdejo-García, Bechara, Recknor, & Perez-Garcia, 2006).

An effective EF system is thought to regulate parenting behaviour and to support the ability of perception, responsiveness and flexibility in relation to parental demands (Kienhuis, Rogers, Giallo, Matthews, & Treyvaud, 2010). Furthermore, good enough EF is suggested to be a prerequisite for sensitive caregiving (Gonzalez, Jenkins, Steiner, & Fleming, 2012). Recently, EF and particularly cognitive flexibility and working memory have been associated with parental reflective functioning (PRF) (Håkansson, Söderström, Watten, Skårderud, & Øie, 2017; Rutherford et al., 2017; Yatziv, Kessler, & Atzaba-Poria, 2017). Reflective functioning (RF) is the operationalization of mentalizing, which is the ability to understand oneself and

others in terms of feelings, wishes and thoughts, in addition to having a capacity to interpret mental states as underlying behavioural expressions (Fonagy & Target, 1997). PRF is specifically related to mentalizing regarding ones' child, oneself as a parent, and the parent-child relationship (Slade, 2005). Prefrontal brain areas that are important for EF are also found to be involved with PRF (Abu-Akel & Shamay-Tsoory, 2011; Oldrati, Patricelli, Colombo, & Antonietti, 2016), supporting a possible association between EF and PRF. Furthermore, mothers with SUD who have negative to low PRF have been found to exhibit weaker EF compared to mothers with adequate PRF (Håkansson et al., 2017).

It has been recommended that research on parenting, EF and stress-regulation in high-risk groups of parents should be prioritised (Crandall, Deater-Deckard, & Riley, 2015). Indeed, to our knowledge, there are no studies exploring the association between different types of stress, EF and PRF in SUD mothers with infants. Considering the potential influence these factors have on caregiving capacities, it is important to advance knowledge in this area in order to contribute to the development of effective clinical interventions to improve parenting capacities.

The current study

The purpose of the current study was to explore the complex association between stress (parental stress, general life stress, and psychological distress), EF (working memory, inhibition, and cognitive flexibility), PRF, and demographic variables (maternal age, education, and marital status) among SUD mothers with infants.

The study consists of two parts. In the first part, we used a correlational design to investigate the associations between the stress variables (parental stress, general life stress and psychological distress) and EF (working memory, inhibition and cognitive flexibility). We aimed to investigate how EF components were associated with different forms of stress. In

addition, we wanted to investigate if particular EF components contributed to the variance in experienced stress more than others, after controlling for demographic variables. We hypothesized that: (1) there would be negative associations between EF components (working memory, inhibition and cognitive flexibility) and stress (parental stress, general life stress and psychological distress) and (2) we expected cognitive flexibility and working memory capacities to specifically contribute to parental stress, while we expected all the EF components to contribute to general life stress and psychological distress.

In the second part of the study we were interested in investigating PRF in relation to stress (parental stress and psychological distress) and EF (working memory, inhibition, and cognitive flexibility). We aimed to investigate the associations between PRF and stress, and between PRF and EF. Further, we aimed to explore whether PRF had a mediating effect between EF (working memory, inhibition and cognitive flexibility) and the experience of stress (parental stress and psychological distress) in mothers with SUD. We hypothesised that: (1) PRF would be positive associated with EF and negative associated with stress and (2) PRF would have a mediating function between EF and parental stress, and between EF and psychological distress.

Method

Participants

The sample for this study consisted of forty-three mother-infant dyads. Inclusion criteria required that mothers ($M = 31.0$ years; $SD 6.4$) had a SUD diagnosis, and a child under the age of 18 months ($M = 8.6$ months, $SD = 3.8$). Mothers with or without a comorbid mental illness in addition to SUD were recruited during pregnancy or early during the postpartum period. Referrals were received from municipality nurses, clinicians in outpatient services and clinicians in institutions specialized in caring for pregnant women with SUD. All the mothers

were abstinent during the assessments. Exclusion criteria were estimated full IQ below 70 in the mother, multi-parity (i.e. giving birth to twins or triplets), premature birth (<32 weeks and <1500g), or severely ill or multi-handicapped child. Neonatal abstinence syndrome was not an exclusion criterion.

Average education of the mothers was 11.5 years (range 7 to 18 years). Two participants (4.7 %) had not completed primary school, and twenty-two (51.2 %) had started but not completed high school. Six participants (14.0 %) had graduate or professional degree beyond high school. During the assessments, all the mothers were on paid maternity leave, or paid sick leave due to the SUD. Twenty-two mothers (51.2 %) did not have a partner and thirteen (30.2 %) had a cohabitant. One participant (2.3 %) was married and seven (16.3 %) had a partner who was not a cohabitant. Although 16 of the mothers (37.2 %) had older children, only one (2.3 %) had custody of the older sibling of the participating child, therefore we did not control for number of children in the household.

Measures

Socio-demographic variables and use of psychoactive substances. Substance use and sociodemographic variables were registered with the European Addiction Severity Index (Europ-ASI) 5th edition (Kokkevi & Hartgers, 1995; McLellan et al., 1992), Norwegian version (Lauritzen, 2010). Europ-ASI is a semi-structured clinical interview and consists of questions related to employment and support status, family and social relationship, legal and illegal substance use, as well as somatic and psychological issues. As all the mothers were abstinent during inclusion and assessment, we did not assign an ASI severity score. Reliability and validity for the Europ-ASI has previously been reported to be satisfactory (Kessler et al., 2012; Kokkevi & Hartgers, 1995; McLellan et al., 1992). In the current study, the Cronbach Alpha coefficient was .79, which was considered satisfying.

Stress. We administered two self-report questionnaires to assess parental stress, general life stress, and psychological distress.

Parental stress and general life stress. We used the Parenting Stress Index -3rd Edition (PSI, long form) (Abidin, 1995) to assess for parental stress and general life stress. The PSI is a 120-item inventory widely used self-report measure of three major sources of stress. The instrument measures the parent's subjective experience of different forms of stress (1) stress related to child characteristics and the parent's appraisal of them, (2) stress related to own appraisal of parental characteristics and family context variables that can compromise parenting and (3) potential stressful circumstances outside the dyadic relationship, usually experienced as stressful. A total stress score may be derived from the sum of (1) child characteristics scale and (2) parental characteristics scale, referred to as *parental stress*. Stressful circumstances outside the dyad is referred to as *general life stress*, and is separately indexed from 19 questions in the questionnaire. The majority of items are rated on a 5-point Likert Scale from 1 = Strongly Disagree to 5 = Strongly Agree. A few items are rated Yes/No depending on if they are present or absent. The manual provides percentile cut-offs indicating adequate stress level < 80th or a clinically high stress level, $\geq 80^{\text{th}}$. The PSI has previously showed good test-retest reliability and good internal consistency (Abidin, 1995). In the current study, the Cronbach Alpha Coefficient was .85, indicating a good internal consistency for the scale within this sample of mothers.

Psychological distress. Hopkins Symptom Checklist (HSCL-10) was used to measure psychological distress. HSCL-10 is a self-administered questionnaire that assesses subjective experiences of anxiety and depression symptoms. HSCL-10 is a short version of the HSCL-90 (Derogatis, Lipman, Rickels, Uhlenhuth, & Covi, 1974). The instrument consists of 10-items, and responses range from 1 = Not at all to 4 = Very much. The average item score is calculated by dividing the total score of the number of items answered. A score of ≥ 1.85 is considered to

indicate clinically high psychological distress (Strand, Dalgard, Tambs, & Rognerud, 2003). HSCL-10 has previously been shown to have satisfactory validity and reliability (Haavet, Sirpal, Haugen, & Christensen, 2010; Strand et al., 2003). The HSCL-10 had a Cronbach Alpha coefficient of .83 in this sample of mothers, which indicates a strong internal consistency.

Executive Functioning. Neuropsychological measures of maternal EF included assessment of several executive sub-functions.

Working memory. The Letter-Number Sequencing sub-test from the Wechsler Adult Intelligence Scale 4th Edition (Wechsler, 2014) was used to assess working memory. The participants were presented with increasingly longer series of mixed letters and numbers at 1-second intervals, and were asked to repeat the series back to the administrator with the numbers presented first, from lowest to highest, followed by the letters in alphabetical order. Higher raw t-scores and longer spans are consistent with a high capacity of auditory working memory. The Wechsler Adult Intelligence Scale has satisfactory validity and reliability (Canivez & Watkins, 2010). In this sample, Cronbach Alpha coefficient was .86 indicating a strong internal consistency for the scale.

Cognitive inhibition. We used the Colour-Word Interference Test, Condition 3 from the D-KEFS (Delis, Kaplan, & Kramer, 2001) to assess cognitive inhibition. Participants were required to inhibit reading a colour word, and instead say the name of the colour in which the word was printed as fast as possible. Higher frequency of errors, in addition to longer time to complete the task, indicated more difficulties with inhibition and provided a lower t-score.

Cognitive flexibility. We administered the inhibition-switching task in Colour-Word Interference Test, Condition 4 from the D-KEFS (Delis et al., 2001) to assess cognitive flexibility. Participants were asked to switch between reading the colour word, and naming the colour in which the colour is printed. The time used and the number of errors committed during

the task was measured. Longer time to complete the task in addition to having more errors, indicate difficulties with cognitive flexibility and provided a lower t-score.

The D-KEFS has good reliability and validity (Delis, Kramer, Kaplan, & Holdnack, 2004). In this sample of mothers, the D-KEFS scale had a Cronbach Alpha of .78, indicating a satisfying internal consistency.

Intelligence. The Wechsler Abbreviated Scale of Intelligence (WASI) (Wechsler, 1999, 2014) measured the participants average estimated full scale IQ.

Parental Reflective Function. We conducted the Parent Development Interview-Revised (PDI-R2) to assess PRF (Fonagy, Target, Steele, & Steele, 1998; Slade et al., 2003), Norwegian translation. PDI-R2 is a 20-question semi-structured interview developed to elicit narratives of parental representations of themselves, their child and the relationship between them. The interview addresses various themes concerning the child's and the parent's feelings, thoughts and intentions, and how these might affect mental processes and behaviour and influence the person reflected upon (both in the parent herself, in the child, and in the mother's own parents). We recorded, transcribed and coded the interview in accordance with guidelines for RF assessment (Fonagy et al., 1998). An independent reliable coder who was not familiar with the respondents rated the interviews. A second independent coder rated 25% of the interviews for reliability purposes. There was a strong intra-class correlation between the coders ($r = .96$). In line with guidelines, the interviews were scored for PRF on an 11-point scale from - 1 to 9, with higher scores reflecting a higher PRF (Slade, Bernbach, Grienenberger, Levy, & Locker, 2005). A score of - 1 indicates a negative PRF and includes a violation of coherence (bizarre) or openly hostile responses. A score of 9 indicates an exceptional PRF with rich and full reflections. Validity for the PDI-RF is found satisfactory in non-clinical populations and in populations of parents with a SUD (Levy & Truman, 2002; Slade, 2005; Slade, Belsky, Aber,

& Phelps, 1999). In the current study, the Cronbach Alpha coefficient was .89, suggesting a very good internal consistency for the scale within this sample.

Procedures

Participants were assessed either at their own home or in the treatment facility where they were currently living. Participants were interviewed with the Europ-ASI, and the PDI-R2, completed the neuropsychological assessments, the PSI full version and HSCL-10, during the assessment period. We collected data from a large battery of measures, and only selected results are presented in this paper. Estimated time for data collection using the larger test-battery was approximately seven hours per family, and each participant met with the researcher on three to six separate occasions to complete the assessment. Each session lasted between one and two hours. Data collection for the particular part of the test battery in this study lasted for approximately four hours per respondent.

Ethics

The study was approved by The Norwegian Regional Committee for Medical Research Ethics in Eastern Norway (REK-Øst), and was conducted in accordance with the Helsinki Declaration of the World Medical Assembly (2004).

Statistical Analyses

All analyses were conducted with IBM Statistical Package for Social Sciences (SPSS) (versions 22/23/24), IBM Corp. Released 2016. IBM Statistics for Windows, version 24.0. Armonk, NY: IBM Corp. All cases ($N = 43$) were included in the analyses and there no missing data. To assess internal consistency, Cronbach Alpha coefficients were calculated for all the measurements used in this study. Stress (parental stress, general life stress and psychological stress), EF (working memory, inhibition and cognitive flexibility), PRF and demographics were summarized using descriptive statistics (see Table 1). Bivariate correlations (Pearson's r , two-

tailed) were carried out to study the relationship between the stress variables (parental stress, general life stress and psychological distress), EF components (working memory, inhibition and cognitive flexibility), PRF and demographic variables (age, education and marital status) (see Table 2). To further examine the links between EF and stress components, we carried out two hierarchical ordinary least square regression analyses, using stress components that were significantly correlated with EF (that is, parental stress and psychological distress, but not general life stress) as dependent variables and the EF components (working memory, inhibition and cognitive flexibility) as independent variables. As education (but not age or marital status) was significantly associated with EF in the correlational analysis, we used education as a control variable. The control variable and the independent variables were entered in two blocks: the first block consisted of education, and the second block consisted of the EF components. The analytic strategy allowed us to examine how much additional variance in stress the EF components accounted for before and after controlling for education (see Table 3).

In the second part of the study mediation models were tested to verify the hypothesis that PRF mediated the relationship between EF (working memory, inhibition and cognitive flexibility) and stress (parental stress and psychological distress). Due to lack of significant correlations, we did not conduct mediation analyses between the EF components and general life stress. According to Baron and Kenny's approach (1986), mediation was estimated by multiple regressions among independent, mediating and dependent variables. In the present study, EF (working memory, inhibition or cognitive flexibility) was used as independent variables, PRF was used as the potential mediating variable, and stress (parental stress and psychological distress) was used as the dependent variable. Initially we regressed the independent variable onto the proposed mediator. Next, we tested the contribution of the independent variable (working memory, inhibition or cognitive flexibility) across the dependent variable (parental stress or psychological distress). Finally, to investigate mediation, we

examined the effect of the EF as an independent variable (working memory, inhibition or cognitive flexibility) on stress as the dependent variable (parental stress or psychological distress) controlling for the proposed mediator of PRF. Indirect effect tests addressed whether the total effect of the independent variable on the dependent variable was significantly reduced with the addition of the proposed mediator to the model (Preacher & Hayes, 2004) (see Figure 1 and Figure 2). The Sobel's test (Sobel, 1982) was applied to calculate the indirect effect and its significance using the Indirect.sps tool, version 2.0 Beta, added to the IBM SPSS 25 (see also Preacher & Hayes, 2008).

Results

Means and standard deviations for all measured variables are presented in Table 1. Measures of working memory, inhibition and cognitive flexibility show that EF skills were around 1 to 2 SD below the average norm (Delis et al., 2001; Weschler, 1999). The entire sample reported experiencing high levels of stress; specifically general life stress and psychological distress were within a clinical range (Abidin, 1995; Strand et al., 2003). The PRF in the whole sample was 2.91 (SD = 1.17), which indicates that reflective capacity was low but not completely absent (Slade, 2005).

Insert Table 1 about here

Part 1.

In the first part of the study we aimed to investigate associations between EF (working memory, inhibition and cognitive flexibility) stress (parental stress, general life stress and psychological distress) and PRF. Pearson's correlations were calculated for the main variables, and are presented in Table 2.

Insert Table 2 about here

Findings shown in Table 2 indicate that parental stress was significantly negatively associated with working memory, inhibition and cognitive flexibility. General life stress showed no significant correlations with any of the EF components, while psychological distress was strongly negatively associated with working memory, inhibition and cognitive flexibility. PRF was significantly negative associated with parental stress and psychological distress, but not with general life stress. In addition, PRF showed a significant positive association with all the EF components. The results indicated that high parental stress and psychological distress, but not general life stress were significantly associated with lower EF capacities and lower PRF. Amongst the demographic variables, only education was significantly associated with the EF components (working memory, inhibition and cognitive flexibility) and with psychological distress but not with parental stress or general life stress.

Further, two multiple linear regression analyses were conducted to assess the effect of EF (working memory, inhibition and cognitive flexibility) on parental stress and psychological distress, controlling for education. Table 3 presents the results of the multiple regression analysis on parental stress and psychological distress.

Insert Table 3 about here

Table 3 demonstrates that education only explained 3.5 % of the variance in parental stress. Introducing EF (working memory, inhibition and cognitive flexibility) increased the explained variance to 24.2 %, an increase of 20.7 % that was significant ($p = .03$). The regression model was significant ($F(4, 38) = 3.03, p = .03$), and cognitive flexibility made unique significant contribution ($p = .04$) to variance in parental stress.

Education explained 20.2 % of the variance in psychological distress. Introducing working memory, inhibition and cognitive flexibility in the regression model increased explained variance to 44.2 %, an increase of 24 % that was significant ($p = .003$). Working

memory made a significant unique contribution to the variance in psychological distress ($p = .05$) in the final model that was significant ($F(4, 38) = 7.51, p < .001$).

Part 2.

In the second part of the study, our aim was to examine whether PRF mediated the relationship between EF (working memory, inhibition and cognitive flexibility) and stress (parental stress and psychological distress). Following Baron and Kenny's approach for mediation (1986), the mediation model was tested using linear regressions between the EF components, the stress variables and PRF. The inclusion of PRF as a mediator led to a considerable reduction in the effect of the EF on parental stress, working memory ($\beta = .06, t = .30, p = .76$), inhibition ($\beta = -.20, t = -1.36, p = .18$) and cognitive flexibility ($\beta = -.30, t = -1.83, p = .08$). The results indicated that PRF mediated the link between each of the EF components individually and parental stress. Standardized coefficients (Beta) for the linear regression analyses are shown in Figure 1. The Sobel test confirmed the significance of causal chains in this complete mediation model between parental stress and working memory: ($Z = -2.51, p = .01$), as well as between parental stress and inhibition ($Z = -2.07, p = .04$). Although the Sobel test did not significantly confirm full mediation between cognitive flexibility and parental stress ($z = -1.85, p = .06$), results were almost significant and indicated a clear tendency towards a mediating effect of PRF (Cohen, 1994, Greenland, Senn, Rothman, Carlin, Goodman & Altman, 2016). In summary, results of the Sobel's test supported the mediation analyses that PRF mediated the relationship between EF and parental stress.

Insert Figure 1 about here

The analyses showed that PRF partially mediated the relationship between working memory and psychological distress ($\beta = -.44, t = -2.38, p = .02$), inhibition and psychological distress ($\beta = -.29, t = -2.13, p = .04$), as well as between cognitive flexibility and psychological

distress ($\beta = -.37, t = -2.50, p = .02$). Standardized coefficients (Beta) for the linear regression analyses are shown in Figure 1. The Sobel test confirmed the significance for partial mediation using PRF as a mediation variable for inhibition and psychological distress ($z = -2.21, p = .03$), and cognitive flexibility and psychological distress ($z = -2.07, p = .04$), but not for working memory and psychological distress ($z = -1.27, p = .20$). The results indicate that PRF significantly affects how cognitive flexibility and inhibition associate with psychological distress.

Insert Figure 2 about here

Discussion

The first aim of the present study was to examine the relationship between EF (working memory, inhibition and cognitive flexibility) and stress (parental stress, general life stress and psychological distress). Poorer EF capacities were associated with experience of higher parental stress, even after controlling for education. A well-functioning EF system is critical for sensitive caregiving where mothers have to adapt behaviour to meet environmental demands across multiple contexts and exhibit flexibility in caring for a child (Gonzalez, 2015). Partly supporting our expectations, cognitive flexibility, but not working memory showed unique contribution to variance in parental stress. Supporting our results, individual differences in cognitive flexibility have recently been suggested to be important for regulatory capacities associated with perspective taking (Long, Horton, Rohde, & Sorace, 2018). Previous studies have found that cognitive flexibility is impaired in individuals with SUD (Cunha et al., 2010). In addition, impairments in cognitive flexibility are associated with a heightened experience of stress in parents (Sturge-Apple, Jones, & Suor, 2017) and with emotion dysregulation in women with SUD (Marceau, Kelly, & Solowij, 2018). Mothers with young children and mothers with SUD

are shown to have a readily activated “hot” EF system when faced with distress (Gladwin & Figner, 2014; Gonzalez, 2015; Volkow & Baler, 2014). It is possible that weaker capacities in cognitive flexibility made it particularly difficult for the mothers in our study to tolerate the demands of a dyadic focus, switching between self and the child, and between activities outside and inside the dyad, hence experiencing a heightened parental stress level. Indeed, mothers with SUD, interacting with their children are shown to be more prone for stress compared to mothers without SUD (Rutherford, Williams, Moy, Mayes, & Johns, 2011). For example, a child demanding attention or an infant crying seems to trigger stress reactivity rather than reward salience in SUD mothers (Rutherford et al., 2011). In addition, mothers with SUD exhibit reduced activation in reward regions of the brain when they are observing their own children (Kim et al., 2017). Neurobiological evidence shows that reduced prefrontal functioning, related to EF capacities, is associated with increasing levels of stress (Li & Sinha, 2008). Together, these studies might help explain the effect of EF, and particularly cognitive flexibility on parental stress seen in the mothers in our study. We suggest that our group of mothers with weak cognitive flexibility capacities were less able to access adequate regulation strategies associated with a heightened experience of parental stress.

As expected, poor EF capacities were also significantly associated with heightened psychological distress in mothers in this study. Supporting our results, differential vulnerability to internal demands has been found to affect distress tolerance (Belsky, Bakermans-Kranenburg, & Van IJzendoorn, 2007). Previous studies have demonstrated that mothers with SUD have a heightened risk for difficulties in emotion regulation capacities (Suchman et al., 2012), which in turn relates to reduction in distress tolerance (Daughters, Lejuez, Kahler, Strong, & Brown, 2005; Deater-Deckard et al., 2016; Leyro et al., 2010). Reduced distress tolerance is further considered a central component of SUD (Li & Sinha, 2008; Tronick et al., 2005). Amongst the EF components, working memory showed a unique contribution to

variance in psychological distress in the mothers after controlling for education. Our results indicate that the ability to keep information in mind, and integrate current content with new information might be particularly important for less psychological distress in mothers with SUD. Supporting our results, reduced working memory has previously been associated with difficulties in emotion regulation strategies in mothers (Rutherford, Booth, Crowley, & Mayes, 2016). Problems with the capacity to regulate emotions (e.g. “hot” EF capacity) have been associated with psychological distress in general populations (Leyro, Zvolensky, & Bernstein, 2010), mothers with young children (Deater-Deckard et al., 2016), and in individuals with SUD (Daughters, Lejuez, Kahler, Strong, & Brown, 2005). Our results might indicate that weak working memory exhausts emotion regulation capacities associated with heightened vulnerability to psychological distress. This process might in turn affect the dyadic relationship. Indeed, mothers with heightened psychological distress tend to perceive their infant's behavior as stressful (Sheinkopf, Lester, LaGasse, Seifer, Bauer et al., 2005). It is therefore possible that high psychological distress adversely affects parental stress.

Surprisingly, general life stress was not significantly associated with any of the EF components. Contrary to the results in our study, previous studies have found that EF impairments are associated with experience and management of general life stress (Hofmann et al., 2012; Koenig, Walker, Romeo, & Lupien, 2011; Schmeichel & Tang, 2014; Williams et al., 2009). However, in our study PRF was strongly correlated with all the EF components as well as with parental stress and psychological distress, but not with general life stress. Studies have found that PRF was associated with tolerance of child distress, but not with tolerance of general life stress (Rutherford, Goldberg, Luyten, Bridgett, & Mayes, 2013) and PRF was associated with EF (Håkansson et al., 2017; Rutherford et al., 2017; Yatziv et al., 2017). We suggest that that EF capacities and deficits might affect relational forms of stress (parental stress and psychological distress), and particularly in SUD mothers because of a possible mediating

functioning of PRF. Indeed, these associations between EF and general life stress may not be present as general life stress is less relationally focused compared to parental stress and psychological distress.

Our second aim in the study was to increase our understanding of the role between PRF, EF (working memory, inhibition and cognitive flexibility) and stress (parental stress and psychological distress). Congruent with our hypothesis, the results confirmed a clear mediating effect of PRF in the association between EF (working memory, inhibition and cognitive flexibility) and parental stress. In other words, EF might have indirectly influenced parental stress via the capacity to mentalize (i.e. PRF). Poor PRF might lead mothers to be more vulnerable to parental stress because of weaker EF capacities. In contrast, adequate PRF capacities might have strengthened mothers' regulation capacities, leading to access of EF in a more helpful way when facing demanding parental situations. Supporting our results, findings from previous studies have suggested PRF as a core capacity in regulating strong emotions when confronted with relational stress, including parental stress (Fonagy & Bateman, 2016; Slade, 2005). Furthermore, mothers with weaker PRF capacities that demonstrate difficulties reflecting around their child's mind and with a low capacity to tolerate demands from the child have been found to exhibit decreased tolerance of stress (McQuillan & Bates, 2017; Rutherford, Booth, Luyten, Bridgett, & Mayes, 2015). Together, previous research and our results indicate that the mediating effect of PRF in the association between EF and parental stress might affect the dyadic relationship.

PRF also mediated the relationship between EF (working memory, inhibition and cognitive flexibility) and psychological distress, but to a lesser degree than to parental stress. It is likely that other variables in combination with PRF constituted mediators between EF and psychological distress. Impairments in perspective taking, a capacity fundamental for PRF, have previously been associated with psychological distress (Allen & Fonagy, 2002). In

addition, a recent study found that low PRF heightens stress sensitivity in mothers with mental health problems (Krink, Muehlhan, Luyten, Romer, & Ramsauer, 2018). Numerous studies have demonstrated that mental health issues adversely affect RF (Borelli, West, Decoste, & Suchman, 2012; Conklin, Bradley, & Westen, 2006). Our results indicate that EF associated with psychological distress partly via poor or adequate PRF. Interestingly, the Sobel test (Sobel, 1982) showed that PRF partially mediated the relationship between inhibition, cognitive flexibility and psychological distress, but not between working memory and psychological distress. As the regression showed that working memory was particularly related to psychological distress, but not mediated by PRF, it is likely that working memory is more directly associated with psychological distress.

Recent studies have suggested that individual capacities in allocating EF in the face of stress work in a dynamic manner, where individuals with deficits in EF might have a limited capacity for stress tolerance (Kluwe-Schiavon et al., 2016). We suggest that the experience of parental stress and psychological distress in the mothers in our study could be heightened because of a pre-existing weak EF system in combination with deficits in PRF. Indeed, mothers with adequate PRF could have had enhanced capacity to access EF during demanding intra and inter-relational situations (e.g. parental stress and psychological distress) because they were able to reflect upon them (e.g. having adequate PRF) and therefore were more able to regulate stress in demanding contexts concerning internal or relational situations.

Limitations and strengths

First, based on our theoretical focus, we have tested one model regarding associations between EF, stress and PRF. However, no single model can fully predict reality and our model is one out of many possible approaches. In addition, the reliance on a cross-sectional design precludes inferences about causality. Future research with prospective or longitudinal designs could determine the direction and temporal order of relationships among the variables. Second,

self-report data could generate participant bias and future studies should include physical measurements of stress. Third, results of the current study may have been influenced by unmeasured confounding variables. For instance, we did not include details about the SUD, such as preference for a particular substance or severity of dependence (Pajulo et al., 2012). We did not include specifics about PTSD or developmental trauma which have been found to affect PRF, EF and stress (Augusti & Melinder, 2013; Briere, Kaltman, & Green, 2008; Cromer & Sachs-Ericsson, 2006; Håkansson, Watten, Söderström, Skårderud, & Øie, 2018). Fourth, our sample size was rather small, although within the norms for this kind of study (Pajulo et al., 2012; Suchman, Decoste, McMahon, Rounsaville, & Mayes, 2011). Because the Sobel's test (1982) relies on the assumption of normal distributed samples, a small sample size may have underestimated the mediation effect. To increase statistical power our study should be replicated using a larger sample size.

To our knowledge, this is the first study to investigate associations between EF and different types of stress in SUD mothers to small children. In addition, we do not know of any previous studies that have investigated PRF as a mediator between EF and stress. Our study therefore extends on previous theoretical and clinical knowledge in the field. Furthermore, we conducted semi-structured interviews and administered a selection of measures with strong psychometric properties. In addition, all the mothers completed the full assessment battery. Mothers with SUD are often considered particularly vulnerable in the parental role, in addition to being difficult to offer appropriate, customized interventions (Pajulo, Suchman, Kalland, & Mayes, 2006). They are also vulnerable to intergenerational transmission of risk (Håkansson et al., 2018; Kelly, Slade, & Grienenberger, 2005), and therefore are an important population to offer targeted effective interventions. Results of our study may be useful when considering the development of psychotherapeutic interventions. The results of our study indicate that there are dynamic processes between EF, PRF and the experience of stress. Targeting individual

capacities and vulnerabilities in these components might help overcome some of the difficulties in developing effective interventions.

Conclusions and clinical implications

The findings from this study suggest that parental stress and psychological distress in mothers with SUD should be understood within the context of EF, with PRF as a mediating variable. Based on our results, we suggest that it is important to consider individual differences in mothers with SUD, particularly in PRF and EF capacities, before developing interventions. Individually customized interventions that targets reflective capacities, such as mentalization based therapies (Sadler et al., 2013; Suchman et al., 2017), dialectal behavior therapy (Neacsiu, Bohus, & Linehan, 2014) or mindfulness-based interventions (Short et al., 2017) might lead to improvements in accessing EFs and reduce the experience of parental stress and psychological distress. In addition, interventions directly targeting EF capacities, particularly cognitive flexibility and working memory could regulate the mother and possibly make her more accessible for the intervention given.

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Tables

Table 1

Descriptive statistics of Demographics, Substance Preference, Stress presented by average raw score and standard deviation Performance on Cognitive tests presented by T-scores, IQ, and Parental Reflective Functioning presented by average score and standard deviation.

Demographics	M	SD	Range	N	%
Mother's age ^{a)}	31.1	6.4	19-44		
Child's age (months) ^{a)}	8.6	3.8	4-18		
Marital Status ^{a)}					
Cohabitant				14	32.6
Partner, not cohabitant				7	16.3
Single				22	51.2
Educated (highest completed) ^{a)}					
Not completed primary school				2	4.7
Primary School				24	53.5
High School				12	27.9
University Degree				6	4.7
Preferred Substance ^{a)}					
Central Stimulant				16	37.2
Opioids				14	32.6
Alcohol				7	16.3
Cannabis				6	14.0
Polysubstance Abuse ^{a)}				37	86.0
Injecting Substances ^{a)}				22	51.2
Overdoses in life ^{a)}					
0				14	32.6
1-5				21	48.9
>5				8	18.5
Prescribed Medications ^{a)}					
Medically Assisted Rehabilitation				11	25.6
Medication for ADHD				4	9.3
Other				8	18.6
Stress					
Parental Stress ^{b)}	70.9	19.2	20-98		
General Life Stress ^{b)}	82.8	18.0	25-99		
Psychological Distress ^{c)}	2.5	0.6	1.3-3.5		
Performance on Cognitive Tests					
Working Memory ^{d)}	41.7	8.8	25-65		
Inhibition ^{e)}	39.8	11.3	20-65		
Cognitive Flexibility ^{e)}	35.2	11.4	20-63		
IQ ^{f)}					
Total IQ	94.1	14.6	71-125		
Parental Reflective Functioning ^{g)}					
General RF	2.9	1.7	0-6		
Mental Health ^{h)}					
HSCL-10	2.5	0.3	1.3-3.5		

-
- a) European Addiction Severity Index (Europ-ASI), 5th edition
 - b) Parenting Stress Index, full scale (PSI)
 - c) Hopkins Symptom Checklist (HSCL-10)
 - d) Letter-Number Sequencing sub-test in the Wechsler Adult Intelligence Scale, 4th Edition
 - e) Colour-Word Interference Test, Conditions 3 and 4 from Delis-Kaplan Executive Function System (D-KEFS)
 - f) Wechsler Abbreviated Scale of Intelligence (WASI)
 - g) Parental Development Interview - Revised, Reflective Functioning Scale
 - h) Hopkins Symptom Checklist – 10 (HSCL-10)
 - i) Mini-International Neuropsychiatric Interview 5.0.0 manual

Table 2

Correlation coefficients between Stress (items 1-3), EF (items 4-6), Parental RF (item 7), and Demographic variables (items 8-10)

Variable	1	2	3	4	5	6	7	8	9
1. Parental Stress ^{a)}									
2. General Life Stress ^{a)}	.42**								
3. Psychological Distress ^{b)}	.57**	.35*							
4. Working Memory ^{c)}	-.34*	-.10	-.61**						
5. Inhibition ^{d)}	-.37*	-.10	-.48**	.72**					
6. Cognitive Flexibility ^{d)}	-.48**	-.10	-.57**	.64**	.64**				
7. Parental RF ^{e)}	-.49**	-.22	-.56**	.74**	.42**	.58**			
8. Maternal Age ^{f)}	-.04	.00	-.01	.12	-.16	.13	-.09		
9. Education ^{f)}	-.19	.15	-.45**	.48**	.34*	.48**	.30	.30	
10. Marital Status ^{f)}	-.01	-.07	.20	-.10	.13	-.02	-.09	-.12	-.21

N=43, ** = $p < .01$, * = $p < .05$, NS = no significant differences

a) Parenting Stress Index, full scale (PSI)

b) Hopkins Symptom Check-list (HSCL-10)

c) Letter-Number Sequencing sub-test in the Wechsler Adult Intelligence Scale, 4th edition

d) Colour-Word Interference Test, Condition 3 and 4 from Delis-Kaplan Executive Function System (D-KEFS)

e) Parental Development Interview – Revised, Reflective Functioning Scale

f) European Addiction Severity Index (EuropASI)

Table 3

Multiple regression Analyses for Executive Functioning (Working Memory, Cognitive Inhibition, and Cognitive Flexibility) predicting Stress (Parental Stress and Psychological Distress), controlling for Education

Variable	B	SE B	B	R ²	R ² adj.	R ² change	T	Sig.
Parental Stress				.24	.16	.21		.03
Education	.75	3.69	.03				.20	.72
Working Memory	1.58	.70	.73				2.27	.98
Inhibition	-.93	.45	-.55				-2.08	.60
Cognitive Flexibility	-.25	.35	-.15				-.72	.04
Psychological Distress				.44	.38	.24		.003
Education	-.11	.10	-.14				-1.01	.32
Working Memory	-.03	.01	-.38				-2.00	.05
Inhibition	.001	.01	-.02				-.12	.91
Cognitive Flexibility	-.02	.01	-.27				-1.56	.13

*p < .05. **p < .01. NS = No significant results

N=43

Figure 1.

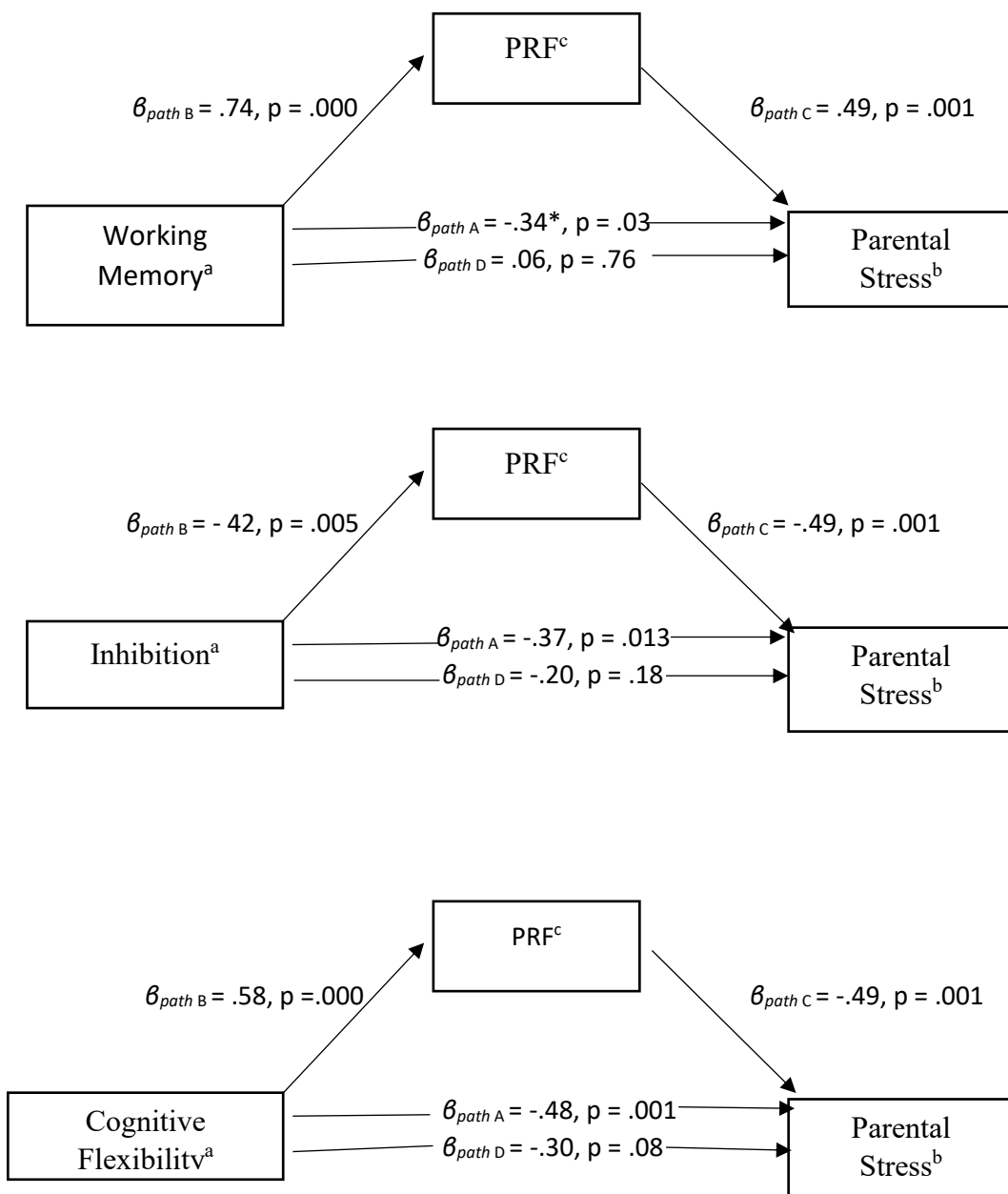


Fig. 1. The Mediating Effect of PRF on the relationship between a) Working memory and Parental Stress, b) Inhibition and Parental Stress, and c) Cognitive Flexibility and Parental Stress (N = 43). Baron and Kenny's path diagram includes standardized path coefficients that were obtained through a series of multiple regressions to construct the mediation models: - Step 1: regression of the dependent variable (Parental Stress) on the independent variable (EF component: working memory, inhibition or cognitive flexibility) (path A): - Step 2: regression of the mediator (PRF) on the independent variable (EF component: working memory, inhibition or cognitive flexibility) (path B): - step 3: regression of the dependent variable (parental stress) on the mediator (PRF) (path C): - step 4 regression of the dependent variable (parental stress)

on both the mediator (PRF) and the independent variable (EF component: working memory, inhibition or cognitive flexibility (path D)).

Figure 2.

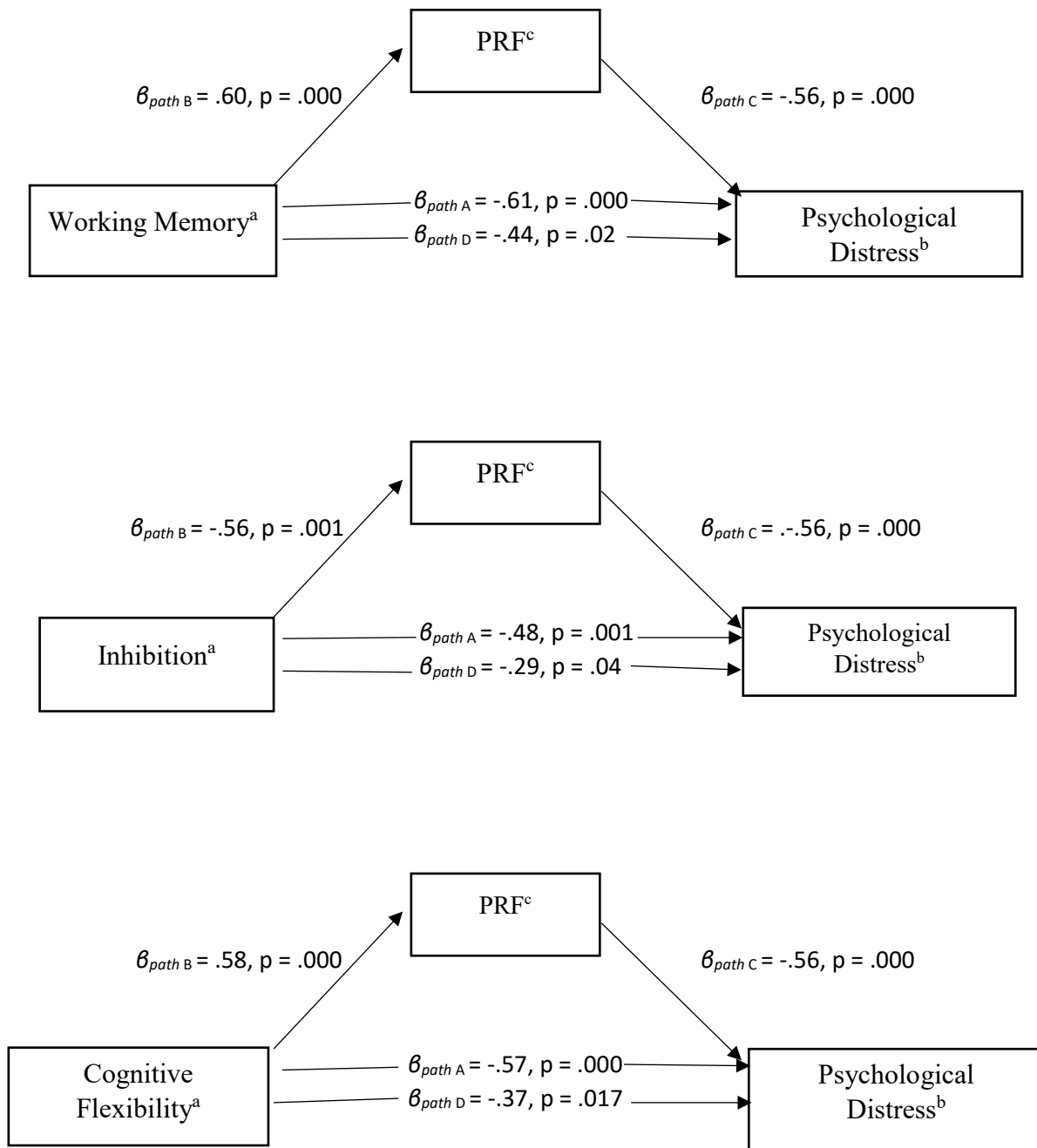


Fig. 2. The Mediating Effect of PRF on the relationship between a) Working memory and Psychological Distress, b) Inhibition and Psychological Distress, and c) Cognitive Flexibility and Psychological Distress (N = 43). Baron and Kenny's path diagram includes standardized path coefficients that were obtained through a series of multiple regressions to construct the mediation models: - Step 1: regression of the dependent variable (Psychological Distress) on the independent variable (EF component: working memory, inhibition or cognitive flexibility) (path A): - Step 2: regression of the mediator (PRF) on the independent variable (EF component: working memory, inhibition or cognitive flexibility) (path B): - step 3: regression

of the dependent variable (Psychological Distress) on the mediator (PRF) (path C): - step 4; regression of the dependent variable (Psychological Distress) on both the mediator (PRF) and the independent variable (EF component: working memory, inhibition or cognitive flexibility (path D)).

Paper 3

Håkansson, U., Watten, R., Söderström, K., Skårderud, F., & Øie, M. G. (2018). Adverse and adaptive childhood experiences are associated with parental reflective functioning in mothers with substance use disorder. *Child Abuse & Neglect, 81*, 259-273. Published



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Research article

Adverse and adaptive childhood experiences are associated with parental reflective functioning in mothers with substance use disorder



Ulrika Håkansson^{a,*}, Reidulf Watten^a, Kerstin Söderström^{a,b}, Finn Skårderud^c, Merete Glenne Øie^{d,e}

^a *Innland Norway University of Applied Sciences, Lillehammer, Norway*

^b *Division Mental Health Care, Innlandet Hospital Trust, Lillehammer, Norway*

^c *Norwegian School of Sport Science, University of Oslo, Oslo, Norway*

^d *Department of Psychology, University of Oslo, Oslo, Norway*

^e *Research Division, Innlandet Hospital Trust, Lillehammer, Norway*

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ABSTRACT

Mothers with a substance use disorder (SUD) are at risk for maladaptive parenting practices, and have heightened likelihood of having experienced childhood adversity themselves. In addition, parental reflective functioning (PRF), a capacity underlying sensitive caregiving, is often low in mothers with SUD. This study examines the relationship between PRF and aversive (emotional, physical, sexual abuse and neglect) and adaptive (safety and competence) experiences, in different developmental phases (early childhood, latency, and adolescence) in mothers with a SUD. A sample of 43 mothers with small children were interviewed with the Parental Developmental Interview to assess PRF, and they completed the Traumatic Antecedents Questionnaire regarding aversive and adaptive experiences. In addition, we used the Hopkins Symptoms Checklist-10 to control for mental health status and a battery of neuropsychological tests to control for executive functions. Results indicated that adaptive experiences in early childhood were positively related to PRF, and that experience of emotional abuse was negatively related to PRF. When separating the group of mothers in two sub-groups based on PRF level, results showed that mothers with negative to low PRF had significantly more experiences of adversities in early childhood and latency, and significantly less adaptive experiences in early childhood, latency and adolescence, compared to mothers with moderate to high PRF. In addition, mothers with adequate to high PRF reported experiencing significantly more types of adaptive experiences, and significantly less adversities compared to mothers with negative to low PRF. Results are discussed in relation to developmental trauma, resilience, epistemic trust and mistrust.

1. Introduction

Adverse interpersonal traumatic experiences in childhood and adolescence are shown to negatively affect somatic health as well as heighten the risk for adult psychopathology (Heloniak, Jenness, Vander Stoep, McCauley, & McLaughlin, 2016; Shonkoff et al., 2012; Teicher & Samson, 2016). Although experiences of early adversity might lead to post-traumatic stress disorder (PTSD) for some

* Corresponding author.

E-mail address: ulrika.hakansson@inn.no (U. Håkansson).

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individuals, others might develop other forms of psychopathological symptoms such as depression, anxiety or a substance use disorder (SUD), and some individuals may not develop any symptoms (Dube et al., 2003, 2006; Ozer, Best, Lipsey, & Weiss, 2003; Strine et al., 2012). In numerous studies, results suggest that there is a high co-occurrence between SUD and the likelihood of having experienced childhood adversity (Felitti et al., 1998; Green et al., 2010; Jansson & Velez, 2011; Norman et al., 2012; Vachon, Krueger, Rogosch, & Cicchetti, 2015). Furthermore, it has been suggested that substance abuse might be conceptualized as a form of coping behaviour, where substances might function as a strategy to manage challenging emotions associated with previous traumatic exposure (Berking & Wupperman, 2012; Haller & Chassin, 2014; Leebes, Pagura, Sareen, & Bolton, 2010; Sheerin et al., 2016).

Trauma is defined as a response to an event that threatens a person's life, physical or psychological integrity whether experienced directly, witnessed or heard about (American Psychological Association, 2013; Rothschild, 2011). Early, recurrent and severe interpersonal trauma has been termed developmental trauma (Ford et al., 2013). Developmental trauma suggests that a primary caregiver is involved in the adversity, and therefore the experience could affect core developmental capacities in the child. Specifically early caregiving relationships are thought to provide the relational context in which children develop the earliest psychological representations of self, others, and self in relation to others (Fonagy, Gergely, & Jurist, 2004). These working models form a developmental foundation of a child's sense of safety, emotion regulation capacity, distress tolerance and a sense of agency, and together these processes influence the experience of controlling one's own actions and having competence to handle events in the outside world (Haggard & Chambon, 2012; Sokol, Hammond, Kuebli, & Sweetman, 2015). When the child-caregiver relationship is the source of adversity, the attachment relationship may be severely compromised (Allen, 2012; Cook et al., 2005; Van der Kolk, Roth, Pelcovitz, Sunday, & Spinazzola, 2005). For instance, when a caregiver is too preoccupied, distant, unpredictable, punitive or distressed to be reliably responsive, children can become distressed easily (Cook et al., 2017; Shonkoff et al., 2012). Different forms of adversity frequently co-occur, and exposure to a higher number of adversities predicts greater psychological and somatic symptom severity in childhood through to adulthood (Cecil, Viding, Fearon, Glaser, & McCrory, 2017; Finkelhor, Ormrod, & Turner, 2007; Finkelhor, Ormrod, & Turner, 2009). Furthermore, there is an increasing risk when victimization in childhood is followed by further traumatization in adolescence and in adulthood (Briere, Kaltman, & Green, 2008; Van der Kolk et al., 2005). Exposure to adversity during sensitive periods, such as early childhood and adolescence are particularly harmful for the developing child, and may compromise core self-regulatory capacities in childhood (Kolk & Fidler, 1994; Manly, Kim, Rogosch, & Cicchetti, 2001; Meaney & Ferguson-Smith, 2010). In addition, individuals exposed to adversity in childhood may be particularly sensitive to stressful experiences and prone for later psychological distress in adolescence and adulthood (Althoff, Verhulst, Rettew, Hudziak, & van der Ende, 2010; Dougherty, Klein, & Davila, 2004; Fonzo et al., 2016; McLaughlin, Sheridan, Alves, & Mendes, 2014).

Transition to parenthood is considered a period of reorganization of the self, that may trigger memories and experiences associated with childhood adversity (Fraiberg, Adelson, & Shapiro, 1975; Lieberman & Van Horn, 2011). Repeated adversities may disrupt the development of appropriate emotion regulation capacities and interpersonal skills needed for parenting, making the cues and demands from the child potentially overwhelming for the parent (Burns, Jackson, & Harding, 2010; Cicchetti & Rogosch, 2009). Indeed, adults with developmental trauma are shown to be at risk for impaired parenting capacities (Belsky & Pluess, 2013; DiLillo & Damashek, 2003; Fuchs, Möhler, Resch, & Kaess, 2015; Gonzalez, 2015). Consequences of adverse childhood experiences may as such extend into the next generation.

Adaptive experiences in childhood and adolescence such as safe relationships, adequate coping mechanisms, and a sense of competence and agency may contribute to resilience in adulthood (Belsky & Pluess, 2009; Block & Block, 1980; Cook et al., 2017; McGloin & Widom, 2001). Resilience is defined as the ability to maintain equilibrium in the face of stressful life events (Bonanno, 2005), or a pattern of positive adaptation in the context of significant risk or adversity (Rutter, 2012). A good enough, safe attachment relationship with the caregiver, in addition to having effective coping capacities have been found to be protective factors when growing up with adversity (Luthar, 2006, 2003; Schofield, Conger, & Neppl, 2014). Adults with SUD exposed to developmental trauma often report low levels of such protective adult relationships in childhood (Brown & Shillington, 2017).

Early adversity is associated with disturbances in mentalizing abilities in individuals with SUD (Allen, Lemma, & Fonagy, 2012). Mentalizing is a developmentally acquired skill that enables an understanding of mental states (e.g. feelings, wishes, thoughts) in others and oneself as underlying behavioural expressions (Fonagy, Steele, Steele, Moran, & Higgitt, 1991; Fonagy et al., 2004). Development of adequate mentalizing capacities may be a protective factor against emergence of psychopathology in the face of childhood adversity by creating a coherent narrative around the adversity (Fonagy, Steele, Steele, Higgitt, & Target, 1994). Reflective functioning (RF) is the manifestation of mentalizing, and is suggested to first develop in an attachment relationship with a sensitive and responsive caregiver (Bouchard et al., 2008; Fonagy & Target, 1997; Fonagy & Target, 2002; Sharp & Fonagy, 2008). Parental RF (PRF) is the capacity to mentalize in the context of the caregiving relationship (Slade, 2005), and is considered a prerequisite of parental sensitivity (Pajulo et al., 2012). The level of PRF also influences the development of child RF, for instance moderate to high PRF has been associated with moderate child RF (Ensink & Mayes, 2010; Sharp & Fonagy, 2008; Slade, 2005). However, as the child develops, peers, teachers and the sociocultural context increasingly influence RF capacity (Luyten, Nijssens, Fonagy, & Mayes, 2017). Indeed, although RF is not directly associated with parenting, RF and PRF are separate but related capacities that capture different aspects of mentalizing (Luyten, Fonagy, Lowyck, & Vermote, 2012; Luyten, van Houdenhove, Lemma, Target, & Fonagy, 2012; Luyten et al., 2017; Steele et al., 2008). Both RF and PRF are considered dynamic capacities as they are influenced by particular contexts (e.g. developmental trauma) and specific relationships (e.g. being a parent). Fonagy et al. (1991, 1995) suggested that PRF has a mediating effect between maternal childhood adversity and the development of attachment security in the child. As such, PRF has been considered an intergenerational resilience factor. Previous studies have identified negative associations between PRF and emotional abuse (Bottos & Nilsen, 2014; Burns et al., 2010; Hart, Binggeli, & Brassard, 1997) and between PRF and neglect (San Cristobal, Santelices, & Fuenzalida, 2017), indicating that different forms of adversity might affect PRF differently (Teicher, Samson,

Polcari, & McGreenery, 2006). Furthermore, a good enough attachment relationship is theorized to lead to an interpersonally transmitted knowledge, called *epistemic trust*. Epistemic trust is a process whereby a child, and later an adult, experience enough trust in the authenticity and personal relevance of interpersonally transmitted knowledge to be able to make use of it for social and interpersonal learning (Fonagy & Campbell, 2017). Mistrust in this context can occur when there are no clear signals of authenticity, and individuals with experience of developmental trauma and profound trust-issues concerning attachment relationships are more prone to *epistemic vigilance* (Fonagy & Allison, 2014). The mistrust in early attachment relationships can lead these individuals to be more vigilant and less likely to profit from later relational experiences (Fonagy & Campbell, 2017). The experience of epistemic mistrust in relational settings may be particularly high in vulnerable populations, which includes mothers with SUD. Indeed, mothers with SUD have been identified to have a low PRF (Håkansson, Söderström, Watten, Skårderud, & Øie, 2017; Levy & Truman, 2002; Pajulo et al., 2012; Suchman, DeCoste, Castiglioni, Legow, & Mayes, 2008). In a previous study, we separated SUD mothers according to their PRF level, which was either negative to low or adequate to high (Håkansson et al., 2017). Negative to low PRF indicates not fully developed reflective capacities and adequate to high represents developed reflective functioning (Kelly, Slade, & Grienerberger, 2005; Taubner et al., 2013). We found that mothers with negative to low PRF started using substances earlier, had a more chaotic substance use pattern and developed SUD significantly earlier compared to mothers with adequate to high PRF. Surprisingly, there were no significant differences between mothers with low and adequate PRF in regards of what type of substance they preferred. Furthermore, mothers with adequate PRF performed according to norms in diverse executive functions (EF), while mothers with negative to low PRF had multiple deficits in EF (Håkansson et al., 2017). This association between PRF and EF was also highlighted in a recent study on mothers from a normal population (Rutherford et al., 2017). EF refers to a set of cognitive processes that involves working memory, inhibition, cognitive flexibility and regulation of emotion and attention (Diamond, 2013; Zelazo, 2015). Studies have found that adverse childhood experiences have been associated with long lasting effects on cognitive development and functioning (Teicher, Samson, Anderson, & Ohashi, 2016), and reductions in EF (Hanson et al., 2015; Hostinar, Stellern, Schaefer, Carlson, & Gunnar, 2012; Viola, Tractenberg, Pezzi, Kristensen, & Grassi-Oliveira, 2013). It is suggested that impairments in the hippocampus, prefrontal cortex, and enhanced amygdala function after early life adversity may increase emotional responses to threat detection and EF capabilities later in life (Kim et al., 2013; Loman et al., 2013; Teicher et al., 2016).

In spite of numerous studies that have highlighted the significance of adverse and adaptive experiences during childhood and adolescence for adult and parental functioning, to our knowledge, no studies have investigated associations between PRF and adaptive and adverse experiences in mothers with SUD. Considering the potential intergenerational transmission of risk and resilience in mothers with SUD, it is important to enhance our knowledge about possible associations, and individual differences, regarding PRF and different forms of adverse and adaptive experiences during childhood and adolescence.

2. The current study

2.1. Part 1

In the first part of the study we aimed to examine associations between PRF and adaptive and adverse experiences during different developmental phases, as well as different forms of adaptive (safety and competence) experiences and adversities (emotional, physical sexual abuse, and neglect), controlling for EF and mental health status in mothers with SUD. We expected to find positive correlations between PRF and adaptive experiences, and negative correlations between PRF and adversities throughout early childhood, latency and adolescence. We hypothesized that adaptive and adverse experiences in early childhood, would be strongly associated with PRF. We expected to find significant negative associations between all forms of adversities and PRF, and anticipated that emotional abuse and neglect in particular would be strongly associated with PRF compared to other forms of adversities. Based on our previous study on the same population of mothers, we predicted EF capacities and the level of experienced psychological distress to affect the association between PRF and adverse and adaptive experiences.

2.2. Part 2

In the second part of the study, we separated the group of mothers in two, based on PRF level and controlled for EF and psychological distress. We expected to find between-group differences depending on whether the mothers exhibited either a negative to low PRF or an adequate to high PRF. We hypothesized that mothers with negative to low PRF would report significantly more adverse and less adaptive experiences in different developmental phases compared to mothers with adequate to high PRF. Furthermore, we expected that mothers with adequate to high PRF would report less experience of emotional, physical, and sexual abuse and neglect as well and more experience of safety and competence compared to mothers with negative to low PRF.

3. Methods

3.1. Participants

The study cohort consisted of 43 mothers (mean age = 31.0 years; *SD* 6.4). We recruited the mothers during pregnancy or early during the postpartum period and referrals were received from municipality nurses, clinicians in outpatient clinics or from clinicians in institutions specialized in caring for pregnant women with SUD. To be eligible for inclusion, mothers had a child under the age of 18 months, and a SUD diagnosis, with or without comorbid mental health diagnosis. Exclusion criteria were: (a) estimated full IQ

Table 1

Descriptive statistics of Demographics, Substance Preference, Parental Reflective Functioning, Amount of experienced adversity in different developmental phases, and amount of adverse and adaptive experiences in a lifetime perspective.

Variable	M	SD	Range	N	%
Demographics					
Mother's age ^a	31.1	6.4	19–44		
Child's age (months) ^a	8.6	3.8	4–18		
Educated (highest completed)^a					
Not completed primary school				2	4.7
Primary School				23	53.5
High School				12	27.9
University				6	4.7
Preferred Substance^a					
Central Stimulant				16	37.2
Opioids				14	32.6
Alcohol				7	16.3
Cannabis				6	14.0
Parental Reflective Functioning^b					
General RF	2.91	1.71	0–6		
Adverse Experiences^c					
Early Childhood	11.3	6.9	0–21		
Latency	13.1	6.0	0–21		
Adolescence	14.7	5.0	0–21		
Adaptive Experiences					
Early Childhood	1.9	1.6	0–6		
Latency	2.2	1.8	0–6		
Adolescence	2.2	1.9	0–6		
Adverse and Adaptive Experiences^c					
Emotional Abuse	9.3	2.4	2–12		
Physical Abuse	6.2	3.6	0–12		
Neglect	8.4	3.2	0–12		
Sexual Abuse	5.6	3.4	0–12		
Competence	6.0	2.9	2–12		
Safety	3.9	2.8	0–11		
Mental health^d					
HSCL-10	2.5	1.6	1.3–3.5		
Performance on Cognitive Tests					
Working memory, Letter-Number ^e	41.2	8.8	25–65		
Inhibition ^f	39.8	11.3	20–65		
Cognitive Flexibility ^f	35.2	11.4	20–63		
Letter Fluency ^g	48.4	11.4	21–70		
Category Fluency ^g	59.0	11.4	30–80		
Planning, Tower ^h	45.1	6.5	30–59		

^a European Addiction Severity Index (Europ-ASI), 5th edition.

^b Parental Development Interview – Revised, Reflective Functioning Scale.

^c Traumatic Antecedents Questionnaire (TAQ).

^d Hopkins Symptom Checklist (HSCL-10).

^e Letter-Number Sequencing sub-test in the Wechsler Adult Intelligence Scale, 4th edition.

^f Colour-Word Interference Test, Conditions 3 and 4 from Delis-Kaplan Executive Function System (D-KEFS).

^g Verbal Fluency test from Delis-Kaplan Executive Function System (D-KEFS).

^h Tower Test from Delis-Kaplan Executive Function System (D-KEFS).

below 70. Factors considered as potential confounding stressors for the mothers as (b) multi-parity (i.e. giving birth to twins or triplets), (c) premature birth (< 32 weeks and < 1500 g), or (d) having a severely ill or multi-handicapped child were also exclusion criteria. Neonatal abstinence syndrome in the infant was not an exclusion criterion. Although the mothers had a recent and severe history of substance abuse, all the mothers were abstinent during the inclusion and assessment period that lasted for several months (Table 1).

3.2. Measures

3.2.1. Socio-demographic variables and use of psychoactive substances

Substance use was registered with the *European Addiction Severity Index* (Europ-ASI) 5th edition (Kokkevi & Hartgers, 1995; McLellan et al., 1992), Norwegian version (Lauritzen, 2010). The Europ-ASI is a well-validated semi-structured commonly used

clinical interview. In addition to questions concerning substance use and addiction severity, questions relate to employment and support status, family and social relationship, as well as somatic and psychological issues. Reliability and validity for the Europ-ASI has been reported to be satisfactory (Kessler et al., 2012; Kokkevi & Hartgers, 1995; McLellan et al., 1992).

3.2.2. Adaptive and adverse experiences

The Traumatic Antecedent Questionnaire (TAQ) (Van der Kolk, Spinazzola, & Hopper, 1995) is a 41-item self-administered instrument that evaluates adverse and adaptive experiences in four different developmental phases; early childhood (0–6 years), latency (7–12 years), adolescence (13–18 years) and adulthood. Information about lifetime experiences is measured in ten domains: (1) competence, (2) safety, (3) neglect, (4) separations, (5) family secrets, (6) physical trauma, (7) sexual trauma, (8) witnessing trauma, (9) other traumas (i.e., natural disaster, serious accident), and (10) exposure to familial or personal alcohol or illicit drug use (Herman & Van der Kolk, 1990). The first two domains represent adaptive experiences, while the latter eight domains assess exposure to adverse experiences or trauma. For this particular study, we investigated four adverse experiences (emotional, physical, sexual abuse, and neglect), and two adaptive experiences (competence and safety). The TAQ allows calculation of summary scores for each of the ten individual domains, as well as across the four developmental periods. For each item of the TAQ, respondents are asked to rate the extent to which they had a particular experience during each developmental period on a scale from 0 to 3. Numerical markers represent both frequency and severity of experience. In general, higher scores on the two adaptive domains represent greater levels of adaptive functioning, while higher scores on the eight trauma/adverse event domains represent greater levels of accumulated risk. A composite score is then calculated for each area and for each age range. The TAQ has shown preliminary incremental validity (Luxenberg, Spinazzola, & Van der Kolk, 2001).

3.2.3. Parental reflective function (PRF)

We used the Parent Development Interview-Revised (PDI-R2) to assess PRF (Fonagy, Target, Steele, & Steele, 1998; Slade et al., 2003), Norwegian translation. The PDI-R2 is a 20-question semi-structured interview designed to assess how the parent makes sense of rewarding and challenging situations with the child, the relationship, or themselves as a parent. To assess for PRF, the PDIs-R2 were transcribed verbatim and were rated according to RF coding guidelines (Fonagy et al., 1998). For reliability purposes, a second independent rater coded 25% of the interviews. There was a strong correlation between the coders ($r = .96$). The interviews were scored for PRF on an 11-point scale from –1 to 9, where higher scores reflected higher RF (Slade, Bernbach, Grienberger, Levy, & Locker, 2005). We made a distinction between negative to low PRF and average to high PRF at a score of 4 in this study. In a vulnerable population (as SUD mothers), a score of 4 indicates average RF capacity (Kelly et al., 2005; Levy, Truman, & Mayes, 2001; Taubner et al., 2013), while a score of 5 or above indicates average RF in a normal population. (Slade, 2005). PDI-RF has good validity in normal populations and in populations of parents with a SUD (Levy & Truman, 2002; Slade, Belsky, Aber, & Phelps, 1999; Slade, 2005).

3.2.4. Mental health status

To measure psychological distress, we used the Hopkins Symptom Checklist (HSCL-10). The HSCL-10 is a self-administered questionnaire designed to measure daily subjective experiences of anxiety and depression symptoms. The HSCL-10 is a short version of the HSCL-90 (Derogatis, Lipman, Rickels, Uhlenhuth, & Covi, 1974), and consists of 10 items, in which responses ranges from 1 = not at all, to 4 = very much. By dividing the total score with number of items answered, a total score is calculated. The cut-off score of 1.85 is an indication of psychological distress (Strand, Dalgard, Tambs, & Rognerud, 2003). The HSCL-10 has good validity and reliability (Haavet, Sirpal, Haugen, & Christensen, 2010; Strand et al., 2003).

3.2.5. Executive functions (EF)

Neuropsychological measures of maternal EF included an assessment of several executive sub-functions. The raw scores were converted into t-scores. We assessed the following EF components:

3.2.5.1. Working memory. In the Letter-Number Sequencing sub-test from the Wechsler Adult Intelligence Scale 4th Edition (Wechsler, 2014), the participants were presented with an increasingly longer series of mixed letters and numbers at one-second intervals. They were required to repeat back to the administrator in a manner in which the numbers were presented, first in order from the lowest to the highest, followed by the letters in alphabetical order. Higher raw t-scores and longer spans indicate a high capacity of auditory working memory. The Wechsler Adult Intelligence Scale has good validity and reliability (Canivez & Watkins, 2010).

3.2.5.2. Verbal fluency. Letter Fluency and Category Fluency from the Verbal Fluency test from the Delis-Kaplan Executive Function System (D-KEFS) (Delis, Kaplan, & Kramer, 2001) were used to assess verbal fluency. In the Letter Fluency condition, participants were required to say as many words as possible that started with either “F”, “A”, or “S” within in a 60-second time frame. In the Category Fluency condition, participants were required to first say as many animals as possible in a 60-s time frame, and then as many boys names as possible at the same time frame. Higher t-scores are indicative of high levels of verbal fluency.

3.2.5.3. Cognitive inhibition. To assess cognitive inhibition, we used the Colour-Word Interference Test, Condition 3 from the D-KEFS (Delis et al., 2001). Participants had to inhibit themselves from reading a colour word, and instead as quickly as possible say the name of the colour in which the word was printed. A higher frequency of errors and a longer time to complete the task indicates difficulties

with inhibition and provide a lower t-score.

3.2.5.4. Cognitive flexibility. To assess cognitive flexibility, we used the inhibition-switching task in the Colour-Word Interference Test, Condition 4 from the D-KEFS (Delis et al., 2001). Participants were required to switch between reading the colour word and naming the colour in which the colour was printed. The time used and the numbers of errors committed during the task were measured. More errors, in addition to a longer time to complete the task, indicate difficulties with cognitive flexibility and provide lower t-scores. The D-KEFS has good reliability and validity (Delis, Kramer, Kaplan, & Holdnack, 2004; Shunk, Davis, & Dean, 2006).

3.2.5.5. Planning. We used The Tower of Hanoi Test (Delis et al., 2001) to measure planning, rule learning and the ability to establish and maintain an instructional set. Participants were requested to place discs of varying sizes on a board with three vertical pegs in the same manner shown on a picture. They were requested to perform as fast as possible and with as few numbers of movements as possible. There is an increasing complexity of the test, starting with two discs and ending with five discs. Taking a long time to complete the task, as well as a high frequency of errors, indicate difficulties in planning and yielded a lower t-score.

3.3. Procedures

The present study had a cross-sectional design. This study is part of a larger study with a broad battery of measures and only results relevant to the aims in the current study are presented in this paper. Assessments consisted of the PDI-R2, which we audio recorded and transcribed verbatim, the EuropASI, and the neuropsychological test battery, and a request of completing the HSCL-10 and the TAQ in between interview sessions. As some mothers found the TAQ challenging, mothers were offered an interview as an alternative, which 16 (37.2%) of the mothers accepted. Estimated time for data collection using the larger test-battery was approximately seven hours per family, and each participant met with the researcher on three to six separate occasions to complete the assessment. Each session lasted between one and two hours. Data collection for this particular part of the test battery lasted for approximately three hours per respondent. The mothers were assessed in the accommodation they were currently living.

3.4. Ethics

The study was approved by The Norwegian Regional Committee for Medical Research Ethics in Eastern Norway (REK-Ost), and conducted in accordance with the Helsinki Declaration of the [World Medical Association \(2004\)](#).

3.5. Statistical analyses

All cases ($N = 43$) were included in the analyses, and there were no missing data. In part 1 of the study, we used descriptive statistics of socio-demographic variables, substance use, PRF, different forms of adverse and adaptive experiences in different developmental phases, mental health status and EF. We calculated Pearson product moment correlations between PRF, adverse and adaptive experiences in different developmental phases (early infancy, latency, and adolescence), the four types of adverse (emotional, physical, sexual abuse, and neglect) and the two types of adaptive experiences (safety and competence), mental health status, and EF. We conducted a principal component analysis on the EF measures and calculated the factor scores of the extracted dimensions. One major factor was extracted accounting for 56.9% of the unrotated variance (eigenvalue = 3.4). The factor loadings of the six EF components were the following: Inhibition: .87; working memory: .86; cognitive flexibility: .80; planning: .79; category fluency: .57; and letter fluency: .57.

To further investigate the links between PRF and adverse and adaptive experiences, we carried out two multiple regression analyses. In the first analysis, we used PRF as the criterion variable, and adaptive and adverse experiences in different developmental phases (early infancy, latency, and adolescence) as predictor variables. We further entered mental health and EF (using the EF-factor) in two subsequent blocks as control variables. The analytic strategy allowed us to determine how much additional variance in PRF adaptive and adverse experiences in different developmental phases accounted for before and after controlling for mental health and EF. In the second regression analysis, we used PRF as the criterion variable and different types of adversities (emotional, physical, sexual abuse, and neglect) as predictor variables. We controlled for mental health status and EF by entering the control variables in two blocks.

In part 2 of the study, three multiple analyses for variance (MANOVAs) were conducted to test differences between two groups of mothers differentiated by exhibiting an adequate to high PRF or a negative to low PRF. In the first and second analysis, we investigated if there were differences in adaptive (experience of safety and experience of competence) and adverse experiences (emotional, physical, sexual abuse, and neglect) in different developmental phases (early childhood, latency, and adolescence) depending on PRF level, controlling for mental health status and EF. In the third MANOVA, we tested whether there were differences in presence of specific types of adverse and adaptive experiences, for mothers with negative to low PRF compared to mothers with adequate to high PRF, controlling for mental health status and EF.

All statistical analyses we carried out using IBM Corp. Released 2016. IBM Statistical Package for Social Sciences (SPSS) version 24.0.

Table 2

Correlation coefficients between Parental Reflective Functioning (item 1), adverse experiences based on developmental phase (items 2–4), adaptive experiences based on developmental phase (items 5–7), type of adversity and adaptive experience (items 8–13), mental health status (item 14), and EF factor (working memory, inhibition, cognitive flexibility, planning, letter fluency, and category fluency), (item 15).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Reflective Functioning ^a														
2 Early Childhood, Adversity ^b	-.33 [°]													
3 Latency, Adversity ^b	-.36 [°]	.88 ^{**}												
4 Adolescence, Adversity ^b	-.22	.63 ^{**}	.80 ^{**}											
5 Early Childhood, Adaptive ^b	.70 ^{**}	-.61 ^{**}	-.59 ^{**}	-.41 ^{**}										
6 Latency, Adaptive ^b	.46 ^{**}	-.73 ^{**}	-.72 ^{**}	-.59 ^{**}	.66 ^{**}									
7 Adolescence, Adaptive ^b	.35 [°]	-.73 ^{**}	-.70 ^{**}	-.62 ^{**}	.59 ^{**}	.94 ^{**}								
8 Emotional Abuse ^b	-.65 ^{**}	.63 ^{**}	.71 ^{**}	.55 ^{**}	-.70 ^{**}	-.62 ^{**}	-.55 ^{**}							
9 Physical Abuse ^b	-.31 [°]	.86 ^{**}	.89 ^{**}	.76 ^{**}	-.53 ^{**}	-.67 ^{**}	-.68 ^{**}	.61 ^{**}						
10 Neglect ^b	-.38 [°]	.77 ^{**}	.79 ^{**}	.79 ^{**}	-.59 ^{**}	-.74 ^{**}	-.73 ^{**}	.66 ^{**}	.74 ^{**}					
11 Sexual Abuse ^b	-.30 [°]	.77 ^{**}	.79 ^{**}	.69 ^{**}	-.47 ^{**}	-.57 ^{**}	-.56 ^{**}	.64 ^{**}	.87 ^{**}	.60 ^{**}				
12 Competence ^b	.38 [°]	-.81 ^{**}	-.76 ^{**}	-.69 ^{**}	.63 ^{**}	.79 ^{**}	.80 ^{**}	-.64 ^{**}	-.70 ^{**}	-.77 ^{**}	-.62 ^{**}			
13 Safety ^b	.47 ^{**}	-.72 ^{**}	-.72 ^{**}	-.65 ^{**}	.64 ^{**}	.72 ^{**}	.74 ^{**}	-.80 ^{**}	-.70 ^{**}	-.77 ^{**}	-.66 ^{**}	.79 ^{**}		
14 HSCL ^c	-.56 ^{**}	.54 ^{**}	.67 ^{**}	.73 ^{**}	-.56 ^{**}	-.58 ^{**}	-.59 ^{**}	.73 ^{**}	.58 ^{**}	.62 ^{**}	.59 ^{**}	-.68 ^{**}	-.66 ^{**}	
15 EF factor ^{d,ef}	.58 ^{**}	-.50 ^{**}	-.56 ^{**}	-.49 ^{**}	.59 ^{**}	.57 ^{**}	.46 ^{**}	-.61 ^{**}	-.45 ^{**}	-.50 ^{**}	.47 ^{**}	.56 ^{**}	.44 ^{**}	-.59 ^{**}

N = 43.

** = p < .01.

* = < 0.05.

^a Parental Development Interview – Revised, Reflective Functioning Scale.

^b Traumatic Antecedents Questionnaire (TAQ).

^c Hopkins Symptom Checklist (HSCL-10).

^d Letter-Number Sequencing sub-test from the Wechsler Adult Intelligence Scale, 4th edition.

^e Colour-Word Interference Test, Condition 3 and 4 from the Delis-Kaplan Executive Functioning System (D-KEFS).

^f Tower Test from the Delis-Kaplan Executive Functioning System (D-KEFS).

4. Results

4.1. Part 1

Pearson’s correlations were calculated for the main variables of interest, and are presented in Table 2.

PRF was negatively associated with adversity in early childhood, $r = -.33, p < .05$, latency $r = -.36, p < .05$. Furthermore, PRF was positively associated with adaptive experiences in early childhood, $r = .61, p < .01$, latency, $r = .33, p < .05$, adolescence, $r = .36, p < .05$. The results indicated that presence of adversities in different developmental phases were associated with lower PRF, while presence of adaptive experiences were associated with higher PRF.

Table 3 presents the results of the multiple regression analysis.

Adverse and adaptive experiences in early childhood, latency, and adolescence explained 54% of the variance in PRF ($R^2 = .54$, adjusted $R^2 = .47, F = 7.09, df = 6, p < .001$). Adding mental health increased the explained variance in PRF to 65% ($R^2 = .65$, adjusted $R^2 = .58, F = 9.44, df = 7, p < .001$). Further, adding the EF-factor increased the variance in PRF to 67% ($R^2 = .67$, adjusted $R^2 = .59, F = 8.44, df = 8, p < .001$). After controlling for mental health and EF, adaptive experiences in early childhood showed a significant positive association with PRF, that is, we found that more adaptive experiences (safety and competence) in early childhood was positively associated with higher PRF. Mental health showed a significant negative association with PRF, indicating that less psychological distress was associated with higher PRF.

Different types of adversities (emotional, physical, sexual abuse, and neglect) explained 45% of the variance in PRF ($R^2 = .45$, adjusted $R^2 = .39, F = 7.81, df = 4, p < .001$). Adding mental health increased explained variance to 48% ($R^2 = .48$, adjusted $R^2 = .41, F = 6.76, df = 5, p < .001$). When the EF-factor was added, the model explained 53% of the variance in PRF ($R^2 = .53$, adjusted $R^2 = .45, F = 6.79, df = 6, p < .001$). After controlling for mental health and EF, emotional abuse showed a significant negative association with PRF. The results indicated that increased experiences of emotional abuse during early childhood, latency, and adolescence were associated with lower PRF. In addition, the EF-factor made a unique contribution to PRF, indicating that greater EF was associated with higher PRF, as we also reported in a previous study (Håkansson et al., 2017).

Table 4 demonstrates the differences in adaptive and adverse experiences between mothers with a negative to low PRF and mothers with an adequate to high PRF.

The MANOVA showed significant differences between the two groups of mothers (negative to low PRF or adequate to high PRF) regarding adverse and adaptive experiences also when we controlled for mental health status and EF. Mothers with a negative to low PRF reported significantly more adverse experiences in early childhood ($F = 6.1, df = 1, p < .05$), and in latency ($F = 4.2, df = 1, p < .05$), but not in adolescence. Furthermore, mothers with adequate to high PRF reported significantly more adaptive experiences,

Table 3

Multiple regression Analyses for adverse and adaptive experiences (in early childhood, latency, and adolescence), controlled for mental health (HSCL-10), and executive functioning (EF) predicting parental reflective functioning (PRF). Different types of adversities (emotional, physical and sexual abuse, and neglect), controlled for mental health (HSCL-10) and executive functioning (EF), predicting parental reflective functioning (PRF).

Variable	B	SE B	B	T	Sig.
PRF, adverse experiences					
Early childhood	.02	.04	.12	.48	NS
Latency	-.001	.06	-.01	-.03	NS
Adolescence	.08	.05	.35	1.72	NS
PRF, adaptive experiences					
Early Childhood	.35	.11	.49	3.16	**
Latency	.36	.24	.56	1.50	NS
Adolescence	-.34	.23	-.54	-1.48	NS
Mental Health	-.95	.33	-.50	-2.91	**
EF-factor	.18	.17	.16	1.08	NS
PRF, type of adverse experience					
Emotional Abuse	-.28	.10	-.58	.377	**
Physical Abuse	-.03	.09	-.10	-.41	NS
Neglect	-.05	.07	.14	-.01	NS
Sexual Abuse	.11	.09	.31	1.22	NS
Mental Health	-.31	.34	-.16	-.90	NS
EF-factor	.36	.18	.30	2.03	*

N = 43.

* p < .05.

** p < .01. NS = No significant results.

Table 4

Differences in presence of adverse and adaptive experiences in different developmental phases, and in different types of experiences between mothers with a negative to low Parental Reflective Functioning and mothers with an adequate to high Parental Reflective Functioning, controlling for mental health status (HSCL-10) and Executive Functions (EF-variable). Multiple Analysis of Variance (MANOVA).

	Negative to Low RF ^a N:32		Adequate to High RF ^a N:11		F	Sig.
	M	SD	M	SD		
Adverse experiences ^b						
Early childhood	12.8	6.7	7.1	5.9	6.1	*
Latency	14.1	6.1	10.0	4.8	4.2	*
Adolescence	15.2	4.9	13.4	5.1	1.0	NS
Adaptive experiences ^b						
Early Childhood	1.3	1.2	3.5	1.4	25.6	**
Latency	1.8	1.6	3.4	1.9	7.0	**
Adolescence	1.8	1.8	3.3	1.9	5.4	*
Type of Experience ^b						
Emotional Abuse	10.1	1.9	6.9	2.3	20.8	**
Physical Abuse	6.9	3.6	4.1	2.9	5.7	*
Neglect	9.1	2.9	6.5	3.2	6.6	**
Sexual Abuse	6.4	3.0	3.3	3.6	7.7	**
Competence	5.5	2.8	7.5	2.9	4.2	*
Safety	3.2	2.4	6.1	2.7	11.2	**

N = 43.

** = p < .01.

* = < .05.

^a Parental Development Interview – Revised, Reflective Functioning Scale.

^b Traumatic Antecedents Questionnaire (TAQ).

particularly in early childhood (F = 25.6, df = 1, p < .01), but also in latency (F = 7.0, df = 1, p < .01), and adolescence (F = 5.4, df = 1, p < .05).

We also found significant differences between the groups in all the forms of adverse and adaptive experiences that we measured. In particular, mothers with negative to low PRF reported significantly more emotional abuse (F = 20.8, df = 1, p < .01), and less experience of safety (F = 11.2, df = 1, p < .01) compared to mothers with adequate to high PRF. In addition, mothers with negative to low PRF reported significantly more physical abuse (F = 5.7, df = 1, p < .05), neglect (F = 6.6, df = 1, P < .01), and sexual abuse (F = 7.7, df = 1, p < .01), in addition to less experience of competence (F = 4.2, df = 1, p < .05) compared to mothers with

adequate to high PRF.

5. Discussion

5.1. Part 1

As expected, the mothers in this study reported a high degree of adversity associated with developmental trauma throughout childhood, latency, and adolescence. Particularly, the experiences of emotional abuse and neglect in childhood were prevalent in the group. In addition, these mothers reported relatively scarce presence of adaptive experiences, specifically the experience of safety. Other studies have also documented that a large proportion of mothers with SUD have been exposed to developmental trauma in close relationships during childhood (Pajulo et al., 2012; Siqveland, Smith, & Moe, 2012). Furthermore, individuals with SUD often have few adaptive relationships (Brown & Shillington, 2017). As we have previously suggested, the mothers in our study demonstrated a low capacity in PRF (Håkansson et al., 2017) compared to what is expected in a normal population (Fonagy & Target, 1997; Slade, 2005), although comparable to other populations of mothers with SUD (Pajulo et al., 2012; Suchman, Decoste, Leigh, & Borelli, 2010).

Congruent with our first hypothesis, we found numerous positive correlations between PRF and adaptive experiences, and negative correlations between PRF and adverse experiences in different developmental phases. In addition, there were moderate to strong negative associations between different forms of adverse experiences (physical, emotional, sexual abuse and neglect) and PRF, as well as positive correlations between adaptive experiences (safety and competence) and PRF. Although we did not find any studies examining possible associations between adversities, adaptive experiences and PRF in SUD mothers, previous studies have found significant relationships between deficits in RF and having experienced developmental trauma in individuals with SUD (Allen et al., 2012) and in pregnant women (Ensink, Berthelot, Bernazzani, Normandin, & Fonagy, 2014). Although one study highlights the association between the capacity to mentalize around the trauma to significantly influence parental capacities, and not RF per se (Ensink, Normandin, Plamondon, Berthelot, & Fonagy, 2016), our results indicate a possible association between adaptive and adverse experiences and PRF.

As a group, the mothers in our study reported a particularly high presence of adversity during adolescence; however, we found no significant correlations with PRF. As RF and PRF are suggested to be somewhat different although related capacities (Luyten et al., 2017; Steele et al., 2008), it is possible that influence from peers and the wider sociocultural context in adolescence might have been more influential for development of general RF, hence not directly targeting PRF capacities. While RF may represent a more generalized process, the capacity of a parent to think about their child's mental states is suggested to represent a qualitatively different function (Luyten, Fonagy et al., 2012), that become more refined through the emerging parent-child relationship (Slade, 2005). It is possible that adversities and adaptive experiences during childhood and latency could be predominately influenced by the experiences of being parented, and therefore important for the development of PRF in the group of mothers, while experiences during adolescence might not have had such a significant influence on PRF.

Our results supported our expectations that adversities, as well as adaptive experiences in different developmental phases, strongly correlated with each other. The findings indicated that some mothers in our study had prolonged cumulative adverse exposure throughout childhood and adolescence, which could have led them to be particularly vulnerable for mental health issues (Briere et al., 2008; Van der Kolk et al., 2005). In contrast, another group of mothers had prolonged experience of adaptive experiences, possibly allowing them to develop resilience factors based on having safety and a sense of agency and competence during childhood (Fonagy & Campbell, 2017; Holmes, 2017; Luthar, 2006), leading to greater levels of wellbeing.

Congruent with other studies, we found that different forms of maltreatment strongly correlated with each other (Cecil et al., 2017). Our results indicated that a sub-group of mothers experienced multiple adversities simultaneously. Multiple adversities are suggested to be detrimental for the developing child and the becoming adult (Anda, Felitti, & Corwin, 2014) as they pose a risk for child emotional, cognitive and social development (Gunnar, 2016; Shonkoff, Boyce, & McEwen, 2009). Further, exposure to a higher number of maltreatment types predicts greater severity in mental health and somatic symptoms in adulthood (Finkelhor et al., 2009, 2007). Our results indicated that mothers raised in adversity, are those least likely to encompass resilience-enhancing resources, such as access to safety from their own parents or experience of competence during childhood, or an adequate PRF in adulthood. Conversely, children raised in conditions that foster resilience might have had a buffer against adversity by having access to safety and a sense of agency/competence. Our results are congruent with a recent study demonstrating that greater the experience of adversity, is associated with less resilience (Holmes, 2017).

Adaptive experiences in early childhood uniquely predicted variance in PRF. The results suggested that compared to experiences of adversities, the presence, or absence of adaptive experiences were more closely related to PRF level. Supporting our results, adaptive experiences, including safe positive relationships and a sense of agency and competence in childhood have been found to be protective for children growing up during adverse circumstances (Luthar, 2006, 2003; Shonkoff et al., 2012). Indeed, in our study we found that mothers with a high degree of adaptive experiences in early childhood reported less adversity, as well as exhibiting a higher PRF. In contrast, mothers with less adaptive experiences reported more adversities as well as exhibiting a lower PRF. The results indicated that the presence or absence of adaptive experiences might be a mediator between developmental trauma and PRF in mothers with SUD. It is suggested that resilience and the experience of early secure attachment are highly related and built into an individual's biology (Holmes, 2017). Indeed, our results indicated that early childhood and relational adaptive experiences were particularly related to adult PRF. In early childhood, the parent's capacity to regulate the infant's emotions is vital for development of resilience, and of stress inoculation (Tronick, 2007). Stress and threat activates the limbic system. The left prefrontal cortex that

regulates and modulates these affective responses is underdeveloped in early childhood, and the child draws upon the caregiver to help co-regulate emotions (Tronick, 2007). Affect co-regulation within a safe attachment relationship, thereby builds the capacity to recognize and regulate affect in the developing child, and is suggested freeing energy to lessen adverse consequences of unregulated emotions (Friston, 2010; Holmes, 2017; Schore & Schore, 2008). In addition, it may allow a child to endure some adverse or painful experiences without it targeting self-development or expectations of others (Stein, 2006). Well-developed or under-developed capacity for affect co-regulation may continue throughout life (Fonagy et al., 2004; Schore, 2005, 2015). As such, adaptive experiences in early childhood may function as a resilience factor when an individual faces adversities later in life, either by drawing on own pre-existing regulation capacities, or having the capacity to relate to others for safety and support. According to our results, we found that a sense of safety and competence in early childhood were associated with moderate to high PRF, and therefore adaptive experiences in early childhood could be considered an intergenerational resilience factor. Furthermore, it is important to note that experiences in early childhood, including those of safety, agency and coping, is predominately stored as a part of the procedural memory, that is implicit, without conscious awareness, and not necessarily in the episodic memory where conscious recollection is more accessible and hence possible to reflect upon (Fonagy, Campbell, & Bateman, 2017). Previous studies have suggested that the potential emotional charge related to the presence or lack of safety and agency in early childhood could become embodied (Shai & Belsky, 2011; Shai, Dollberg, & Szepeswol, 2017). Therefore, early adaptive experiences could be transferred to the next generation through the implicit ways the caregiver relates and interacts with their child, as have previously been suggested in relation to the experience of developmental trauma (Ensink et al., 2014; Fraiberg et al., 1975).

Mental health status also made a unique contribution to variance in PRF, and had a positive association with adaptive experiences in early childhood. The results indicated that mothers with adaptive experiences also had higher mental health status. Supporting our results, previous studies have reported that mental health problems in adulthood may decrease reflective capacities including PRF (Borelli, West, Decoste, & Suchman, 2012; Camoirano, 2017; Heim, Shugart, Craighead, & Nemeroff, 2010; Luyten, van Houdenhove et al., 2012), and that presence and lack of adaptive experiences in early childhood is related to adult mental health (Cecil et al., 2017).

Congruent with our hypothesis, emotional abuse significantly explained variance in PRF, when we controlled for EF and mental health status. Our results are supported by previous studies that have highlighted that the impact of emotional abuse in childhood is harmful for development (Burns et al., 2010; Hart et al., 1997), and affecting mentalizing capacities (Bottos & Nilsen, 2014). Although neglect did not make a unique contribution in the regression, it was strongly correlated with PRF, an association supported by a previous study highlighting the negative correlation between childhood neglect and PRF (San Cristobal et al., 2017). Emotional abuse is one of the most common, yet often underreported forms of adversity (Trickett, Mennen, Kim, & Sang, 2009). Furthermore, emotional abuse is suggested to often underlie other forms of abuse (Bottos & Nilsen, 2014). Although physical and sexual abuse are without doubt harmful for the developing child (Norman et al., 2012), emotional abuse may target fundamental aspects of self-development. By psychologically depriving the child of safe and secure caregiving experiences, emotional abuse might hinder the creation of a coherent narrative of own experiences. Children who experience emotional abuse may have a heightened experience of fear and emotional dysregulation, which could represent a substantial risk for developing inadequate reflective capacities in childhood and adulthood (Ensink et al., 2016; Fonagy & Target, 2002; Fonagy, Gergely, & Target, 2007), and according to our results, also transmitted to PRF.

Finally, EF made a unique contribution in variance of PRF and had a negative association with emotional abuse. The results indicated that mothers with increased emotional abuse had a less functioning EF system in addition to a lower PRF. Supporting our results, previous studies have highlighted the association between adversities in childhood and impairments in adult EF (Hanson et al., 2015; Hostinar et al., 2012; Viola et al., 2013). In addition, we have previously found a positive association between EF and PRF (Håkansson et al., 2017), which is in accordance with a recent study in a normal population of mothers (Rutherford et al., 2017). Based on results in the current study, the association between PRF and EF may be particularly affected by experience of emotional abuse in childhood and adolescence.

5.2. Part 2

In the second part of the study, our aim was to investigate whether differences within the group of mothers with SUD existed based on PRF. As hypothesized, the results showed that adverse (emotional, physical, sexual abuse and neglect) experiences throughout the developmental phases (early childhood, latency, and adolescence) were significantly more common in mothers with negative to low PRF, while adaptive (safety and competence), experiences in early childhood, and latency were more common in mothers with adequate to high PRF. In addition, mothers with negative to low PRF reported experiencing significantly more of all forms of adversities, as well as less adaptive experiences compared to mothers with adequate to high PRF. The experience of safe relationships serves an important function beyond securing the physical and psychological development of a child. The good enough attachment relationship is also the foundation of epistemic trust, which is an authenticity in the interpersonal transmitted knowledge, (Fonagy & Allison, 2014; Sperber et al., 2010). Learning that takes place in a developmental context, where caregivers are trusted, gives the child an opportunity for acquiring social learning that is associated with resilience, and benefiting from positive influences from others (Antonovsky & Sagy, 1986; Fonagy & Campbell, 2017; Luyten et al., 2017). Epistemic trust promotes structured and manageable cognitions and the capacity to navigate in a social and physical environment, as well as learning from new relational experiences later in life (Fonagy & Allison, 2014; Fonagy et al., 2017; Luyten et al., 2017). Drawing on these theoretical considerations, it is likely that the mothers in our study with negative to low PRF, with increased presence of adversity and less adaptive experiences, did not have the opportunity to develop epistemic trust. We suggest that the differentiation between mothers with

negative to low PRF and mothers with adequate to high PRF might reflect differences between epistemic trust and epistemic vigilance in the mothers. The lack of epistemic trust might have prevented interpersonal learning in relating to self and the child, and hence inhibited the development of an adequate PRF (Fonagy & Campbell, 2017). Research indicates that absence of epistemic trust creates a rigidity that makes capacity for change challenging (Fonagy & Allison, 2014). Our findings demonstrated that mothers with a moderate to high PRF had significantly less experiences of adversity, as well as significantly more adaptive experiences. This sub-group of mothers could have grown up in an environment that fostered the development of epistemic trust and inter- and intrapersonal curiosity, which could have facilitated them to develop moderate to high PRF capacity when becoming a mother. It is possible that this sub-group of mothers with adequate PRF capacities developed SUD for reasons like genetic vulnerability (Palmer et al., 2015), specific personality traits (Belcher, Volkow, Moeller, & Ferré, 2014), tendency for sensation seeking (Holmes, Hollinshead, Roffman, Smoller, & Buckner, 2016), or traumatic experiences in adulthood (Roberts, Roberts, Jones, & Bisson, 2015), that did not target PRF capacities.

5.3. Strength and limitations

This study has several advantages. First, it increases our understanding of how adaptive and adverse experiences in different developmental phases could affect PRF in SUD mothers. This group of mothers are considered a difficult population to offer appropriate and individually customized interventions. Indeed, the clinical challenges of working with this group are exacerbated by the risk of intergenerational transmission of adversity. Therefore, we suggest clinicians should endeavour to offer a more targeted focus depending on previous adaptive and adverse experiences. Second, our assessment tools strengthened our findings as all the mothers completed a comprehensive test-battery that consisted of well-validated and reliable instruments. Finally, we included EF and mental health status as control variables, as these have previously been found to be associated with PRF. Including these control variables in the current study enabled us to investigate the contribution of adverse and adaptive experiences in early childhood, latency, and adolescence.

Despite these strengths, the study has some limitations. First, this was a cross-sectional study and therefore no casual or temporal inferences could be concluded. However, we compared two groups of mothers (mothers with adequate to high PRF and mothers with negative to low PRF) in the MANOVAs to provide an opportunity to develop inferences about causation. Second, as the focus was on five constructs (i.e. PRF, adaptive and adverse experiences, EF and mental health status), results may have been influenced by unmeasured confounding variables that were associated with the variables of interest. For instance, the current study did not include specifics of the SUD. In our previous study on the same group of mothers, we found that onset age, and using multiple substances had negative associations with PRF, but not preference of a specific type of substance (Håkansson et al., 2017). Third, we administered self-reports questionnaires to measure mental health, adaptive and adverse experience. Although self-reports are susceptible to recall bias or deficits, longitudinal follow-up of adults have demonstrated that reports of childhood abuse often are underestimated, which might attenuate the association between adversities and PRF (Hardt & Rutter, 2004). Finally, the sample size, although well within the norm for this type of study, is relatively small, and replication with a larger sample should be considered in future studies.

5.4. Clinical implications

Mentalization-based interventions are gaining popularity as effective for parents with SUD (Neger & Prinz, 2015). These specialist interventions focus on improving parental mentalizing skills in order to improve parent-infant interactions (Kalland, Fagerlund, von Koskull, & Pajulo, 2016). Since mothers with SUD show different levels of PRF, clinicians should be able to assess the level of PRF in the mothers and adapt the intervention accordingly. Findings from the current study particularly highlight the importance of investigating adaptive as well as adverse childhood experiences before initiating the intervention. Specifically, parents with negative to low PRF might require interventions focusing on developmental trauma, establishment of emotion regulation capacities and epistemic trust in addition to improving PRF, while mothers with adequate PRF might profit on a more limited intervention. For the majority of SUD mothers it would be relevant to develop interventions that have a multiple focus, where change in one function may promote change in others in reciprocal fashion. A multimodal intervention strategy using both verbal and non-verbal, embodied methodology might be particularly regulating for mothers with low PRF. We suggest that it is important to have an overall targeted and specific focus on developing a sense of safety and competence in the mothers, as these experiences seem to influence PRF especially. A focus on enhancing epistemic trust in the therapeutic relationship and in the dyadic relationship in parents with negative to low PRF might offer new experiences of relational learning as a foundation for training PRF.

Competing interests

The authors declare they have no competing interests.

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Attachments

Forespørsel om deltakelse i forskningsprosjektet

"Barn som pårørende – Deltakelse, utvikling og kompetanse"

Bakgrunn og hensikt

Høgskolen i Lillehammer har fått støtte fra Norges forskningsråd til å gjennomføre et større forskningsprosjekt om barn som opplever at forelder(e) har rusproblemer eller problemer med psykisk helse. Den overordnede hensikten med prosjektet er å utvikle kunnskap om hvilke type støtte som fremmer barns livskvalitet, sosiale kompetanse og deltakelse når de vokser opp i familier hvor forelder(e) har rusproblemer eller psykiske helseproblemer. Barnas perspektiv og egne erfaringer står sentralt i prosjektet. Prosjektet er delt i tre delprosjekter med følgende delmål: 1. Økt forståelse for hvordan barna mestrer dagliglivet på skolen, blant venner og hjemme 2) økt forståelse/kunnskap om samarbeidet mellom familiemedlemmer og tjenesteytere og hvilke erfaringer familiemedlemmene og de profesjonelle har med ulike former for profesjonelle intervensjoner. 3) Økt kunnskap og forståelse om hvordan spe- og småbarn håndterer foreldrenes stress pga rus eller psykiske helseproblemer og hvordan mor/barn interaksjonen er påvirket av barnets utvikling og symptomer på stress.

Forskningsprosjektet er altså delt inn i tre delprosjekter med ulikt fokus, men som også er delvis overlappende.. Hovedfokuset i delprosjekt 1 er barns hverdagslivserfaringer. Her ønsker vi å intervju foreldre og barn i alderen 8 -16 år. I delprosjekt 2 har vi fokus på tjenesteyternes erfaringer med å hjelpe og støtte barn og foreldre, altså et tjenesteyterperspektiv. Delprosjekt 3 har fokus på de aller minste barna (6- 18 mnd) og samspillet mellom mor og barn, når mor har (har psykiske vansker og/eller et problematiske forhold til rusmidler.

Forespørsel om deltakelse i delprosjekt 3: Mor og de små barna

Dette er et spørsmål til deg om å delta i delprosjekt 3. I dette delprosjektet er hensikten å få mer kunnskap om hva som er god hjelp til mor og barn når mor har eller har hatt et problematisk forhold til rusmidler. Foreldres omsorgskompetanse er viktige for god helse og utvikling av barnet. Derfor ønsker vi å studere hvordan mødres stress, problemer og tidligere belastninger påvirker hvordan de opplever foreldrerollen. Vi håper å lære mer om hva som påvirker samspillet mellom mor og barn og barnets utvikling. Du spørres om å delta fordi du er mor til et barn som er under 18 måneder og fordi du har eller har hatt et problematisk forhold til rusmidler, med eller uten psykiske problemer i tillegg. . Høgskolen i Lillehammer er ansvarlig for studien ved prosjektleder Astrid Halså.

Hva innebærer studien?

De som deltar i studien vil gjennomgå en nevropsykologisk utredning (mål på konsentrasjon og hvordan du samler tankene). Du blir bedt om å svare på noen spørreskjemaer om bl.a. din psykiske helse, rusmiddelbruk og tidligere stresserfaringer, og om ditt barns utvikling. Du vil også bli intervjuet om hvordan du opplever det å være mor. Intervjuet blir tatt opp på bånd. I tillegg vil korte (5 minutt) samspillepisoder mellom deg og ditt barn videofilmes.. Dessuten vil vi spørre om tillatelse fra deg om å innhente fødselsinformasjon fra sykehuset ditt barn ble født på. Det dreier seg om vekt, tilpasset fødselsalder, apgar score, hodeomkrets og NAS (neonatal abstinenssyndrom). I alle deler av datainnsamlingen vil det bli tatt hensyn til mor og barn, slik at det ikke oppleves som belastende. Undersøkelsene vil bli gjort av de som jobber ved institusjonen eller avdelingen hvor du eventuelt får behandling, og av de ansvarlige forskere som er nevnt ovenfor. Behandlingen du får vil være den samme enten du deltar i undersøkelsen eller ei. Vi ønsker også å forespørre noen av dere som deltar delprosjekt 3 vil være med i delprosjekt 1 (hverdagslivet i familien). Om du er av de som blir forespurt blir ikke avgjort før seinere, og du forplikter deg ikke til å delta i dette, selv om du samtykker til å delta i delprosjekt 3

Mulige fordeler og ulemper

Intervjuet som blir tatt opp på bånd vil handle om deg som forelder og om barnet. Vår erfaring er at de fleste opplever dette intervjuet som nyttig og til ettertanke. Samlet vil du og barnet få en grundig utredning, som kan bidra til bedre forståelse av eventuelle vansker, og hva som er rett hjelp. Ved din deltakelse vil du også gi et verdifullt bidrag til forskningsprosjekt som prøver å få bedre kunnskap om hva som er god hjelp for mødre med ruslidelser og deres barn. Siden studien er opptatt av omsorg og barns utvikling, kan noen oppleve det negativt at det blir så mye fokus på seg selv som forelder. Noen kan også mislike at samspill blir videofilmet. Derfor er det viktig å vite at opptakene ikke kan brukes til noe annet enn denne studien. Du har også full anledning til å trekke tilbake ditt samtykke til opptak, og du kan be om at opptak slettes, uten å måtte begrunne det.

Hva skjer med informasjonen om deg?

Høgskolen i Lillehammer er ansvarlige for opplysninger som samles inn i studien. Informasjonen som registreres om deg og barnet ditt skal kun brukes slik som beskrevet i hensikten med studien. Hvis du samtykker kan noen av informasjonen som kan ha verdi for din eller barnets behandling, videreformidles til din/barnets ansvarlig behandler. Dersom testene inngår som ledd i utredning og behandlingsplanleggingen, vil resultatene lagres både i din pasientjournal og på sikker forskningsserver. På forskningsserveren vil alle opplysninger og prøver bli behandlet uten navn og fødselsnummer eller andre direkte gjenkjennende opplysninger. En kode knytter deg til dine opplysninger og prøver gjennom en navneliste.

Det er kun autorisert personell knyttet til prosjektet som har adgang til navnelisten og som kan finne tilbake til deg. All informasjon og alle opptak vil bli slettet når studien er avsluttet, og senest 1. desember 2025. Vi ber om tillatelse til å henvende oss til deg for ytterligere spørsmål og detaljer ved videre faser i prosjektet, og at innsamlede opplysninger også kan benyttes i de videre fasene. Dersom nye studier basert på de innsamlede data blir aktuelle, ber vi om tillatelse til å henvende oss for nytt samtykke for slik bruk. Opplysningene som samles inn i prosjektet om barnet ditt vil også oppbevares i barnet pasientjournal på vanlig måte på det stede barnet er henvist til, fordi de skal brukes i den videre behandlingen av barnet. Dette gjelder imidlertid kun hvis barnet ditt er henvist til Sykehuset Innlandet.

Det vil ikke være mulig å identifisere deg eller barnet ditt i resultatene av studien når disse publiseres.

Frivillig deltakelse

Det er frivillig å delta i studien. Du kan når som helst og uten å oppgi noen grunn trekke ditt samtykke til å delta i studien. Dette vil ikke få konsekvenser for din eller ditt barns videre behandling. Dersom du ønsker å delta, undertegner du samtykkeerklæringen på siste side. Om du nå sier ja til å delta, kan du senere trekke tilbake ditt samtykke uten at det påvirker din eller ditt barns øvrige behandling. Dersom du senere ønsker å trekke deg eller har spørsmål til studien, kan du kontakte forsker Ulrika Håkansson, 930 49 312 eller prosjektleder Astrid Halså 908 99 396.

Ytterligere informasjon om studien finnes i kapittel A – utdypende forklaring av hva studien innebærer.

Kapittel A- utdypende forklaring av hva studien innebærer

Hvem kan delta?

Mødre og deres yngste barn (6 – 18 måneder) hvor mor mottar en eller annen form for behandling eller bistand fra hjelpeapparatet på grunn av rusproblemer. Barnet må ikke være født prematurt (før uke 32) og kan ikke være tvilling/flerling. Mødrene må snakke godt norsk.

Det er frivillig å delta, og behandlingen som gis vil være den samme, enten man velger å delta eller ei.

Bakgrunn for studien:

Det bred helsepolitisk og faglig enighet om at det må forskes mer for å utvikle god rusbehandling. Særlig viktig er det å forebygge belastning og lidelse hos barna, og å få mer kunnskap om foreldre med rusproblemer, og hvordan de kan hjelpes til å utvikle god omsorgskompetanse. Denne studien har nettopp dette som målsetning.

Hva skjer og når skjer det?

Mor-barn par rekrutteres i tiden mellom fødsel og barnets toårsdag. Personal ved den avdeling/tjeneste som mor mottar behandling fra, gir først informasjon om studien og deler ut brosjyre. Deretter vil en av de ansvarlige for studien informere i mer detalj og gi aktuelle deltakere informasjon og samtykkeskjema. Mulige deltakere får så noen dager til å tenke over, før de evt. signerer samtykke til å delta.

Datainnsamling vil tidligst starte fire måneder etter fødselen, og vil foregå dels på nærmeste BUP-avdeling, dels på institusjonen hvor mor og barn oppholder seg, hvis de er i døgnbehandling. Datainnsamling fra mødrene vil ikke overstige 2 x 1 ½ time. Samspillsobservasjonen tar ca 20 minutt, og undersøkelsen av barnet tar ca 1 time. Dersom undersøkelsene, som foretas i forskningsøyemed, avdekker vansker som krever behandling utover det som allerede gis, kan forskerne være behjelpelig med å henvise til hjelp, dersom mor ønsker det.

Samtykkeerklæring Mor

Studiens tittel: Barn som pårørende – deltakelse, utvikling kompetanse

Jeg har lest informasjonen om intervjuundersøkelsen. Jeg er videre kjent med at deltakelse i undersøkelsen er frivillig og at jeg når som helst kan trekke meg hvis jeg ønsker det. Jeg er kjent med at den informasjonen jeg gir vil bli anonymisert og at min konfidensialitet vil bli sikret i fremstillingen av resultatene.

Jeg samtykker med dette til å delta i delprosjekt 3.

Sted/dato.....Navn..

Samtykkeerklæring Far

Jeg har lest informasjonsskrivet og samtykker til at mitt barn kan delta i undersøkelsen.

Sted/dato..... Navn

Samtykkeerklæring Deltakelse i mulig oppfølgingsstudie

Studien du har sagt ja til å delta i er en avgrenset studie hvor datainnsamlingen vil bli avsluttet i løpet av ca ett år. For å få bedre grunnlag til å utvikle gode hjelpetilbud til deg og ditt barn, kan det være aktuelt å søke om økonomisk støtte til en oppfølgingsstudie. Det betyr at forskerne ønsker å kunne kontakte deg om noen år, for å undersøke hvordan det går med barnet når det har blitt eldre. Vi ber deg ikke bestemme nå om du vil delta i en oppfølgingsstudie, men om du gir samtykke til at forskere knyttet til prosjektet kan kontakte igjen (om 4-6 år).

Barn som pårørende – deltakelse, utvikling og kompetanse, WP3 – Kapittel A og B - dato]

Jeg samtykker med dette at jeg kan bli kontaktet igjen (om 4-6) med forespørsel om videre deltakelse.

Sted/dato.....Navn...



Hva er Mosaikk-prosjektet?

Mosaikkprosjektet består av 3 delprosjekt der vi ut fra ulike perspektiver vil vite hva slags type støtte som er viktig for barn som lever i familier der foreldre strever med psykiske problemer/lidelser og/eller rusmiddelproblematikk.

Delprosjektet **Hold meg i ditt sinn** har fokus på små barn og deres mødre og vi ønsker å finne ut på hvilken måte faktorer hos mor, som stress, relasjonserfaringer, mentalisering og eksekutive funksjoner henger sammen med relasjonen mellom mor og barn, og hvordan dette påvirker barnets utvikling slik at vi på en bedre måte kan tilby riktig hjelp.

FORSKERTEAMET består av: prosjektleder Astri Halså, hovedveileder professor/nevropsykolog Merete Gløne Øie, biveileder postdoc/barnepsykolog Kerstin Söderström, biveileder professor/psykiater Finn Skårderud og stipendiat/psykologspesialist Ulrika Håkansson

Prosjektet er finansiert av Norges Forskningsråd, er godkjent av REK og er et samarbeidsprosjekt mellom Høgskolen i Lillehammer og Sykehuset Innlandet



VIL DU VITE MER?

KONTAKTPERSON:

ULRIKA HÅKANSSON

(PSYKOLOGSPESIALIST OG PHD-STIPENDIAT)

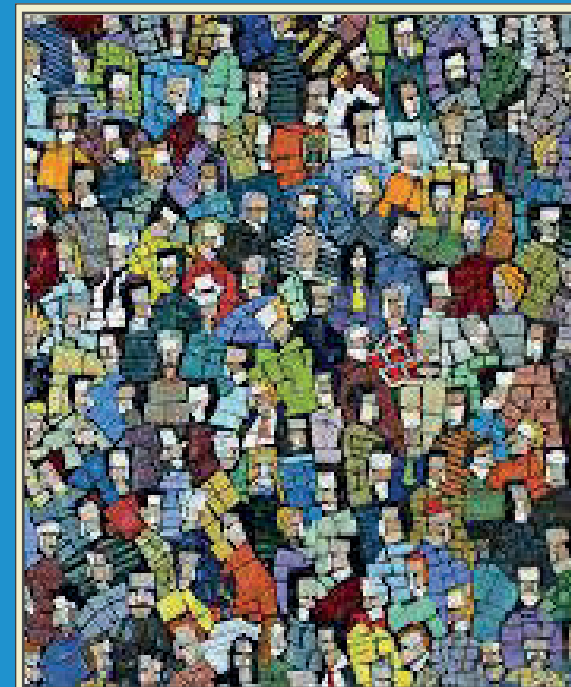
TLF: 930 49 312

ULRIKA.HAKANSSON@HIL.NO



MOSAIKKPROSJEKTET

Hold meg i ditt sinn

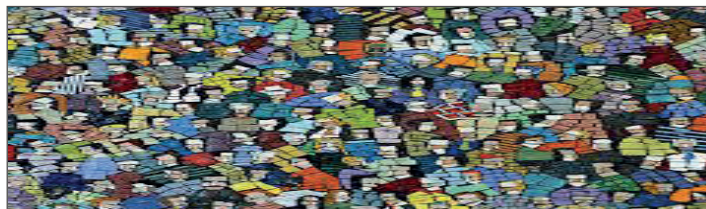


Hvem ønsker vi kontakt med?

- Vi ønsker kontakt med kvinner som har barn mellom 6 og 18 mnd. Det er mulig å etablere kontakt før barnet har blitt 6 mnd, også i graviditeten
- Kvinnene har, eller har hatt et problematisk forhold til rusmidler (alkohol, illegale stoffer eller medikamenter), med eller uten psykiske problemer/lidelser i tillegg
- Kvinner kan ha en behandlingskontakt i systemet til Sykehuset Innlandet, men kan også være uten nåværende behandling

Hva innebærer deltakelse?

- Kvinner som deltar i studien vil fylle ut spørreskjemaer knyttet til tematikken vi er interessert i å forske på
- Kvinnene vil møte psykolog og stipendiat Ulrika Håkansson for intervjuer, nevropsykologisk testing samt samspillsobservasjon sammen med sitt barn
- Kvinnene vil også gjennomføre et intervju sammen med sin behandler
- Kvinnene kan selv velge hvor og når deltakelsen skal foregå



Hvordan kan deltakelse hjelpe familien?

- Om kvinnen selv ønsker det, vil resultatene kunne formidles tilbake til henne, med eller uten behandler til stede
- Med bakgrunn i resultatene vil man kunne anbefale hensiktsmessig type oppfølging/hjelp for familien videre
- Familien vil raskere kunne få riktig tilpasset hjelp basert på den grundige utredningen som studien innebærer

Doctoral dissertation submitted for the degree of Philosophiae Doctor (PhD) at
Inland Norway University of Applied Sciences

Keeping Mind in Mind

Parental Reflective Functioning and Executive Functioning in Mothers with Substance Use Disorder

This is the first study investigating the associations between parental reflective functioning (PRF) and executive functioning (EF) in mothers with young children and a substance use disorder (SUD). Compromised EF and PRF are associated with heightened stress and difficulties in stress-regulation. In addition, dysregulated levels of stress in adulthood have been associated with presence of adversities and lack of adaptive experiences during childhood.

The sample for this study consisted of 43 mother-infant dyads. We used neuropsychological tests to assess for EF, and interviewed the mothers for PRF. Mothers were also required to complete questionnaires regarding parental stress, mental health status and adaptive and adverse childhood experiences.

Findings indicate that there is an association between PRF and EF in SUD mothers that could be bi-directional. Although mental health status affects the association between PRF and EF, particularly mothers with negative to low PRF exhibited significantly higher capacities in EF compared to mothers with adequate PRF. Results indicated EF to be a prerequisite for PRF. Further, PRF mediated the relationship between EF and parental/psychological stress, indicating adequate PRF to allow access to EF capacities. In addition, presence or absence of adaptive experiences in early childhood was associated with higher PRF in adulthood. Amongst different forms of adversities, emotional abuse stood out as significant for PRF.

Findings indicate that development of effective interventions for mothers with SUD should have a dual focus on PRF and EF when targeting stress, dynamic intergenerational risk factors, and sensitive caregiving capacities.

Ulrika Christina Håkansson, born in 1971 in Karlskrona, Sweden. Cand. Psychol from NTNU, Trondheim in 2003, specialized in clinical community psychology and clinical family, infant and toddler psychology. Håkansson holds a position at the Department of Psychology at Inland School of Business and Social Sciences at Inland Norway University for Applied Sciences.

