SHARED PLEASURE IN EARLY INFANT INTERACTIONS

Dissertation by

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DECLARATION

By submitting this dissertation electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

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SUMMARY

Infant mental health is strongly connected to the quality of caregiving relationships, specifically to the mutual adaptation of the infant and caregiver. Positive shared emotions in infant–caregiver relationships build social, intellectual and psychological resources for the infant, which facilitates optimal growth and development. Sharing positive affect fuels the organisation of early infant experiences of socialisation, and the mother–infant interaction may constitute the first environmental context to shape these abilities. Synchronised behaviours (such as mutual gaze and gaze following) between mothers and their infants are thought to create the foundation of early social connectedness and regulation. Infants are extremely sensitive to the emotional states of their mothers and shared joy is the goal for which mother and child instinctively strive. Shared pleasure (SP) moments in parent–infant interaction are defined as "the parent and the child sharing positive affect in synchrony". This is expressed in facial expressions, such as a laugh or curving of mouth to smile, together with a direct gaze contact, and a simultaneous or synchronised beginning and ending. SP sequences are analysed from free play video recordings of mother–infant interaction situations by coding the occurrence and duration of moments, including shared eye contact and mutual, synchronous smile or laughter. Shared pleasure is considered a marker of more regulated emotions and, when absent, serves as a possible screening marker for early identification of at-risk dyads.

This original study of SP in South Africa focused on mothers and their young infants in a clinical and community setting. The aims of the study were to determine the frequency and duration of SP moments in infants born to mothers with and without mental illness, to correlate SP moments with the Bayley scales of infant toddler development and to determine the presence of sustained infant withdrawal as assessed by the Alarm Distress Baby (ADBB) meausurement of infant withdrawal.

The first two studies (Maternal and Infant Mental health study, n = 91) showed an overall low occurrence of SP moments (20%) in the clinical sample, although significantly more SP moments ($p = 0.02$) were recorded in mothers with no mental illnesses. When infants were screened for withdrawal behaviours measured by a validated tool (the Alarm Distress Baby Scale), there was a significant correlation between low occurrence of SP and higher rates of Infant withdrawal ($p = 0.0002$). Interestingly, in this sample of high-risk infants, those who experienced SP moments with their mothers at 6 months showed an improvement in cognitive ($p = 0.052$) and motor (0.007) scores at 18 months. While overall cognitive improvements were noted across the sample, further regression modelling showed stronger associations for the presence of SP moments. Additionally, having an SP moment resulted in a smaller decrease in later motor scores compared with those without an SP moment.

Results of the third Drakenstein Child Health Study of SP in the community-based sample of 291 infants and mothers showed a much higher occurrence (82%) of SP. There were no associations with SP and any risk factors, including on- screens of substance use, intimate partner violence, or postpartum depression. The high frequency of SP in a sample of high exposure to risk factors may suggest that SP in reciprocal interactions may only be disrupted in extreme cases(such as severe mental illness) and so may serve as an early red flag for screening if absent early in the interaction. A significant positive quality of the mother–infant relationship and parenting capacity has potential to contribute to favourable child development, especially in mothers at risk of mental illnesses. SP as demonstrated in this study may likely be one of those protective contributors. In a lower- and middle-income country such as South Africa, it is important to recognise and screen early for relational difficulties between infant and caregivers, and SP may be considered as a potential screening tool for early, culturally appropriate social connectedness.

OPSOMMING

Daar is 'n nou verband tussen die geestesgesondheid van babas en die gehalte van versorgingsverhoudings – veral ten opsigte van die wedersydse aanpassing van die baba en versorger. Gedeelde emosies wat as positief in die verhouding tussen die baba en versorger ervaar word, lei tot die vestiging van sosiale, intellektuele en psigologiese hulpbronne vir die baba wat optimale groei en ontwikkeling fasiliteer. Die deel van positiewe affek bevorder die ordening van die baba se ervarings van sosialisering, en moeder-kind- interaksie is gewoonlik die eerste omgewingskonteks waarin hierdie vermoëns gevorm word.

Daar word gemeen dat gesinchroniseerde gedrag tussen moeders en hul babas, soos wedersydse blik (*mutual gaze*) en bliknavolging (*gaze following)*, die grondslag vir vroeë sosiale verbondenheid en regulering vorm. Babas is uiters sensitief vir die gemoedstoestande van hul moeders, en beide babas en moeders streef instinktief na gedeelde vreugde. Oomblikke van gedeelde plesier (*shared pleasure*) in versorger-kind-interaksies word gedefinieer as die *gesinchroniseerde deel van positiewe affek*. Dit word getoon deur middel van gesigsuitdrukkings soos lag, of die trek van die mond om te glimlag, saam met direkte oogkontak, en 'n gelyktydige of gesinchroniseerde begin en einde. Oomblikke van gedeelde plesier word ontleed aan die hand van video-opnames van vrye spel tussen moeders en babas. Die voorkoms en duur van sodanige oomblikke sluit in gedeelde oogkontak en wedersydse, gesinchroniseerde glimlagte of gelag. Gedeelde plesier word as 'n merker van meer gereguleerde emosies beskou, en wanneer dit afwesig is, dien dit as moontlike siftingsmerker vir die vroeë identifisering van risiko's verbonde aan moeder-baba-verhoudings.

Hierdie oorspronklike studie wat gedeelde plesier in Suid-Afrika ondersoek, fokus op moeders en hul jong babas in 'n kliniese en gemeenskapsomgewing. Die eerste twee gevallestudies (Maternal and Infant Mental Health Study, n = 91) toon 'n algehele lae voorkoms van oomblikke van gedeelde plesier (20%) in 'n kliniese steekproef, terwyl daar aansienlik meer oomblikke van gedeelde plesier (p = 0,02) in moeders sonder enige psigologiese versteurings aangeteken is. Tydens die sifting van babas ten opsigte van onttrekkingsgedrag met 'n gevalideerde meetinstrument (die *Alarm Distress Baby Scale*), was daar 'n beduidende korrelasie tussen die lae voorkoms van oomblikke van gedeelde plesier en hoër koerse van baba-onttrekking (p = 0,0002). In hierdie steekproef van hoërisikobabas is dit interessant dat diegene wat op 6 maande oomblikke van gedeelde plesier met hul moeders ervaar het, 'n verbetering in kognitiewe (p = 0,052) en motoriese (p = 0,007) tellings op 18 maande getoon het. Hoewel algehele kognitiewe verbeterings regdeur die steekproef opgemerk is, het verdere regressiemodellering sterker assosiasies met die teenwoordigheid van oomblikke van gedeelde plesier getoon. Daarbenewens het 'n oomblik van gedeelde plesier gelei tot 'n kleiner toename in latere motoriese tellings in vergelyking met dié sonder 'n oomblik van gedeelde plesier.

Resultate van die derde studie (Drakenstein Child Health Study) van gedeelde plesier in die gemeenskapsgebaseerde steekproef van 291 babas en moeders toon 'n veel hoër voorkoms (82%) van oomblikke van gedeelde plesier. Daar was geen assosiasies met oomblikke van gedeelde plesier en enige risikofaktore, insluitend siftings van substansgebruik, geweld teen 'n intieme lewensmaat of postpartumdepressie nie. Die hoë frekwensie van oomblikke van gedeelde plesier in 'n steekproef met hoë blootstelling aan risikofaktore, kan suggereer dat gedeelde plesier as resiprokale interaksies slegs in

uiterste gevalle, soos 'n erge psigologiese versteuring, ontwrigtend kan wees. In sodanige gevalle kan dit dien as 'n vroeë waarskuwingsteken tydens sifting indien dit vroeg reeds in die interaksie afwesig is.

'n Beduidende positiewe eienskap van die moeder-baba-verhouding en ouerskapkapasiteit het die potensiaal om tot gunstige kinderontwikkeling by te dra – veral in moeders wat die risiko loop om psigologiese versteurings te ontwikkel. Soos in hierdie studie gedemonstreer word, kan gedeelde plesier waarskynlik 'n beskermende faktor wees. In 'n lae- en middelinkomsteland soos Suid-Afrika, is dit baie belangrik om verhoudingsprobleme tussen babas en versorgers vroegtydig te identifiseer, en gedeelde plesier kan beskou word as 'n potensiële siftingsinstrument vir vroeë kultuurtoepaslike sosiale verbondenheid.

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DEDICATION

This dissertation is dedicated to the memory of my loveliest mummy Asha Lachman, who literally lost her memory before she completed her own PHD.

LIST OF COMMONLY USED ABBREVIATIONS

ADBB	Alarm Distress Baby Scale
ASSIST	Alcohol, Smoking and Substance Involvement Screening Test
BSD III	Bayley Scales of Infant and Toddler Development Third Edition
CPMD	Common Perinatal Mental Health Disorders
DCHS	Drakenstein Child Health Study
EAS	Emotional Availability Scales
EPDS	Edinburgh Postnatal Depression Scale
FACS	Facial Action Coding System
HICs	High income countries
IMH	Infant Mental Health
IPV	Intimate Partner Violence Questionnaire
LMICs	Lower-and-middle-income countries
MIMH	Maternal and Infant Mental Health Study
MINI	Mini-International Neuropsychiatric Interview
RLEQ	Recent Life Events Questionnaire
SP	Shared Pleasure
SRQ-20	Self-Report Questionnaire-20

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CHAPTER 1

INTRODUCTION

> *"Facial expressions are innate in human nature and therefore evolutionarily significant for survival..."* *Descent of Man.* (1)

Infants strive instinctively to engage in social interactions. Facial expressions importantly contribute to the social, emotional and cognitive development of early communication. The face is a visible signal of others' social intentions and motivations, and facial expression is considered a critical variable in social interaction. Having experiences of and exposure to seeing faces and their accompanying expressions lays the groundwork for infants to develop their ability to perceive, recognize and distinguish the familiar from the unfamiliar (2). This impacts on the young infants' abilities to not only communicate and engage, but also to survive in their environments. Developmental competencies such as socio-emotional, behavioral or academic attainments contribute to children reaching their developmental potential. The infant's regulatory capacity for emotional and physical needs after birth is limited, with the mother-infant relationship identified as one of the first contextual environmental supports that influences and shapes these regulatory abilities (3).

In the first 1000 days of life, there are multiple sensitive periods during which significant brain growth and development occurs (4). It is particularly during these sensitive periods that the foundation for an infant's developmental competencies is established, and this is supported by a secure infant-caregiver relationship. These competencies are also influenced by interacting domains like health, nutrition, safety, responsive caregiving and early learning (5,6), which mutually reinforce each other through the developmental processes. Nurturing care occurs, as a function of reciprocal caregiver and infant interactions, which are sustained by their environments. There are certain fundamental components of "nurturing care" which include responsive and emotionally supportive care, stimulating environments, including the creation of opportunities for children to explore and learn from their surroundings in developmentally appropriate ways (5). Conditions of adversity, such as poverty, or poorly treated mental health disorders can compromise the capacity of caregivers to provide care that can promote attachment security which in turn may influence developmental outcomes (7). However, the precise impact of maternal mental health disorders on attachment relationships remains complex (8). Wan and Green (8) highlighted in their review that most children of mothers with mental health problems do not in fact necessarily develop lasting difficulties. While children in this setting of vulnerability (specifically social adversity and caregiver mental illness) may be at higher risk to develop relational difficulties, many go on to develop positive developmental outcomes and more secure attachments indicating that childhood resilience may be more robust and more supported in situations of maternal mental illness where the caregiver makes exceptional efforts to mitigate the potential impact of their illness on their infants' outcomes (9).

1.1. Understanding Parent infant interactions

1.1.1. Infant Mental Health

Infant mental health is influenced by the mutual adaptation of the caregiver and the infant, specifically reliant on the quality of the caregiving relationships (10). Its central concern is the relationship between infants and caregivers with robust evidence that appropriate care in the earliest period of life establishes durable emotional and relational stability that facilitates cognitive development (10,11). It is in the interplay between genetic predispositions, and the physical and psycho-social environment that the foundations are laid for mental and physical health (12). Infant mental health helps understand that these are mediated by relationships in context.

Many studies from lower-and-middle income countries (LMICs) have highlighted the importance of the early infant-parent relationship as one of the critical contributors to the development, particularly the socio-emotional aspects of the growing child (13,14). This capacity of parents can be compromised by repeated and unrelenting exposures to adversity. In this context of adversity, mothers who are faced with uncertainty or psychological distress are more challenged when required to respond to their infants in a sensitive, responsive, or attuned manner (15). For young children, one of the most significant contributing factors for positive outcomes, is the experience of a responsive relationship with a warm and available caregiver (16). Caring interactions and by extension close social bonds between caregivers and infants possibly promote resilience and healthy development in the context of potentially damaging and often unavoidable consequences of material deprivation and poverty (17,18).

Synchrony, Sensitivity, and reciprocal engagement

The behavioral foundations of synchrony (vocalizations, facial expressions, affectionate touch, and movements) are cross cultural patterns of relating observed across communities (19) and originate in maternal postpartum bonding interactions. In all communities, infants depend on warm, protective, and responsive relationships to thrive, with this being compromised in environments that do not provide some level of threshold for these engaging relationships.

Synchrony

Synchrony refers to the intricate ‘dance’ that occurs during bursts of intense yet playful interactions. This often depicts an enhanced state of positive arousal that is co-constructed between infants and their caregivers during the daily brief episodes of face-to-face interactions (20). This reciprocal adaptation between interactive partners (in this case the mother and the child) reached only during shared moments, provides critical environmental inputs for the development of social connectedness and regulation of the infant, thereby accelerating the maturation of relational skills for the infant (20,21). The term affect attunement has also been used to describe the state of shared emotions in a dyadic

interaction (22). Synchrony reflects an attunement between infants and mothers that facilitates active regulation of distress. Synchronized behaviors (such as mutual gaze and following of gaze) between infants and their mothers, are thought to create the early building blocks of self-regulation which fuels early social connectedness (23).

Sensitivity

Sensitivity in the context of maternal-infant interactive behaviors, is widely considered to be fundamental to '*good enough'* mothering. A mother's awareness of her infant's signals, the accuracy of her interpretation, as well as how appropriate and prompt her response is, is recognized as her "sensitivity" in the interaction (24). Sensitivity and responsiveness towards infants and young children is demonstrated in all cultures, although the form and actions of caregivers may have considerable cultural variation (18,25). There is a significant imbalance in the understanding of infant mental health in that current knowledge relies largely on evidence generated in high income countries (HICs) which may not necessarily be generalizable to lower-and-middle income countries (LMICs), given their vastly different social, cultural, economic resources and expectations of what constitutes "good enough" parenting (26). While theoretically the infant-caregiver attachment relationship is universal, there are variations in demonstrations of sensitivity and responsiveness found across cultural interactions (27,28). This is particularly relevant in the South African setting, where family relations tend to be less individualistic and an extended, collective culture of child rearing is adopted, where other relatives such as grandmothers or aunts may share the caregiving responsibilities (15). This may influence aspects of maternal sensitivity that incorporate the collective culture of child rearing.

Reciprocity in Engagement

Reciprocity involves shared or complementary experiences or affect and is critical for laying the groundwork for social development in the growing infant. Between infants and parents, the sharing of emotions is a crucial component of interactions. Winnicott (29) famously said "*there is no such thing as just a baby*" implying that a baby cannot exist without its caregiver (or parent) and by inference is impacted on by the reciprocal engagement between the dyad. This type of reciprocity is called "emotional availability" which, when optimal, provides the parent and infant with a range of emotions including a balance of positive emotions, pleasure and downregulation of emotions when needed between the dyad (30).

Attachment in Caregiving relationships

When the infant-caregiver relationship functions well, there is an expectation from the infant, that its needs will be consistently and sensitively met by the adult in the relationship (17). Within the context of the environment, attachment behaviors are driven by biology, and is fundamental for human survival (31). Attachment Theory proposes that the safety and protection of children is enhanced by the contact

with their caregivers that is facilitated by their attachment systems (32,33). In situations of distress, as part of attachment relationships, infants seek out their primary caregivers for safety and nurturing support which in turn motivates their caregiver to respond with protection and comfort. This interaction in the context of attachment is considered an emotional *connection* that an infant develops with their caregiver(s) (34). The attachment style and organization of the infant is associated with the quality of mother-infant interaction. Attachment relationships were originally classified into three main categories or patterns, which include a) secure, b) insecure avoidant, and c) insecure ambivalent (resistant) attachments (24). Infants learn from these attachment experiences, ways of reacting and responding to future relationships (35). It is well described for example that infants who experience insecure attachment styles have higher rates of ambivalent and unpredictable emotional responses, poorer developmental outcomes, demonstrate insensitive peer relationships and have a greater risk of cognitive and affective challenges in early childhood when compared with infants in secure attachment relationships (17).

Impact of perinatal mental health disorders

Common perinatal mental health disorders (CPMDs), includes anxiety and depression, and are highly prevalent in women living in high-risk environments and may compromise the parent-infant relationship (36). A systematic review by Fisher (37), suggested that CPMDs are significantly more prevalent (20%) in LMICs than that reported in HICs where rates of CPMDs range between 10 and 12%. CPMDs are known to influence mothers in their ability to detect and respond to changes in their infants' communication. Mothers support their infants' dependence for physical care and comfort, including instinctive desires for social interactions. If mothers are poorly responsive to or insensitive to behavioral cues and needs of their infants, this may potentially compromise infant development (13,38).

Perinatal mental health disorders, in addition to risk factors such as poor social support, substance use, or socio-economic stressors may impact on and undermine a mother's capacity to respond appropriately to and provide optimal nurturing care to her infant (39). As alluded to previously developmental outcomes may be compromised in conditions of adversity which includes situations in which mothers are at high risk for mental illness (7). When untreated in the primary caregiver, perinatal mental health disorders affect parental cognitions and beliefs, attachment, and infant neurodevelopmental milestones (40,41). What is considered developmentally typical negative behaviors in infants such as crying or fussiness for example, may be considered particularly stressful for mothers who struggle with mental health disorders and may in turn impact on the mother's responsiveness and attachment to the infant (42). A potential impairment in the attachment relationship may threaten the reciprocity of the engagement and by extension, impacts on the infant's typical developmental trajectory. However, the precise impact of maternal mental health disorders on early infant relationships remains complex.

1.1.2. Infant Communication and interaction

Mothers and young infants engage in intense interpersonal reciprocal communication involving the domains of vocalization, visual attention, and touch. Prior to language development, communication is largely based on a range of non-verbal signals (such as touch and facial expressions) produced by the caregiver. Amongst the repertoire of skills that the infant uses to engage a caregiver in a mutual interaction, the use of facial expressions, the initiation and maintenance of eye contact and the use of head and body movements are crucial (43). While there is correspondence between mothers across groups in their interactive interpersonal early interactions with their infants, stylistic differences have been reported between Western mother-infant pairs and those from other social and cultural groups. As reported by Richter (25), African mothers specifically behave differently with their infants from Western mother-infant pairs, in that they often are more vocally expressive and reactively responsive to their infants' communicative behaviors.

Infant social competencies

Infants possess a remarkable array of biosocial competencies that allow them to make meaning, understand motivation and react to emotions (44). Trevarthen and Aitken (16) suggested that infants possess an innate communicative competence as a result of biological consequences and this impacts importantly on thinking, learning and recognition. In fact, the infant brain is often described as experience expectant and experience dependent (4,45). This implies that infants primitively and genetically are programmed to want to learn about the environment through exposure and their brain development depends on this exposure. Infants imitate other adults to enter a communicative and co- operative relationship with them. Evidence suggests that infants from all societies are similar across a wide range of dimensions, such as the sequence and timing of sensory milestones, the order of language development, vocalizations, gaze patterns or differential sensitivity to the human face or voice (25,46). Table 1 presents the early social communicative behaviors with its correlated developmental milestones. These characteristics serve as potential for adult-infant interactions to be interpreted as communicative and meaningful.

Table 1: Early Social Communication Behaviour and Selected Developmental Milestone Correlates*

Age range (months)	Social Communicative Behaviour	Visual	Auditory	Language	Cognitive	Emotional
0-2	Gazes at Caregiver Responsive to sensory stimulation	Gaze preference for faces (mother's) Discriminates happy from sad faces	Prefers human voices Prefers mother's voice	Attends to acoustic and phonetic information from others	Reflexive Behaviours and tracking	Increasing periods of calm and alertness Orients to attentional and defensive reflexes
3-5	Develops social smile Laughter	Discriminates intensity of	Allocates more attentional	Discriminates speech in normal and	Emergence of early object	Behaviours of emotion regulation

	Seeks eye contact Development of care relatedness Attempts to match caregiver expressions Increased sensitivity to face to face interactions	happy and sad faces Distinguishes sad, angry and surprise expressions Gazing and following abilities begin with auditory integration	resources to mother's voice	reversed patterns	permanence abilities	Reactivity to frustration and novelty Physiological regulation to stress
6-9	Maturation of earlier abilities Emergence of understanding of feelings, intentions and attention Emergence of triadic interactions	More specific processing of familiar faces Larger positive component to emotionally congruent face/voice pairs	Discriminates and recognizes emotional content Functional specialization for processing human voice	Critical period for development of communication skills Joint attention associated behaviours	Mouthing and exploring objects Attention expands to wider world Memory recognition	Recognizes common affect and emotional content Functional specialization for processing negative emotions Recognition of facial expressions in the mother
10-12	Waves bye bye Intentional gestures Early words	-	-	Emergence of early words and reference communication	Co-ordinates attention to objects with caregiver. Emerging ability to perceive objects as independent entities	Increasing abilities in behaviour regulation

*adapted from (47)

During the first two months of life, interactions between caregiver and infant often involves a repetitive rhythmic cycle for various behaviors including gaze and affective expression. During this stage, interpersonal relatedness is characterized by gaze (rather than touch) and synchrony of gaze takes over as the main vehicle for social interactions throughout life (20,48). Evolutionarily, this shift from touch to gaze makes way for a uniquely human relational behavior – *"the mutual gaze*" which includes the matching and facial mirroring of expressions. The patterns of interactions between both the adult and the child are considered consistent and follow a well-defined developmental course. Between one and two months, the infant is more interactive towards its environment and may smile as a response to visual stimuli. By six weeks, the social smile develops and smiling becomes primarily a social-emotional expression (49). From the age of 3 months the social gaze that is shared between infant and caregiver, assumes the central modality of coordinated interactions. The infant is noticeably more socially focused and appears to be more communicative with an emergence of a range of emotions recognized as joy and sadness and includes social smiling. In the field of infant social interactions, at least two general developmental phases are described originally by Trevarthen (50) referred to as primary and secondary intersubjectivity.

Primary intersubjectivity: from birth up to 4 months of life, infants and their caregivers can be observed engaging in mutually attentive interactions, that are maintained by symmetrical alterations in their gaze, facial and body movements. The major significance of this period, of "mirroring" of attention between

the infant and caregiver is the communicative contact and correspondence between them into which meaning can be later introduced.

Secondary intersubjectivity: around the fourth month of life, the infant begins to develop a heightened awareness of objects and events outside of the intimate exchanges with the caregiver. Exchanges between infant and caregiver become very playful with mutual amusement and can be expressed in games with conventional and predictable features. The back and forth or to and fro style of interactions drawing in both partners is referred to as "contingency" and is considered an important element of a high-quality social interaction. Infants respond to and are attracted very early in life to contingent response offerings. The sharing of a mutual gaze becomes one of the central modalities of coordinated interactions to activate the social brain circuitry (51).

Positive emotional expressions and positive affect

Positive emotional expressions between infants and caregivers are not only enjoyable to witness but also contribute a crucial role in brain development (45). For the most part, communication especially emotionally between infant and caregivers are positive, authentic, and genuine. The parent considered to be highly sensitive demonstrates interest, pleasure, and amusement with their infant. The relationship between caregivers and infants is strengthened by positive emotions and is regarded as important for the future emotional development of the infant. This may be evidenced by warm smiles, interested eye contact, comforting "motherese" and playful physical contact (52). When these are shared in meaningful relationships, they serve to construct social, psychological and intellectual resources for the infant (53). Demonstrations of affection are important for parents to be able to empathize with an infant's experiences, to manage their own reactive responses to their baby's dependence and to illustrate regulatory behaviors. Regulatory behaviors in infancy such as feeding, sleeping, self-comforting and crying are challenging for both infants and caregivers (54), however positive maternal interactions may play a moderating role in certain regulatory behaviors like excessive crying and sleep difficulties (55). Emotion perception also plays an important role in that interaction and emotional states influence each other. In an electroencephalogram (EEG) study of emotional valence, Santamaria et al. (56) reported that inter-brain networks between mother- infant dyads were significantly modulated by each other during social interaction (positive or negative). During positive emotional interactions the connectedness and influence of mothers on infants was consistently higher. The study involved naturally playful interactions between mothers and infants and indicated increased neural interpersonal synchrony specifically for emotional displays that were positive (56). This connectedness also showed stronger integrations of neural processes between dyads specifically during positive maternal directed demonstrations of emotions. This is possibly due to the maternal neural networks being more mature and hence more strongly integrated permitting more efficient communication (56).

Positive Affect broadly refers to positively valanced attitudes, moods, and emotions (53).

Attitudes include stable beliefs about a positive experience, while positive moods (like happiness) are more general feelings. Positive emotions such as joy or pleasure are usually brief,occur in response to good situations and could be considered a state positive affect. Feelings of joy may trigger play behavior with others which then helps to solidify close relationships and emotional connections (53). Positive affect bidirectionally influences social bonds of close relationships by promoting intimacy and harmony (57) and by buffering against negative experiences (54).

Regardless of the effects of negative emotions, positive shared emotions are essential to improved emotional regulation, influencing both parent and the infant (58). While there are extensive studies on maternal mental illness, negative interactions, and child outcomes specifically in high risk LMIC settings (9,59,60), limited attention has been directed at how positive emotional interactions between mothers and infants may contribute to infant development and mutual regulation. A study by Ursache et al. (61) reported that infants who experienced early (before the age of 12 months) high levels of positive parenting and early positive interactional engagements were more likely to exhibit high levels of emotion regulation and executive functional abilities at 48months of age. Similarly, Sheinkopf (62) investigated the relationship between maternal and infant positive behaviors and subsequent verbal and non-verbal intelligence quotients in a sample of diverse high-risk infants. At 4 months of age, positive maternal vocalizations and affect during interactions predicted positive visual spatial and verbal abilities in children at 4 years of age (62). These studies draw attention to the importance of interactive displays of positive affect and potentially joyful emotional engagement between infants and caregivers in predicting cognitive outcomes in infants. These results are further consistent with the theory that positive maternal affect encourages an infant to maintain engagement with the mother and by extension will increase opportunities for learning (62).

Infant Smiles

Not all smiles are the same. Smiles typically occur because of contraction of the facial zygomatic major muscle, which in then pulls the corners of the lips laterally and upwards. Within the first 1000 days of life, infant smiles develop from an unintentional, unstimulated expression during sleep to more mature social, and environmentally reactive smile (49,63).

Smiles have different proposed/theorized meanings ranging from the theory of evolution where the infant smile is considered to be an adaptive response (1,64), with the appearance of initial social smiles thought to be an equivalent behavioral expression of emotional engagement that is positive. The social smile is thought to emerge after the first month, gradually evolving into a socio-emotional expression with the highlight for the infant being the face-to-face interactions with a contingent adult or caregiver (65,66). In the first 2–3 months of infancy, smiles are believed to represent a relaxation in the cognitive tension the infant experiences related to the recognition of a visual stimulus (67). Within these early face to face interactions, it is more likely for a smile to occur when an infant gazes directly at its mother(caregiver) and when the mother smiles back (63,68). Through six months of age, the time and frequency of infants' smiles increase, especially when infants look at the mother rather than away from her (69). Prior to early social smiling, the infant may demonstrate up to a 20 second

period of brow knitting accompanied by a visual fixation on the maternal face (67,70).

Infant smiles have broadly been defined based on descriptions of facial anatomical contributors to the smile. These include four different types of smiles: a) simple smile (without cheek raising or mouth opening), b) Duchenne smile (with cheek raising), c) play smile (with open mouth) and d) duplay smile (with cheek raising and open mouth) (49). Smiling alone may indicate a positive emotion, but the last type of smile with open mouth-cheek raising has been found to correlate with the most positive periods of interaction, as it is presumed to be involved in stronger feelings of joy (49).

Researchers have verified that depending on the specific facial actions that accompany the dynamic social interactions between infant and caregiver, smiling can reflect different qualities of positive emotions (63,71,72). For example, accompanying qualities may include specific eye constrictions indicating more authentic joyful smiles, or open mouth smiles indicative of more playful smiles (67). Critical to the progression of emotional and social communication, is the capacity to coordinate emotional responses with expressive motor behaviors (63,73).

While there has been advancement in the field of understanding infant smiles, caregiver interactions and its long-term impact on social-developmental outcomes, most of this work has been focused on mother-infant dyads in western, educated, industrialized, rich and democratic (WEIRD) societies (73,74) that may not necessarily represent culturally diverse or LMIC settings. In fact, in a 2014 review of studies specifically focusing on infant and maternal interactions and outcomes, less than 2.5% of all reviewed literature published included data from LMICs where 90% of the world's infants live (75).

Shared Pleasure moments

The sharing of positive affect, specifically within the infant-caregiver interaction, is thought to fuel the configuration of initial infant experiences of socialization (20,58). Infants are remarkably sensitive to their mother's emotional states and shared pleasure is the goal to which infants and their mothers inherently strive towards.

While several studies have explored positive emotional affectivity in parent-infant interactions looking at features such as infant temperament, behavioral regulation and parental affect responses (20,76,77), there are fewer examples of studies that look at simultaneous direct gaze contact while expressing positive emotional expressions (78). A study that examined skin conductance arousal in a sample of children with autism spectrum disorders, reported greater autonomic arousal associated with a greater intensity of shared reciprocal experience of direct gaze contact (79).

Shared pleasure (SP) moments in the parent-infant interaction are defined as "*the parent and the child sharing positive affect in synchrony"* (80,81). This may be expressed specifically as facial expressions

demonstrated by the curving of a mouth to smile or laugh, coupled with a direct gaze contact, and a simultaneous or synchronized beginning and ending. SP sequences are analyzed from video recordings of mother-infant interaction situations (free play or feeding) by coding the occurrence and duration of moments including shared eye contact and mutual, synchronous smile or laughter (80,81).

SP is thought to represent a measure of high intensity positive affect and mother-infant pairs considered to have favorable skills in interactions are presumed more likely to experience SP moments (80). As part of the European Early Promotion Project, SP was originally assessed in Finnish mothers and their infants to determine the occurrence of SP and its potential associations with factors that build infant resilience (82,83). In this setting, the number and length of SP moments were associated with the infants' later socio-emotional wellbeing. SP was also considered to be a protective factor for later emotional and behavioral problems in the presence of parental psychopathology (80,81). Another study by the same group of researchers described the mean duration of SP relating to subsequent socioemotional outcomes of the child. This study showed that infants with longer mean duration of SP at 2 months of age, showed fewer behavioral problems (both externalizing and internalizing) 2 years later (81). Results also suggested that Shared Pleasure was a crucial component in fostering positive psychological development and interestingly was reported to moderate the effects of risks like parental psychopathology.

SP has not been described in populations outside of the Global North. While looking for positive signs as an indicator of relational competency is common internationally to inform choices of therapeutic interventions with the mother-infant dyad (84), little has been reported on or explored in the context of LMIC settings that are characterized by diverse parenting behaviors which may not be easy to quantify. Smiling (as a social signal) may be interpreted very differently in different societies, and rules of social behaviors must be learned by infants in any particular culture. Caregiving itself is influenced by beliefs and attitudes that arise from personal, social, and cultural experiences and Richter (25) reminds us that this needs to be considered when investigating variations and universality in early infant development. The ability to assess early parent-infant interactions in this setting may offer an opportunity to identify dyads at risk in a culturally diverse setting as early as possible.

1.2. Infant Outcomes

1.2.1. Risk Factors for Infant Development

In LMICs, infants may be disproportionately exposed to multiple cumulative developmental risk factors that impact negatively on infant outcomes (85). Synchronicity in the early mother-infant relationship is believed to support optimal infant development but research is limited in low resource settings on either this construct or its associations, such as maternal mental health or infant early development (37). Evidence from HICs shows that risk factors such as substance misuse, poverty and exposure to violence and interpersonal trauma, unemployment and poor maternal education all contribute to the

increased risk for maternal mental illnesses (41,86), which has the potential to adversely impact on infant neurodevelopment (87). A systematic review by Burger et al. (88) reported that studies in LMICs that interrogate the associations between neurodevelopmental outcomes in infants and perinatal mental health are sparse, and that the environmental and contextual pathways are poorly understood. These associations itself are complex, and the multifaceted nature of maternal mental illness and its interaction with infant development makes differentiating between moderators and mediators of maternal mental illness difficult (87,89). What has however emerged in multiple settings as a key domain linked to enhanced physical, psychosocial and cognitive health in children, is responsive caregiving. A study by Scherer (90) reported on the importance of sociodemographic factors (such as maternal education, depression, household assets) which significantly determine responsive caregiving in a LMIC setting in South Asia. This study additionally highlighted responsive caregiving significantly associated with positive outcomes in socio-emotional domains for rural Pakistani children. Even in this low resource setting, this finding remained significant statistically after controlling for maternal depression and other socio-demographic confounders (90). Another study that examined data from over 40 lower-and-middle-income countries reported improved child outcomes linked to education of mothers, mediated by responsive caregiving behaviors (91). These included behaviors that promoted stimulation and encouraged learning (91).

Although there have been some trials that examine the risk factors for development, sufficient data is lacking from LMICs that directly and comprehensively measure socio-emotional outcomes that affect the development of children. In the Drakenstein Child Health Study, Donald et.al (89) reported on critical risk factors that contributed to sub-optimal neuro-developmental outcomes. Notably child sex interacted with key protective and risk factors and in this high-risk environment, male infants were reported at greater risk of poorer developmental outcomes (89). Maternal education levels, healthy birth weights and better socioeconomic circumstances were identified as key protective factors with poor maternal mental and physical health (such as HIV) contributed to child developmental risk. The lack of sufficient research in this environment puts into focus the urgent need for investigations into multifactorial risk and protective factors. What is essential to enhancing our understanding of resilience will be to address disparities especially in terms of interventions in lower resource settings (36,92). While there have been useful constructs for interpreting child development in its local cultural context, there is a growing recognition that contemporary conditions in Africa may influence our understanding of risk and resilience in early infancy (93).

1.2.2. Socially withdrawn infant behavior

The degree and style of responsivity to social stimuli in infancy is referred to as infant social behaviors. Infant withdrawal may be considered a normal component of the regulatory capacity of an infant and serves an important purpose (94). Often this is to temper and regulate the amount of and nature of the flow of stimulation that an infant receives, especially when they become overstimulated or fatigued (95,96). This may take the form of something simple like closing eyes or using bodily gestures to turn

away from the overstimulating experience, as part of its attempt to help regulate themselves (97,98). In a typically developing infant, the withdrawal responses may follow a positive encounter or even a short episode of non-responsiveness from the mother. However, regardless of the context or cause, sustained social withdrawal – which may be a severe restriction of or even an absence of positive or protest behaviors must be considered a signal or alarm of infant distress (99). This signals to alert the observer that the infant is not displaying expected appropriate social behavioral responses (100). When infants make persistently reduced efforts to interact – so often less vocalizing, diminished eye contact or fewer smiles this should be considered an early warning of withdrawal (99,101). There are several risk factors (including biological and environmental) that are associated with sustained social withdrawal in infants (100–102). Notably, in higher risk infants such as those with regulatory difficulties (e.g. crying or sleeping or feeding problems) or in dyads where there are concerning parent-infant relationships, distributions of sustained infant withdrawal are higher (101,102). From as early as 3 months of age, social withdrawal can be identified as either lacking positive (smiles, cooing, avoiding eye contact) or reduced negative (diminished cries, apathy, or dampened protests) behaviors (103). The concern with sustained infant social withdrawal is not only the flagging of risk, but the potential to be associated with suboptimal emotional and developmental disorders (96,104).

1.3. Motivation for this studyin this setting

The literature on early mother infant reciprocal engagement and synchronicity particularly in LMIC settings has several gaps. First, limited studies have explored mother-infant relationships in this context (89). Second, the assessment of reciprocal engagement or synchronicity in culturally diverse settings is not well established (105). Thirdly, studies in this environment have mostly focused on highlighting negative or identifying problematic infant interactions with their caregivers (59,106,107). Positive relational experiences need to gain more prominence in infant mental health interventions. Positive emotions can not only enhance the caregiver-infant relationship, but when shared in a meaningful way can build sufficient social and psychological resources for the infant throughout their lifespan. The need for affirmative and approving relationships is immediate and urgent for the young infant, and if absent, may serve as a potential indicator of early difficulties (84). It is imperative that if we are to fully understand infants, their relationships, and the potential for early intervention, we need to assess and research in more culturally diverse environments (74). To this purpose the aims of the study were to determine the frequency and duration of Shared Pleasure (SP) moments in infants born to mothers with and without mental illnesses, to correlate SP moments with the Bayley scales of Infant and Toddler Development and to determine the presence of sustained infant withdrawal assessed by the Alarm Distress Baby (ADBB) measurement of infant withdrawal.

1.4. Overview of Chapters and Related Publications

This dissertation is presented in the Hybrid Dissertation format as specified by the Faculty of Medicine and Health Sciences of Stellenbosch University. The Hybrid format requires the inclusion of two articles published in accredited peer reviewed journals and a combination of a published article in a peer reviewed journal and an additional chapter outlining the research.

This dissertation comprises seven chapters. In addition to the Introduction and Methodology chapters, chapter 3 describes the novel paradigm of Shared Pleasure used in this research. Published versions of the journal articles are included in chapters 4, 5 and 6. Each chapter has its own reference list. Chapter 7 provides an integrated discussion of the main findings and offers recommendations for future research and practice including the concluding comments.

1.5. Publication Citations

Chapter 4

Lachman A, Niehaus D.J, Jordaan E.R, Leppanen J, Puura K, Bruwer B. Shared Pleasure in early mother–infant interactions: a study in a high-risk South African sample. Early Child Development and Care 2021;191(2):230-41.

Chapter 5

Lachman A, Burger M, Jordaan E.R, Leppanen J, Puura K, Niehaus D.J. Maternal shared pleasure, infant withdrawal, and developmental outcomes in a high risk setting in South Africa. Frontiers in Psychiatry. 2021:1181-14.

Chapter 6

Lachman A, Jordaan ER, Stern M, Donald KA, Hoffman N, Lake MT, Zar HJ, Niehaus DJ, Puura K, Stein DJ. The Shared Pleasure Paradigm: A study in an observational birth cohort in South Africa. Archives of women's mental health. 2022;25(1):227-235.

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CHAPTER 2

METHODOLOGY

This study is a nested study and forms part of two larger case-control studies. Study A is a case-control prospective cohort project on Maternal and Infant Mental Health (MIMH) conducted at Stikland Hospital, Cape Town, South Africa (SU HREC Ref S12/04/111). Study B is a birth cohort of mother-infant pairs and an observational comparison group that form part of the Drakenstein Child Health Study (DCHS) (UCT HREC Ref 401/2009) conducted in the Drakenstein region of Paarl, South Africa.

2.1. Sites

Participants were selected from two ongoing studies in the Western Cape. Participants enrolled in the parent study of the Maternal and Infant Mental Health (MIMH) Project were assessed at an onsite specialist maternal mental health clinic at Stikland Hospital. Participants in the parent study of the Drakenstein Child Health (DCH) study were assessed onsite at specialist clinics at Paarl Hospital, Mbekweni and TC Newman Community Clinics in the Drakenstein region. Permission for recruitment at these sites was obtained from the Western Cape Department of Health (DoH) Provincial Research Committee.

2.1.1. Parent studies

2.1.1.1. Study A: The Maternal and Infant Mental Health Project (MIMH)

This study forms part of a larger ongoing prospective observational study, The Maternal and Infant Mental Health (MIMH) study, based at Stikland Psychiatric Hospital (Bellville, Western Cape, South Africa). The community of Bellville is situated in an urban area just outside of Cape Town city and is considered representative of an emerging lower middle class. The MIMH study aims to investigate the impact of maternal mental illness and infant measures of social cognitive deficits and oto-acoustic characteristics on mother–child interaction and attachment. The MIMH study recruits participants from state-based maternal mental health clinics at Stikland Hospital in Bellville, Cape Town South Africa.

2.1.1.2. Study B: The Drakenstein Child Health Study (DCHS)

The DCHS is a population-based birth cohort study investigating the early-life determinants of child health and development. The study is based in a peri-urban, low socio-economic community located in Paarl outside of Cape Town, South Africa. The Drakenstein community is characterized by a high prevalence of health risk factors including poverty, and depression (1,2). It is considered representative

of peri-urban regions across South Africa with the majority of the population utilizing primary public health care clinics. The DCHS aims to investigate the aetiology, epidemiology, the role and interaction of potential risk factors for childhood lower respiratory illness. Maternal and child health are investigated through longitudinal assessments of a range of clinical, environmental, molecular genetic, nutritional, immunological and psychosocial risk factors.

The map below (Figure 1) adapted from the Municipal Demarcation Board Boundaries (3) highlights the various districts within the Western Cape Metropole. The Drakenstein district falls within the Cape Winelands district (in purple), and Stikland district (green) falls within the City of Cape Town. Drakenstein currently is estimated to have a population of 300 991, rendering it the largest municipal area within the Cape Winelands District. Stikland is a district within Bellville, which forms part of the Eastern metropole of the City of Cape town, which has a total population of approximately 4.710000.

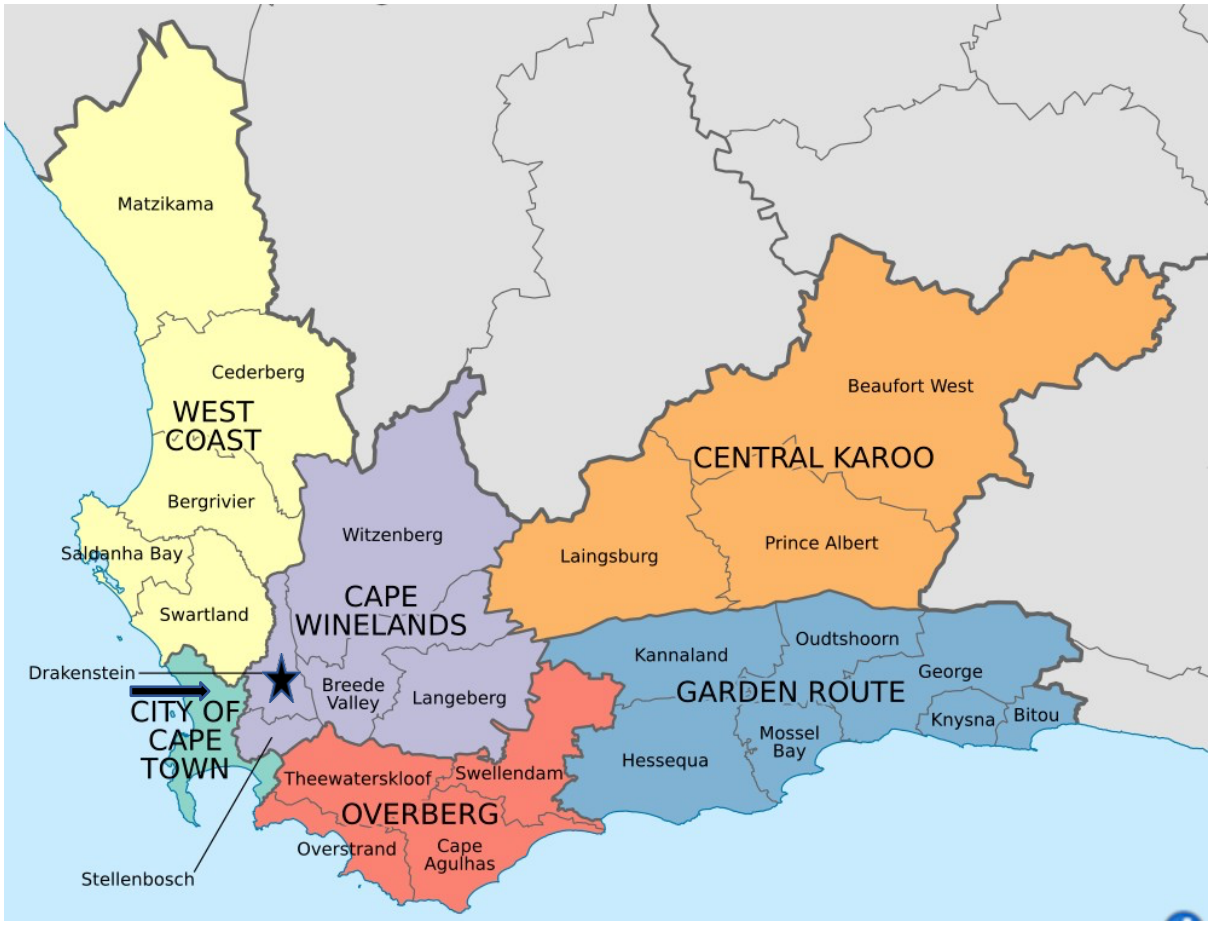

Figure 1: Western Cape Municipalities*

*Adapted from the Municipal Demarcation Board

Key:

Drakenstein indicated by ★

Stikland, Bellville indicated by ⟶

2.2.Study designandParticipants

This PhD study on Shared Pleasure (SP) Moments was conducted as a case-control cohort.
Case infants: refer to those infants whose mothers have mental illnesses
Control infants: refer to those infants whose moms are mentally well and not receiving any treatment or have any diagnosis of mental illness.

2.2.1. Inclusion criteria:

In the Maternal and Infant Mental Health (MIMH) study (Study A), all mothers and babies were eligible for inclusion as part of their 6 week post-partum visit. These consisted of participants who attended Stikland Hospital's Maternal Mental Health (MMHC) Outpatient Clinic and community clinics in the Stikland drainage area which provide perinatal mental health care on an outpatient basis. All mothers recruited at these clinics have experienced mental health problems at some point in the perinatal period. Age of the infant, gender and nutritional status, gestational age, exposure to medication and birth weight parameters were collected. Only age and gender were used to determine associations with SP in the MIMH study. For the Drakenstein Child Health Study (DCHS) (Study B) pregnant women were enrolled between gestation ages of 20 and 28 weeks, while attending routine antenatal care. Participants of the DCHS are prospectively followed through childbirth until children are 10 years of age. All mothers and infants were eligible for inclusion if the mothers were over 18 years of age and followed up for at least one year at the clinic. Maternal mental disorders included the following Axis 1 diagnoses as assessed by the Mini International Neuropsychiatric Interview Version 5.0.0 (MINI)^{R} (4), as well as the Recent Life Events Questionnaire (RLEQ) and The Edinburgh Postnatal Depression Rating Scale (EPDS) measures for maternal mental health risk were used in the MIMH study. The DCHS included the EPDS, Life Events Questionnaire (LEQ) and Self Report Questionnaire (SRQ) measures for maternal mental health risk assessment.

2.2.2. Exclusion criteria:

For the MIMH study, any mothers who were part of the psychiatric inpatient service as involuntary users were excluded. Mothers of case infants who did not fulfil criteria for severe mental illness from the MMH study as measured by the MINI^{R} or who were younger than 18 years of age were excluded. For the DCHS, any mothers younger than 18 years of age, who did not attend one of the two study clinics and who moved out of the area within the year were excluded.

2.3. Ethical Considerations

2.3.1. Informed Consent

Participation was voluntary, and informed consent was obtained from participants before interviews were conducted. Participants were able to withdraw consent at any point in the study and participation or non-participation did not prejudice or influence care as usual as provided at the study sites.

Consent was obtained for the dyadic interactions (participants and their infants) videotaped as part of the assessments in the MIMH and DCHS study protocols. Participants were aware that video material was accessible to and would be viewed by the research team. This study assessed a pre-recorded 5-10 minute segment of a dyadic video recording. There was no additional face to face contact with the dyads for the purposes of this study that could contribute to any additional distress or fatigue endured during the larger study.

At enrolment, mothers gave voluntary, written, informed consent in their preferred language (English, Afrikaans or isi-Xhosa). Mothers gave consent for children younger than 12 months as per South African National Health Research Ethics Council (NHREC) guidelines that extend the parameters for informed consent by parents to include infants specifically under 12 months of age (Department of Health: RSA 2015). All data were anonymised using a study number to code for each mother–infant dyad. Infants will have the right to withdraw consent at any point once attaining the legal age for consent. Video material will not be shared as part of any research outputs and participant identities are kept confidential.

2.3.2. Ethical Approval (Appendix A)

Amendments to both parent studies were submitted to the Health Research Ethics Committees at both the University of Cape Town and Stellenbosch University. The amendments requested the use of the dyadic videos for additional ratings by the principal investigator (AL) as a new investigator on the existing studies. The ratings requested included the assessment of Shared Pleasure and Infant withdrawal on the existing videos. No additional videos or interventions were conducted. The study amendment was approved by the SU HREC (Ref #: S12/04/111A) and the UCT HREC (Ref #: 401/2009). Approval from the Western Cape Provincial Department of Health (2011RP45) was also granted for this study. The study was performed in accordance with the ethical guidelines and principles of the World Medical Association's (WMA) International Declaration of Helsinki (2013) and South African Guidelines for Good Clinical Practice (2006).

2.3.3. The inclusion of Race

The referral to Racially classifying terms in this study has been used as defined in the Employment Equity Act No.55 of 1998(5). The legislative basis for racial classification during Apartheid was the Population Registration Act No. 30 of 1950. This Act divided the South African population into three main racial groups: Whites, Blacks, Indians and Coloured people (people of mixed ancestry). Race was used for political, social and economic purposes. These terms are used in this study to provide context to the background of the historically marginalized participants, the socio-economic disadvantage inferred by the Apartheid regime and not meant to infer any sociocultural constructs in general about these population groups.

2.4. Data Collection

2.4.1. Video Recordings

All mother–infant pairs in both parent studies were videotaped during free play at various time points. Free-play was defined as unrestricted, undirected and unstructured play between mother and infant. The mothers were instructed to play with their infant in the same manner as they usually would. No further instructions were given to the mothers about the use of toys or of how to interact with the infant. In the MIMH study videos of mother-infant interactions were recorded at 3 time points: 6 weeks, 6 months and 18 months. For the purposes of rating SP, videos were used from the first 2 time points which were free play. For the DCHS, videos of mother-infant interactions were recorded between 13- 15 weeks, 6 months and 12 months. For SP ratings, free play videos were used from the 13-15 week time point.

2.4.2. Study Phases

2.4.2.1. Phase 1: Shared Pleasure Moments

This phase involved rating the Shared Pleasure moments between the cases and controls. A 5-10 minute segment of the video showing the dyad engaged in free play was rated for the presence of Shared Pleasure moments as defined by the baby and mother sharing a positive affect (such as a laugh, smile or positive verbal engagement) in synchrony with each other. The procedure of SP measurement is explained in detail in the chapter on the Shared Pleasure Paradigm.

2.4.2.2. Phase 2: SP and Associated Characteristics

This phase involved assessment of cases with and without SP moments for the following relationships between SP and:

a) presence or absence of maternal mental illness
b) psychosocial and demographic variables
c) infant withdrawal as measured by the Alarm Distress Baby Scale (ADBB)
d) infant developmental outcomes as measured by the Bayley Scales of Infant Development (BSD III)

2.5. Hypotheses

2.5.1. Phase 1: Shared pleasure moments

Mothers with a history of mental illness (MI) (current MI assessed by the MINI, past MI assessed by clinical interview) and their infants (case babies) experience fewer Shared Pleasure (SP) moments than mothers without mental illness and their infants (control babies).

2.5.2. Phase 2: SP and associated characteristics

I. Infants who experience SP moments with their mothers (independent of mental illness) will have better neurodevelopmental outcomes (as measured by the Bayley Scale of Infant Development III) compared with infants who don't experience SP moments.
II. Infants (case infants) of mothers with mental illnesses (current or past) are more withdrawn (as measured by the ADBB) than infants (control infants) of mothers without mental illness, and the relationship is not independent of SP moments.

2.6. Measures

2.6.1. Maternal Measures

2.6.1.1. Mini International Neuropsychiatric Interview Version 5.0.0 (MINI) (4)

The MINI is a brief, structured diagnostic interview for DSM-IV and ICD-10 psychiatric disorders. It was developed as a brief but precise, structured psychiatric interview for multicentre clinical trials and epidemiology studies. The standard MINI assesses the 17 most common disorders in mental health. The disorders were selected based on current prevalence rates of 0.5% or higher in the general population in epidemiology studies. The MINI Screen uses only the screening questions in each module of the MINI. A negative response to the screening questions usually means it is unlikely the patient has a major psychiatric disorder. A positive response to any questions in the MINI Screen prompts the clinician to ask additional questions using the standard MINI. In the parent studies, the MINI was administered either telephonically or personally within a week after the study visit, at a time convenient to the participant. The MINI has been validated for use in South Africa and is available for administration in English, Afrikaans and isiXhosa (6–8).

2.6.1.2. The Edinburgh Postnatal Depression Scale (EPDS) **(9)**

The EPDS is a 10-item self-report measure of recent depressive symptoms. Each item is scored on a frequency scale ranging from 0 to 3. The total score is obtained by summing individual item responses. A higher score indicates stronger depressive symptoms; a cut-off score ≥ 13 indicates probable depression. The EPDS has been found to have good validity and reliability in South African population groups (10–12).

2.6.1.3. *The World Health Organization (WHO) endorsed Self-Reporting Questionnaire-20 (SRQ-20) (13)*

The SRQ-20 measures psychological distress. Prolifically used locally and internationally, it maintains good reliability and face validity and consists of 20 items assessing non-psychotic symptoms. This WHO-endorsed measure of psychological symptoms has been used widely in South African settings showing good reliability and face validity (14,15). Individual items are summed to generate a total score. A cut-off score ≥ 8 can help sort participants into "high risk" versus "low risk". The measure demonstrated adequate reliability (α = 0.82) amongst Malawian and South African samples (14,15).

2.6.2. Psychosocial Measures

2.6.2.1. The World Mental Health Life Events Questionnaire (LEQ) (16)

The LEQ is a 17-item tool which assesses exposure to stressful life events during the previous 12 months. The questionnaire used in this study is based on the items used in the South African Stress and Health Study and has been adapted for and validated in this setting (6,17,18). A total score is obtained by summing the total number of life events reported during this time frame; higher scores indicate greater exposure to stressful life events, with α = 0.71.

2.6.2.2. The Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) **(19)**

The ASSIST was developed by the WHO to detect and manage substance use among people employing primary healthcare services. It has shown good reliability, feasibility and validity in multisite studies by the WHO. It assesses substance use and substance-related risk across diverse categories of substances and is widely used in South Africa (14,20). Total scores are obtained for each substance by summing individual item responses, with a higher score indicative of greater risk for substance-related health problems. For alcohol use, scores of 0–10 indicated low risk, 11–26 moderate risk, and scores > 26 a participant's high risk of experiencing severe problems resulting from their current pattern of use and likely dependence. The alcohol use subscale demonstrated adequate reliability (α = 0.91)

2.6.2.3. The Intimate Partner Violence (IPV) Questionnaire (21)

The IPV Questionnaire is a 12 item inventory adapted from the WHO multi-country study and the Women's Health Study in Zimbabwe to assess lifetime and recent (past 12 months) exposure to emotional, physical and sexual IPV(21). The adapted version has been used in studies in South Africa with good reliability (22,23). Categories are assessed across multiple items measuring frequency and number of acts. Scoring guidelines for the DCHS categorised participants as above or below threshold depending on responses of low (once), mid (more than once) or high (many times) frequency of

exposure to violence (24). Emotional abuse subscale: α = 0.85; physical abuse subscale: α = 0.86 & sexual abuse subscale: α = 0.83.

2.6.3. Infant Measures

2.6.3.1. Shared Pleasure Paradigm

SP in parent-infant interactions were analysed from the first 5 minutes of the recorded free play interaction. The first 5 minutes are considered sufficient for the assessment of positive interactional styles where interrater reliability is good (25). For a good reliability rating the expected agreement between two video raters that is considered sufficient is κ = 0.41-1.00 or proportion of agreement: 4/5-5/5. SP in parent-infant interaction was defined as "the parent and the child sharing positive affects in synchrony" (26). This had to be expressed in a facial expression as the curving of the mouth into a smile or laugh with gaze contact and a simultaneous or synchronized beginning and ending. Tapes were first observed at full speed, and all possible sequences of SP were sought and tagged. The tagged sections of the videotapes were then reviewed at half speed, and the beginnings and endings of the SP sequences were registered second by second. SP moments between mother and baby were measured by a single rater (AL) while being blinded to the history of the mother. AL received training to reliability by K Puura (KP) who originated this method of SP analysis. The measurement for SP consisted of three components: the occurrence of an SP moment, the total number of SP moments, and the duration of an SP moment. To assess interrater reliability for this study, 10% of the videos were randomly selected using the random number generator in Excel and were rated by two independent coders (AL and KP). The kappa values for the SP variables used in the analysis, i.e. the occurrence of SP sequences and the mean duration of SP (<0.5 or >0.5 seconds), were 0.79 and 0.46 respectively. The respective rates of interrater agreement may be regarded as substantial for occurrence of SP moments and moderate for mean duration of SP (27).

2.6.3.2. Bayley Scales of Infant and Toddler Development (28)

Child development was assessed using the Bayley Scales of Infant and Toddler Development, Third Edition (BSID-III) (28). The BSID-III is a gold-standard observational measure of development for children from 0 to 42 months and has been validated for and is considered culturally appropriate for a South African population (29). The tool measures development by direct observation across 5 subscales: cognition, receptive and expressive language, and fine and gross motor. The test takes 45 -60 minutes to administer and each test item is scored a credit or no credit according the manual. The credited scores are summed for the total raw scores for each scale and the test continues until five consecutive scores of no credit. These scales were measured by direct observation by a trained rater blinded to the risk factors. The socio-emotional and adaptive behaviour subscales were assessed by direct observation as well as caregiver report. Quality control and monitoring processes were

implemented to ensure accuracy. Age-standardised composite cognitive, motor and language scores were generated from cognitive, fine and gross motor, language, socio-emotional, and adaptive behaviour subscale scores using BSID-III normative and conversion tables, which account for gestation at delivery. In the original DCHS parent study analysis, raw and scaled scores were calculated using a normal US population, scaled to a mean of 10 and a standard deviation of 3. Poor developmental outcomes were assessed by categorising the scores into 'delay' or 'no delay', defined by scoring ≤1 standard deviation below the mean scaled score (using a cut off of 7). For this study analysis, composite scores were used and categorized with a score of < 85 indicating a "delay" which was 1 SD from the mean for the South African population (30).

2.6.3.3. Alarm Distress Baby Scale (31)

Infant social withdrawal was assessed using the Alarm Distress Baby Scale (ADBB) (31). This clinical instrument is aimed at evaluating social behaviours that can be easily observed during a brief observation of children 2–24 months of age. The ADBB Scale that measures sustained infant withdrawal has been used in several high income countries (32) in addition to the local South African context (33,34). The behaviours are organised into eight items: (a) Facial Expression, (b) Eye Contact, (c) General Level of Activity, (d) Self-Stimulating Gestures, I Vocalisations, (f) Response to stimulation, (g) Relationship, and (h) Attraction. Each item is rated on a scale from 0 (no unusual behaviour) to 4 (severe unusual behaviour). Guedeney and Fermanian (31) used a cut-off threshold score of 5 and reported a sensitivity of 0.82, a specificity of 0.78, and construct validity measures varying from 0.63 to 0.67. Similar results have been reported from several studies using the ADBB in different cultures, including South African cohorts. A threshold cut-off of ≥5 was used as it has shown optimal sensitivity and specificity to detect infants at risk. The PI was trained and achieved reliability in the ADBB in Finland. Videotaping each assessment allowed for review of the ADBB scoring by two local accredited scorers (AL and a trained research assistant) who reviewed 10% of the more difficult assessments to achieve consensus.

2.7. Statistical Analysis

2.7.1. Study A: MIMH Study

All analyses were done using the SAS (V.9.4) statistical analysis system. Infant and maternal demographic characteristics (maternal age, marital status, education level, employment status, infant gender) and clinical characteristics of the mothers and infants (MINI Psychiatric diagnosis, EPDS, RLEQ) were described using frequencies, percentages or means and standard deviations. The occurrence of SP moments was described with frequencies (%) and the duration and number of SP moments were graphically depicted. Bayley's subscales (cognitive, receptive and expressive language, fine and gross motor, socio-emotional, and adaptive) were described using means and standard

deviations. All modelling with the occurrence of SP as outcome were done using univariate log-Binomial models. Least square means for each covariate category were reported. The risk ratios (RRs with 95%CI) were reported as effect measure. All modelling with the number of SP moments were done using linear regression and the regression estimate (slope) and standard errors and p-values were reported. The average differences were compared between the SP and no SP groups (Chi-Square and p-values were provided). All models assumed a significance level of 0.05.

2.7.2. Study B: DCHS

A series of bivariate models were conducted to test the link between preceding perinatal maternal and infant factors on and SP at 3½ months. SP was assessed in two metrics: (1) frequency of SP moments [SP Frequency] and (2) occurrence of SP moments (i.e. presence vs absence)[SP Occurrence]. Due to the overdispersion of SP frequency data, negative-binomial regression models were conducted to gauge the potential impact of maternal and infant factors on SP frequency. Logistic regression was used to model SP occurrence regarding maternal and infant factors. Further sensitivity analyses were run to assess whether findings differed according to additional SP metrics which included (3) aggregated duration of SP [SP Sum] or (4) average duration of SP [SP Short-Average], both using negative-binomial regression modelling. Perinatal maternal mental health factors like perinatal depression (EPDS), lifetime and recent intimate partner violence (IPV), psychological distress (SRQ- 20), stressful life events (LEQ) and alcohol use (ASSIST) were measured at antenatal and/or 6–10- week postnatal visits. The maximum score across perinatal visits was used to minimise the amount of missing maternal mental health data in bivariate analyses of each mental health factor and SP. Early infant development was assessed using several continuous composite scales taken at 2 years, including cognition, motor, language, socio-emotional and general adaptive behaviour, each assessed in relation to SP. Additional factors like maternal age at birth, marital status, employment status, education, HIV status, infant sex, gestational age and birth weight were investigated. All models assumed a significance level of 0.05, and all estimates were presented with 95% confidence intervals. Analyses were run using SAS (V9.4) and R (R Core Team 2021).

2.8. Role in the Study

I was the primary investigator in this study on Shared Pleasure Interactions and received training and reliability in the paradigm under the tutelage of the co-supervisor Professor Kaija Puura at her research laboratory in Tampere University, Finland. Under the guidance of my primary supervisor Professor Dana Niehaus, I formulated, designed and wrote the protocol for this study. Dr Esme Jordaan and Dr Marilyn Lake performed the statistical analysis on the data sets for the MIMH and DCHS respectively. I analysed and rated all the videos for SP interactions and performed all the ADBB assessments on the videos. I am the first author on all three published manuscripts from this study, for which I conceptualized and

wrote the articles under the supervision of the PI (Professor Dana Niehaus) of the Maternal Mental health study and the PI of the Drakenstein Child Health Study (Professor Dan Stein).

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CHAPTER 3

SMILES & SHARED PLEASURE

The representation of the human face changes over the course of infant development. Infants are able to categorize faces as a function of experience within a specific *face-space*, which is a multi-dimensional space in which a face is coded at a point within a continuum (1). Infants are born with general vague mechanisms to process faces in addition to other visual stimuli, but with time they become more attuned to human faces. New-born infants are unable to show visual preference for specific ethnic group faces (either their own or other groups), however by the age of 3 months, this effect of preference is present (2). Similarly the preferential responses to different genders of faces also develops over time, where 3 month old infants can detect difference but new-borns do not (3). The ability to perceive and differentiate between faces lays the groundwork for infants to recognize and adapt to social cues, which by extension allows for survival in different environments (4). The ability to detect and understand facial expressions specifically as a social signal is at the core of social and emotional communication. Ekman et al suggested that facial expressions may influence the observing person's emotional experiences by providing clues about how an individual feels (5). It is also recognized that there are distinctive movements of the facial muscles for different facial expressions that are universally recognizable even though there may be different emotional and cultural connotations to the facial expressions (5,6).

3.1. The Infant Smile

3.1.1. Facial Action Coding System (FACS)

A novel technique for measuring facial behaviour called the Facial Action Coding System (FACS) was created in an attempt to differentiate all possible visibly identifiable facial movements that are anatomically situated (6). FACS offers anatomically defined nomenclature for facial movement research, that facilitates its diverse application in a variety of fields including comparison of facial repertoires across species. FACS consists of a system of "action units" (AU) which comprise the actions of individual or groups of muscles. The AUs are identified by a number and include the anatomical basis for each action, as well as the intensity of the movement. Table 1 is a selected and adapted version of the FACS nomenclature (6). FACS are commonly used to interpret non-verbal communication skills like facial expressions although the FACS itself includes no emotion specific descriptions. To account for subjectivity and time complexity issues, FACS has been established as a computed automated system that initially detects faces in videos, follows on by extracting specific geometrical components of the faces, and then produces temporal feature profiles of each facial movement.

Table 1: Facial Action Coding System*

Action unit (AU) number	Name of Action	Muscle(s) activated
1	Inner brow raiser	Frontalis (pars medialis)
2	Outer brow raiser	Frontalis (pars lateralis)
4	Brow Lowerer	Depressor glabellae, depressor supercilii, corrugator supercilli
5	Upper lid raiser	Levator palpebrae superioris, superior tarsal muscle
6	Cheek raiser	Orbicularis oculi (pars orbitalis)
7	Lid tightener	Orbicularis oculi (pars palpebralis)
8	Lips toward each other	Orbicularis oris
9	Nose wrinkler	Levator labii superioris alaeque nasi
10	Upper lip raiser	Levator labii superioris, caput infraorbitalis
11	Nasolabial deepener	Zygomaticus minor
12	Lip corner puller	Zygomaticus major
13	Sharp lip puller	Levator anguli oris (i.e., caninus)
14	Dimpler	Buccinnator
15	Lip corner depressor	Depressor anguli oris (i.e., triangularis)
16	Lower lip depressor	Depressor labii inferioris
17	Chin raiser	Mentalis
18	Lip pucker	Incisivii labii superioris and incisivii labii inferioris

*adapted from (5,6)

FACS has been used in a variety of settings such as to consider only emotion related expressions. Examples include using the combination of AU 6+12 to code for *"happiness*" or AU 1+4+15 to code for "*sadness"* (5,6). Importantly, FACS has also been used to distinguish between two types of smiles such as the *insincere and voluntary* smile which is contraction of the zygomatic major (AU 12) alone and the *sincere and involuntary* or "Duchenne smile" which consists of the contraction of the zygomatic major ("cheek raiser") and inferior part of the orbicularis oculi muscles (AU 6+7+1). The Duchenne marker, named after Duchenne de Boulogne who first described it in 1862, has been found to be reliably associated with felt enjoyment smiles compared with "faked" or social smiles and is considered evolutionarily significant from the fact that it is difficult to control deliberately. Ekman and colleagues estimated that less than 10% of people can contract AU 6 voluntarily, thus being able to fake a credible enjoyment smile (7,8).

3.1.2. Types of Smiles in Infants

All smiles involve the contraction of the zygomaticus major and may involve cheek raising produced by the contraction of the orbicularis oculi, pars lateralis muscles. Ekman made the classic distinction between cheek raising (Duchenne) smiles and other smiles (5,7). While infant and adult smiles may be anatomically similar, smiles with and without cheek raising appear to have different meanings. For example in adults, the distinction is often made between smiles of joy (cheek-raise smiles) that are associated with positive emotions, and other smiles without cheek raising that may serve to hide several socially negative or uncomfortable emotions (such as smirking, discomfort, embarrassment etc). During their first year of life, infants display both Duchenne and non-Duchenne smiles (7,9). Early studies attempting to distinguish between smiles in infancy found that 10 month old infants were more likely to display smiles with cheek raising when approached by mothers who were smiling, versus smiles without cheek raising when approached by strangers (10). Infants in this study also showed greater left frontal cortical activation patterns associated with positive emotions when displaying cheek raising smiles. Follow up studies however suggest that features of an interaction that produce one type of smiling (for example without cheek raising), are likely to produce another type of smiling (with cheek raising) immediately thereafter, suggesting a process of intensification of a positive emotion that may be minimally reflected initially (11,12). The most common type of cheek raising smile amongst infants involves mouth opening which is considered more likely to reflect playful sociality and is often referred to as “playful smiling” (13).

Several studies have attempted to categorize infant smiles according to positive emotional responses, with most findings supporting the understanding that early in infancy, Duchenne smiles may represent a state of heightened joy or enjoyment in infants (9,12,14). Most commonly referenced are the following infant smile codings: Simple, Duchenne, Play and Duplay (Table 2).

Table 2: Infant smiles*

Description of Smile	Anatomical association
Simple	lip corner retraction/eye constriction only
Duchenne	simple plus cheek raising
Play	simple plus jaw opening/drop
Duplay	simple plus cheek raise and jaw drop

*adapted from (14)

Infant play and Duplay smiles occur in visually similar situations as Duchenne smiles, and are considered to be reflective of a form of enjoyment related to physical touching (14). Figure 1 is an adapted pictorial representation of the four types of smile descriptions (15).

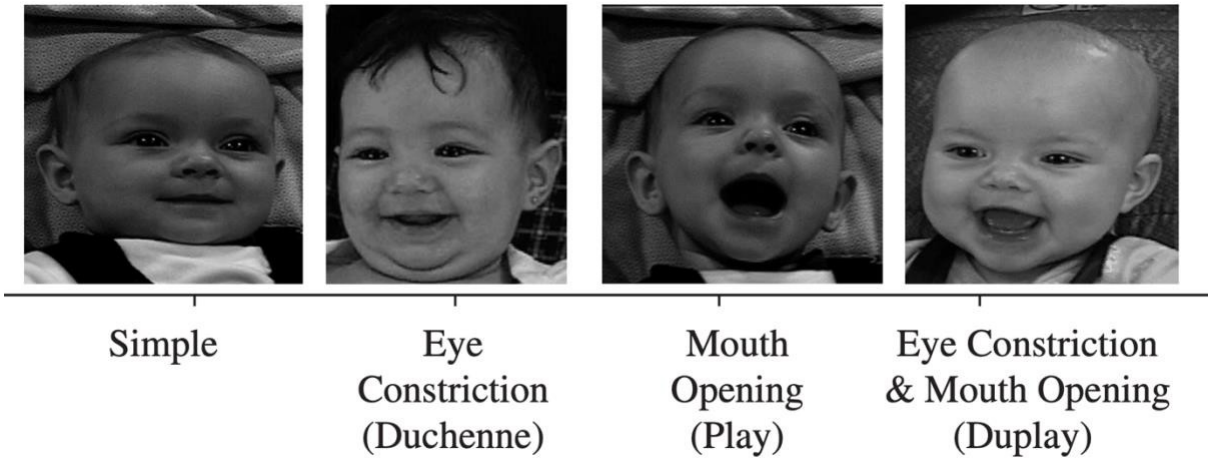

Figure 1: Pictorial representation of typical infant smile types* (15)

In a study investigating the nature of smiles specifically in common mother-infant games like peekaboo and tickle, the results showed that each type of smile has an association with the pattern of interaction or game and the direction of the infant's gaze (14,15).

Smiling alone appears to be part of a joyful process, evidenced often during interactions with caregivers who are familiar to the infant, smiling with or without cheek raising or mouth opening may occur during interactions of a positive nature. Smiles may be considered part of an infant's subjective experience of joy or happiness in the presence of ongoing interactions with caregivers. Infant smiling with cheek raising and open mouth dimensions alongside visual engagement also appear to be associated with an amplification of experiencing shared positive emotions compared with smiling alone (12,16). Qualitatively infants may experience different types of enjoyment depending on the social situation, the build-up to the interaction and the corresponding facial actions (FAC) units. However, emotional expressions and meanings are dynamic and relational within the context of the social situation with the caregiver. Periods of positive emotional contact with the parent often begin and end with smiles during continuous visual contact with the parent (17). In fact, the very pattern of embedding a smile in a gaze at the mother is considered quite characteristic of young infants in face to face interactions. While it is possible to attempt to categorize smiles and progressions of the smiles, it is important to consider that true emotional meaning of smile early in infancy is difficult to quantify or generalize.

3.2. The Gaze

Human infants from birth have the capacity to orient preferentially towards face stimuli. Specifically cues for attention or social gaze are not only provided by the eyes, but also the direction of the head, the orientation of body, and whether or not eyes are clearly visible or obscured (18). When all cues are considered in a hierarchy of importance, the human primate eyes are thought to provide more important cues especially for social nuances (18). In fact, human primates, as opposed to other primates, are often distinguished by the complex ability to perform facial expressions using sophisticated

combinations of facial muscles along with eye movements (19,20). The morphology of the body, face and eyes alongside the environmental context determines the ability of humans to use gaze in a communicative capacity (18).

New-borns instinctively engage by making gaze contact but with often neutral expressions (21). Infants may also reflexively smile without there being an intention of emotional communication. This however begins to change around 2 months when there is an emotional regulatory response to a smile with a gaze contact – believed to be an evolutionary response to a reward and reciprocal social behavioural exchange between parent and infant (21,22). Human eyes are considered unique in their morphology in that they have a widely exposed white sclera surrounding an iris of a darker/denser colour. This helps to discern the focus of the other person's gaze during face to face interactions (20,23). Infants rely on specific expressions of facial cues such as gaze contact and direction to infer intention and meaning. In prominence of all cues, direct gaze is considered the most salient to convey communicative intent and usually results in mutual eye contact (24,25). Gaze also serves to reinforce individual social responses for the infant like smiling and vocalisations and sends out social signals about the interaction. When infants are interacting with someone they often mirror the other person's movements and mannerisms, even though they may not be aware of it (23). This mirroring system enables a simple form of sharing, and forms part of the function of social cognition that allows a shared world in which one can interact (20,23). This act of mimicry or mirroring is bidirectional, where mothers typically may complement what the infant is expressing and the infant then will typically look at the mothers' face to couple its own expressive behaviours with the mothers (22,26).

New-born infants show preference for faces offering direct gaze over faces with averted gaze suggesting that they are looking for a prototypical eye contact stimulus (20,24) by displaying a tendency to and seeking an opportunity to engage in a mutual eye contact. Mutual gaze (eye contact) helps establish the non-verbal communicative link between two people (23). In infant social communication, the role of infant gaze has been studied especially in the context of eye contact between mothers and infants from as young as 6 weeks old. Eye contact is believed to have a critically significant impact on the response of the mother to the infant as they experience the sense of increased responsiveness from the infant (27). When infants start to follow gaze at around 3 months of age, their visual acuity is not well developed but they are able to perceive contrast at low frequencies (28). There are naturally variations to be expected in visual attention in the first year of life, however these are important markers that have also interestingly been associated with later cognitive development (28,29).

Direct gaze is an unambiguous stimulus with evolutionary significance, and neural responses are relatively automatic. This may involve a range of neural substrates that follow a developmental course, for example a fast developing pathway for early reflexive gaze following and then a slower time dependent pathway with cognitive maturity that allows for gaze comprehension (30). This following of gaze early in infancy appears to be contingent on specific signals such as mutual gaze or infant directed speech that are sensitive to the context in which the infant and adult engage. This context may include emotional expressions that can potentiate the gaze following and serve as an

initiator of social engagement (30). A response to a gaze cue is considered ubiquitous in neurotypical human behaviour, and a failure to respond or react to social gaze cues can sometimes be associated with disrupted social and linguistic development (28,31). Infants who have sight impairments may still experience mirroring or develop language related networks, however they often have delays in social behaviours (32). This is an important consideration in infants who have no sight impairment but who demonstrate an absence of gaze thereby impairing an critical developmental cue. The reasons may not always be that of dysfunctional social behaviours, but may require consideration of other contributors such as motivation, fear, infant withdrawal or problems with attention (31–33).

While it is difficult to pin point exact neural and cortical structural contributors to social gaze responses in an unnatural laboratory setting, there are some common anatomical and physiologically attributed brain regions involved in infant gaze development, and perception. The main anatomical regions that contribute to the neurobiology of gaze processing includes the Anterior Superior temporal sulcus though to be essential for recognizing the eyes and head as stimuli, and the amygdala which is essential for attaching socio-emotional significance to the stimuli (18).

Adults and infants can also show neural wave coupling during social interactions that work together to strengthen connectivity at a neural level. The dyadic synchronization further fuels communicative efforts by the infant as a result of the contingent social exchanges that are reinforced at a neural level (34). In fact the ability to discriminate between facial expressions occurs remarkably early in life, with this often thought to support the idea that there is biological preparation for discrimination of faces as early as the first 2 months. There is evidence to suggest that neural architecture for processing emotions and detecting visually different stimuli in expressions emerges early in infancy (35,36). In EEG studies, increased relative Alpha wave power in the left-frontal regions of the brain is frequently associated with the experience of joy or interest, which are positive emotions (35). Neuro-imaging studies suggest that 4 month old infants interpret eye contact as an “intention to communicate” by demonstrating that neural structures that respond to communicative signals, similar to those in adults, are activated by direct gaze (20). Mutual gaze activates cortical brain regions similar to those activated in adults namely right posterior superior temporal cortex and right fronto-polar cortex. The same neural responses are produced by two different facial signals which are eye-brow raise and direct gaze (20,34). Simply put, direct mutual gaze activates the same pre-frontal areas in infant brains as those activated in adult brains when responding to social communication.

3.3. The Social Smile in different contexts

Early occurrences of face to face communication between the infant and its mother are observed usually within the first two months of life, as a result of what is referred to as “primary intersubjectivity” (26). This is represented by tuning processes of emotional conditions (coordinated and non-coordinated) that can be observed between infants and their caregivers engaging in mutually attentive interactions that are maintained by alternations in their gaze, body and facial movements. Emotional expressions

become increasingly complex but also better coordinated usually after the 2nd month of life. This developing ability to combine different behavioural actions into specific communicative meanings evolves over time and represents the infants' expanding interactive abilities (9). The ability to coordinate expressive behaviours such as facial expressions and vocalizations, is fundamental to the evolution of social and emotional communication. Specifically, gazing at a parent is thought to provide a social stage for the infant to produce affective displays. Smiles help organize emotional exchanges, enhancing social communication and thereby providing the parent with the sense that they are in touch with and connecting well with their baby (37).

Early emotion regulation and the early development of intentional communication also depends on the ability to coordinate smiles, gestures and shared experiences. For example, at 3 months infants often initiate and end their smiles within gazes at their parent's faces, whereas 6 month and older infants tend to display a more mature pattern of emotional regulation by gazing first at a mothers' face to establish social contact, and then delivering the smile's emotional message. Older infants are considered to be more strategic in directing attention after shared positive emotional expressions with parents (17,38) and this ability to coordinate smiles and gazes in a shared experience indicates the increasing precision with which infants learn to communicate their positive affect. Mendes and Seidl-De-Moura (9) reported that infants' gazes at their parents are more coordinated with smiles than frowns with increasing age of the infant. Infants are more likely to smile while gazing at the mother and are likely to use smiles to actively initiate communication regardless of the mother smiling in return (13).

Researchers in the field of smiles suggest that infant smiles are intrinsically and essentially pro-social and may reflect positive emotional processes. While infants may experience joy in non-social situations, they only express smiles in social situations and are thought to be part of an infant's subjective experience of happiness (13,14,38). The social emotional development of young infants is influenced broadly by multiple factors that may include maternal, infant and environmental factors. In studies focusing on positive smiles, and reciprocal gaze contact, the following factors are considered to impact including dyadic attachment, temperamental styles of the infant, genetic variations and other physical and neuro-atypical factors (17,31,36). Important neurological contributors to the development of the social smile include the presence of sensory impairments (such as cortical visual or hearing impairments), impairments in facial affect recognition including Autism spectrum disorders and other developmental disorders such as Rett's Syndrome (36).

While much of the research to date has aimed to understand the origins and meanings of infant smiles and its role in mother infant relationships, very limited exploration of these factors have been conducted in relation to different cultural settings outside of American or European contexts. When considering socio-cultural meanings and developmental impacts, it is necessary to investigate infant smiles and meanings in diverse and non-WEIRD (Western, Educated, Industrialised, Rich, Democratic) settings (39). This is especially true with recent studies on Adult smiles suggesting that culturally different or diverse adults for example those of Gabonese or Chinese origin, may not utilize the Duchenne smile to demonstrate happiness (8) or that in certain cultural contexts, smiling may not be associated with pro-social behaviours (40).

There are limited equivalent research studies specifically examining the social-cultural context of infant smiles in diverse settings. This is important in our understanding of what is considered culturally appropriate or critical interactions between infants and caregivers that will influence socializing strategies, regulation of emotions or the effects on infant development. The emergence of social smiling provides an opportunity to test assumptions and explore the development of social smiling in different cultural contexts. Early studies in Chinese and Japanese infants showed cultural differences in measures of smiling and crying when compared with European American infants, questioning how infant affect and expressions are understood outside of the "western standardized" laboratory settings (41). Small sample studies in Latin America have also attempted to describe and document the diversity of infant's smiling in mother infant interactional contexts, the increasing frequency of certain types of smiles and contingent associated maternal responses to the infant smiles (9,42). In an early study of two infant-mother pairs in a lower socio-economic setting in Rio de Janiero, it was reported that smiling develops gradually within a specific environment of reciprocal affective exchanges between the dyad and that this social-emotional communication is dynamic as the infant grows (42). Expanding on this study to a larger sample of sixty infant-mother pairs, the results verified a significant association between mothers' behaviours to convey affection and an increased frequency of infant smiles, in the first 6 months of development, emphasizing the critical impact of early interactions (9) in high risk settings. Another study of 6 week old infants from two different cultural communities in Germany and Cameroon demonstrated important contextual differences. When the infants were 6 weeks old, both sets of mother-infant dyads smiled at each other for short amounts of time without much imitation between the dyads. However when infants were re-examined at 12 weeks of age, the German mother- infant dyads smiled and imitated each other more often than the Cameroonian mother-infant dyads (43).

The latter study was important in demonstrating additionally that Western (German) mothers in this setting perceived smiling as joyful occasions, which led to the mother reciprocally smiling in response, while the Cameroonian mothers did not interpret their infant smiles as being particularly in need of a mirrored response (43). The authors noted importantly that this did not imply that mothers in this particular African context were less sensitive, but that it rather reflected a different style of parenting strategy where this particular Nso-Cameroonian culture attached more importance to proximal parenting (like body contact or stimulation) than to dialogic communication like infant smiling. In fact, a later follow on study of Nso-Cameroonian dyads compared with Italian rural dyads and West African immigrants in Italy reported that mutual regulation in early infancy occurs via many different, culture- specific pathways that may be substantially different from the western pattern of one dimensional face-to-face communication (44).

Regarding South African mother-infant social interactions, Richter reported that South African mothers were vocally expressive and actively responsive to their infants' communicative behaviours matching an almost complete correspondence with Western dyads (45). This review also highlights that there does exist certain universal similarities in the early infancy especially in terms of social communication, to suggest infants are similar across dimensions like gestural, vocal and gaze patterns, sensitivity to the human face and voice and quality of preferential responses to caregivers.

3.4. The Shared Pleasure Paradigm

During social play, the smile often features during the sharing of pleasure. In the first few weeks of life, the smile is used in response to stimulation, while at an older age, it becomes a critical part of the infants' experience within the dyadic interaction (37). What mostly appears to promote a functional positive mutual exchange is thought to be the smile, which will enable a successful transition to eventual joint attention. Mothers selectively respond to specific socio-emotional cues including vocalizations or smiles, with what is known as "positive marking" which is highlighting and mirroring certain infant expressions like smiles and eyebrow raising (22) that is thought to support the development of social skills. Specifically, the infants' smile itself can serve as an activator to the mother's dopamine reward brain regions (46). Work in sharing positive emotion regulation, including positive affect between mothers and their infants support the understanding that mutual and reciprocal responsivity is a significant contributor not only to early socialization and self-regulation for the infant, but also influences maternal reward related experiences (44,47,48).

Positive emotions expressed in the context of an infant engagement are not only enjoyable to witness, but play an instrumental role in early brain development (49). Sharing of emotional states within synchronous interactions is thought to be highly rewarding and beneficial for the infant in fostering healthy psychological development (50,51). Infants and their parents regulate their interactions socially by responding within a moment-to-moment affective and behavioural display, and if this functions well, over time it will support positive developmental outcomes (52). A study by Santamaria et al (2020) using dual electroencephalography (EEG) to measure both inter and intra brain network connectivity between infants and mothers, found a strong effect of emotional valence on the neural network (35). Infants showed strengthened integration of their neuronal processes during positive maternal demonstrations of emotions compared to negative emotions
(35). Further brain metrics in this study also indicated that mother to infant directional influences were stronger during positively expressed emotional states, suggesting that the infant parent brain network is attuned by the emotional quality and tone of the dyadic interactions.

It is hypothesized that the "*sharing of a smile together with direct eye contact*" between a mother and an infant is a marker of high intensity positive affect (53,54). Direct gaze has also been shown to strengthen bidirectional adult-infant neural connectivity during communication (34) supporting the view that a shared smile with a simultaneous direct eye contact may have an independent role in early infant social interactions. Using dual-electroencephalography, this study specifically provided evidence that infants may up-regulate neural synchronization when offered a direct gaze as opposed to gaze aversion by adults. This brings dyadic neural activity into alignment which in turn facilitates communication (34).

Shared Pleasure (SP) in parent-infant interaction is defined as "the parent and the child sharing positive affects in synchrony" (55, 56). This is measured in facial expression as a curving of the mouth to smile or laugh, with gaze contact, and with a simultaneous or synchronized beginning and ending. SP is measured by observation of video recordings of mother-infant interactions in feeding or free play which is defined as unstructured, voluntary and spontaneous free play (56).

One of the first research projects to use the SP paradigm was the Emotion Regulation and Mental Development (EMORE) project in 2011 in Finland, that aimed to look at timing aspects and importance of parental emotion regulation with regard to child development (53). This study looked at the occurrence of SP in the first 2 years of infant life and explored its association with maternal depression and subsequent child mental health outcomes at ages 2 and 8 years of age. Previously recorded mother-infant interaction materials from 1989 to 2005 that were collected in Finland were reanalysed to explore SP (54–56). The samples included recorded materials from the following studies:

a) The European Early Promotion Project of 58 mothers with 2 month old infants (54).
b) The Finnish sample of the European Early Promotion Project of 137 mothers with their 2 month old infants (54).
c) A longitudinal population based study on post-natal depression and breastfeeding using 29 Finnish mothers and 2-3 month old infants (56).
d) Mothers recruited from the Population Register Center in Tampere, Finland consisting of 48 mothers but with older (7 month) infants (53).

SP situations of interactions varied from free play situations to settings where infants were being fed. The study reported that SP was more frequently present in free play situations and that the duration of the SP moments were longer in younger infants (2-3 months) regardless of the type of interaction. SP number and length was associated with the infants' later socio-emotional wellbeing. Maternal depression did not appear to affect SP occurrence, although the SP presence appeared to be protective for the child in the presence of paternal mental health problems.

The Finnish study of 48 mothers and their healthy 7-month-old infants that were included from the database of the Population Register Center in Tampere assessed SP in a free play situation (56). The frequency of SP in this non-clinical sample was 67% with the median length of sequences being 1.0 seconds. The number of SP moments was not correlated with maternal depressive symptoms, however the mean length of SP was negatively correlated with depressive symptoms. When maternal sensitivity, structuring and infant responsiveness were measured as markers of emotional availability, they correlated positively with the number and proportion of SP moments experienced by the dyads. This study concluded that there are more likely to be moments of shared pleasure in mothers and infants with good interactional skills, and the ability of parents to maintain an SP moment appeared to be affected by depressive symptoms.

A smaller sub-study of a larger study looking at social cognition in infants in Tampere, Finland, examined 13 mother-infant dyads to determine whether shared pleasure between the pair was dependent on the infant's temperament or the mother's level of depression (57). This study reported a correlation between the duration of shared pleasure and the mother's perception of her child's positive affective but there was no effect of risk of maternal depression as measured by the Edinburgh Post Natal Depression Scale and the quantity or duration of SP. Infants in this study however that were more introverted and

reserved shared less moments of shared pleasure with their mothers. Although this was a relatively small sample study, the finding of reduced shared pleasure was considered important, as infants receiving less positive interaction and less sensitivity from mothers were particularly considered at risk for later developmental problems (57).

Another Finnish study on SP looked at 58 pairs of mothers and infants in face to face interactions at 2 months and examined the association between SP and the infants' emotional and behavioural outcomes at 2 years (58). The study also explored the relationship between SP and other infant factors like health problems, and temperament, as well as maternal factors like parenting stress, maternal mental health and whether SP was protective in the presence of parental psychopathology. Interestingly in this study, the duration of SP moments was important rather than the occurrence or frequency of SP. Here, a longer mean duration (MD) of SP was related to fewer behavioural problems 2 years later. The SP mean duration (i.e. a shorter mean duration) also significantly contributed to socio-emotional responses, such as internalizing problems after adjusting for maternal interactive behaviours, infant and maternal factors. Parenting stress and mother's perinatal depression and anxiety were not significantly related to SP-MD. This study concluded that SP was an important feature that fosters positive psychological development and may moderate the risk of parental psychopathology. It is important to note however that mothers with severe mental illness were excluded from this study.

In 2019, Puura and colleagues investigated the maternal factors (including depressive symptoms, the effects of recent life events, maternal emotional availability) and infant characteristics (social withdrawal, temperament, interactive behaviors, genotype and gender) which contribute to the experience of Shared Pleasure (59). The participants consisted of 113 volunteers (non-clinical) mother infant dyads in Finland who completed mental health questionnaires, and were videotaped between 5 and 10 minutes in unstructured undirected free play situations. The infants in this study however were older – at an average age of 7 months. Videos were rated for SP, infant withdrawal and maternal sensitivity and structuring. Infants were genotyped for four genes known to be involved in emotion regulation. The study reported a high occurrence of SP moments (71%). Shared Pleasure and the experience of mutual positive affect was most likely in those dyads that were best able to read and respond reciprocally to each other's positive cues. SP occurrence was associated with higher maternal sensitivity and improved infant responsiveness, as well as the infant having the GG Variant of the gene TPH2-307 which has been linked to a lower risk for depression. Lower depressive symptoms in mothers, better maternal structuring and greater infant involvement was also associated with a longer duration of SP. There was no association with infant gender and the occurrence of mean duration of SP, and the number of SP moments was slightly lower in this older sample (7 month old) of infants compared to a previous study from this lab with a sample of 2-3 month old infants. From this study there is some support for the hypothesis of SP being a possible marker of adequate parent–infant interaction, albeit in a community, non-clinical European sample.

In summary, Shared Pleasure rating as a paradigm has a research base total of 385 mother infant pairs, across 4 different studies based in Finland. The largest single rating has been on a sample

of 137 mother infant dyads (54). All studies used a free play situation where mothers were asked to play with their infant as they usually would at home, to try to simulate a situation as close to a natural play interaction as possible. Infants were between the ages of 2 to 7 months. SP was rated from video recordings between 5 and 10 minutes in duration, with the first 5 minutes of all recordings utilized as the preferred time point. The first 5min are considered adequate for the assessment of positive interactional styles where interrater reliability is good (60). No studies on the SP have applied them to a clinical sample of mothers with severe mental illnesses.

To date studies exploring the use of Shared pleasure have only been conducted in Europe, specifically in Finland, which as part of the Nordic region, is considered one of the best and most supported regions in which to have a baby (61). It stands to reason that in a country where parental leave, economic support, infant physical and emotional support are considered to be of legislative importance, there would be an environment that lends itself to a high occurrence of joyful, pleasurable and positive engagement between infants and their mothers, even in the face of mental health stressors. It is of interest that an observational marker of positive engagement holds a possibility for a marker of adequate dyadic interactions. In a setting like South Africa, with high rates of perinatal depression, socio-economic adversity, poverty and malnutrition that places infants at high risk of poorer developmental outcomes (62–64), there is need for an exploration of ways to screen for concerns in everyday dyadic interactions. While many tools exist to assess infant interactions in the clinical setting, there are fewer opportunities to perform the assessments in these settings (65). The field of infant mental health interventions focusses largely on enhancing positive relational experiences. The importance of allowing mothers the possibility of noticing and engaging in positive interactions cannot be under-estimated (66,67). The Shared pleasure paradigm offers a promising opportunity for screening for positive engagement in a South African context, both in a community setting and in mothers with mental health disorders.

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CHAPTER 4

SHARED PLEASURE IN EARLY MOTHER–INFANT INTERACTIONS: A STUDY IN A HIGH-RISK SOUTH AFRICAN SAMPLE

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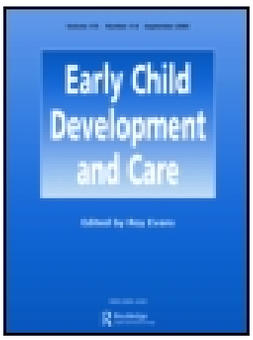

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Shared Pleasure in early mother–infant interactions: a study in a high-risk South African sample

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ABSTRACT

Infant mental health is strongly connected to an infant's relationship with a responsive, warm, and available caregiver. However, maternal mental illness reduces a mother's ability to detect and respond to changes in her infant's expressions and communication, which may have important consequences for infant attachment and emotion regulation. The Shared Pleasure (SP) paradigm in parent–infant interactions is defined as 'the parent and the child sharing positive affect in synchrony' and is considered to be a possible screening marker for early identification of at-risk dyads. A paucity of data exists for the application of SP as a measurable paradigm in developing countries. This study aimed to evaluate the SP paradigm using women attending a tertiary psychiatric maternal mental health clinic in Cape Town, South Africa. A sample of mothers ($N = 78$) and young infants (2–6 months old) were assessed for SP moments using video recordings of the dyad in free play. SP moments occurred in only 20.5% of the sample. SP moments were more frequent in younger babies (under 3 months of age). There were significantly more SP moments in dyads where mothers had no mental illnesses ($p = 0.021$) or were married ($p = 0.016$). Black African mothers also experienced significantly more SP moments with their babies ($p = 0.033$) than their Caucasian or Mixed-ancestry counterparts. This study explored the application of the 'SP paradigm' on women with and without mental illness who attended a maternal mental health clinic. Tracking SP moments in a larger sample of culturally diverse, at-risk and, mentally-ill population of mothers and their infants offers the possibility of a simple language- and culture-free measure to identify at-risk dyads.

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Introduction

Infant mental health is strongly connected to the quality of caregiving relationships, especially to the mutual adaptation of the infant and caregiver (Mäntymaa et al., 2008). For infants and young children, having a relationship with a responsive, warm, and available caregiver is likely one of the most important factors for positive outcomes (Feldman, 2007; Gerhardt, 2004; Trevarthen & Aitken, 2001).

The primary goals for the infant during the first postnatal year are the creation of an attachment bond of emotional communication with the primary caregiver and the development of self-regulation (Schore, 2005). The infant, however, has a limited ability to regulate its own emotional as well as physical needs after birth, and a caregiving adult is responsible for what is called mutual

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regulation (Stern, 1985). When a caregiver is sufficiently sensitive and available emotionally, the infant learns to control their own behaviours and emotions, which in turn may facilitate further social development (Braungart-Rieker, Garwood, Powers, & Wang, 2001; Feldman et al., 2009).

Infants develop their ability to experience, express, and regulate positive affective states from the parent–infant interaction, creating the basis for the infants' own emotion regulation (Manian & Bornstein, 2009; Schore, 2001). Emotion regulation is crucial to mental health and wellness (Cole & Deater-Deckard, 2009) and may serve as one of the mechanisms through which attachment security affects later socio-emotional outcomes (Braungart et al., 2001). Empathic care promotes secure attachment in infancy and, by extension, good developmental outcomes in childhood (Bowlby, 1969; Schore, 2001).

An infant's skills for interaction include initiation and maintenance of eye contact, the ability to vocalize and use facial expressions, and head and body movements to engage the caregiver in mutual interaction (Trevarthen & Aitken, 2001). During episodes of mutual gaze, the mother and infant engage in spontaneous facial, vocal, and gestural communications. Such highly arousing, face-to-face interactions allow the infant to be exposed to high levels of social and cognitive information (Schore, 2005). The capacity of the infant to experience increasing levels of positive arousal states is reciprocally regulated by the mother and depends on her capacity to engage in an interactive communication of emotions (Feldman, 2007). Sharing positive affects in the parent–infant interaction may serve as a foundation for the development of infant self-regulation by fuelling early socialization and organization of the infants' experiences (Feldman, 2003, 2007). Synchronized shared positive affects in the mother–infant interaction increases the infant's relatedness and, by extension, the development of self-regulation (Feldman, 2007; Feldman, Greenbaum, & Yirmiya, 1999). To regulate the high positive arousal, the dyad synchronizes the intensity of their affective behaviour within split seconds. These episodes of 'affect synchrony' occur in the first expression of social play and generate increasing levels of joy and excitement (Feldman et al., 1999; Schore, 2005).

Paradigms that focus on positive emotions, including joy, happiness and affection (Watson & Tellegen, 1985) are often considered critical markers of a person's well-being. How a mother's positive emotional state contributes to positive child development in the face of psychosocial adversity or mental illness has garnered greater interest in recent years (Mäntymaa et al., 2015; Puura et al., in press). From birth, infants are able to engage in face-to-face interactions and, at around 2 months of age, the neutral infant gaze gradually progresses towards positive emotional expressions with gaze contact (Lavelli & Fogel, 2005). In particular, this face-to-face interaction may elicit a positive effect on both infants and their mothers. For the mother, the infants' smile may serve as a powerful activator of her dopaminergic reward-related brain regions (Strathearn, Li, Fonagy, & Montague, 2008).

Puura et al. (2005, in press) hypothesized that the sharing of a smile or laugh with simultaneous direct gaze contact between a mother and her infant represents a marker of high-intensity positive affectivity and named this paradigm 'Shared Pleasure (SP)' (Mäntymaa et al., 2015; Puura et al., 2005, in press). SP moments in parent–infant interaction is defined as 'the parent and the child sharing positive affect in synchrony' (Puura et al., 2002). This is expressed in facial expressions such as a laugh, or curving of mouth to smile, together with a direct gaze contact, and a simultaneous or synchronized beginning and ending. The phenomenon of SP was originally studied in early mother–infant interactions utilizing videos of dyads engaging in free play. Results demonstrated that SP buffered the influence of parental psychopathology on child development and was considered an important feature for fostering positive psychological development (Mäntymaa et al., 2015).

SP is considered a marker of more regulated emotions and serves as a possible screening marker for early identification of at-risk dyads (Mäntymaa et al., 2015; Puura et al., 2002). Most compelling is the potential that a shared positive affect between mother and infant may correlate with attachment security, and may be highly malleable in the first 12 months of life (Mäntymaa et al., 2015).

Maternal mental illnesses reduce the mother's ability to detect and respond to changes in expressions and communication by the infant, which places at risk various aspects of mothering, including attachment and emotion regulation (Walker et al., 2007). Challenges with emotion

regulation are the cornerstone of nearly all psychiatric illnesses and may be associated with behavioural problems in young infants (Suveg, Morelen, Brewer, & Thomassin, 2010). Psychiatric illness in the mother or caregiving adult may potentiate these challenges. In a systematic review, Fisher et al. (2012) reported that maternal mental disorders are approximately three times more prevalent in low and middle-income countries (LMICs). In an LMIC like South Africa, mental and reproductive health makes a substantial contribution to the burden of disease in terms of disability, injury and interpersonal violence (Norman et al., 2007). In developing world settings, high rates of maternal mental illnesses, coupled with adverse social conditions, compromise the capacity of caregivers to provide consistent empathic care (Tomlinson, Cooper, & Murray, 2005).

The practice of parenting and the development of attachment patterns naturally vary between the cultural communities that influence child rearing. Learning from developed countries, certain aspects of parenting are consistently related to the cognitive and social-emotional competence in infants (Goodman et al., 2011; Walker et al., 2007). Given the context of ongoing exposure to psychosocial stressors and trauma in their daily lives, practitioners working with parents need an observational measure of parent–infant interaction that would be simple to apply and appropriate in diverse ethnic groups while considering contextual risk exposures. The SP paradigm holds promise as a screening observational marker for at-risk dyads, with a potential for early identification and intervention. In an ethnically and psychosocially diverse population in South Africa, the need for a reliable but simple observational tool is great. Many of the current tools to measure attachment security and sensitive caregiving have either not been validated in this population, or found to not be culturally sensitive in this diverse population. A paradigm that is not dependent on language or culture, but relies on the observation of natural non-verbal facial expression and gaze contact may be appropriate in this context.

While SP moments as a measurable paradigm have been studied in Europe, a paucity of data exists for developing countries. Given the higher number of adverse life events experienced in developing countries (Fisher et al., 2012) and the higher prevalence of maternal mental health problems in LMICs (Rahman, Surkan, Cayetano, Rwagatare, & Dickson, 2013), the South African population will provide valuable data in terms of cross-cultural generalizability of SP moments. The ease of applicability and the data generated in this study will help build the foundation for the exploration of early screening tools for infant emotional regulation in a previously unexplored South African population of mothers and their at-risk babies. This study, therefore, explored the application of the SP paradigm on women with and without mental illness who attended a tertiary psychiatric maternal mental health clinic in Cape Town.

Materials and methods

Study design

This study forms part of a larger ongoing prospective observational study, The Maternal and Infant Mental Health (MIMH) study, based at Stikland Psychiatric Hospital (Bellville, Western Cape, South Africa). The MIMH study aims to investigate the impact of maternal mental illness and infant measures of social cognitive deficits and oto-acoustic characteristics on mother–child interaction and attachment. The MIMH study recruits participants from a state-based maternal mental health clinic at Stikland Hospital and a private-funded Well Baby follow-up clinic in Bellville, South Africa. The data for this sub-study originated from Stikland Hospital. The main procedures applicable to the current study are briefly outlined below.

Sample

We included all mothers with and without psychiatric diagnoses, measured by the MINI interview (Sheehan et al., 1998) and diagnosed according to the *Diagnostic and Statistical Manual of Mental Disorders* IV criteria (DSM-IV; American Psychiatric Association, 2000), with infants who participated in the

MIMH study between 1 April 2013 and 31 December 2016. The sample included 78 dyads who were Caucasian, Mixed-ancestry (Coloured) and Black African (Xhosa), which is in keeping with the population demographics of the study catchment area.

Data collection

Data were collected when mothers and infants presented at the aforementioned clinics for mental health care follow-up, or for immunization and physical examination of their baby. As part of the MIMH study, mothers and their infants were scheduled to attend a visit when the baby was between 6 and 12 weeks old and again at 6 months. Demographics and general information about the mothers' health, baby's health, and pregnancy and/or birth pregnancy complications were recorded. Rating scales, including the Maternal-to-Infant Bonding Scale (MIBS) (Taylor, Atkins, Kumar, Adams, & Glover, 2005), the Maternal Postnatal Attachment Scale (MPAS) (Condon, Corkindale, & Boyce, 2008), the Edinburgh Postnatal Depression Scale (EPDS) (Cox, Holden, & Sagovsky, 1987), and the Recent Life Events Questionnaire (RLEQ) (Brugha, Bebbington, Tennant, & Hurry, 1985) were recorded individually as part of the parent study.

An interactional video is recorded of the mother communicating with the baby as well as engaging in free play during both visits. Babies range between the ages of 6 weeks to 6 months. For the interactional video, mothers participated in a 10 minute, video-taped free-play session with their infants. Free-play was defined as unrestricted, undirected and unstructured play between mother and infant. The mothers were instructed to play with their infant in the same manner as they usually would. No further instructions were given to the mothers about the use of toys or of how to interact with the infant.

Measuring SP

We assessed SP moments from a single recorded segment (first 5 minutes) of the dyadic free-play video recordings of mothers and infants. The first five minutes are considered sufficient for the assessment of positive interactional styles where interrater reliability is good (Kemppinen et al., 2005). SP moments between mother and baby were measured by a single rater (AL) by observing video recordings at full speed. The measurement for SP has three components: the occurrence of an SP moment, the total number of SP moments, and the duration of an SP moment. All possible sequences of SP, from the synchronized dyadic curving of the mouth to a smile together with a direct gaze contact, were tagged if they had a simultaneous beginning and end. The tagged parts of the video recordings were then reviewed at half speed, and the beginnings and endings of SP sequences registered second by second. This process was repeated to ensure that all possible SP moments were tagged. To reduce bias, the rater was blinded to the psychiatric history of the mother.

The first author (AL) received training and achieved reliability in rating SP moments in Finland under the tutelage of the last author (KP). For initial reliability, training videos from a French cohort ($n = 11$) were coded by AL and reviewed by KP, and then case videos were rated independently by both raters and statistically compared for inter-rater reliability. To assess interrater reliability for this study, eight videos (10%) were randomly selected using the random number generator in Excel and were rated by two independent coders (AL and KP). The kappa values for the SP variables used in the analysis, i.e. the occurrence of SP sequences and the mean duration of SP (<0.5 or >0.5 seconds), were 1.00 and 0.78, respectively. The respective rates of interrater agreement were 100% and 87.5%. These rates may be regarded as strong (Healey, 2012; Altman, 1999). Furthermore, none of the SP variables showed a statistically significant difference between the raters, thus showing excellent reliability.

Statistical analysis

All data were entered in a Microsoft Excel spreadsheet, and analyses were conducted using SAS statistical software (version 9.4, Cary, NC). The demographic and clinical characteristics were summarized using frequencies and percentages. From the recorded SP moment information, a binary outcome (yes/no) was coded to indicate whether or not the infant–mother experienced any SP moments, i.e. the occurrence of an SP moment. The next two components of SP moments were recorded: (1) how many SP moments were experienced by the infant–mother pair (frequency) and (2) the duration (in seconds) of each SP moment. Regression analysis was used to assess the possible association between the occurrence of an SP moment and demographic and clinical characteristics of the mothers. A generalized linear mixed model was used with a binomial distribution, and a log link was used to model the probability of an occurrence of an SP moment. Univariate unadjusted prevalence (% and 95% CIs) and relative risk (PR prevalence ratios) for the various covariates, entered as categorical variables, were reported. The multiple regression model included all the univariate significant risk factors to assess the independent risk factors for SP moments. The statistical significance level for the *F* tests was 5%.

Ethical considerations

The study was approved by the Health Research Ethics Committee (HREC) of Stellenbosch University (Ref #: S12/04/111A). Study approval was also obtained from the Western Cape Provincial Department of Health for studies conducted at Stikland Hospital. Participation was voluntary, and all mothers provided written informed consent. As the children were under 12 months, consent was gained from the parent. Participation or non-participation in the study had no effect on the standard care offered to mothers and their infants. All data were anonymized using a study number to code for each mother–infant dyad.

Results

Demographic and clinical characteristics of mothers ($N = 78$) who participated in this study are summarized in Table 1. The mean maternal age ± standard deviation (SD) was 30.9 ± 6.4 years. Most (72.0%) mothers were aged between 17 and 34 years and 28.0% were aged between 35 and 45 years. The mean baby age ± SD was 66.2 ± 29.2 days (median = 59.5 days), which is approximately

Table 1. Demographic and clinical characteristics of mothers at their first visit ($n = 78$).

Variable	Frequency, *n* (%)
Age	
17–34 years	56 (72)
35–45 years	22 (28)
Race	
Caucasian/Mixed race	40 (51)
Black/African	38 (49)
Family income	
<R10,000 p.m.	64 (82)
≥R10,000 p.m.	14 (18)
Employment status	
Employed	5 (6)
Unemployed/on maternity leave	73 (94)
Marital status	
Married	35 (45)
Separated, divorced, single, other	43 (55)
Mental health status	
With mental illness	42 (54)
Without mental illness	36 (46)

2 months and 6 days on average. The youngest baby was 27 days old and the oldest was 192 days. Out of a sample of 78 babies, 64 were under 3 months and 14 were over 3 months.

In terms of ethnicity, 51.0% of the mothers were Caucasian or Mixed-race, while 49.0% were Black/African. The majority of the sample was unemployed (94.0%), and most of the participants (82.0%) earned less than R10,000 (700 USD) per month. More than half the participants (55.0%) were either divorced, single or separated from their life partner, while 45% were married. Half (54.0%) of the participants had a diagnosed psychiatric illness, the most common being psychosis or schizophrenia spectrum disorder (33.3%), major depressive disorder (33.3%), and bipolar disorder (21.4%).

For the 78 dyad pairs assessed, SP moments occurred in only 20.5% ($n = 16$). Further analysis of SP moments (Table 2) demonstrated that a single SP moment lasted at least 0.5 seconds in 24.0% of the SP positive sample, with the longest duration of an SP moment lasting 2 seconds (27.0%). The majority of SP moments (46.0%) lasted at least 1 second.

Of the 64 babies (that were younger than 3 months), 22.0% ($n = 14$) and 14.0% ($n = 2$) of the 64 babies were older than 3 months had an SP moment. The length of the video sequences did not appear to account for the absence of SP moments. SP moments were not observed even when extended (greater than 5 minutes in duration) video sequences were evaluated.

For mothers who experienced SP moments, 21.4% ($n = 12$) were between the ages of 17 and 34 years, while 18.2% ($n = 4$) were older than 35 years. The numbers for the individual ethnic groups were Caucasian $n = 6$, Mixed-race $n = 34$, Blacks $n = 36$ and African $n = 2$ (Table 3). Similar ethnic groups were combined for analysis due to small numbers. An SP moment was significantly more likely to occur in Black/African mothers (31.6%; $p = 0.033$) compared to Mixed/Caucasian race mothers (10%), as well as in mothers who were married (34.3%; $p = 0.016$) compared to unmarried mothers (9.3%) (Table 3). The chance of an SP moment was three times more likely in the Black/African group compared to the Mixed-race/Caucasian group. Mothers without mental illness also had significantly more SP moments (33.3%, $p = 0.021$) than mothers with mental illness (9.5%). More mothers that did not have SP moments acknowledged current use of substances (22.0%) compared to mothers with SP moments (17.9%), but this difference was not significant ($p = 0.668$).

The multiple regression model included the significant covariates from the univariate model, race, marital status and psychiatric illness. The results show that not being married was the only variable that was significantly associated with the occurrence of SP moments (34% of married and 9% of unmarried women having SP moments; $p = 0.027$). Married women are 3.7 times more likely to have an SP moment with their babies compared to unmarried women. The multiple regression model is probably underpowered to detect other significant associations due to the small sample size.

Discussion

In infant research, direct observation of behaviours is thought to provide more sensitive and accurate data than questionnaires and interviews (Aspland & Gardner, 2003). Most observation methods, however, were developed in Western developed countries with little room for application in ethnically diverse populations. South African mothers and their experiences cannot be homogenized or

Table 2. Frequency and duration of SP moments.

Duration of SP moment	Frequency, *n* (%)							
	SP Moment 1	SP Moment 2	SP Moment 3	SP Moment 4	SP Moment 5	SP Moment 6	SP Moment 7	SP Moment 1–7
0.5 seconds	3 (19)	3 (33)	1 (17)	0 (0)	1 (50)	0 (0)	1 (100)	9 (24)
1 second	8 (50)	4 (44)	3 (50)	2 (100)	0 (0)	0 (0)	0 (0)	17 (46)
2 seconds	5 (31)	1 (11)	2 (33)	0 (0)	1 (50)	1 (100)	0 (0)	10 (27)
3 seconds	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
4 seconds	0 (0)	1 (11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (3)
Total	16 (100)	9 (100)	6 (100)	2 (100%)	2 (100%)	1 (100)	1 (100)	37 (100)

Table 3. The number (*n* and %) of women with an occurrence of an SP moment for the various categories of the demographic and clinical characteristics at the first visit ($n = 78$)[a].

Variable	Total ($N = 78$)	*n*	%	*p*-Value
Age				
17–34 years	56	12	21.4	
35–45 years	22	4	18.2	0.753
Race				
Caucasian, $n = 6$/Mixed race, $n = 34$	40	4	10	
Black, $n = 36$/African, $n = 2$	38	12	31.6	0.033*
Family income				
<R10,000	64	14	21.9	
>R10,000	14	2	14.3	0.542
Marital status				
Married	35	12	34.3	
Separated, divorced, single, other	43	4	9.3	0.016*
Education level[b]				
Primary (Grades 1–7)	6	0	0	–
Secondary (Grades 8–12)	64	15	23.4	
Other (technical or tertiary)	8	1	12.5	
Employment status				
Employed	5	1	20	
Unemployed/on maternity leave	73	15	20.6	0.977
Current maternal substance abuse				
Yes	28	5	17.9	0.668
No	50	11	22	
Mental health status				
With mental illness	42	4	9.5	0.021*
Without mental illness	36	12	33.3	

Note: The % in Table 3 indicates the number and % of mothers with an SP moment (occurrence) and the *p*-value indicate if the occurrence is different for the 2 ethnic groups.
[a]A positive response of experiencing an SP moment was modelled as the outcome.
[b]Sample size does not meet assumptions for statistical analyses.
*Significant at a *p*-value of <0.05.

generalized if we recognize the historical, social and political influences on racial and linguistic groups. In this study, the SP paradigm was applied to video-recorded observation of mothers and their infants and was measured according to the strict SP paradigm descriptions (Puura et al., 2002). This is the first application of the SP paradigm in an ethnically diverse sample outside of a Eurocentric clinical setting.

Puura et al. (2002) demonstrated that mothers and infants with good interactional skills had more moments of SP. In a Finnish sample of 2-month-old infants and their mothers, SP moments occurred in 80.0% of dyads (Latva et al., 2013) with the median SP sequence length of 1.0 second. In older infants (7 months old) in the same population, the occurrence of SP was 67.0%. The number and proportion of SP moments in this Finnish normal population were positively correlated with higher infant involvement with the parent, infant responsiveness and greater maternal sensitivity as measured by the Emotional Availability Scale (Biringen, Robinson, & Emde, 2000).

Contrary to expectations, very few SP moments (20.5%) were observed in the South African sample, even within interactions between infants and their mentally well mothers. More than two decades following democracy, ordinary South Africans continue to be at risk of multiple socio-economic adversities such as poverty, intimate partner violence, mental illness, substance use and malnutrition (Tomlinson et al., 2014) with infants from poorer communities being at risk of lifelong socio-emotional and developmental vulnerability. Infants in this situation may be especially vulnerable to harsh or distant parenting under the strain of marked socio-economic hardship (compounded by exposure to violence and substance misuse) that has been linked with lower maternal sensitivity and lower infant engagement with mothers (Cooper et al., 2002). We speculate that this may in part explain the unexpectedly low occurrence of SP moments in the general sample.

In those dyads who did share SP moments, 46.0% of the SP sequences lasted at least 1 second, similar to international studies (Latva et al., 2013; Mäntymaa et al., 2015). The presence of more SP

moments in infants under the age of 3 months is also in keeping with the Finnish experience of more SP moments in younger infants (Latva et al., 2013). This coincides developmentally with the first bio-behavioural shift between ages 2 and 3 months that is characterized by the onset of the social smile.

It is suggested that parental mental illness may profoundly affect the parent's ability to reciprocate emotion and regulate their infants (Schore, 2001; Suveg, Shaffer, Morelen, & Thomassin, 2011). Our sample did demonstrate low initial frequencies (20.5%) of SP moments in the total sample. However, when the sample is stratified for psychiatric illness, mothers without mental illnesses experienced significantly more SP moments (33.3%) than mothers with mental illness (9.5%; $p = 0.021$). Maternal mental illness reduces the mother's ability to detect and respond to changes in expressions and communication by the infant (Feldman, Magori-Cohen, Galili, Singer, & Louzoun, 2011). The current study supports research conducted by Mäntymaa et al. (2015) who hypothesized that the presence of maternal mental illness would limit the capacity for the mother and infant to experience SP moments.

Significantly more married women experienced an SP moment with their babies than single/unmarried women ($p = 0.027$), with the regression model showing that married women are 3.7 times more likely to have an SP moment. There are many theories to suggest that women who are married are likely to be more emotionally and socio-economically supported than their unmarried counterparts. A review by Hetherington and Stanley-Hagan (1999) reported that the consequence of single parenthood (particularly following the separation of parents) is often financial hardship and lower socio-economic status. This, in turn, exacerbates mother's emotional distress that impairs or has an adverse effect on parenting for single mothers. The underlying predictor of positive maternal attitudes, with regard to interactive behaviours in infants under the age of 4 months, was found to be significantly associated with intimate support and quality of marital relationships (Crnic, Greenberg, Ragozin, Robinson, & Basham, 1983). A Canadian study (Muhammad & Gagnon, 2010) reported that motherhood did not affect perceived stress among married or cohabitating women. However, this previous study also demonstrated that single and divorced mothers endured the highest levels of stress and this, in turn, appeared to affect perceived parental efficacy. These studies, albeit international, suggest that maternal perceived efficacy and stress levels influence maternal capacities to sensitively and positively interact with babies, and this could support the finding that SP moments were more commonly experienced amongst the married participants in our local study.

Education and financial status and, by inference, socio-economic status may influence parenting (Cooper et al., 2002; Tomlinson et al., 2005), and this additional stress influences the mother's ability to respond sensitively to and interpret interactional cues. However, in the current study, there was no statistically significant relationship between education level or financial status and SP moments.

Black/African mothers in our sample experienced significantly more SP moments with their infants compared with mothers of other race groups. Culture influences a mothers' behaviour toward her infant, and different ethnic groups may emphasize different dimensions of interactions with their children. It is important to consider South Africa's history when considering how cultural influences impact on motherhood in different communities, and that it may be problematic to extrapolate that all mothers belonging to a particular cultural community have the same experience, especially in contemporary South Africa. Research that addresses the experiences of mothers and their interactions with their babies living in the South African context is limited. Magwaza (2003) suggested that the social and cultural contexts in which Black mothers live shape their perspectives and behaviours related to sensitive mothering. In a doctoral thesis by Dale (2013) that explored the narrative understanding of urban Black South African mothers, participants spoke about enacting 'good mothering' through meeting the needs of their babies by providing for them 'emotionally' rather than physically. The sentiment was to offer their babies a good example of mothering, despite the adverse environmental and social challenges, and this translated into providing babies with optimal mothering experiences. One could speculate that the Black mothers in our sample may also have had similar intentions and that providing joyous and pleasurable experiences between themselves and their infants may be seen as an example of providing positive role modelling. However, we acknowledge

that the experience of motherhood is multifaceted and complex, and this sample is too limited to make further inferences. Ethnic and cultural differences within this sample may explain the difference between race and SP moments, and future studies involving a larger cohort with further explore this hypothesis.

Limitations of this study include the small sample size of mother–baby pairs. In addition, the small number of observed SP moments limited the statistical analyses that could be formed in this preliminary investigation. Furthermore, the small sample size means the multiple regression model may be underpowered to detect significant associations.

Conclusions

This study used a language- and culture-free paradigm 'the SP moment' of synchronized direct eye gaze contact and simultaneous smile between mothers and their infants to assess reciprocal positive interaction in a group of mothers attending a maternal mental health clinic in Cape Town. While results demonstrated a low overall occurrence of SP moments in both groups of mothers (that is, mothers with and without mental illnesses), there were significant associations between SP and race group, marital status and the presence of mental illness. Tracking SP moments in a broader sample of a culturally diverse, at-risk and mentally-ill population of mothers and their infants could be simple and easily identifiable observable measure to identify at-risk dyads. The benefit of this measure is that it does not rely on education or a sophisticated understanding of infant responses on the part of the mother. The role of the infant's positive affectivity could influence the capacity for SP in its interaction with the mother (Varpula, 2014); however, as our study did not assess the infant's withdrawal or inhibition at baseline, correlations between the presence of SP and the level of positive affectivity in the infant was not determined.

The findings in this study were preliminary and would need to be further confirmed and correlated with sociodemographic variables. This study will serve as the foundation for a more comprehensive exploration of SP moments as a screening tool in a local population. The follow-up study will assess correlations with infant developmental outcomes and more robust measures of maternal sensitivity and reciprocity.

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CHAPTER 5

MATERNAL SHARED PLEASURE, INFANT WITHDRAWAL, AND DEVELOPMENTAL OUTCOMES IN A HIGH RISK SETTING IN SOUTH AFRICA

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Maternal Shared Pleasure, Infant Withdrawal, and Developmental Outcomes in a High Risk Setting in South Africa

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Background: Infants in lower middle income countries are often exposed to early adversities which may lead to suboptimal caregiving environments and place them at risk of not achieving their developmental potential. Synchrony and positive engagement in the mother-infant relationship plays a critical role in buffering the impact of early adversity. Shared Pleasure (SP) is considered a marker of high intensity positive interaction and may hold a promise of improving developmental outcomes.

Methods: This study was part of a prospective observational study of mothers with and without mental illness in South Africa. Dyadic videos were assessed for SP and infant withdrawal (using the Alarm Distress Baby Scale) at 6 months. Infant developmental outcomes were assessed using the Bayley's Scales for Infant and Toddler Development, third edition at 18 months.

Results: Ninety-one dyads were assessed for SP. The occurrence of SP was low (20%). There was no significant association with an EPDS measure of maternal depression ($p = 0.571$) and SP moments. Infant withdrawal was high (72%) and associated with male infant gender ($p = 0.025$). There was a significant association between the occurrence of SP and a lower score of infant withdrawal (estimate $= -1.29$; SE $= 0.4$; $p = 0.0002$). The number of SP moments at 6 months was significantly associated with motor (estimate $= 2.4$; SE $= 0.9$; $p = 0.007$) and marginally significant with cognitive scores (estimate $= 1.9$; SE $= 1.0$; $p = 0.052$) at 18 months. Regression modelling differential outcomes showed a greater improvement in cognitive scores at 18 months in infants with an SP moment compared to those without an SP moment [SP average difference (AD) $= 7.4$ (2.4), no SP AD $= 10.4$ (1.2); $p = 0.012$]. Infants without an SP moment experienced a larger decrease in motor scores at 18 months compared to those with an SP moment [SP AD $= -3$ (3.0); no SP AD $= -10.6$ (1.5), $p = 0.027$].

Conclusion: While the occurrence of SP in this sample was low and the rates of infant withdrawal were high, there were promising results suggesting early positive SP interactions may contribute to improvements in subsequent developmental outcomes.

Keywords: shared pleasure, infant withdrawal, positive interactions, mother infant interaction, infant development, synchrony

BACKGROUND

The 2016 Lancet Global Health report estimated that in lower middle-income countries (LMICs), up to 250 million children under the age of 5 risk falling short of their full developmental potential due to early exposure to adversities (1). Sub-Saharan Africa recorded the highest prevalence (66%) of children at risk of not reaching their developmental potential (1). The effects of maternal mental health and poverty are especially influential early in life when positive experiences are more likely to contribute to the development of synaptic connexions important for development, and negative experiences can shift a child off the optimal developmental trajectory.

Environmental adversity, particularly caregiver mental illness and toxic stress, may contribute to the disruption of normal developmental processes (2, 3). Infants born in such circumstances are considered as high risk and susceptible to psychosocial and physical developmental challenges (4). Multiple interacting domains such as health, nutrition, responsive caregiving, and early stimulation are needed to promote not only physical growth but also to enhance social and emotional development in infancy (3, 5). Responsive caregiving in this context refers to the ability of the caregiver to make eye contact with, to model and encourage interaction while responding appropriately to the infant, and is considered a foundational component of the nurturing care that infants require in order to thrive.

Environmental Risk and Depression/Outcomes

Infants from poorer communities are especially vulnerable to maternal mental illnesses as they are often subject to sub optimal caregiving environments that are strained under social adversity, substance use, and high rates of depression (6, 7). Tomlinson et al. (8) reported maternal depression rates as high as 35% in Khayelitsha, a lower socio-economic community in Cape Town, South Africa. In this setting, maternal mental illness and substance abuse have been linked to lower infant engagement with their mothers (6) and by inference, a poorer experience of responsive caregiving (9). Infants of depressed mothers have also demonstrated significantly lower cognitive and social emotional competence and compromised growth parameters (10–12). It is important however to note that depression in the mother does not necessarily mean that the infant interaction will definitely be impaired, as this interaction also depends on individual infant characteristics and can often be buffered by environmental support from a secondary or alternate caregiver (13). The parent-infant relationship itself plays a critical role in buffering the impact of early adversity on long term stress responses and developmental trajectories (14). Evidence relating to the regulation of stress hormones in young children suggests that the presence of a supportive adult caregiver strongly regulates and in effect buffers the stress response (15, 16).

Parent/Infant Interaction

From as early as 2 months of age, infants demonstrate skills that support engagement and interaction with their caregivers as part of a social interaction (17, 18). Amongst these biologically determined skills, the ability to initiate and maintain eye contact and the use of facial expressions to engage the caregiver, serves as part of early social communication. Synchrony, which is described as the face to face mechanism mothers use for building and maintaining positive affect with their infants within the early mother-infant relationship, supports the optimal development of infants (19, 20). In particular, face-to-face interactions may elicit a positive effect on both the infant and the mother (21). During episodes of mutual gaze, the mother and infant may engage in spontaneous facial, vocal, and gestural communications. Such highly arousing, face-to-face interactions allows the infant to be exposed to high levels of social and cognitive information (19, 22). Direct gaze strengthens bi-directional adult-infant neural connectivity during this communication (23) and is associated with higher autonomic arousal that may indicate a stronger intensity of the shared interactional experience (24). Maternal behavioural interactions are also associated with the amount of expressed positive emotions (19, 25).

Field et al. (26) reported that depressed mother-infant dyads expressed less positive emotions and spent more time in negative behavioural states. A meta-analysis by Goodman et al. (27) also found an association with negative child affectivity and maternal depression. Puura et al. (28, 29) hypothesised that the simultaneous sharing of a smile with direct gaze contact between mother and infant was a marker of high intensity positive affectivity and named this paradigm Shared Pleasure (SP). SP has since been shown to correlate with attachment security (28) and is considered highly malleable in the first 12 months of life (30), which holds promise for dyads where the positive interaction is less than optimal. SP has also been applied in a culturally diverse sample in South Africa where SP was experienced more frequently in married mothers ($p = 0.016$) and significantly more Black African mothers ($p = 0.033$) (31). That study also found a significant relationship between the presence of SP moments and the absence of mental illness in the mothers ($p = 0.021$).

Infant Withdrawal

Social behaviour during infancy refers to the degree and style of responsiveness to social stimuli (32). Infant withdrawal is

part of the infant's normal regulatory capacity (33) that serves to transiently regulate the flow of stimulation when the infant is tired or over stimulated after a positive encounter (34). It is normal for infants to display brief social withdrawal behaviour like closing their eyes or turning away, which helps them to regulate (33, 35). Even very short episodes of non-responsiveness on the part of the caregiver, may initiate withdrawal or protest reactions from a normally developing infant (36). Social withdrawal, indicated by a lack of either positive or negative behaviours, is an alarm signal of infant distress regardless of the cause (37) and may alert the clinician to the possibility that the infant is not displaying age-appropriate emotional or social behaviour (32). Sustained or persistent withdrawal behaviours are not normal and infants may make less eye contact, smile or vocalise less during interactions which may be an early warning of lack of synchronicity with their parents (37, 38). Increased social withdrawal behaviour is associated with both biological risk factors (such as preterm deliveries) and environmental stressors including maternal psychiatric disorders (such as depression and anxiety) (19, 37). Studies of the relationship between infant withdrawal behaviours and maternal depression have been mixed. Mäntymaa et al. (39) reported infant withdrawal in a low risk sample where the parents' perceived mental health was associated with infant social withdrawal, while other studies did not find an association with current depressed maternal mood and withdrawn infant behaviours (32, 35). There are however higher distributions of infant withdrawal in higher risk samples of infants with sleeping, eating or crying difficulties, or problems within the parent-infant relationship (38, 40). Sustained social withdrawal may also be associated with serious developmental, physical and emotional disorders in infants (41, 42). In an Australian study by Milne et al. (43), significant negative correlations were found between infant social withdrawal and Cognitive and Language scales on the Bayley Scales of Infant and Toddler Development. Higher scores of social withdrawal behaviour were also found to be associated with delays in reaching language and motor milestones in infants in a longitudinal French birth cohort (44). These studies provide some support for the association of infant withdrawal and later infant development.

The relationship between positive maternal infant engagement and its impact on infant withdrawal and developmental outcomes has not received much attention in LMIC settings. In environments of high psychosocial adversity, there is room for the exploration of and promotion of positive maternal infant interactions if they hold potential to influence better infant outcomes.

The current study aimed to assess the association between early SP moments, withdrawn infant behaviour, and its relationship to later infant neurodevelopmental outcomes in a high risk sample of South African mothers and their infants.

MATERIALS AND METHODS

Study Design

This study formed part of a larger prospective observational study, The Maternal and Infant Mental Health (MIMH) study, based at Stikland Psychiatric Hospital (Bellville, Western Cape, South Africa). The MIMH study aims to investigate the impact of maternal mental illness and infant measures of social cognitive deficits and oto-acoustic characteristics on mother–child interactions and attachment. The parent MIMH study recruited mothers with and without current mental illnesses attending a state and private clinic. Potential participants were recruited for participation from the maternal mental health clinic at the hospital and were screened first by the research team for capacity to provide informed consent before participation. The current study used the data collected from the state clinic between 2014 and 2019. Depending on the quality of the videos, and the presence of infant developmental data, 91 mother infant pairs out of a possible 117 were suitable for assessment of infant and maternal interactions. Babies were videotaped and assessed at their 6-month visit. At the time of the video recordings of SP moments, the dyads had not received any therapeutic intervention together. Mothers with mental illnesses were known to mental health services and received mental health care, but babies were only seen prior to participation in the developmental assessments. Any babies identified as being at risk or of concern, were referred to the psychologist or the local clinic for further intervention.

The Inclusion of Race

The referral to Racially classifying terms in this study has been used as defined in the Employment Equity Act No.55 of 1998 (45). These terms were used to provide context to the background of the historically marginalised participants and is not meant to infer any sociocultural constructs in general about these population groups.

Tools

Shared Pleasure (SP)

SP was defined as the parent and the child sharing positive affects in synchrony (46). This had to be expressed in a facial expression as the curving of the mouth into a smile or laugh with gaze contact and a simultaneous or synchronised beginning and ending. SP moments were assessed from the first 5 min of a single recorded segment of the dyadic free-play video recordings of mothers and infants. Mothers were asked to play with their infants in an unstructured, undirected unrestricted free play situation as part of the Maternal and infant mental health study. Mothers were encouraged to play spontaneously with no restrictions or directions pre-empted. The first 5 min are considered sufficient for the assessment of positive interactional styles where interrater reliability is good (47). SP moments between mother and baby were measured by a single rater (AL) with the rater blinded to the psychiatric history of the mother. The measurement for SP consisted of three components: the occurrence of an SP moment, the total number of SP moments, and the duration of an SP moment. To assess interrater reliability for this study, 10% of the videos were randomly selected using the random number generator in Excel and were rated independently by two coders (AL and KP). The kappa values for the SP variables used in the analysis, i.e., the occurrence of SP sequences and the mean duration of SP (<0.5 or >0.5 s), were 1.00 and 0.78,

respectively. The respective rates of interrater agreement were 100 and 87.5% which may be regarded as strong (48). None of the SP variables showed a statistically significant difference between the raters, thus showing excellent reliability.

Infant Withdrawal Behaviour

Infant social withdrawal was assessed using the Alarm Distress Baby Scale (ADBB) (41). This clinical instrument is aimed at evaluating social behaviours that can be easily observed during a brief observation of children 2–24 months of age. The ADBB Scale that measures sustained infant withdrawal has been used in several high income countries (20, 44), in addition to the local South African context (49, 50). The behaviours are organised into eight items: (1) Facial Expression, (2) Eye Contact, (3) General Level of Activity, (4) Self-Stimulating Gestures, (5) Vocalisations, (6) Response to stimulation, (7) Relationship, and (8) Attraction. Each item is rated on a scale from 0 (*no unusual behaviour*) to 4 (*severe unusual behaviour*). Guedeney and Fermanian (41) used a cut-off threshold score of 5 and reported a sensitivity of 0.82, a specificity of 0.78, and construct validity measures varying from 0.63 to 0.67. Similar results have been reported from several studies using the ADBB in different cultures, including South African cohorts (50, 51). A threshold cut-off of $\geq$5 was used as it has shown optimal sensitivity and specificity to detect infants at risk. The PI was trained by the last author (KP) and achieved reliability in the ADBB in Finland. Videotaping each assessment allowed for review of the ADBB scoring by two local accredited scorers (AL and a trained research assistant) who reviewed 10% of the more difficult assessments to achieve consensus.

Infant Development

Infant development was assessed using the Bayley Scales of Infant and Toddler Development, Third Edition (BSID-III) (52), a gold-standard observational measure of development for children from 0 to 42 months. It has been validated in a South African population and found to be culturally appropriate without modifications (53), although the tool has been found to slightly underestimate the developmental delay in this population (54). The tool measures development by direct observation across five subscales: cognition, language (receptive and expressive), and motor (fine and gross). These scales were measured by direct observation by a trained physiotherapist (MB) blinded to the child and family risk factors. The socio-emotional and adaptive behaviour subscales were assessed by direct observation as well as caregiver report. Quality control and monitoring processes were implemented to ensure accuracy. Age-standardised composite cognitive, motor and language scores were generated from cognitive, fine and gross motor, language, socio-emotional, and adaptive behaviour subscale scores using BSID-III normative and conversion tables, which account for gestation at delivery.

Maternal Mental Health

The Mini International Neuropsychiatric Interview (MINI version 5.0.0) (55), a brief, structured diagnostic interview for DSM-IV and ICD-10 psychiatric disorders was administered to parents as part of the MIMH study. The Edinburgh Postnatal Depression Scale (EPDS) (56) and the Recent Life Events Questionnaire (RLEQ) (57) were recorded individually as part of the parent study.

The EPDS is a 10-item self-report measure of recent depressive symptoms. Each item is scored on a frequency scale ranging from 0 to 3. A total score is then obtained by summing individual item responses with a higher score indicative of more severe depressive symptoms. A cut-off score of $\geq$12 has been used to indicate probable depression as has previously been validated in a South African cohort of women (58).

The RLEQ was derived from the List of Threatening Experiences (LTE) with the aim of devising a more practical and cost-effective tool for use in psychological, social, and psychiatric populations (57). It is a 21-item self-report scale, assessing whether a person or someone close to him/her experienced specific stressful life events (such as serious illness, injury, death, unemployment, etc.) during the past 12 months. The respondent answers whether they have had such a life event (no = 0, yes = 1), and whether the respondent thinks it is still affecting him or her (no = 0, yes = 1). The scores are summed, with a higher score indicating more stressful events and a stronger effect.

Statistical Analysis

All analyses were done using the SAS (V.9.4) statistical analysis system. Infant and maternal demographic characteristics (maternal age, marital status, education level, employment status, infant gender) and clinical characteristics of the mothers and infants (MINI Psychiatric diagnosis, EPDS, RLEQ) were described using frequencies, percentages or means and standard deviations. The occurrence of SP moments was described with frequencies (%) and the duration and number of SP moments were graphically depicted.

Bayley's subscales (cognitive, receptive and expressive language, fine and gross motor, socio-emotional, and adaptive) at 18 months were described using means and standard deviations. The number and percentage of delayed infants at 18 months were provided.

All modelling with the occurrence of SP as outcome were done using univariate log-Binomial models. Least square means for each covariate category were reported. The risk ratios (RRs with 95%CI) were reported as effect measure. All modelling with the number of SP moments were done using linear regression and the regression estimate (slope) and standard errors and *p*-values were reported.

For each subscale of the Bayleys' outcomes, the differential between subscale scores at 18 months were examined relative to the scores at 6 months (motor score at 18 months—motor score at 6 months). The average difference (95%CI) was given as a measure of effect. The average differences were compared between the SP and no SP groups (Chi-Square and *p*-values were provided). All models assumed a significance level of 0.05.

Ethical Approval

Study approval was obtained from the Health Research Ethics Committee (HREC) of Stellenbosch University (Ref #: S12/04/111A) and the Western Cape Provincial Department of Health. Participation was voluntary, and all mothers provided written informed consent. As the children were under 18

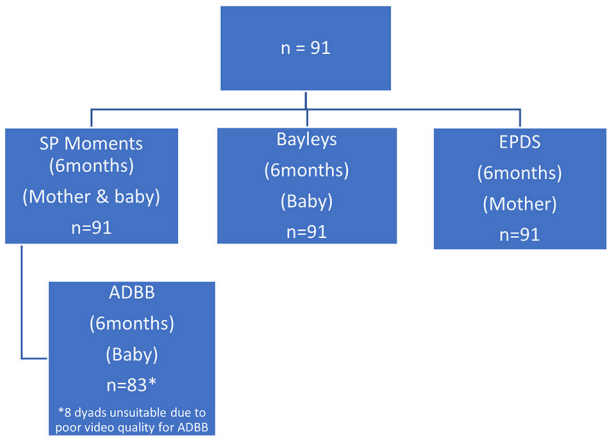

FIGURE 1 | Flow chart of Mother—Baby assessments at 6 months.

months, assent was provided by the parent. Participation or non-participation in the study had no effect on the standard care offered to mothers and their infants. Participants were screened by the research assistant, when flags were raised, or concerns were noticed they were referred to the follow up psychiatric clinic at Stikland Hospital or referred to the psychologist. All data were anonymized using a study number to code for each mother–infant dyad.

RESULTS

Out of 117 study participants, 91 (78%) dyads were eligible for inclusion and could be assessed for dyadic SP (**Figure 1**). Sixty five percent of mothers were between 17 and 33 years of age, with 35% being older than or equal to 34 years old. The mean age of the mothers was 31 years (SD 5.6). The majority of mothers (59%) in this sample were either divorced or single parents, and 90% of the mothers had completed at least a primary or secondary school level of education. Demographic and clinical characteristics of the dyads ($n = 91$) who participated in this study are summarised in **Table 1**.

The parent (MIMH) study assessed maternal clinical variables to investigate its impact on infant and relational outcomes. **Table 2** presents the maternal psychiatric diagnoses (using the MINI Psychiatric screen) from the first visit, and subsequent 6-month screens of depression (via EPDS) and recent life events (via RLEQ). At the baseline visit, five of the participants did not have a recorded measurement of psychiatric illness. Nine participants had more than one recorded psychiatric diagnosis. Thirty seven percent of the sample did not meet criteria for any psychiatric illnesses, but 41% fulfilled criteria for a major mood disorder and 15% fulfilled criteria for a major psychotic disorder. At 6 months, 73% percent of the mothers scored below the threshold (less than total score of 12) for depression using the EPDS. Using the RLEQ, mothers reported having at least 4 recent life events that had an enduring effect over the last 12 months.

TABLE 1 | Demographic* and clinical characteristics of mothers ($n = 91$) of babies at age 6 months.

Characteristics	Variable frequency, *n* (%) or mean (SD)
Maternal age (years)	Mean 31.1 (SD 5.6)
17–33	59 (65%)
≥34	32 (35%)
Ethnicity	
Caucasian/Mixed ancestry	48 (53%)
Black/African	43 (47%)
Marital status	
Married	37 (41%)
Divorced/Single	54 (59%)
Education level	
Primary/Secondary	82 (90%)
Tertiary	9 (10%)
Baby gender	
Male	49 (54%)
Female	42 (46%)

**Demographic information from mothers were from their first research visit.*

TABLE 2 | Maternal clinical variables.

Clinical parameters	Variable frequency, *n* (%) or mean (SD)
***MINI psychiatric diagnoses at 1st visit**	
No diagnoses	34 (37%)
Mood disorders	37 (41%)
Psychotic disorders	14 (15%)
Anxiety disorders	11 (12%)
Edinburgh post natal depression score at 6 months (EPDS)	Mean 8.1 (SD 6.7)
Depressed ≥ 12	25 (27%)
Sub threshold <12	66 (73%)
Recent life events questionnaire at 6 months (RLEQ)	Mean 4.5 (SD 4.3)
Number of events	Median = 4

**5 of the 91 mothers did not have psychiatric illness measurement.*

Shared Pleasure (SP) Moments

Of the 91 participants, 80% ($n = 73$) did not experience a SP moment. Amongst those who did experience a SP moment (20% $n = 18$), the maximum number of SP moments recorded in a single dyad was 7 (**Figure 2**).

A single SP moment lasted at least 0.5 s with the longest duration of an SP moment lasting 8 s (**Figure 3**). The modal (17%) duration of SP moments was 1 s.

Twenty-two percent ($n = 13$) of mothers younger than 34 years had an SP moment, while 16% ($n = 5$) of older mothers had an SP moment ($p = 0.46$).

There was no significant difference between the age groups ($p = 0.457$). Thirty percent ($n = 13$) of Black African mothers

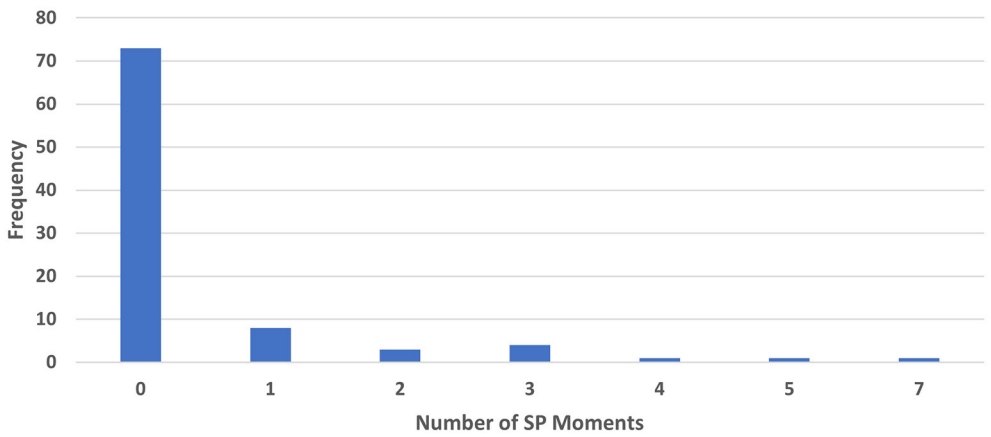

FIGURE 2 | Number of SP Moments at 6 months.

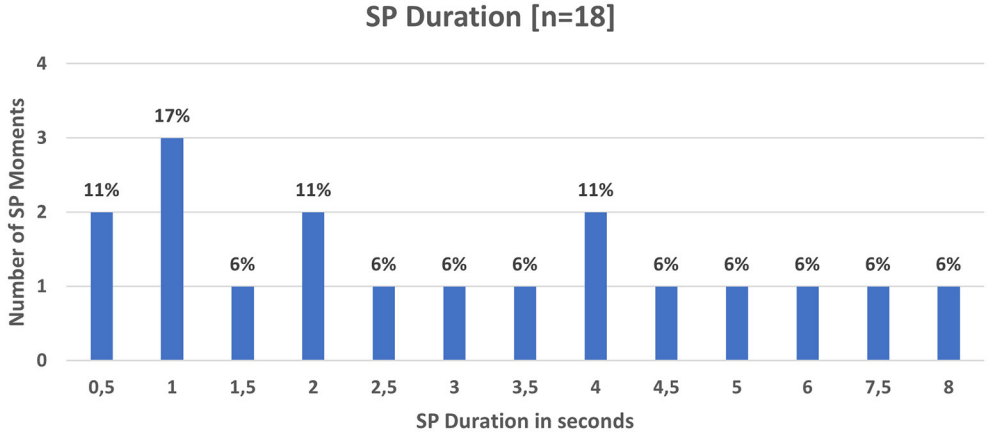

FIGURE 3 | SP moments Frequency and duration ($n = 18$).

had an SP moment, while only 10% ($n = 5$) of Caucasion/Mixed ancestry mothers experienced an SP moment. Significantly more Black African mothers had SP moments compared to Caucasion/Mixed ancestry mothers ($p = 0.017$).

Of the 34 mothers without a psychiatric diagnosis, 10 (33%) experienced SP moments. The breakdown of SP occurrences in mothers with psychiatric diagnosis are presented in **Table 3**. None of the 3 psychiatric disorder groups vs. the no psychiatric disorder group were statistically different for the percentage of SP moment occurrences ($p > 0.05$).

Looking specifically at depression in mothers, 16% of depressed mothers (EPDS score ≥12) experienced an SP moment whereas 21% of mothers who were not depressed experienced an SP moment. There was no significant relationship between having depression and experiencing an SP moment ($p = 0.571$). There was a very weak negative correlation between the EPDS total score for depression and the number of SP moments (Spearman correlation coefficient = −0,186). There was a very weak negative correlation between the number of SP moments and number of events on the RLEQ at 6 months ($r_s = -0.174$), as well as a moderate negative correlation with the number of events on the RLEQ at 18 months ($r_s = -0.404$).

TABLE 3 | Maternal psychiatric illness and SP.

Psychiatric diagnosis (MINI) at baseline	Number of mothers	Number with SP moments (%)
*No diagnosis	34	10 (33.0%)
Mood disorders	37	5 (13.5%)
Psychotic disorders	14	1 (7.1%)
Anxiety disorders	11	4 (36%)

Of the 5 mothers with no psychiatric diagnosis, 1 had a SP moment and 4 did not have an SP moment.

Alarm Distress Baby (ADBB) Scale of Infant Withdrawal at 6 Months

From the original sample of 91 participants, only 83 dyads were suitable for assessment of infant withdrawal using the Alarm Distress Baby Scale due to the quality of the early videos in the study, which did not allow for the full assessment of the ADBB categories. Twenty eight percent ($n = 23$) of dyads had an ADBB score in the normal range (score ≤5) and 72% ($n = 60$) scored in the withdrawn (score>5) category (**Table 4**).

Infant withdrawal (ADBB score > 5) was associated with infant gender. Boys had a significantly higher ADBB score (mean = 9.1; 95%CI: 7.9–10.3) compared to girls (mean = 7; 95%CI: 5.7–8.3) ($p = 0.025$). There was no correlation between the ADBB score and the total score on the EPDS (Pearsons correlation coefficient = 0.09).

SP and Infant Withdrawal

There was a significant linear association (estimate = −1.29; 95%CI: −1.97 to −0.60; $p = 0.0002$) between the number of SP moments and the ADBB score. **Figure 4** illustrates how the ADBB score decreases as the number of SP moments increase with the association suggesting that with every additional SP moment the ADBB score decreases by 1.29.

TABLE 4 | ADBB Scoring ($n = 83$).

Scoring range	*N* (%)
Normal	
(≤5)	23 (28)
Withdrawn behaviours	
> 5 <10	41 (49)
>10	19 (23)

Infant Development

Infants were assessed using the BSID-III at 6 and 18 months. While 91 infants were assessed at 6 months, only 86 continued to follow up for assessment at 18 months. Composite scores were categorised with a score of <85 indicating a "delay" which was 1 SD from the mean for the South African population (59). At 6 months the majority of infants scored in the normal range for the composite motor (98%), cognitive (96%) and language (98%), adaptive behavioural (92%) and socio-emotional (100%) subscales (**Table 5**). For those whose scores were available ($n = 86$) for follow up at 18 months, the majority of infants also scored in the normal range for all BSID-III subscales.

Shared Pleasure, Depression, and Infant Withdrawal in Relation to Infant Development

Table 6 demonstrates the relationships between the 6-month SP, ADBB and EPDS scores and the BSID-III composite subscales at 18 months.

The number of shared pleasure moments at 6 months was significantly associated with a higher motor score (est = 2.37; 95%CI: 0.67–4.06; $p = 0.006$), adaptive behaviour score (est = 2.12; 95% CI: 0.13–4.11; $p = 0.037$) and marginally significantly associated with a higher cognitive score (est = 1.86; 95%CI: −0.02 to 3.74; $p = 0.052$) at 18 months.

The ADBB score at 6 months was significantly negatively associated with the adaptive behavioural score at 18 months

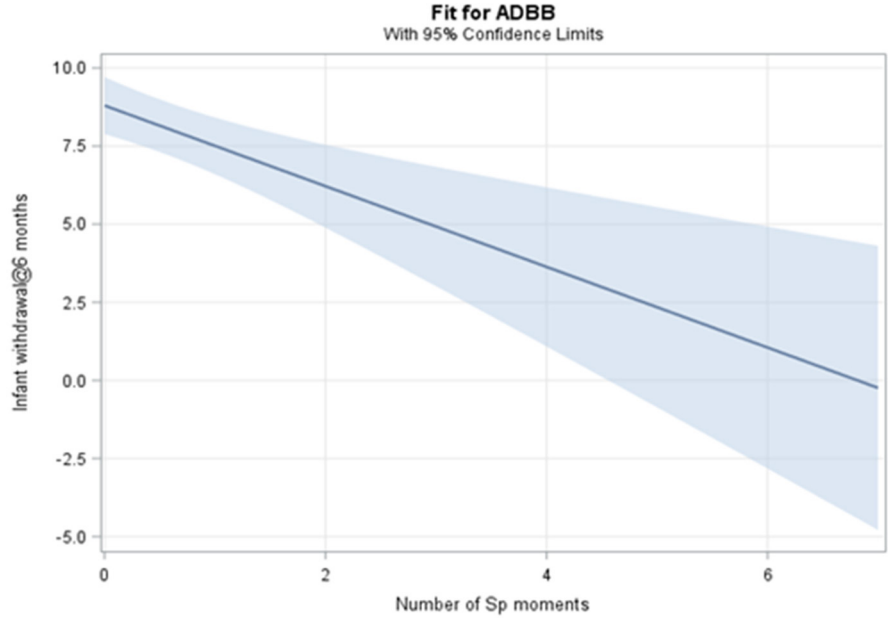

FIGURE 4 | SP moments and association with Infant Withdrawal.

(est = −0.76; 95%CI: −1.31 to −0.21; $p = 0.007$), the socio-emotional score at 18 months (est = −0.58; 95%CI: −1.03 to −0.13; $p = 0.012$), and also significantly negatively associated with the language score at 18 months on the BSID-III (est = −0.77; 95%CI: −1.23 to −0.32, $p = 0.001$).

There were no significant associations between the EPDS at 6 months and infant motor, cognitive, or language scores at 18 months. A higher EPDS score at 6 months was significantly associated with a higher adaptive behavioural score at 18 months (est = 0.398; 95% CI: 0.04–0.76; $p = 0.031$).

TABLE 5 | BSID-III Composite Developmental Scores at 6 and 18 months.

Subscales	BSID-III composite score 6 months *n*, (%) (*n* = 91)	BSID-III composite score 18 months *n*, (%) (*n* = 86)*
Motor		
No delay (≥85)	89 (98)	81 (94)
Mild/moderate (≥75)	1 (1)	1 (1)
Severe delay (<75)	1 (1)	4 (5)
Cognitive		
No delay (≥85)	87 (96)	83 (97)
Mild/moderate (≥75)	3 (3)	3 (3)
Severe delay <75	1 (1)	0
Language		
No delay (≥85)	89 (98)	83 (97)
Mild/moderate (≥75)	2 (2)	2 (2)
Severe delay (<75)	0	1 (1)
Adaptive behavioural		
No delay (≥85)	84 (92)	74 (86)
Mild/moderate (≥75)	7 (8)	10 (12)
Severe delay (<75)	0	2 (2)
Socio-emotional		
No delay (≥85)	91 (100)	86 (100)
Mild/moderate (≥75)	0	0
Severe delay (<75)	0	0

**missing frequency at 18 months due to no follow up attendance.*

Modelling Differential Outcomes

For each subscale of the BSID-III outcomes, the differential between subscale scores at 18 months were examined relative to the scores at 6 months (motor score at 18 months—motor score at 6 months).

The differences were statistically significant (>0) for the motor, cognitive and socio-emotional subscales but not for adaptive behaviour and language subscales (**Table 7**). For the socio-emotional subscale there was an increase of 5 points from 6 to 18 months, for the cognitive subscale there was an increase of almost 12 points and for the motor subscale there was a decrease of 9 points.

For the three subscales for which significant differences were observed, a logistic regression analysis tested for a mean difference between the group with SP moments and the group with no SP moments (**Table 8**). The observed statistics are summarised in **Tables 7**, **8**:

Differences in Motor Scores

A significant difference was observed in motor scores at 18 months vs. at 6 months with the mean difference being −9.1 (SD 10.50), indicating that on average the 18-month scores were worse than the 6-month scores. The logistic regression results show that the average decrease in motor scores is larger for the group without SP (10.6) compared to the group with SP (3). The likelihood ratio demonstrates that the absence of SP moments

TABLE 7 | Observed differences in BSID-III Subscale Outcome (18–6 months).

Variable	N	Mean	Std Dev	*p*
Motor difference	86	−9.1	12.96	<0.0001
Cognitive difference	86	11.7	10.50	<0.0001
Adaptive behaviour difference	86	−2.3	11.27	0.062
Language difference	86	−1.3	9.11	0.174
Socio–emotional difference	86	5.0	10.71	<0.0001

TABLE 6 | SP, EPDS, ADBB 6 months, and BSID-III Composite Scores 18 months.

	Motor 18 months			Cognitive 18 months			Language 18 months			Adaptive behaviour 18 months			Socio emotional 18 months		
	Est.	95% CI	*p*	Est.	95% CI	*p*	Est.	95% CI	*p*	Est.	95% CI	*p*	Est.	95% CI	*p*
ADBB 6 months	−0.34	−0.81 to 0.14	0.169	−0.38	−0.93 to 0.17	0,176	−0.77	−1.23 to −0.32	***0.001**	−0.76	−1.31 to −0.21	***0.007**	−0.58	−1.03 to −0.13	***0.012**
Number of shared pleasure 6 months	2.37	0.67–4.06	***0.006**	1.86	−0.02 to 3.74	**0.052**	1.65	−0.004 to 3.30	0.0506	2.12	0.13–4.11	***0.037**	1,08	−0.54 to 2.68	0,191
EPDS 6 months	0,187	−0.13 to 0.51	0.249	0.20	−0.15 to 0.55	0.258	0,256	−0.03 to 0.57	0.079	0.398	0.04–0.76	***0.31**	−0.03	−0,33 to 0.26	0.822

**Significant at a p < 0.05 are indicated in bold.*

TABLE 8 | Likelihood ratio and Least Squares results for BSID-III and SP outcomes.

BSID-III Subscale/Type 3 analyses	SP presence	Estimate (SE)	Likelihood ratio chi square	*p*-value
Motor difference	No SP	−10.6 (1.5)	4.89	0.027
	With SP	−3.0 (3.0)		
Cognitive difference	No SP	10.4 (1.2)	6.33	0.0118
	With SP	17.4 (2.4)		
Adaptive behaviour difference	No SP	5.1 (1.3)	0.02	0.8988
	With SP	4.7 (2.6)		

is 4.89 times more likely to produce a negative difference (i.e., a worse motor outcome) at 18 vs. 6 months.

Similarly, **Table 8** shows that while the average motor score is worse at 18 months regardless of the presence of SP moments, the average motor scores differentials are significantly worse ($p = 0.027$) at 18 months if SP moments are absent (−10.6) versus if they are present (−3.0).

Differences in Cognitive Scores

A significant difference was observed in cognitive scores at 18 months vs. at 6 months with the mean difference being 11.7 (SD 12.97), indicating that on average the 18-month scores were better than the 6-month scores. The likelihood ratio demonstrates that the presence of SP moments is 6.33 times more likely to produce a positive difference at 18 vs. 6 months (i.e. a better cognitive outcome).

Similarly, **Table 8** shows that while the average cognitive score is better at 18 months regardless of the presence of SP moments, the average cognitive scores differentials are significantly better ($p = 0.0118$) at 18 months if SP moments are present (17.4) vs. if they are absent (10.4).

Differences in Socio-Emotional Scores

A significant difference was observed in socio-emotional scores at 18 months vs. at 6 months with the mean difference being 5.0 (SD 10.71), indicating that on average the 18-month scores were better than the 6-month scores. The likelihood ratio demonstrates no significant difference in socio-emotional outcome linked to the presence or absence of SP moments. Similarly, **Table 8** shows no significant difference ($p = 0.898$) in the average socio-emotional score differentials at 18 months if SP moments are absent (5.1) vs. if they are present (4.7).

DISCUSSION

The present study assessed SP moments in early interactions between 91 mothers and their 6-month-old infants and its associations with infant withdrawal behaviours. The contribution of SP to later developmental outcomes at 18 months was also examined in a subset of 86 infants.

Shared Pleasure

The low occurrence of SP (20%) at 6 months was consistent in that the same low occurrence of SP was observed when infants were 2 months old (31). This is much lower when compared to studies in Europe which reported higher rates (above 60%) of SP, although these studies were conducted in community non-clinical samples (29, 60). We speculate that infants in LMIC's who are disproportionately vulnerable to socioeconomic and environmental adversities (8) are less likely to experience positive engagement with their mothers who themselves are at risk for multiple stressors. While there is no one single style of parenting that can characterise mothers as a group, life circumstances and experiences may contribute to shaping the nature and quality of the engagement (61). Maternal age did not influence the experience of SP between mothers and their infants ($p = 0.457$). Black African mothers experienced significantly more SP moments ($p = 0.017$) than their Mixed ancestry/Caucasian counterparts. This may speak to many postulated cultural factors such as a strong intergenerational transmission of positive parenting styles (62) or the social contexts in which Black mothers shape their perspectives around positive sensitive mothering (63). However, given the small sample and the diversity of community cultural constructs in South Africa, it is difficult to assume that all mothers of a particular community experience or practise similar caregiving. In addition, infants are often co-parented in this setting by more than one adult caregiver which may influence the infant's socialisation experiences. The co-ordinated co-parenting dynamic in families may fundamentally influence the young infants' early social and acculturation experience as described by McHale et al. (64).

At baseline, 41% of mothers in the parent study had been diagnosed with a mood disorder. At the 6-month baby visit, 73% of mothers did not report any symptoms of depression. The occurrence of an SP moment was not significantly associated with depressive symptoms measured by the EPDS ($p = 0.571$). This is similar to other studies of SP in Europe which did not find an association between depressive symptoms measured by the EPDS and SP (30). While there are studies that show maternal depression specifically influencing the parents' capacity to provide adequate stimulation or to respond adequately to the infant (65, 66), other factors such as infant temperament or maternal maturity can also influence the interaction. The infant itself plays an important role in this relationship (67). For example it is possible that a highly empathetic infant may persistently attempt to engage with a depressed mother by smiling and striving for eye contact. It has in fact been suggested that the infant of a depressed mother might become exceedingly sensitive to the mother's emotional state in order to read her better and to better regulate the interaction (68). The family interactional dynamics and co-ordinated parenting efforts may also influence the infant's social responses to the mother's depression. This may include learned social interactions within the family alliance such as participation and affect sharing (69).

While depression may not have been associated with lowered levels of the positive reciprocal interactions, economic stress, and

disadvantage could also be considered to exacerbate the residual effects of depression and demands on parenting by mothers feeling more physically and emotionally strained (70). In this study, mothers reported on average 4.5 (SD = 4.3) stressful life events having an enduring effect during the past 12 months. Mothers who have previously been depressed may even find engaging in positive parenting interactions more challenging, with exposures to psychosocial stressors moderating this effect (70). We noted a moderate negative correlation between having an SP moment at 6 months and the number of life events at 18 months ($r_s = -0.404$), supporting the suggestion that stressful life events themselves are associated with impaired parent infant interactions (71). This was somewhat similar to a Finnish study which found a negative correlation (−0.23) between parental stress and the presence of SP (30), although a later study by the same researchers when using the LEQ, found no significant relationship between number of life events and the presence of SP (29).

Infant Withdrawal

Given the low occurrence of positive SP interactions as a measure of synchrony and engagement between the dyad, it was expected that there would be a high occurrence of withdrawn infant behaviours in this cohort. Seventy two percent ($n = 60$) of those interactions that could be coded with the ADBB, scored in the risk of concern for infant withdrawal (i.e., an ADBB score >5). This is much higher than rates of infant withdrawal reported in high income countries (20) but in keeping with the higher reported rates in South African infants with HIV (31%) (35), infants with Foetal Alcohol Syndrome (27%) (51), and infants from a high risk community (46.7%) (49). More concerning, 23% of these infants scored in the very high risk for severe infant withdrawal (ADBB>10). This is similar to other studies in high or at risk infant populations who were exposed to environmental adversities including socioeconomic stressors and maternal mental health risks (32, 72) and who responded less interactively in engagements with their mothers. Infant withdrawal was associated with a gender difference, in that male infants had a significantly higher ADBB score (mean = 9.1) compared to female infants. This mimics similar findings by (29) and may be explained by the fact that male infants (due to sex hormones, endocrine alterations and social experiences) may experience a later differential maturation of the brain (73, 74). This may confer more vulnerability to the male infant that is exposed to stressors in the social environment and during the regulation of socio-emotional engagement the mother (68, 74). Similar to other South African studies (35, 49), there was no correlation between maternal depression and infant withdrawal in our study. However, there was a significant linear association ($p = 0.0002$) between the number of SP moments and infant withdrawal, where the ADBB score decreased by 1.29 points, with each additional SP moment. This makes sense in that the more interactive and synchronised the dyadic engagement is, the less likely it is for an infant to show features of withdrawal. This echoes findings of Puura et al. (29) who reported a lack of infant withdrawal associated with the presence SP in female infants in their study.

Infant Development

Using the BSID-III, the majority of infants in this study fell into the normal developmental range at 6 months, and this persisted for most at the 18-month follow up assessments. It is well-documented that positive features within the early mother infant relationship should be supported due to their association with better infant developmental outcomes (75, 76). In this sample, the number of SP moments experienced by infants at 6 months was significantly associated with a higher motor score ($p = 0.006$), adaptive behaviour score ($p = 0.037$) and cognitive score (0.052) at their 18-month developmental assessment. Mother-infant relationship synchrony is considered an important determinant of infant outcomes (19). The contribution of SP in this sample to later developmental outcomes support the theory that early positive emotional engagement expressed during joyful circumstances may account for better later infant development (77).

Similar to findings in other populations of withdrawn infants (43, 44), our study found significant negative associations between ADBB scores at 6 months and later language ($p = 0.001$), adaptive behavioural ($p = 0.007$) and socio-emotional ($p = 0.012$) composite scores at 18 months. Excessive social withdrawal can disrupt the ability of the infant to interact adequately and reciprocally with their caregivers, which is necessary for the normal development of effective social communication and emotional responsiveness by the infant (34, 78). Early infant withdrawal may serve as a risk indicator for later socio-emotional disorders (79), and as our study shows, this can be seen in later impaired adaptive behavioural and socio emotional developmental competencies.

While there were no significant associations between EPDS and motor, cognitive or language scales of development, an interesting result was the significant association between a high maternal EPDS depression score at 6months and higher infant adaptive behavioural composite scores at 18 months ($p = 0.031$). The lack of associations between early postpartum depression and objective assessments of motor, cognitive, and language developmental scales has been commonly described (80, 81). The adaptive behavioural domain in the BSID III however is based on information supplied by the primary caregiver rather than an objective assessment of the competency of the infant. The behaviour and perceptions of depressed mothers is heterogenous, however Weinberg and Tronick (68) reported that depressed mothers' self-evaluations are not always concordant with their behaviours and interactions with infants, and that their perceptions may in fact not always reflect how their infants are actually performing. This could possibly explain the association here, and that while mothers at risk of depression may have negative perceptions of their own parenting capabilities, they may over-estimate their infants' individual competencies as a way of compensating for their own perceived negative parenting.

Modelling Outcomes

Studies in LMICs inconsistently show associations between maternal mental health disorders and developmental outcomes (81, 82). As significant differences between the 18 -month and 6-month scores for motor, cognitive and socio-emotional scores

were noted, we were interested in whether the presence of an SP moment influenced these differences between the scores.

For motor scores, the mean difference between scores at the 2 time points was −9.1 (SD 10.50), with a larger decrease in motor scores noted for the group that did not have an SP moment. In LMICs the accumulation of risk exposures including various environmental stressors across time is likely to affect child development and result in poorer outcomes (82). In our study however, logistic regression modelling suggests that experiencing an SP moment when infants were 6 months appears to confer some protection later in motor developmental outcomes, with a worse motor outcome being more likely in infants who did not experience an early SP moment ($p = 0.027$). The potential for better infant motor developmental outcomes being influenced by positive maternal interactions has been described in other settings (83, 84). Specifically, supporting the influence of early experiences of the high maternal engagement, findings in a longitudinal birth cohort in the UK showed that children whose mothers engaged more with them from early infancy (6 months) had higher gross and fine motor skills 12 months later, particularly significantly for mothers who had lower socio-economic backgrounds (85). Similarly, while our study sample size is much smaller, our results suggest that the potential protective influence of SP (at 6 months) may manifest itself later in moderating developmental outcomes.

Assessing cognitive outcomes, overall improvements were noted across the sample, but modelling showed stronger associations for the presence of SP moments. This included a significantly larger improvement ($p = 0.018$) in the average cognitive score differentials at 18 months if SP moments were present (17.4) vs. if they were absent (10.4). This difference was 6.33 times more likely if there was an SP moment at 6 months. Children's cognitive development is influenced by several factors, including psychosocial exposures like parent-child interactions, cognitive stimulation and shared nurturing learning opportunities (86). The WHO's Nurturing Care Framework highlights the presence of bidirectional communication and enjoyable stimulating care as core to the provision of responsive care within a healthy mother–child relationship. Specifically the positive caregiver-child interaction helps to develop the social and emotional development of the infant. Shared pleasure requires a synchronous and joyful engagement which enhances the shared experience and thereby creates an opportunity for learning which may ultimately support infant cognitive development. As other studies have proposed, a significant positive quality of the mother infant relationship and parenting capacity has potential to contribute to favourable child development attachment (6, 87) and SP in this case, may likely be one of those protective contributors.

For socio-emotional scores, while there were improvements noted overall at 18 months, SP was not shown to significantly impact on the difference in scores from 6 months to 18 months.

CONCLUSION

Given the disproportionately high rates of maternal perinatal illness and environmental adversities in LMICs, it is important to explore possible opportunities that may contribute to improving outcomes in infants. This study explored associations between maternal SP interactions, infant withdrawal, and infant developmental outcomes. While the occurrence of SP in this at-risk sample was low and the rates of infant withdrawal were high, there were promising results suggesting that early positive shared pleasure interactions may contribute to improvements in subsequent developmental outcomes. Further more, the SP paradigm could serve as an observation based screening marker for health care workers in the primary care setting where high risk dyads are followed up.

LIMITATIONS

While SP, EPDS, and ADBB were associated with subscales of the BSD-III, due to the small sample size, we could not assess these as intervening variables. This will be explored in the larger sample population of this study. A further limitation include the influence of the parenting roles on the infants' developmental milestones which were not assessed. Additional parameters such as a measure of infant temperament and genetic profiles that could influence infant withdrawal and SP were beyond the scope of this study. The videos available at 18 months to assess infant outcomes were only of the infant alone during the developmental assessment and not of the mother with the infant. Hence dyadic assessments were not possible at 18 months. Additionally, the SP is most sensitive in younger infants, in that older infants (usually older than 7 months) who are able to crawl away or independently explore, are thought to have fewer/less frequent opportunities for spontaneous synchronised direct gaze contact (29). The SP was therefore not assessed at 18 months.

DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Human Subjects Research Ethics Committee, STellenbosch University, FMHS. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin.

AUTHOR CONTRIBUTIONS

AL, KP, DN, and JL contributed to conception and design of the study. EJ performed the statistical analysis. MB performed assessments and data collection. AL wrote the first draught of the manuscript. All authors contributed to manuscript revision, read, and approved the submitted version.

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The reviewer MF declared a shared committee with one of the authors KP at time of review.

CHAPTER 6

THE SHARED PLEASURE PARADIGM: A STUDY IN AN OBSERVATIONAL BIRTH COHORT IN SOUTH AFRICA

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ORIGINAL ARTICLE

The Shared Pleasure Paradigm: A study in an observational birth cohort in South Africa

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Abstract

Mother–infant dyads in low- and middle-income countries (LMICs) may be exposed to a range of factors associated with suboptimal development. Optimal infant development is likely supported by synchronicity in the early mother–infant relationship, but limited corroborative research is available in LMICs. The Drakenstein Child Health Study (DCHS) provided an opportunity to study this synchronicity and its associations in South Africa. A South African birth cohort study investigating early-life determinants of child health in a LMIC context provided participants. The Shared Pleasure (SP) paradigm helped assess early mother–infant synchronicity in videos of a sub-set of 291 mother–infant dyads at their 14-week well baby visit. General linear regression models investigated the relationship between selected maternal and infant characteristics and the presence of Shared Pleasure moments. Out of a possible 291 dyads, 82% (n = 239) yielded Shared Pleasure moments. The mean age of mothers was 27 years, while infant sex distribution comprised 54% females and 46% males. The shortest single Shared Pleasure moment lasted at least 0.5 s and the longest 28 s. Shared Pleasure moments were associated with higher gestation age at delivery ($p = 0.008$) and higher infant birth weight ($p = 0.006$), but were not related to mother's mental health and infant health outcomes at 14 weeks. The high frequency of positive Shared Pleasure moments in reciprocal dyadic interactions in this sample suggests that significant disruption in shared pleasure may be present only in extreme cases (e.g. mothers with severe mental disorders). Further work is needed to investigate the mechanisms underlying the associations between early mother–infant synchronicity and better outcomes noted here, and to assess whether SP may serve as a culturally appropriate screen for assessing connectedness.

Keywords Shared pleasure · Synchronicity · Mother–infant relationship · Infant development · Low and middle-income country 35

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Introduction

Mother–infant dyads in low- and middle-income countries (LMICs) may be exposed to a range of factors associated with suboptimal developmental outcomes. Substantial numbers of perinatal mental health disorders occur in LMICs, particularly in poorer peri-urban and rural areas (Fisher et al. 2012; Brittain et al. 2015). The early social environment fundamentally determines early child development and influences long-term child health outcomes (Maggi et al. 2010; Richter et al. 2020). Risk factors such as socio-economic stressors, poor social support and substance use, perinatal mental health disorders may impact and undermine mothers' capacity to respond optimally to infants' needs (WHO 2018). Adverse conditions like poverty inhibit parents' capacity for providing security and assuring good developmental outcomes, especially for mothers vulnerable to mental health disorders (Patel et al. 2008). Early parent–infant relationships are key contributors to the socio-emotional development of growing children (Wachs et al. 2009; Richter et al. 2017).

Synchronicity within early mother–infant relationships seemingly supports optimal infant development, but there is limited relevant research in LMICs (Leclère et al. 2014). Synchronised behaviours like mutual gaze and gaze following between mothers and infants allegedly create the foundation of early social connectedness and regulation (Brooks and Meltzoff 2013), with positive emotions shared in meaningful relationships contributing social, intellectual and psychological resources (Ramsey and Gentzler 2015). Sharing positive affect in parent–infant interactions fuels the organisation of early infant experiences of socialisation (Feldman 2007), and positive caregiver–child interactions help infants develop socially and emotionally. Demonstrations of affection convey empathy to infants, manage responses to their dependence and model regulatory behaviours, and positive emotional interactions consistently increase mothers' influence on and connectedness to their infants (Santamaria et al. 2020). The WHO's Nurturing Care Framework (2018) highlights bidirectional communication and enjoyable, stimulating care as core to the provision of responsive care within healthy mother–child relationships.

Few studies have explored mother–infant relationships and synchronicity in LMICs (Donald et al. 2019) and few tools for assessing synchronicity have been validated in LMICs (Keller et al. 2018). Most studies in this setting focused on negative infant–caregiver interactions (Murray et al. 1996; Cooper et al. 2002; Christodoulou et al. 2019) with limited work exploring "Shared Pleasure (SP)" (Lachman et al. 2021). The former studies in similar settings in South Africa, reported more negative engagements (less sensitivity, less positive affect, less talking) between depressed mothers and their children and interventions were targeted at identifying and improving these negative interactions. Shared Pleasure is ideally measured in younger infants. During the first two months of life, touch gives way to gaze as a mode of interpersonal relatedness and gaze synchrony becomes the main vehicle for social interactions. (Feldman et al. 1999; Feldman 2007). By three months of age, an infant is seen to be more communicative and socially focused. This includes the emergence of emotions like sadness and joy, as well as social smiling. Younger infants are more likely to engage in direct face interactions as compared to older infants who are able to crawl away, thus limiting spontaneous opportunities for eye contact and positive emotional expressions (Sallquist et al. 2010; Puura et al. 2019).Two months seem to be the age at which mothers smile most automatically at their infants (Puura et al. 2019).

Culture influences a mothers' behaviour towards her infant, and different communitiesmay emphasise different dimensions of interactions with their children. At the same time, it is problematic to assert that all mothers belonging to a particular cultural community behave in the same way. Parenting behaviours may be influenced by a broad range of determinants, including psychological and societal factors. At the same time, reciprocal positive SP interactions involve innate mechanisms, may overlap across different cultures, and can be measured effectively through direct observation in a range of settings.

The Drakenstein Child Health Study (DCHS), an ongoing birth cohort study in South Africa, assesses a range of maternal and infant measures (Stein et al. 2015; Zar et al. 2015). The current study aimed to explore the prevalence of shared pleasure moments in mother–infant dyads, to investigate associations of maternal and infact characteristics with the frequency and occurrence of shared pleasure. We hypothesised that greater SP would be associated with better maternal mental health and early childhood development.

Methods

Site

The Drakenstein Child Health Study (DCHS) is a population-based birth cohort study investigating early-life determinants of child health and development (Zar et al. 2015) provides details on the parent study). It is based on a peri-urban, low socio-economic neighbourhood in Paarl outside of Cape Town. Drakenstein is a stable community comprising approximately 200,000 people, and characterised by a high prevalence of health risk factors like depression, childhood trauma and poverty (Donald et al. 2019).

It is considered representative of peri-urban regions across South Africa with most residents utilising primary public healthcare clinics.

Population

Pregnant women between 20 and 28 weeks gestation were recruited from a public sector primary healthcare facility in the Drakenstein district, enrolled into the DCHS while attending routine antenatal care, and prospectively followed through childbirth and early childhood. This study included the subset of infants who were seen at the 14-week follow-up visit and had a 6-month developmental assessment.

Measures

Demographic and clinical (physical and psychological) child measures were assessed. Variables included maternal social and biological risk and protective factors (including maternal education, employment, mental illness and substance use) and an infant neurodevelopmental assessment (Bayley Scales of Infant Toddler Development—BSID-III scale). Video-recorded dyadic interactions between mothers and infants were assessed for SP. Videos with at least 5 min unobstructed interactional visuals of infant and mother were deemed acceptable. Dyads were videotaped at 14-week well baby follow-up clinic visits.

Video Recordings

At these 14-week visits, mothers were recorded interacting with their infants for 5–10 min. The video camera was positioned for a full-face view of infants and mothers in profile. A mirror adjacent to the infants' seat included infants' faces and whole bodies, as well as full-face reflections of mothers, in the frame. Mothers played freely with their infants without using toys.

SP Paradigm

SP in parent–infant interactions—defined as "the parent and the child sharing positive affects in synchrony" (Puura et al. 2002) —was analysed from the first 5 min of the recording, a time span in which interrater reliability is good (Kemppinen et al. 2005). This had to be indicated by synchronised facial expressions like the mouth curving into a smile or laugh during gaze contact. If infants were sleepy or close to feeding, a second video was attempted when they were more alert. Tapes were observed at full speed, tagging all possible sequences of SP. Tagged parts were then reviewed at half speed, registering beginnings and endings of SP sequences per second. SP moments were measured by a single rater (AL) blinded to the history of the mother. Measurement for SP comprised three components: occurrence of an SP moment, total number of SP moments, and duration of the SP moment. AL received training in reliability by KP who developed this SP analysis method. To assess interrater reliability, 10% of the videos were randomly selected using the random number generator in Excel and were rated independently by two coders (AL and KP). The kappa values for the SP variables used in the analysis, i.e. the occurrence of SP sequences and the mean duration of SP (< 0.5 or > 0.5 s), were 0.79 and 0.46, respectively. The respective rates of interrater agreement were substantial for occurrence of SP moments and moderate for mean duration of SP157 (McHugh 2012).

Child development: Bayley Scales of Infant and Toddler Development

The Bayley Scales of Infant and Toddler Development, Third Edition (BSID-III) (Bayley 2006) —a gold-standard observational measure of childhood development from 0 to 42 months —assessed child development at 24 months as part of the DCHS parent study. It has been validated and is considered culturally appropriate for South African application (Rademeyer and Jacklin 2013). It measures development by direct observation across five subscales: cognition, receptive and expressive language, and fine and gross motor development. For this study, the 24-month BSID-III composite cognitive, motor and language scores were generated using BSID-III normative and conversion tables, accounting for gestation at delivery. These scales were measured via direct observation by a trained physiotherapist blinded to the risk factors, and overseen by a paediatric neurologist (Donald et al. 2018). The original DCHS parent study analysis calculated raw and scaled scores using a normal US population, scaled to a mean of 10 and a standard deviation of 3. Poor developmental outcomes were assessed by categorising scores into 'delay' or 'no delay', defined by scoring ≤ 1 standard deviation below the mean scaled score (using a cut-off of 7). For the current study analysis, composite scores were used and categorised with a score < 85 indicating a 'delay' which was 1 SD from the mean for the South African population (le Roux et al. 2018).

Maternal measures

Several aspects of maternal mental health were assessed

The Edinburgh Postnatal Depression Rating Scale (EPDS) (Cox et al. 1987) is a 10-item self-report measure of recent depressive symptoms. Each item is scored on a frequency scaleranging from 0 to 3. The total score is obtained by

summing individual item responses. A higher score indicates stronger depressive symptoms; a cut-off score ≥ 13 indicates probabledepression. Cronbach's alpha (α) in the larger cohort of 1137 mothers = 0.79.

The WHO-endorsed Self-Reporting Questionnaire-20 (SRQ-20) (Beuenberg and Orley, 1994) measures psychological distress. Prolifically used locally and internationally, it maintains good reliability and face validity (Harpham et al. 2003) and consists of 20 items assessing non-psychotic symptoms. Individual items are summed to generate a total score. A cut-off score ≥ 8 can help sort participants into "high risk" versus "low risk" (Harpham et al. 2003). The measure demonstrated adequate reliability (α = 0.82).

The Intimate Partner Violence (IPV) Questionnaire is a 12 item inventory adapted from the WHO multi-country study (Jewkes 2002) and the Women's Health Study in Zimbabwe (Shamu et al. 2011) to assess lifetime and recent (past 12 months) exposure to emotional, physical and sexual IPV. Categories are assessed across multiple items measuring frequency and number of acts. Scoring guidelines for the DCHS categorised participants as above or below threshold depending on responses of low (once), mid (more than once) or high (many times) frequency of exposure to violence. Emotional abuse subscale: α = 0.85; physical abuse subscale: α = 0.86 & sexual abuse subscale: α = 0.83. Studies in South Africa have used the adapted IPV including in high-risk HIV-positive samples (Donald et al. 2019; Jewkes et al. 2010).

The World Mental Health Life Events Questionnaire (LEQ) is a 17-item tool which assesses exposure to stressful life events during the previous 12 months. The questionnaire used in this study is based on the items used in the South African Stress and Health Study (Myer et al. 2008). A total score is obtained by summing the total number of life events reported during this time frame; higher scores indicate greater exposure to stressful life events, with α = 0.71.

The Alcohol, Smoking and Substance Involvement Screening Test (ASSIST) (WHO Assist Working Group 2002) was developed by the WHO to detect and manage substance use among people employing primary healthcare services. It assesses substance use and substance-related risk across diverse categories of substances and is widely used in South Africa (van der Westhuizen et al. 2016). Total scores are obtained for each substance by summing individual item responses, with a higher score indicative of greater risk for substance-related health problems. For alcohol use, scores of 0–10 indicated low risk, 11–26 moderate risk, and scores > 26 a participant's high risk of experiencing severe problems resulting from their current pattern of use and likely dependence (Humeniuk et al. 2010). The alcohol use subscale demonstrated adequate reliability (α = 0.91).

Statistical Analysis

A series of bivariate models were was conducted to test the link between preceding perinatal *maternal* and *infant* factors on and SP at 3 ½ months. SP was assessed in two metrics: (1) frequency of SP moments [SP Frequency] and (2) occurrence of SP moments (i.e. presence vs absence) [SP Occurrence]. Due to the overdispersion of SP frequency data, negative-binomial regression models were conducted to gauge the potential impact of maternal and infant factors on SP frequency. Logistic regression was used to model SP occurrence regarding maternal and infant factors. Further sensitivity analyses were run to assess whether findings differed according to additional SP metrics which included (3) aggregated duration of SP [SP Sum] or (4) average duration of SP [SP Short-Average], both using negative-binomial regression modelling.

Perinatal maternal mental health factors like perinatal depression (EPDS), lifetime and recent intimate partner violence (IPV), psychological distress (SRQ-20), stressful life events (LEQ) and alcohol use (ASSIST) were measured at antenatal and/or 6–10-week postnatal visits. The maximum score across perinatal visits was used to minimise the amount of missing maternal mental health data in bivariate analyses of each mental health factor and SP. Early infant development was assessed using several continuous composite scales taken at 2 years, including cognition, motor, language, socio-emotional and general adaptive behaviour, each assessed in relation to SP. Additional factors like maternal age at birth, marital status, employment status, education, HIV status, infant sex, gestational age and birth weight were investigated. All models assumed a significance level of 0.05, and all estimates were presented with 95% confidence intervals. Analyses were run using SAS (V9.4) and R (R Core Team 2021).

Ethical Considerations

The DCHS study was approved by the Faculty of Health Sciences Research Ethics Committee, University of Cape Town (401/2009) and Western Cape Provincial Research Committee (2011RP45). An amendment for the inclusion of the Shared Pleasure Analysis was granted (16/12/2016). At enrollment, mothers gave voluntary, written, informed consent in their preferred language (English, Afrikaans or isiXhosa) and were reconsented annually for study involvement. Parents gave consent for children younger than 12 months as per South African National HREC guidelines that extend the parameters for informed consent by parents to include infants specifically under 12 months of age (Department of Health: RSA 2015). All data were anonymised using a study number to code for each mother–infant dyad.

Results

Maternal and infant characteristics

A sample of 291 out of a possible 296 videos of mother–infant dyads was suitable for assessing Shared Pleasure (SP). Infant sex distribution comprised 54% females and 46% males. Mothers were young (mean age = 27 years (SD 5.9)), mostly unmarried (84%) and largely had at least a secondary school level education (95%). Seventy-three percent of mothers were unemployed (see Table 1), and the majority scored below the threshold for depression (63%) as measured by the EPDS. Seventy-six percent indicated a low risk of psychological distress as measured by the SRQ-20 screen. Most participants (86%) reported few (< 5) stressful events in the past year.

Table 1 reports on maternal characteristics and mental health measures.

Table 2 reports on infant characteristics and infant BSID-III composite scores corrected for gestation.

SP moments and their associated factors

Of the total sample (N = 291), 239 (82%) maternal–infant dyads experienced SP moments [SP occurrence], displaying a median of 5 (IQR: 1–11) SP moments [SP frequency]. The maximum number of SP moments recorded in a single dyad was 31, with 50% of dyads having ≤ 5 moments. The minimum duration of an SP moment was 0.5 s and the maximum 28 s. The maximum aggregated duration for all SP moments was 133 s. The median aggregated duration of SP moments [SP Sum] was 16 s (IQR: 3–36 s), with a median SP short-average of 3 s (IQR: 2–4 s). The aggregated duration and frequency of SP moments are presented in Fig. 1.

Table 1 Maternal characteristics

Variable		*n (%)*
Age at birth (years)		27 (5.9) *
Marital status	Married	47 (16%)
	Single/cohabiting	243 (84%)
Education	Primary	190 (65%)
	Secondary	85 (29%)
	Tertiary	16 (6%)
Employment	Employed	48 (16%)
	Unemployed	243 (84%)
HIV status	Infected	69 (24%)
	Negative	222 (76%)
Depression (EPDS)	Below threshold (< 13)	179 (63%)
	Above threshold (≥ 13)	103 (37%)
Psychological distress (SRQ-20)	Low risk (< 8)	213 (76%)
	High Risk (≥ 8)	69 (24%)
Stressful life events (LEQ)	< 5 events	242 (86%)
	≥ 5 events	39 (14%)
Intimate partner violence (IPV)		
Lifetime (exposure > 12 months)		
	Above threshold	154 (54%)
	Below threshold	131 (46%)

Table 2 *Infant characteristics*

Variable	*Mean (sd)*
Sex	
Female n (%)	136 (46%)
Male n (%)	155 (54%)
Gestational age (weeks)	38.5 (2.7)
Birth weight (kg)	3.1 (0.6)
BSID-111 composite scores	
Motor	91.8 (12.1)
Cognition	85.3 (10)
Language	83.9 (11.8)
Socio-emotional	115.5 (20.1)
Adaptive behaviour	82.1 (12.2)
Recent (exposure ≤ 12 months)	
Above threshold	113 (45%)
Below threshold	140 (55%)
Risk of alcohol use disorder (ASSIST)	
Low (< 10)	229 (81%)
Moderate (11–26)	35 (12%)
High (> 26)	19 (6.7%)

Note: *mean (sd)

Mental health and other maternal factors

Maternal age at birth, employment status, education, marital status and HIV status were associated with neither SP occurrence nor SP frequency (see Online Resource 1).

Unexpectedly, perinatal maternal depression was associated with a significantly greater number of shared positive moments (SP frequency) ($ICC = 1.03[1.00–1.06]$, $p = 0.040$). However, SP frequency appeared to be unrelated to EPDS among depressed mothers (n = 103) ($ICC = 0.98[0.78–1.27]$, $p = 0.893$) and rather driven by mothers who were not depressed (n = 179) ($ICC = 1.42[1.13–1.76]$, $p = 0.001$). These findings were not further supported when looking at SP occurrence as the outcome ($p > 0.05$), and may then potentially be viewed as coincidental, especially given the absence of clinician-evaluated delineation between mothers who were clinically depressed relative to those who weren't.

There were no significant relationships between other perinatal maternal mental health factors and SP frequency or occurrence, including lifelong or recent exposure on the IPV,

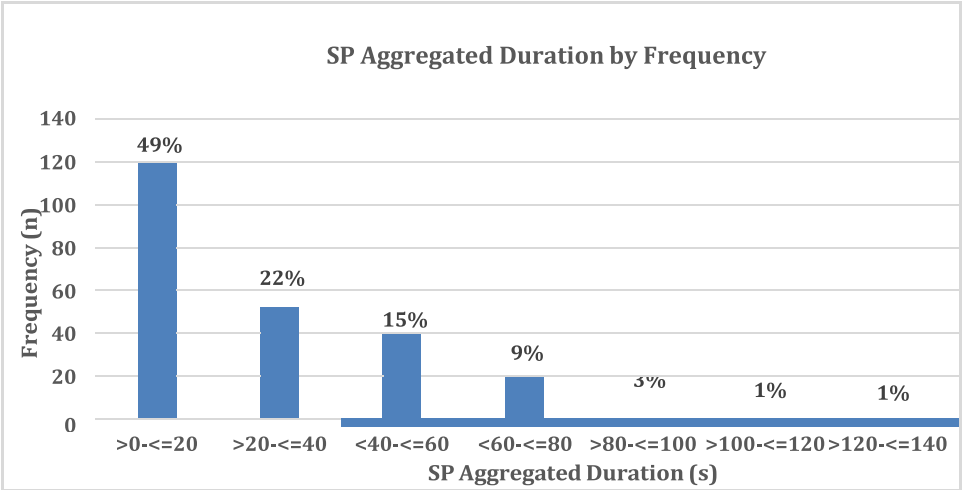

Fig. 1 Aggregated Frequency and Duration of SP moments

stressful life events (LEQ), psychological distress (SRQ-20) and risk of Alcohol Use Disorder (ASSIST).

Infant birth and development

Greater gestational age ($OR = 1.45[1.10–1.93]$, $p = 0.008$) and birth weight ($OR = 1.50[1.12- 2.02]$, $p = 0.006$) were significantly associated with increased odds of SP occurrence. Furthermore, none of the infant development scales were associated with SP frequency or occurrence at age 24 months (see Online Resource 2).

Sensitivity analysis findings

Sensitivity analyses confirmed similar findings to those from main analyses (see Online Resource 3), greater gestational and birth ages significantly linked with a higher average SP duration, whereas greater risk for alcohol use disorder was significantly associated with a lower SP short-average duration [SP Short-average] ($IRR = 0.90[0.76–1.06]$, $p = 0.027$). However, a sub-analysis limited to mothers at risk for alcohol use disorder (n = 54) appeared to dismiss this relationship ($IRR = 0.97[0.76–1.22]$, $p = 0.768$), likely reflecting an underpowered analysis.

Discussion

This study demonstrated 1) a high occurrence of positive interactional affectivity in a general population sample, 2) SP moments associated with higher age of gestation at delivery and infant birth weight, and 3) SP moments unrelated to maternal mental health or infant developmental outcomes in this cohort.

SP moments in this sample of 3½-month-old infant-and-mother pairs were common (82%). Transpiring SP moments were enduring (median aggregated length of 17 s) and frequent, similar to previous SP studies (Latva et al. 2013; Puura et al. 2013). SP occurred in only 20.5% of dyads at 2 months (Lachman et al. 2021), but at 3 months infants typically took to their developmental milestones and spent more time smiling, specifically when gazing at their mothers (Messinger et al. 2001; Yale et al. 2003). So despite significant environmental stressors in our context (e.g. 84% unemployment rate), mothers could respond sensitively to and engage positively with their infants. The presence of SP moments was significantly associated with an older gestation age and higher birth weight at delivery. Previous SP studies have not fully explored these associations (Latva et al. 2013; Mäntymaa et al. 2015) and further work is needed to investigate the mechanisms which underlie these associations. The finding in our sample may be related to the neurotypical behaviour of full-term or closer- to-term infants during face-to-face interactions, characterised by typically "wide" smiles (Segal et al. 1995). An older (closer-to-term) gestational age may also foretell a better developed capacity for pro-social engagement in the first 2 years of life (Dueker et al. 2016). Underlying infant reactivity and self-regulation can furthermore affect infant ability to signal or seek out interaction with caregivers and depend on both temperamental vulnerabilites and caregiver sensitivity(Rothbart and Bates 2006).

Contrary to our hypothesis, SP moments were not associated with better maternal mental health or infant developmental outcomes in this cohort. Our findings contradict other studies linking maternal stressors and depressive symptoms with lower SP (Puura et al. 2019; Lachman et al. 2021). Although mothers with depressive symptoms can interact positively with their infants (Goodman and Gotlib 1999; Cornish et al. 2008). In prior work in the South African context, we found that SP was lower in mothers with severe mental illness (Lachman et al.2021). There are very few opportunities and tools available to sensitively

and appropriately assess infant and maternal mental health in vulnerable populations, especially those in LMICs (Keller et al., 2018). Further work is needed to determine whether SP may be a culturally appropriate screen for mother–infant connectedness. It may therefore be a combination of risks rather than depression alone that determines adverse outcomes (Cornish et al. 2008). Increasingly, literature emphasises that even under adverse conditions, significant resilience may be evident (Ellis et al. 2017). Thus, for example mothers in this cohort also demonstrate remarkable resilience. Further work is, however, needed to assess SP in mothers with more severe mental illness.

Several limitations deserve emphasis. Firstly, this study did not consider a number of factors relevant to shared pleasure, including individual factors like maternal sensitivity and infant temperament. Secondly, it failed to measure a number of variables that impact synchronicity. Thirdly, the assessment of video content did not allow for implementation of computerised analysis methods and only moderate interrater agreement for mean duration of SP was found.

Taken together, our work indicates that despite mother–infant dyads facing risk factors for suboptimal development, there is frequent occurrence of positive SP moments in reciprocal dyadic interactions. Significant disruption in shared pleasure may be present only in extreme cases (e.g. mothers with severe mental disorders). Further work is needed to investigate the mechanisms underlying the associations between early mother-infant synchronicity and better outcomes noted here, and to assess whether SP may serve as a culturally appropriate screen for assessing connectedness.

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CHAPTER 7

DISCUSSION AND CONCLUSION

7.1. Summary of Key Results and Discussion

7.1.1. Introduction

Many studies from lower and middle income countries have highlighted the importance of the early parent-infant relationship as one of the fundamental contributors to the development of socio-emotional competencies in the child (1,2). Mother-infant dyads in LMICs are exposed to multiple cumulative environmental risk factors for infant outcomes, and early psychosocial and maternal emotional factors potentially play a key role in influencing long term infant development (3,4).

The capacity to provide the quality of care required to support security in infancy may be compromised in conditions of adversity, more especially in circumstances of poverty and poor mental health of parents (3,5). The parent-infant interaction creates the foundation for emotional regulation in the infant (6) by supporting the infant's ability to experience, express and regulate negative and positive mood states (7). Synchronized behaviours involving gaze evolution (both mutual gaze and following) between mothers and their infants are thought to form the basis of the development of social connectedness (8,9). Sharing positive emotions in the context of meaningful relationships enable the infant to build sufficient resources (psychological, social and intellectual) throughout their life span (10,11). A mother's influence on and connectedness to her infant has been found to be consistently higher during shared positive emotional interactions which correlate with stronger neural integration processes (12).

This study aimed to assess the applicability of an observation screening tool, the Shared Pleasure paradigm, to measure positive affectivity in two samples of South African mother-infant dyad. The study also explored the relationship between SP and associated maternal and infant factors that may influence infant development. The key findings are summarized and elaborated on for each of the studies below. The dissertation consists of 3 studies namely Study 1: Shared Pleasure in a clinical sample of mothers attending a maternal mental health clinic (13), Study 2: Maternal Shared Pleasure, Infant Withdrawal, and Developmental Outcomes in a High Risk Setting in South Africa (14) and Study 3: The Shared Pleasure Paradigm: A study in an observational birth cohort in South Africa (15). The limitations, possible explanation of findings and suggestions for future research will be discussed below.

7.2. Study 1: Shared Pleasure in a clinical sample of mothers attending a maternal mental health clinic (Chapter 4) (13)

7.2.1. Key Results

The frequency of SP moments in this clinical sample of 78 mother-infant dyads attending a maternal Mental Health Clinic was very low (20.5%) with SP moments occurring more frequently in younger infants (under 3 months of age). A single SP moment lasted at least 0.5 seconds in 24.0% of the SP positive sample, with the longest duration of an SP moment lasting 2 seconds (27.0%) (13). The majority (46.0%) of SP moments were short and lasted at least 1 second. There was poor social support (55% were single parents) and there were high rates of unemployment (94%) despite 64% of mothers attaining a secondary school education. In this clinical sample, 54.0% of participants had been diagnosed with a major psychiatric illness, most commonly Psychosis or Schizophrenia spectrum disorders (33.3%), Major Depressive Disorder (33.3%) and Bipolar disorder (21.4%) (13). The other psychiatric diagnoses included Anxiety disorders, Substance Use disorders, panic attacks and Obsessive compulsive disorders. SP moments were significantly more frequent in dyads where mothers had reported no current maternal mental illnesses (p=0.021), compared to those with mothers that had current mental illnesses on the MINI (version 5.0.0). In summary the main findings in this study were that SP was significantly more commonly experienced in Black African mothers (p=0.033), married mothers (p=0.016) and those who had no current mental illnesses (13).

7.2.2. Critical Appraisal

This study is the first rating of the Shared Pleasure paradigm in a South African population, as well as the only application of SP on a sample of mothers with a history of diagnosed severe mental illness. These results highlight a few important considerations when exploring the nature and quality of early infant interactions with caregivers.

Firstly, as suggested by the low occurrence of SP in the sample, the capacity for mothers to still engage in joyful or pleasurable interactions was compromised. We speculate that there are many possible explanations for this in this setting including psycho-social adversity, cultural differences in child rearing practices or perhaps mental health vulnerability. Mental health disorders in the peripartum period may disrupt the initial development of maternal responsiveness (referred to as “maternal programming”) that prepares the mother to respond to her infant (16). This is thought to be because mental illnesses may disrupt the neurocognitive precursors associated with reward and motivational neural networks, resulting in reduced attentional engagement between mothers and their infants (16,17). Although mostly reviewing studies from HICs, Davidsen et al., reported limited evidence on the variable quality of the relationship between maternal schizophrenia and dyadic interactions, suggesting that an additional vulnerability to stress in the context of a psychotic illness, further impairs the reciprocal engagement (18). We cannot underestimate the role of psycho-social adversity (exposure to trauma,

poverty, financial stressors) combined with mental health disorders (including substance misuse) in the peripartum period, that impacts on the mothers' positive parenting behaviours and perceptions of their infants (19,20). In this study, there were multiple psychosocial stressors including high rates of unemployment, substance use and poor socio-economic supports that most likely contributed to the low experiences of shared pleasure, which raises concern about the potential impact on developmental outcomes of the infants in this study. Infants born in poorer communities may be vulnerable to and are at risk of socio-emotional and developmental compromise across their lifespan (21). These infants are also considered to be at risk of harsher or distant parenting which may be exacerbated by marked socio-economic hardship, exposure to violence and substance misuse. Environmental influences also are associated with decreased maternal sensitivity and poorer infant engagements in dyadic interactions (22). In fact, findings from a prospective birth cohort study in the United Kingdom demonstrated that mothers with reduced economic resources and exposure to persistent strife are more likely to experience ongoing stressors which in turn is associated with less involvement and investment in stimulating and mutually enjoyable parent child interactions (23).

Studies conducted in mentally ill populations of mothers in South Africa have indicated risks on future outcomes for infants of these mothers, however all the studies have focussed on the expected negative interactional styles and highlighted the challenge in changing or reversing the negative outcomes (24–28). Specifically looking at the presence or absence of positive interactions offers a different possibility in a setting of high adversity where the focus on negative outcomes is the norm, and perhaps a potential to encourage or promote the pleasurable interactions if they are reduced. In terms of the SP being more common in younger infants – this is not unexpected, in that developmentally, this aligns with the initial bio-behavioural shift occurring between ages 2 to 3 months. This is illustrated by the onset of the social smile and responsive smiles are more noticeable. It is also likely that older infants are more likely to explore by crawling or independently moving away from direct engagement with their mothers, and so less likely to maintain the direct gaze and smile. This is supported by similar findings in the European samples (29,30).

Secondly, despite the mothers being treated for severe mental illness, and being well enough to participate in this study, the experience of the SP was significantly lower than expected when compared to results from studies in Finland (31,32). While mothers were receiving mental health treatment at the Stikland mental health facility, this study offers some preliminary evidence that the mother-infant dyad may not be as protected simply by treating the maternal mental illness. Evidence suggests that while treating a mother's symptoms of mental illness per se may improve her mental health, this does not necessarily extend to an improvement in the interaction between herself and her baby (26). In fact some studies in HICs have shown that with appropriate mother-infant directed support, mothers with diagnoses like Schizophrenia or Bipolar disorder can make significant improvements in their interactions with their infants, and this contributes to the infant responses improving as well (33). While there has been an increased awareness of the need for identification, treatment and support of maternal mental illnesses in LMICS, as a means of improving the long term developmental outcomes of infants (3,34), there has actually been very limited focus, if at all, on screening the infant or directing therapeutic

interventions towards the infant that is part of the dyad. Studies focussing on home based interventions with depressed mothers in Khayelitsha, South Africa also directed guidance and parenting support to the mother with a focus on attachment, maternal sensitivity and later developmental outcomes in the infants, but again there was limited attention given to recognition of and contributions made by the infant itself to the interactions within the relationship (24,35,36). Our finding of low SP in this high risk sample of mothers with treated mental illness serves as a red flag and further strengthens the call within the field of Infant mental health for research to focus more on early socio-emotional screening of the infant alongside the mother, rather than a singular focus on the mother and later development of the infant.

Thirdly, significantly more married women experienced an SP moment with their babies than single/ unmarried women ($p = 0.027$) (13). We speculate that the consequence of single parenthood is often associated with socio-economic (financial) difficulties that may in turn exacerbate the mother's emotional distress and compromise parenting if they feel unsupported and have poorer outcomes for infants and parenting experiences especially in Sub-Saharan Africa (37). In fact, a predictor of positive attitudes in mothers regarding infant interactive behaviours under the age of 4 months, was significantly associated with the quality of the intimate support experienced within marital relationships (38). Some international studies have suggested that perceived maternal efficacy and stress levels influence mother's capacity to engage positively in interactions with their infants, highlighting also that single or divorced mothers sometimes may endure much higher levels of stress that compound their perception of being "good enough" mothers (39). This is not to suggest that single mothers as a demographic themselves are necessarily a risk to parenting or infant interactions. Single mothers who are at risk are more likely determined to be so by social conditions in that they are more likely to be unemployed, have less home security and diminished access to resources than married women (40) who are more likely to have access to support (economically and socially) that enable them to better meet environmental challenges (39,40). However, there are many single mothers who successfully negotiate environmental risks, and still may have positive interactions. This particular finding of this study would need to be replicated in a larger sample.

Finally, the finding of significance in the occurrence of SP in Black African mothers compared to mothers from different race groups highlights another important consideration. Culturally specific features in mother-infant interactions have been shown to predict socio-emotional development, however it is unclear in the available research what the specific processes are that determine this. There is limited research in South Africa that specifically addresses experiences of mothers and their interactions with their infants. In the late 1980's Richter and colleagues documented interactions and communication styles between Black African mothers and their infants, and reported that they were more verbally expressive and responsive to the communicative offerings from their infants when compared to Scottish counterparts (41). Magwaza suggested that the cultural and social contexts in which Black mothers live, may shape their perspectives and behaviours which relate to what is considered sensitive mothering (42). A doctoral thesis in South Africa explored the understanding of the maternal experience in Black South African mothers in urban settings (43), where participants expressed their desires to

enact ideals of 'good mothering' by meeting the needs of their babies by 'emotionally' providing for them rather than physically providing. The sentiment was to offer their babies a good example of ''optimal" mothering experiences, despite the adverse environmental and social challenges. It also is important to note there is insufficient clarity about how child rearing behaviours affect infant-caregiver interactions, with the safest assumption being that it is a complex and nuanced engagement that cannot be attributed to culture alone but may need to consider individual differences including between mothers (41,43). Depending on social status, employment opportunities and reliance of child support (either familial or paid carers), parenting styles and interactional practices can vary widely even within culturally similar communities (42,43). Black African mothers are historically underrepresented and understudied in the field of infant mental health, and the finding in this study may represent just one of many potentially complex differences in parenting practices within a diverse Black African population of mothers.

On the African continent, much of the research focus on cultural differences between maternal-infant responses in Western (European-Mediterranean) settings have been compared with North or West African mothers (44–47). The limitation in these studies is the categorizing of Africa as a uniform continent of culture. Africa is home to diverse cultures, with the development of attachment relationships influenced by distinct organizations of caregiving relationships (48). While infant research has acknowledged that certain milestones such as the evolution of the smile for example, is universal (41), the idea of social communication, maternal responsiveness and sensitivity and infant reciprocity is more complex in the context of social and emotional dyadic vulnerabilities. While the finding in our sample was interesting, it is difficult to generalize given the small sample size, but also the acknowledgment that parenting styles and infant interactions in this setting is influenced by many dynamic and intersecting factors including practices to ensure survival of the infant in the face of environmental adversity (49). It is important to pay attention to and give credence to community specific methods of child rearing such as verbally expressive engagements, and demonstrable responses to infant communication (41,43), because they grow out of environmental necessities as well as parental belief systems and could explain the almost "instinctive" pleasurable engagement witnessed in this specific subsample of Black African mothers.

7.3. Study 2: Maternal Shared Pleasure, Infant Withdrawal, and Developmental Outcomes in a High Risk Setting in South Africa (Chapter 5) (14)

7.3.1. Key Results

This study was an expansion of the first rated SP sample of mothers attending the Stikland maternal mental health study when the babies turned 6 months of age. More dyads were recruited to increase the sample size and to explore later neuro-developmental outcomes as part of the parent study. This time in a total of 117 participants, a total of 91 dyads were eligible to be assessed for SP. Infants were assessed for developmental outcomes at 6 months and 18 months using the Bayley Scales of Infant Development. Associations between Shared Pleasure and motor, cognitive, language and socio-

emotional developmental scales were explored. The presence of infant withdrawal using the Alarm Distress Baby Scale (ADBB) was also assessed at 6 months. The occurrence of SP remained low (20%) even with the additional participants at an older age of assessment (6 months). Specifically, there was no significant association with risk of maternal depression (p = 0.571) and SP moments (14). Infant withdrawal was high (72%) and significantly associated with male infant gender (p = 0.025). There was a significant association between the occurrence of SP and a lower score of infant withdrawal (p = 0.0002) (14).

There was a significant association between the number of SP moments at 6 months and motor scores (p = 0.007) at 18 months. There was a marginally significant association with SP and cognitive scores (estimate = 1.9; SE = 1.0; p = 0.052) at 18 months (14). Modelling analysis was performed for each subscale of the BSID-III outcomes, with the differential between subscale scores at 18 months examined relative to the scores at 6 months (motor score at 18 months-motor score at 6 months). The differences were statistically significant (>0) for the motor, cognitive and socio- emotional subscales but not for adaptive behaviour and language subscales (14).

Regression modelling differential outcomes showed a greater improvement in cognitive scores at 18 months in infants with an SP moment compared to those without an SP moment [SP average difference (AD) = 7.4 (2.4), no SP AD = 10.4 (1.2); p = 0.012]. Infants without an SP moment experienced a larger average decrease in motor scores at 18 months compared to those with an SP moment [SP AD = −3 (3.0); no SP AD = −10.6 (1.5), p = 0.027] (14).

7.3.2. Appraisal/ Critique

This 2nd study was an extension of the first to explore SP and its relationship to infant behaviour and developmental outcomes. The implications of key findings are discussed below.

The results demonstrate a few critical examples of the overall vulnerability that infants born to mothers in environments of high adversity and risk exposures face. These include again the low occurrence of SP as a reminder that there is a compromised experience of pleasurable engagement between mothers and their infants in this clinical sample. In this sample, at baseline 41% of mothers were diagnosed with a mood disorder, although at the 6month well baby visit, 73% of mothers did not report any symptoms (14). This is not necessarily unusual as finding in that other prevalence studies of perinatal depression in South Africa have found higher rates of depression in pregnancy and the early postpartum period (50–52) with rates after 6months postpartum being lower or dependent on other factors like social support and exposure to violence or physical stressors (52). Similar to SP studies in Europe, SP was not significantly associated with the EPDS measure of depressive symptoms (31,53). Only one smaller previous European study of 48 dyads found a negative correlation between mean length of SP and depressive symptoms on the EPDS (32). Our study did not however note any correlation between SP mean length, duration or presence of high depressive scores on the EPDS.

There are many theories to explain this, most commonly the expectation that mothers who are experiencing depressive symptoms are aware, are more anxious and may make a more concerted effort to smile at their infants, who in turn respond reciprocally (54,55). However, while it may be more likely for them to smile at their infants, the SP paradigm applies a much stricter criteria to include both the smile and the synchronized gaze contact as a measure of authentic and shared pleasurable engagement. Additionally in situations of high socio-economic stress and adversity, economic disadvantage is considered an additional risk factor in women who are depressed even if the depression itself is not associated with less positive parenting behaviours, which may explain the decreased frequency of the SP.

Infant withdrawal within a certain range is an expected feature of normal infant behaviour in interactions. It is accepted as a means for the infant to regulate the flow of interaction (56). However, when withdrawal becomes sustained (including features of avoidance, self-stimulating, freezing) it can be recognized as a sign of distress, often considered even as an early alarm signal for the infant. The sustained withdrawal becomes an important component in the infants' physiological and psychological response to stress and relational and other disorders including attachment, anxiety, pain or trauma related disorders (57,58). Previous studies in the South African setting also reported high rates of Infant withdrawal – including 31% in a sample of infants with HIV (59) and 27% in infants with Foetal Alcohol Syndrome(FAS) (60). Both these rates were higher than international studies, but lower than our study rate of 72%. In the previous two South African studies however, the infant had increased risk factors for withdrawal namely HIV and FAS, and the mothers had high rates of depressive symptoms (52.6% of mothers in the HIV study and 39% in the FAS study). In our study, the dyad was considered to be at risk as a result of the history of mental health disorders and risks in the mother, rather than in the infant. With an estimated prevalence rate of perinatal depression over 30% in South Africa (3,61), as reported by Honikman and colleagues using the EPDS, the impact of maternal mental health problems affecting infants' social behaviours cannot be underestimated. The combination of mental health vulnerability, social adversity and life events are well known contributors to poorer infant outcomes, more especially impacting on quality of engagement and security of relationships (16,24,62). It is however, not just the presence of these expected adversities in high risk environments, but also ones' vulnerability to the distress that they cause that will determine the ease at which mothers can parent their infants. We expected that if an infant is withdrawn they are unlikely to engage warmly, joyfully or reciprocally (56,63) and this study showed a significant relationship between being withdrawn and not experiencing an SP moment.

The finding of male infants being more likely to be withdrawn is not unusual, in that it is often observed in infant interaction studies that male infants exposed to more environmental stressors during the regulation of socio-emotional engagement with caregivers, are more demanding, and have maturation related vulnerabilities (due to endocrine, sex hormone and later differential brain maturations) (64). This makes them less able to withstand or recover from less optimal parenting responses (54,64).

In other words, male infants are considered more demanding in social interactions, they are less likely to self- regulate and require more support from their mothers to help them. In the absence of reciprocal responses, we expect them to be more withdrawn (54,65).

While there was a gender difference related to withdrawal behaviours, the same was not true for the presence of SP. This is possibly explained by the fact that SP depends also on the authentic response from the mothers, so while male infants may need and seek out more engagement, the SP is sensitive to both participants reciprocating rather than the infant's response alone. It may be difficult to observe signs of impaired development or interactions immediately in dyads of mothers with mental illnesses as significant negative interactions of impairment may take time to be noticed. However, studies have suggested that in a parent with mental health problems, the infants withdrawn social behaviour should be examined (63,66,67) as the presence of infant withdrawal can serve as an early easily identifiable flag of impairment – i.e. it may be an earlier alarm to notice if an infant is avoidant, anxious, limits eye contact and withdraws from the observer (56,58). Eye contact between an infant and caregiver has been connected with appropriate or acceptable early interactions, with gaze contact negatively correlating with infant withdrawal behaviour score on the ADBB (68). In fact, as part of a Brief Infant mental health screening (BIMHS) tool in South Africa, gaze contact is considered as one of the 5 red flags to consider when screening for at risk parent-infant interactions (67). In resource limited settings, where access to comprehensive infant assessments is unlikely, perhaps the presence of infant withdrawal together with the absence of Shared pleasure can be considered a red flag or marker of potential risky future interactions.

Regarding developmental outcomes, the number of SP moments experienced at 6 months was significantly associated with a higher motor score, adaptive behaviour and cognitive scores at 18 months (14) which supports the theory that early positive emotional engagement, especially maternal synchrony may influence developmental outcomes (11). Shared pleasure relates to synchronous engagement and studies of synchrony have reported positive correlations with improved developmental outcomes especially in motor and cognitive domains (11,69). This idea of high emotional vitality (the lively usually positive expression shared with the mother) in the first year of life is thought to influence neurodevelopmental pathways that promote greater alertness, increased environmental exploration and the improved organization of developmental tasks (70). As described by Robinson & Acevedo, the combination of the positive sharing of emotion and strong environmental stimulation will support better developmental outcomes particularly in cognitive and motor domains (70,71). Adaptive behaviour scores are self-reported and may also be influenced by the presence of improved affective engagement, in that some of the areas assessed in this domain include social and directed play and self-care– responses to efforts by the mother that are likely to be rated highly in dyads where the mother experiences more positive or shared engagement.

To expand on the idea that the absence of SP in a setting of multiple risks, but specifically with mental illness vulnerability, can be considered an early warning, the next significant result from this study may provide some preliminary weighting. Identifying children at risk of poor developmental outcomes is

critical, as infants and their mothers in LMICs are disproportionately exposed to environmental and socio-economic factors (1,28). There are a number of interrelated factors that impact on poor infant development in LMICS including genetic vulnerability, perinatal substance exposure and mental illness, lack of learning opportunities and relational or attachment problems as examples (17,72,73). In a recent systematic review specifically looking at the impact of perinatal mental illness on infant development in LMICs, findings were inconclusive due to the limited research conducted in the field (74). Importantly however, it highlighted that inter-related risks and cumulative exposures to adversity makes understanding of the causal factors difficult (74). In a large South African birth cohort study, over 55% of children were identified as having delays in two or more domains on the BSID III, in the context of high prevalence of socio-economic stressors, trauma, and maternal psychosocial risks including mental illness and substance use (75). This is despite the BSD III being standardized to South African norms, in light of the dynamic interplay of developmental risk factors, we expect that South African infants will do poorer on the developmental assessments compared to their peers in HICs (4,76,77).

In light of the above potential for poorer outcomes in the context of mental illness and adversity, our study looked at differential BSID III scores between 18 months and 6 months, and found an increase in cognitive and socio-emotional scores as well as a decrease in motor scores that were significant (14). What is an important finding in this study is that when modelled against the presence or absence of an SP moment, the following two findings were significant. Firstly while average cognitive scores were better at 18 months regardless of the presence of SP, the average cognitive scores differentials are significantly better at 18 months if SP moments are present (14). This is important since cognitive development (including general cognitive abilities and executive functioning such as attention, memory, planning, flexibility) is critical for children to thrive and attain future milestones (78). Even more so, early cognitive ability is considered malleable and sensitive to environmental input and social contexts. The likelihood ratio in our study demonstrates that the presence of SP moments is 6.33 times more likely to produce a positive difference at 18 vs. 6 months (i.e. a better cognitive outcome). This implies that in the context of this high mental health and adversity exposed group of dyads, having a positive reciprocal engagement appears confer a significant impact on a cognitive milestone. What is more promising, is that despite the lower motor score at 18months (regardless of the presence of SP or not), the average motor score is significantly worse if SP moments are absent (14).

These key findings potentially imply that in a group of very high risk dyads, specifically for mothers with mental illness vulnerability, the *absence* of an SP moment could potentially be a red flag for tracking risk for poorer later motor development. Additionally the *presence* of an SP moment could then also possibly be used as a marker of resilience/protective factor for an enhanced or better cognitive outcome. While this sample was very small, and will need replication, it is perhaps the most significant potential support for the use of SP as a marker of risk in early infancy. Data originating in LMICs that comprehensively investigates the development of children in the context of cognitive, motor and language outcomes is critically needed. Although there have

been some studies that examine risk factors, there are significantly fewer that focus on protective factors, particularly on positive engagement within the infant-mother interactions (75,79) in resource limited settings. There are widespread calls to scale up interventions that would minimise the impact of risk factors with limited success given the financial, and socio-political obstacles in LMICs (1,79,80). The WHO Nurturing Care Framework impresses on the urgency for interventions and frameworks that not only target risk, but that promote and support parents and caregivers in providing nurturing care as part of the United Nation's Sustainable Millennial Goals in order for infants to achieve their developmental potential (81,82).

Shared Pleasure could be considered as a potential screening tool to identify positive engagement, and by extension to identify risk when this is absent. As suggested in findings above, the lack of SP may raise the alarm for the clinician to explore or search for other associated risks, like infant withdrawal. In addition, this study provides some support for the potential screening of shared joyful interactions in mothers at risk of mental illnesses especially, as a means to identify risk if the SP is absent, and to direct interventions potentially at promoting the shared positive engagement.

7.4. Study 3: The Pleasure Paradigm: A study in an observational birth cohort in South Africa (Chapter 6) (15)

7.4.1. Key Results

The Drakenstein Child Health Study, provided the opportunity to use the SP paradigm in a community based sample in a real world setting. With a sample size of 291 mother-infant dyads seen at a 14 week well baby visit, it is the largest single sample assessed for Shared pleasure (15). Out of 291 pairs, 82% (n = 239) yielded Shared Pleasure moments. The shortest single SP moment lasted at least 0.5 seconds and the longest 28 seconds. SP were associated with higher gestation age at delivery (p = 0.008) and higher infant birth weight (p = 0.006), but were not related to mother's mental health or infant health outcomes (15). None of the infant developmental scales at 24 months were associated with SP frequency or occurrence. Maternal age at birth, employment status, education, marital status and HIV status were associated with neither SP occurrence nor SP frequency (15) There were no significant relationships between other perinatal maternal mental health factors and SP frequency or occurrence, including lifelong or recent exposure to Intimate Partner Violence (IPV), stressful life events (LEQ), psychological distress (SRQ-20), and risk of Alcohol Use Disorder (ASSIST) (15).

7.4.2. Appraisal/Critique

This study served as a community control sample to the clinical sample in the previous two studies. Table 1 reports on the differences in the Shared Pleasure observation across the three studies.

Table 1: Shared Pleasure across study samples

	DCHS Community Sample	Stikland Sample Study 1	Stikland Sample Study 2
Average age of infants	3.2 months	2.3 - 6months	6 months
Shared Pleasure Occurrence	82.0 %	20.5 %	20.0 %
Shorted duration of SP	0.5 seconds	0.5 seconds	0.5 seconds
Longest duration of SP	28.0 seconds	2.0 seconds	8.0 seconds

There are two important findings in the Drakenstein Child Health study sample that need to be highlighted.

Firstly, the high occurrence of SP moments (82%) in a community sample which were frequent and enduring is similar to findings in previous European studies (29,30,31,32). This is in the context of a community characterised by high levels of unemployment, crowded housing conditions, low socio- economic support, high prevalence of substance use, malnutrition, infectious diseases and other poverty related exposures (28,83). The main difference between this sample and the previous two studies is the presence of mental illness vulnerability in the mothers. We speculate this may be the reason for the lower occurrence of SP in the Stikland sample versus the DCHS, given that the environmental adversities and exposures were similar. The finding that SP was more significantly related to greater gestational age and higher birth weight can be explained by what is expected as neuro-typical behaviour in full term infants, in that their capacity to engage in typically wide smiles at this time is anatomically supported (84,85). Term infants also are more likely to have a mature capacity for more pro-social engagement than pre term (or lower gestational age) infants (86).

The parent DHCS sample study was characterized by high levels of unemployment and low household incomes (39.1% earned less than R1,000 per month) (75). Cumulative social determinants such as country level political and economic factors (poverty, unemployment, limited resources, violence), cultural norms and physical health risks serve as mechanisms that impact on families and individuals navigating everyday circumstances (87). If we consider the social determinants and its impact on both mental health and physical outcomes of children and their families, context specific risks in South Africa cannot be under-estimated. In fact, the Lancet series on Advancing Early Childhood development reported that Sub-Saharan Africa had the highest prevalence rate (66% in 2010) of children at risk of suboptimal development (1,88).

Our findings suggest that despite exposure to, or in the face of multiple psychosocial and environmental risk factors, mothers may still have the capacity to positively engage with and respond reciprocally to their infants. In her review of psychosocial and specific economic vulnerabilities affecting maternal competency and mental health of infants in Africa, Richter reported that poor communities here are no different than their American counterparts in terms of effects on infant engagement (89). It is useful to remember that the WHO definition of “nurturing care” includes the ability of the mother to provide an environment that is responsive in creating opportunities to learn and explore, despite there being limited resources and exposure to environmental adversities (81). The ability to provide the nurturing care (and by extension positive mutually enjoyable learning opportunities) depends not only on the environment but the mother’s mental health and social support systems. It also may be possible that environmental stressors (like relational challenges, exposure to trauma, stressful life events) alone may not have impaired the mothers’ ability to interact with and share positive connections with their infants – and that instead, there are other factors in the face of adversity that impact on what are thought to be spontaneous joyful interactions (90). The infant may also play a part in this interaction, and individual child factors (such as temperament, genetic differences and nutritional support) can influence the infants’ attempts to also engage in this interaction (32).

The high frequency of SP in this sample however, may not necessarily be a marker of resilience, but may reflect instead that SP is a more appropriate and sensitive marker of connectedness that is culturally sensitive. Western methods of assessing mother-infant sensitivity is not universally applicable, and it is possible that the expectation is that stressors will limit the capacity of mothers to engage in specific "expected sensitive" roles (like following the infant's lead, taking turns, allowing independence of the infant) that are measured by traditional rating scales (91,92,93). The original definition of acceptable "sensitive" caregiving by Ainsworth, does not make reference to *positive emotionality*, warmth or *joy* as necessary components of sensitive responsiveness (92). An important limitation in our study, however is that we did not test for infant factors like temperament, or neurophysiological contributors that impact on infant synchronicity in the face of other adversities.

The second important finding in this study was that Shared Pleasure was not associated with better infant or maternal mental health outcomes (15). This is contrary to our hypothesis and previous studies (including the first study in our cohort of mentally ill mothers), that showed associations between maternal mental health symptom risks and lower SP (30). Importantly mothers in the Stikland study had histories of more severe mental illnesses which may have had a greater impact on their capacity to engage with their infants (13,14). It is not unusual though, since there is an increasing awareness that mothers who are struggling with mental health conditions are very aware of their illnesses and impact thereof, and may actually make more effort to engage with their infants (94,95). In fact, in the study by Cornish et al, it was also noted that a high proportion of the participants from a non-English speaking background had experienced ongoing low mood, and yet still had acceptable infant interactions (95), again drawing attention to our observation that in a non-Western population, the way we understand parenting and caregiving models may not be similar to Western assumptions (95).

What these findings highlight is, that despite various psychosocial factors, including potentially having a mental illness risk of a common perinatal mental health disorder, mothers can still have positive and reciprocally joyful interactions with their young infants. The specifically high frequency of SP in this sample also suggests that significant disruption in SP may also be a risk only in extreme conditions of for example severe mental illnesses (15).

7.5. Limitations

7.5.1. Sample size

While the DCHS (Study 3) is a large sample size in a LMIC compared to other studies in this area of research, with exhaustive measures taken to screen for important psychosocial factors, the sample size of the Mentally ill population (Study 1&2) was small. Despite international studies reporting on infant observation based studies using smaller numbers (ranges from 12 and up to 50 infants on average) (97,98), our study had aimed to also assess associated variables like screening tools for psychosocial stressors, developmental outcomes and maternal mental health, and

the small sample size limited our ability to assess these as intervening variables. Larger sample sizes for both clinical and non-clinical samples will be the focus of future studies using the SP in this setting.

7.5.2. Video Assessment

Microanalysis of video recordings of infant interactions are common in the field of infant mental health, however they rely largely on individual and inter-rater reliability. As this is a new experimental tool used only in a different context (HIC) previously, the moderate inter-rater agreement in the study 3 is recognized as a limitation. Video recordings were also conducted only in one setting, and did not offer the opportunity of a different setting for comparison. In keeping with advances in the field using laser and artificial intelligence to assess infant behaviours, the assessment of video content in this study did not allow for implementation of computerized analysis. No video assessments of the SP were possible at a later time point (e.g. 18 months or 24 months) when the developmental assessments were done. This is partly also due to the fact that SP is considered most sensitive in younger infants (under 7 months of age) where they are less likely to crawl away or be easily distracted by environmental stimuli that can limit sustained reciprocal gaze contact.

7.5.3. Infant characteristics

This study did not consider specific individual factors that influence infant synchrony at baseline such as infant temperament, negative affect or physiological vulnerabilities. Genetic testing to look for associations with genes linked to infant characteristics that make them lower risk for withdrawal for example was beyond the scope of this study.

7.5.4. Maternal Characteristics

Mothers were not assessed for individual factors like genetic vulnerability or parenting roles that could influence infant engagement. They also were not assessed for sensitivity or responsivity through internationally validated tools such as Global rating scales (99) or Emotional Availability Scales (100). The reason for this is two-fold. Firstly there were no tools available that specifically ranked positive engagement, instead of tools that focus on increasing or decreasing negative responses or hostility in the parenting style. Secondly the EAS scales for which the researcher received international training and reliability, impressed as not necessarily being culturally sensitive or applicable in this ethnically diverse study. Validating the EAS in this population was beyond the scope or focus of this study.

7.6. Conclusion

Screening for the presence of early positive infant interactions as a marker of early connectedness is not routinely done in the South African setting. There are limited opportunities or tools available to appropriately or sensitively assess infant and maternal mental health in vulnerable populations, especially those in LMICs (92). This is largely due to the use of tools that are influenced by Euro-centric based models of assessments, which may not always apply in diverse and multicultural settings, and where traditional models of caregiving widely differ.

Altogether our work has demonstrated two important findings. Firstly, that frequent occurrence of positive SP moments in dyadic interactions in an environment which has high maternal and psychosocial risk factors is possible, and secondly that the absence of SP specifically in dyads where mothers have vulnerability for severe mental illnesses can be a potential early warning sign as a contributor to poorer infant outcomes. A better understanding of the extraordinary resilience's expressed in this study, as well as how exactly this early synchronicity is associated with better outcomes remains a potential area of promise for further research in this setting. With the SP providing a potential for recognizing early synchronicity or flagging up an early cause for concern, it also allows the clinician an opportunity to intervene early and support sensitive dyadic engagement where it is missing.

7.7. Future Directions

The focus on positive relational experiences is a familiar direction for infant mental health related interventions. The infant's need for affirmative relationships is urgent and immediate, and if absent, may need to be highlighted or interpreted as a potential indicator of early difficulties (101). There are few recommendations for future impact and potential of SP as follows.

7.7.1. Clinical potential

A focus on positive interactive signs and engagement may be more acceptable (and intuitive) to many health care providers who often feel unable to adequately identify or screen for early negative or problematic signs in young infants. Its focus on a positive interactive marker, could be a welcome development away from focus on 'what goes wrong' between caregivers and infants, and rather can be more easily integrated into routine screening in settings where well babies are seen for example at immunization or feeding clinic follow ups. By encouraging the screening for positive pleasurable interactions, it is anticipated that more infants will be identified when the positive moments are missing, and by extension will be referred sooner for intervention. The WHO calls for an awareness and focus on supporting nurturing interactions especially in limited resource settings (81), and SP offers a potential screening marker to identify risk and direct support appropriately in optimising quality nurturing caregiving.

7.7.2. Research opportunity

Positive interactions have been less well studied in high risk environments, with limited attention afforded to it compared to the negative signals indicating problems with early interaction. How best to assess the quality of interactions between mothers and infants that are culturally sensitive or that do not rely on sophisticated ideals of caregiving (41,92), remains a challenge especially in LMICs. The ability to screen infants effectively and appropriately is needed to address maternal and infant mental health and decrease later morbidity in these vulnerable populations (102,103). This study can be seen as a harbinger for further future larger studies in a LMIC focussing on specific mental illnesses in not only in mothers, but fathers and other primary caregivers who form dyadic relationships and comparing them to healthy dyads. This study also highlights the need to conduct local research on the quality of the infant-caregiver relationship and how psychosocial factors impact this. Another potential research opportunity is to engage in the opportunity to utilize new technology such as Artificial Intelligence (AI) in rating and to compare this with local clinician/ human researcher ratings. Is AI able to tease out synchronized SP with ease or is it that the authenticity of the smile is more than just a combination of Facial Action Units and anatomical markers, but actually a more nuanced appreciation of culturally appropriate synchronized behaviours.

7.7.3. The role of Culture and developmental origins

Culture influences a mothers' behaviour toward her infant, with different ethnic groups emphasizing varied dimensions of interactions with their children. One must not forget South Africa's colonial and apartheid histories when considering how cultural influences impact on motherhood, parenting and what is considered as desirable interactions in different communities. It may therefore be problematic to extrapolate that all mothers belonging to a particular cultural community have the same experience. South Africa offers a melting pot of ethnic diversity, and parenting behaviours are influenced by perspectives that vary greatly within socio-economic, environmental and relational contexts. We expect however that the instinctive reciprocal positive SP interactions which are not dependent on cultural or language specific restrictions, are spontaneous and present cross culturally and can be measured effectively through direct observation in this setting. This gives an exciting opportunity for research potentially addressing SP within cultural variations, and speaks to the field of health in humanities in exploring the developmental origins of health and disease (104).

7.7.4. Impact of COVID, Masked faces and Shared Pleasure

No field clinical, social or cultural has been untouched by the impact of the COVID-19 pandemic (105). The world has collectively been traumatised and is slowly emerging from the aftermath of a pandemic that has not been experienced in modern times. The casualties beyond the direct impact of the disease, remain to be seen. One of the internationally adopted social behaviours has been the wearing of masks

that essentially cover one's nose and mouth. When thinking about the face mask itself, the eyes remain the only visible form of non-verbal communication. Our research study has focussed (pre-COVID) on infant smiles to communicate joy and their reciprocal positive emotional responses elicited in their interactions with adults (14,15). We have deliberately tried to demonstrate the value and importance of the authentic smile that includes synchronised gaze and smiles between dyads. What happens when faces are masked and infants have no opportunity to recognize, reflect and mirror the facial expressions of their caregiver? In the absence of this full exposure to the human face, how do they process and what effect does it have on the neural regulatory pathways that trigger the reward systems for both the infant and the mother? Ed Tronick and colleagues attempted to address the concern that mask wearing distorts emotional communication by observing 23 dyads interacting at home using a smart phone recording. They reported that while infants reacted to the act of wearing the mask in some form, the mask itself did not appear to disrupt their usual interactions (106). But the questions remain - are infants born in the pandemic times less or more likely to seek out and rely on facial expressions for social communication? Do mothers have to try harder to engage young babies who are seeking out that facial reciprocal engagement and how does this affect mentally ill mothers who additionally have other risks that may impact on this capacity. This is an important area of research that needs to be explored, the impact of the COVID-19 pandemic on infants who were born into a masked world brings new challenges. The researcher was aware of this evolving challenge and has published an additional piece on SP in the time of COVID early in the pandemic days (Appendix B).

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Stellenbosch UNIVERSITY IYUNIVESITHI UNIVERSITEIT

forward together
sonke siya phambili
saam vorentoe

Approval Letter
Progress Report

20/05/2022

Project ID: 4252

Ethics Reference No: S12/04/111A

Project Title: Shared Pleasure in Early Infant Interactions: A study of two South African samples of mothers and their babies, with and without Maternal Mental Illne

Dear Dr A Lachman

We refer to your request for an extension/annual renewal of ethics approval dated 12/04/2022 22:07.

The Health Research Ethics Committee reviewed and approved the annual progress report through an expedited review process.

The approval of this project is extended for a further year.

Approval date: 21 May 2022

Expiry date: 20 May 2023

Kindly be reminded to submit progress reports two (2) months before expiry date.

Where to submit any documentation

Kindly note that the HREC uses an electronic ethics review management system, *Infonetica*, to manage ethics applications and ethics review process. To submit any documentation to HREC, please click on the following link: https://applyethics.sun.ac.za.

Please remember to use your Project Id 4252 and ethics reference number S12/04/111A on any documents or correspondence with the HREC concerning your research protocol.

Please note that for studies involving the use of questionnaires, the final copy should be uploaded on Infonetica.

Yours sincerely,

Ms Brightness Nxumalo
Coordinator: Health Research Ethics Committee 2 (HREC 2)

National Health Research Ethics Council (NHREC) Registration Number:
REC-130408-012 (HREC1)•REC-230208-010 (HREC2)

Federal Wide Assurance Number: 00001372
Office of Human Research Protections (OHRP) Institutional Review Board (IRB) Number:
IRB0005240 (HREC1)•IRB0005239 (HREC2)

The Health Research Ethics Committee (HREC) complies with the SA National Health Act No. 61 of 2003 as it pertains to health research. The HREC abides by the ethical norms and principles for research, established by the World Medical Association (2013). Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects; the South African Department of Health (2006).Guidelines for Good Practice in the Conduct of Clinical Trials with Human Participants in South Africa (2nd edition); as well as the Department of Health (2015). Ethics in Health Research: Principles, Processes and Structures (2nd edition).

The Health Research Ethics Committee reviews research involving human subjects conducted or supported by the Department of Health and Human Services, or other federal departments or agencies that apply the Federal Policy for the Protection of Human Subjects to such research (United States Code of Federal Regulations Title 45 Part 46); and/or clinical investigations regulated by the Food and Drug Administration (FDA) of the Department of Health and Human Services.

Shared Pleasure in the Time of COVID 19: The Importance of the Shared Smile for Babies in a World of Masked Faces

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As South Africa prepares for the winter to arrive and with it, the increased risk of COVID-19 infections, the economic toll of a continued lockdown meant that despite this risk, there had to be an easing of the harsh strict lockdown to allow for some salvage and restoration of livelihoods. As parents resume work, domestic helpers in the informal sector doubling up as the nannies also return to work. Part of the relaxing of the lockdown in South Africa is accompanied by the compulsory wearing of face masks in all public places, including places of work, and during the utilization of overcrowded public transport services where social distancing is virtually impossible. As such, the domestic nannies travel amid high-risk environments to enter homes in the leafy suburbs to help with the essential service of childminding. The level of risk to these adults is high as South Africa has a disproportionate burden of respiratory disease (Tuberculosis), immuno suppression (HIV and related infections), and psychosocial adversities. Whatever little protection can be offered, needs to be adhered to as the population braces for the inevitable surge of the Coronavirus infections.

While face masks have clear benefits in reducing transmission of the virus, the impact this has on social engagement remains to be seen. As adults, we adapt. We rely on verbal cues, re-adjust our gestures, and incorporate the mask as part of the new normal. For children, the mask is reframed as their "super-power" to protect themselves and is integrated fairly easily into the routine of wearing it on the playground, at school, and as part of a safer peer interaction.

But what about the babies? The Center for Disease Control (CDC) does not recommend the use of face masks in infants under 2 years of age - however, they make no clear statement on the use of masks by external caregivers providing the care but who themselves are at risk prior to entering the home. The fear and uncertainty around infection is palpable amongst professionals and parents alike. A colleague sent me the following message:

> I return to work soon leaving my four-month-old boy with his lovely responsive nanny. She is choosing to wear a mask in the house. I have explained that the mask mostly protects others from her and that I am happy for her to not wear it in the home, but she feels more comfortable with it on. However, as the primary person interacting with the baby, her entire face except for the eyes is not visible. I am concerned about his development with this "semi blank face" caring for him. Is it enough for him to just see the nanny's eyes and hear her voice? What are your thoughts?

This made me wonder. What does the science and our understanding of what babies need in those early few months tell us? Will the mask cause more harm than benefit to the baby? How do we assess the risk before we can offer advice?

The ability to detect and focus on faces is a fundamental prerequisite for developing social skills. Immediately after birth, babies are attracted to moving objects and show preferences to face-like stimuli over other objects (Johnson, Dziurawiec, Ellis, & Morton, 1991). The attraction for faces continues to develop over the next year of life, with the focus on faces allowing for infants to learn social-environmental cues and interactions with them (Baron-Cohen, 1994; Gliga & Csibra, 2007).

From as early as two months of age, infants demonstrate skills like eye contact and facial expressions as part of social communication (Stern, 2018; Trevarthen & Aitken, 2001). During episodes of mutual gaze, the mother and infant engage in spontaneous facial and vocal communications that may elicit a positive effect on both mother and infant (Lavelli & Fogel, 2005). Such highly arousing, face-to-face interactions allow the infant to be exposed to high levels of social and cognitive information (Feldman, 2007; Schore, 2005).

For the next four to six months, shared smiles with caregivers are considered the high point of face-to-

face interactions (Weinberg & Tronick 1994). Smiles help organize social and emotional exchanges, providing the parent with the feeling that they are in touch with and have "doing well", by their baby (Spitz, 1949; Sroufe & Waters, 1976).

Infant smiles communicate joy and elicit positive emotional responses and interactions with adults (Bowlby, 1982). As in adults and children, infant smiles involving cheek raising along with the raised orbicularis occuli (eyelid muscles) and zygomaticus muscles are called "Duchenne Smiles" which tend to occur during emotionally positive smiles (Bolzani-Dinehart et al., 2005; Ekman, Davidson & Friesen, 1990; Fogel, Hsu, Shapiro, Nelson-Goens, & Secrist, 2006). Infants engage in smiles involving cheek raising when they are being smiled at by their mothers (Messinger, Fogel, & Dickson, 2001).

As development progresses, infants alternate their attention and smiles from their caregivers to objects in the environment (Rochat, 2001). These smiles progress when they use gestures, vocal stimuli, and eye contact to attract their caregivers to their own actions and their environment (Messinger & Fogel, 1998). While young infants observe and mimic the facial expressions of their mothers, the mothers in turn monitor and emphasize their infant's emotional expressions allowing babies to almost "fine-tune" their expressions (Gergely & Watson, 1999; Holodynski & Friedlmeier, 2006). This interactional exchange allows for the enhancement of their emotional displays and by inference their social development.

Young infants' social expectations and sense of self-efficacy are formed within their interactions with their caregivers. In a study of contingent smiles between 4-month old babies interacting with their mothers, Mcquaid, Bibok, and Carpendale (2009) showed that mothers' contingent smiles during an interactive engagement accounted for unique variance in infant social bids during a still-face phase beyond that which could be accounted for simply by the frequency of mother and infant smiles during the interactive phase. In face-to-face interactions, infants are more likely to smile when they are gazing at their mothers and when their mothers are also smiling back at them (Messinger et al., 2001; Weinberg & Tronick 1994). In a Brazilian cohort of mothers and young infants, there was a strong association between mothers' behaviors and their babies' smiles, emphasizing the importance of affective interactions in early development (Mendes et al., 2014).

The simultaneous sharing of a smile with synchronized direct gaze contact between mother and infant is hypothesized to be a marker of high-intensity positive affectivity and is referred to as a "Shared Pleasure (SP)" moment (Puura et al., 2002; Puura et al., 2019). SP is interesting in that it has been shown to correlate with attachment security (Mäntymaa et al., 2015), is highly malleable in the first year of life (Varpula, 2014), and maybe a possible marker of adequate parent-infant interaction (Puura et al., 2019). Its absence has been associated with maternal mental illness (Lachman et al., 2019; Varpula, 2014). Based on findings from Puura et al. (2019) in Finland, dyads who were best able to read each other's positive cues and respond to them, were more likely to experience mutual positive affects.

So if babies aren't able to see their caregivers' smiles how do they mimic it? How do they engage in the highly arousing, positive affective interaction if they are essentially faced with a blank screen? If we know babies need to engage face-to-face with their caregivers in the first few months of life, what happens when the caregiver needs to wear a mask?

For the Still Face Experiment, Tronick (2003) hypothesized that face-to-face interactions are co-created by an ongoing moment-to-moment dynamic process that generates unique interactive exchanges between the infant and its mother. The infants first engage in a normal interaction followed by a phase in which they have to cope with a stressful interaction—the "still face" (SF) where the mother freezes and becomes vocally and gesturally unresponsive. In response to this manipulation, infants typically react with less eye contact, express negative affect, and may lose postural control. Following the SF there is a reunion episode, where the positive affect recovers but not fully to the observed initial baseline level.

A review by Mesman, IJzendoorn, & Bakermans-Kranenburg (2009) suggested that the SF effect may also be due to the break-in typical social interaction. The responsiveness of the parent plays an important role in affect regulation, and the type of stress expressed by infants appears to be related to the breakdown in the expected communication within that dyad (Melinder, Forbes, Tronick, Fikke, & Gredebäck, 2010). This suggests that when infants expect a specific relational response from the mother or caregiver (such as a playful smile or expression) and this expected connection is not present (or interrupted in this case by the presence of a masked barrier), it could theoretically result in increased stress reactions. Melinder et al. (2010) further showed that the SF manipulation is perceived as a more dramatic experience for infants who relate to their mothers than for infants who relate to a stranger. Many South African infants are co-reared by a nanny employed as a domestic worker in the family home—as such the presence of the nanny in this situation is less that of a stranger and more closely resembles that of the primary caregiver. Does this mean the baby is more likely to protest and experience this new masked interaction as a stressful response to their normal expected interactions?

Perhaps timing is key?

As development progresses, emotional expressions increase in complexity and coordination. While in the first few months we recognize the reciprocal dyadic synchronous interactions as key to the infant's imitation of expressions, from around four months of age and beyond, communication changes. Social and emotional competencies become increasingly necessary for further relationships, and the type of maternal interaction at this stage is critical (Feldman, 2007; Little & Carter, 2005).

Early experiences have great potential to shape the trajectory of the developing brain and the long-term development of children. The World Health Organization's Nurturing Care Framework reminds us that in situations of unrelenting psychosocial adversity and stress, responsive and attentive nurturing care may be the key modifiable risk factor to protect babies against the negative effects of adversity.

As restrictions on close face-to-face contact in the time of COVID-19 force us to re-examine our instinctive social behaviours, maybe it is time for us to refocus and adapt how we provide responsive caregiving. Before children even learn to speak, engagement, and affection between them and caregivers are expressed through cuddling, eye contact, gestures, and of course smiles. Part of this responsive caregiving also includes observing and responding to infants' attempts to connect with the

world. Perhaps part of the new normal in a masked world needs to be an increased and more deliberate effort to notice and attentively respond to attempts by the infant to communicate. This would include more focussed and attuned responses to gestures, sounds, movements, and non-verbal interactions to help create and reinforce a mutually enjoyable interaction.

But for the really young infant, there likely can be no substitute for an authentic direct gaze with a synchronized shared smile. Regardless of the context, we all still smile in the same language.

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Helping the Helpers. Relationships During the Pandemic: "Good Morning, Margaret" "Good Morning, Heidi"

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Amid a global pandemic, with increased cases of COVID-19 reported everywhere every day, with rates climbing, with calls out seeking health care workers to come to hospitals and medical centers, with the news reporting outbreaks in every part of the world, and death, the Connecticut Association for Infant Mental Health (CT-AIMH) considered:

What do infant mental health professionals and leaders need during this time?

And thus, begins another day with Zoom meetings galore, masks on when out, 6 feet apart when nearing others, and wondering when it will all end, when will the vaccine come, when will we return to something near normal.

The following suggestion was one that was shared as the CT-AIMH worked to maintain relationships through virtual experiences and opportunities for our members and our Infant Early Childhood Mental Health (IECMH) community.

What do we,

those good infant mental health folks,

do

while we wait,

while we wonder,

and while we listen?

You could try starting your day with," Good morning, (your name)"

and if you can,

place your hand on your heart and add,

"I love you (your name).

To begin our work during these unprecedented times, in March, our Executive Director and Board of Directors posted a *Letter of Hope* to our members on the CT-AIMH website. This letter was followed by a list of categorized resources for use by our professionals in infant and early childhood mental health and set the stage for more 'personal' ways to reach out and relate.

APRIL 2020

In Connecticut, the CT-AIMH Executive Director (ED) presented to the Board of Directors (BOD) the possibility of creating opportunities to meet on a daily basis with our members. "Every day???" "That's too much", said some. Nevertheless, we went ahead and posted an invitation to our members to join us at noon, Monday – Friday (every business day), for 45 minutes, for the entire month of April. We called it: "Help for the Helpers".

Why every day? We wanted to be as available as possible to hold our members during this time when everything about their current way of working was changing. CT-AIMH wanted to hear what the infant mental health workforce was experiencing, to offer ways to cope, to provide a space to share resources, to create manageable professional development opportunities and to provide some time for joy. We knew everyone could not come to every session. We wanted to maintain our relationship with our members by being available as frequently as possible and at a predictable time.

The topics and facilitators were the same for each particular day of the week, but the content and participants varied. For example: Monday's facilitator remained the same for each Monday, and the focus for Monday's group remained the same throughout the month, but attendees were not bound by that. Attendees could choose to attend Monday and Thursday one week, and then Wednesday and Friday the following week.

APPENDIX C: ADDITIONAL INFORMATON TO PUBLISHED PAPERS

Chapter 4: Shared Pleasure in Early mother-infant interactions

A) Study Design

- Exclusion Criteria
  Infants with severe congenital abnormalities, HIE, Downs, microcephaly were excluded from the parent study for developmental assessments. For SP, no exclusion criteria for the infants were used other than poor visibility of the face on the video recording.

- Corrected Age for Prematurity
  Infants were corrected for gestational age. Corrected age for preterm infants was calculated by subtracting the difference between infants gestational age at birth and full-term gestational duration of 40 weeks from the post-natal age.
  Age of the infant is noted as a limitation as some were included under 2 months of age.

- The videos were rated for SP by the blinded researcher (AL), who had no contact with the participants prior to the recording. No additional questions were asked.

B) Temporal Stability of SP testing

- The rating of the SP was done for this study at an average age of 2 months 6days and then repeated at age 6months for the 2nd study (Chapter 5) when infants were assessed for developmental outcomes. The SP moments remained the same (20%) in this sample.

Chapter 5: Maternal Shared Pleasure, Infant Withdrawal, and Developmental Outcomes in a High Risk

A) Opportunity for Reassessment of the Infants

For the Bayleys developmental assessments, infants were assessed at an alternative time if they were assessed to be sleepy, tired or unwell. This was determined by the research team performing the developmental assessments. The ADBB was rated retrospectively on the videos that were recorded at the time of the developmental assessments so no reassessment was possible.

B) Antenatal Risk Factors

Ante-natal risk factors were assessed for associations with both developmental outcomes and ADBB. There were no significant associations determined between ADBB and maternal risk factors (such as depression and stressful life events) and of the available infant characteristics that were analysed, the only infant risk factor that was associated with infant withdrawal was male gender.
Nutritional status and anthropometry post-natally were documented with no associated significant findings with SP.

C) Limitations of Video Recordings in a Clinical Setting

The research setting was in a clinical hospital setting, with mothers interviewed and assessed for the parent study in their home language. The participants were familiar to the setting as they attended the hospital for their follow up visits. The mothers were

allowed to explore the toys and given the instruction to engage in "*free play as they normally would* ", with their infants, prior to any video recordings or assessments. It is still possible that they would have felt self-conscious playing while being videotaped.

D) Additional reasons for decreases in the motor performance scales

Raw and composite motor scores were assessed, and the decrease in performance was consistent. Additional reasons for the decrease in scores could be associations with multiple risk factors such as maternal (perinatal stress, adversity and mental illness) resulting in poorer maternal engagement with the infant, and by extension fewer opportunities for exploration and developmental stimulation that influence motor milestones. Infant risk factors could include smaller gestational age, early delivery and genetically influenced developmental competencies.

Chapter 6: The Shared Pleasure Paradigm: A study in an observational birth cohort in South Africa

A) Limitation

The generalization that all South African infants would do poorer on the developmental assessments compared to their peers in high-income countries is noted as a limitation that could be explained by socio-economic status, maternal education and potential cultural and environmental biases.