DOCTORAL THESIS

Clinical applications of the polyvagal theory and attachment theory to play therapy for children with developmental trauma

Hadiprodjo, Natalie

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Clinical applications of the Polyvagal theory and Attachment theory to Play Therapy for children with Developmental Trauma

by

Natalie Hadiprodjo

[BA, MC, MA]

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Department of Psychology

University of Roehampton

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Abstract

In recent decades advances in the field of neuroscience have contributed to a greater understanding of the impact of adverse childhood experiences on the developing brain and nervous system. There is a growing interest in examining how therapeutic interventions redress not only the psychological but also the physiological imbalances caused by early adversity. It is theorised that play therapy effects real change within a child's neurobiology, especially in re-balancing the physiology of the stress response system. This thesis examines the process of play therapy from a physiological perspective and presents two exploratory studies in the application of cardiac measures to play therapy research. The first study examines the individual cardiac physiology of five children during the construction of play narratives during a play-based assessment of attachment. The second study examines the interpersonal physiology of four play therapy dyads for evidence of cardiac linkage or synchrony. Cardiac measures of heart rate (HR) and heart rate variability, specifically respiratory sinus arrhythmia (RSA) were measured in both studies. Few studies have applied autonomic measures to play therapy research and the present studies were designed to gain an initial insight into the physiological mechanisms that underlie play therapy through the lens of the Polyvagal Theory. The Polyvagal theory is pertinent to play therapy given its emphasis on the role of relationships in regulating the stress response system via the vagus nerve - the activity of which is quantified by RSA. The present studies highlight the importance of nervous system regulation within play therapy, for children and therapists, and the vital role of therapists in assisting children in their 'biological quest for safety'.

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Chapter 1

Introduction and Review of the Related Literature

In recent decades advances in the field of neuroscience have contributed to a greater understanding of the impact of adverse childhood experiences on the developing brain and nervous system. Therapists increasingly recognise the importance of revisiting their practice in light of this emerging body of knowledge and examining how therapeutic interventions might be improved, through the application of neurodevelopmental and neurobiological principals. Consequently there is a growing interest in examining how therapeutic interventions redress not only the psychological but also the physiological imbalances caused by early trauma. The play, art and expressive therapies are increasingly recognised as approaches through which traumatic experiences stored in the body and brain can be accessed and integrated (Steele & Malchiodi, 2012). The International Society for Traumatic Stress Studies acknowledges that the creative art and play therapies are emerging approaches in the treatment of stress disorders in children, as they are unique methods for gaining access to traumatic content and enhancing self-regulation (Steele & Malchiodi, 2012). Play in particular, has been deemed a 'neural exercise' that enhances the co-regulation of physiological state and supports physical and mental wellbeing (Porges, 2017). Research into the biological mechanisms of play has also found that play promotes epigenetic changes in the brain and it is therefore argued that play should have a more prominent role in psychotherapy (Pankseep & Biven, 2012). Thus play therapy has been esteemed, "an excellent match for what we are learning from neuroscientists about how children's brains and minds get hurt and heal" (Badenoch, 2008, p.300). It is theorised that play therapy effects real change within a child's neurobiology, especially in re-balancing the physiology of the stress response system, a system acutely sensitive to early adversity and relational trauma (Norton, Ferriegel & Norton, 2011). However, while play therapy is widely recognised as a developmentally sensitive approach to working with children, that allows for the safe processing of trauma (Landreth, 2002), play therapy research has not traditionally considered how play therapy addresses the physiological needs of traumatised children. A mining report for the Association of Play Therapy contends:

> Today, knowledge from the field of neuroscience promises to improve play therapies for traumatised children. The challenge for the future is to create treatments for low brain trauma. Traditional concepts and practices must be re-examined and expanded as play therapists enhance their appreciation of neurobiological principles and their influence on treatment" (Gaskill, 2008, p. 1).

The field of child traumatology is rapidly advancing and the identification of innovative interventions that address the negative effects of childhood stress and adversity is considered the next frontier in paediatric practice (Shonkoff & Garner, 2012). To date a lack of research has prevented play therapy from gaining recognition as a well-founded treatment modality within the mental health field, and play therapy is at a point where it must prove its effectiveness (Frick-Helms & Drewes, 2010; Ogawa, 2004). The creative art and play therapies are generally considered to be unscientific, despite advances in neuroscience that indicate that lower-brain, play-based approaches are more crucial to recovery following childhood trauma than other more widely accepted approaches, such as cognitive behavioural therapy (Steele & Malchiodi, 2012; Pankseep & Scott, 2012). Given that early trauma is implicitly encoded in the lower parts of the brain, where there is no language, these experiences are more readily communicated through imagery and sensory expression, key modalities in the creative art and play therapies (Malchiodi, 2008). Child-centred play therapy historically operates from the Rogerian principal that individuals have an innate trajectory towards healing and growth, given the right conditions. The challenge for present-day play therapists is to examine how emerging insights into the impact of trauma on the brain and nervous system should inform practice, and how therapists go about creating the 'right conditions' for healing and growth, not only psychologically but also physiologically.

Purpose of Study

The present thesis examines the process of play therapy from a physiological perspective through an in-depth, descriptive analysis of several clinical case studies. The thesis presents two exploratory studies examining the application of cardiac measures to play therapy research. The first study examines the individual cardiac physiology of five children who've experienced early adversity, during the construction of play narratives. The second study examines the interpersonal physiology of four play therapy dyads and the presence of cardiac linkage or synchrony. Cardiac measures of heart rate (HR) and heart rate variability (HRV), specifically a type of HRV called respiratory sinus arrhythmia (RSA), were measured in both studies. Heart rate variability is an increasingly popular measure in psychotherapy research as it provides a quantitative marker of the activity of the autonomic nervous system. Few studies have applied autonomic measures to play therapy research and the present studies were designed to gain a preliminary insight into the physiological mechanisms that may underlie play and play therapy through the lens of the Polyvagal theory (Porges, 1995, 2001, 2007, 2011, 2017).

The Polyvagal theory is pertinent to play therapy given the theory's emphasis on the role of relationships in regulating stress via the vagus nerve, a key cranial nerve central to the parasympathetic nervous system that links the brain, heart and body. RSA is a key component of this theory as it provides a quantitative measure of the influence of the vagus nerve on the heart. The Polyvagal theory provides a biological understanding of attachment relationships, and formulates how attachment and social play depend on parasympathetically or vagally mediated processes within the autonomic nervous system. It was anticipated that the live monitoring of cardiac physiology of children and therapists would lead to further insights into the relevance of autonomic regulation, as conceptualised by the Polyvagal theory, to play therapy theory, practice and research. The project addresses several needs identified in the play therapy literature, including a need for research into the impact of therapy on the developing brain and nervous system, and research related to trauma, anxiety, and attachment: areas internationally identified by the Association for Play Therapy for immediate research consideration (APT, 2012). The application of physiological measures to play therapy research has the potential to provide timely evidence into the effectiveness of play therapy and its impact on the dysregulated stress physiology of children who've experienced early adversity.

The Scope of the Problem: Childhood Adversity and Developmental Trauma

The present study is primarily concerned with the use of play therapy as an intervention for children who've experienced early adversity of an interpersonal nature, including exposure to experiences such as domestic or family violence, maltreatment, neglect, physical, emotional or sexual abuse: experiences that fall under the broad umbrella of developmental trauma (van der Kolk, 2005). Childhood trauma specialists increasingly refer to the concept of developmental trauma for children with multiple experiences of early adversity. This type of trauma has also been described as cumulative (Khan, 1963), complex, or Type II trauma (Terr, 1991). These children are typically excluded from research due to the severity of their difficulties and the comorbidity of problems they experience. That said these children represent society's most vulnerable and at-risk children, who are a growing portion of real world play therapy practice. Early experiences of trauma set the stage for vulnerability in the face of future life stress (Scaer, 2005) and there are clear links between the quality of an individual's early attachment experiences and their psychological and physiological stress-coping strategies (Steele & Malchiodi, 2012). It has been shown that it's not necessarily adversity itself, but the absence of a protective relationship that is culpable in the development of stress disorders (Shonkoff & Garner, 2012). Children who've experienced developmental trauma display significant difficulties with self-regulation. These children may be diagnosed with a number of regulatory disorders including depression, attention-deficit and disruptive behaviour disorders, such as ADHD, conduct disorders, oppositional defiant disorders and other pervasive developmental disorders such as autism. These somewhat overlapping diagnoses typically capture some, but not all of the difficulties experienced by these children and several researchers point to the potential misdiagnosis of regulatory disorders in maltreated children, and a failure to treat the underlying trauma (Disseth, 2005; Pankseep & Biven, 2012; Terr, 1991). Maltreated children may also display symptoms of post-traumatic stress, although the diagnostic criteria for childhood PTSD is criticised for being modelled on adult symptoms and not adequately sensitive to the effects of stress and trauma on the developing child (van der Kolk, 2005).

Within the field of childhood trauma a growing number of clinicians support the establishment of a Developmental Trauma Disorder diagnosis as a new framework for encapsulating the symptoms and experiences of children with histories of complex interpersonal trauma (van der Kolk, 2005). Although irrespective of on-going debates as to how to best encapsulate the difficulties displayed by these complex children, it's clear that early adverse life experiences are harmful to a child's development. Traumatic events and inadequate attachment experiences that occur during the first decade of life, while the brain and nervous system are developing, have a pervasive long-term impact on an individual's emotional, social, behavioural, cognitive and physiological functioning (Heller & LePierre, 2012; Heim et al., 2000; Perry, et al., 1995). Childhood maltreatment has been shown to have an etiological role in the development of adult mental illness (Beitchmann et al., 1992; Kendeler et al., 2000) and it is argued that the links between childhood trauma and adult mental health are too often ignored (Read et al., 2001).

Developmental trauma is considered one of the most urgent public health issues for the world today (Heller & LePierre, 2012). The Adverse Childhood Experiences (ACE) study, with over 17,000 participants in the United States, is the largest retrospective investigation into the relationship between childhood maltreatment and later-life health and wellbeing (Felitti et. al., 1998). Adult reported experiences of childhood abuse, neglect, and exposure to traumatic stress and household dysfunction were specified and each item scored as an adverse childhood experience. Example ACEs included: growing up in a home with someone who was depressed, mentally ill, a substance abuser or who had been incarcerated, exposure to acts of abuse, neglect or domestic violence, and the loss of a parent through divorce, separation or death. Over two thirds reported exposure to at least one ACE. More than one in five reported three or more ACEs. The original ACE investigation showed a graded relationship between the number of adverse childhood experiences and adult health outcomes. As an individual's ACE score increased so did the risk of health problems including substance misuse, mental illness, obesity, heart disease, cancer and premature death, along with higher rates of unemployment and continued involvement in violence (Felitti et. al., 1998).

A national ACE study in England, with 1,500 participants, found that almost half (47.1%) reported at least one ACE and 12.3% four or more ACEs (Bellis et. al., 2014). The study also observed that individuals who scored numerous ACEs took more sexual risks, become parents earlier and raised their children in high-risk environments. To estimate the existing prevalence of childhood maltreatment in the UK, the NSPCC released its most comprehensive overview of child protection in the UK, 'How safe are our children?’ (Jutte et al., 2015). The review found that police recorded the highest number of sexual, cruelty and neglect offences against children in 2013/14 for the past decade. In 2013/14 6.5% of 10-15 year old children in England and Wales were the victim of a violent crime. It also concluded that there are more children suffering abuse or neglect than those known to children’s social services, and estimated that for every child on a child protection plan or register, another eight children may also suffer maltreatment. Subsequently the NSPCC released an ‘It’s Time Campaign Report’ (2016) to advocate for improved services for abused children. The report argues that there is a substantial shortage of services for the half-a-million children who are abused in the UK each year, the equivalent of two children in every primary school class. 96% of 1,256 surveyed professionals, including teachers, general practitioners and social workers, felt that current child and youth mental health services in the UK were inadequate. The report called for an increase in funding, therapeutic support and research into therapies that best support these children. They call for services provided by a range of trained professionals including talk therapies, family therapy, cognitive behavioural therapy, play-based therapy, counselling and psychotherapy. It concluded,

> Where there is support available, it is often poorly tailored to meet the needs of children and young people who have experienced abuse and neglect...Research regarding best practice in therapeutic support for abused children is under-developed, which means we don’t always know what will work best. We must improve our evidence base for child-centred, therapeutic support for children who’ve experienced abuse (Ibid p.6).

Childhood maltreatment is a significant public health issue for society today and there is a need for intervention and prevention programs that address the complexity of this serious issue. Play therapists, who work in multiple contexts, including schools, specialist provisions, private practice, and mental health services, increasingly find themselves working with dysregulated children who've experienced interpersonal trauma. Play therapy, though the therapeutic use of a play relationship, has the potential to be a leading therapeutic intervention for children who've experienced early adversity.

Play Therapy

Play serves multiple purposes in the lives of children and aids healthy social, emotional and cognitive development. Play is recognised by the United Nations as a universal right for children (Charter art. 31, 1990) and contemporary neuroscientists argue that play is a universal need, given the dependency of brain development on frequent play experiences early in life (Brown, 2009; Pankseep & Biven, 2012; Pellis & Pellis, 2009). The therapeutic use of play is a relatively recent phenomenon and play therapy is the foremost therapy to advocate the healing power of play. Scafer and Drewes (2014) identified 20 active ingredients in play that lead to therapeutic change. They divide these agents into four key areas: (1) the facilitation of communication, (2) the facilitation of emotional wellness which includes concepts such as abreaction, counterconditioning of fears, stress inoculation and stress management, (3) the enhancement of social relationships, and (4) increasing personal strengths such as resilience and self-regulation. Play therapy is founded on the principle that children innately communicate, organise and express their emotions and experiences through play (Landreth, 2002). Most forms of play therapy fall into one of two groups: directive or non-directive. The key difference between the two groups is the degree to which a therapist structures, directs, and interprets a child's play within therapy. Relationship-based approaches tend to be less structured and interpretive, and include non-directive play therapy (NDPT) or child-centred play therapy (CCPT).

Child-Centred Play Therapy

The model of play therapy examined within the present thesis is non-directive or child-centred. Literature in the UK typically prefers non-directive as a descriptor for this type of play therapy, while US publications prefer the term child-centred play therapy. The British Association of Play Therapists defines non-directive play therapy as:

> The dynamic process between a child and Play Therapist in which the child explores at his or her own pace and with his or her own agenda those issues, past and current, conscious and unconscious, that are affecting the child's life in the present. The child's inner resources are enabled by the therapeutic alliance to bring about growth and change. Play Therapy is child-centred, in which play is the primary medium (of communication) (BAPT, 2015).

Non-directive or child-centred play therapy was established by Virginia Axline (1947, 1964, 1969) who adapted Carl Rogers' (1951, 1955) humanistic person-centred approach including the 'core conditions' of genuineness, authenticity, non-possessive warmth and empathy, to her work with children. Like Rogers Axline believed that the therapy relationship was the key condition for change. Axline surmised that play was a child's natural means of self-expression, and therapy provided children with an opportunity to 'play out' their difficulties, as an adult might 'talk out' his (Axline, 1947). Non-directive play therapists believe that play, within a safe therapeutic relationship, is inherently healing, irrespective of whether the child is able to consciously understand or verbalise his experiences (Wilson & Ryan, 2005). Through play a child can, "show more adequately than through words how he feels about himself and the significant persons and events in his life" (Ginott, 1961, p.33). Axline's approach was further developed in the US by therapists including Moustakas (1955), Guerney (1983) and Landreth (2002). Landreth expanded on Axline's principles to formalise child-centred play therapy, which is now the most widely known and practiced form of play therapy. Correspondingly, West (1992, 1996) and Wilson and Ryan (1992, 2005) furthered the field of non-directive play therapy in Britain. Wilson and Ryan (2005) describe the current method of non-directive play therapy in Britain as follows.

> The choice of issues and the focus of play and actions in the play room are determined by children…The therapist's role is to develop a close and trusting relationship with the children, and to reflect and respond to their thoughts, feeling and activities in such a way as to facilitate the resolution of children's emotional difficulties at their own pace and through the means they have chosen…Unlike some other therapeutic methods with children, the reflection process does not involve praise, interpretation of underlying motives, problem-solving or challenging of children's mental defences. Basic limits to behaviour in the playroom are set, and therapists always have adult responsibility for children's physical and emotional safety...Therapist's behaviour and communication are designed to promote a sense of trust and safety in which children feel free if they wish to express and explore issues of emotional saliency (p.23).

The Developing Theoretical Framework of Play Therapy

Since its inception play therapy has been shaped by several waves of thinking traversing psychoanalytic, developmental and attachment theories. At the present time play therapy is on the cusp of a new wave of development and is being shaped by findings and insights emerging from the field of neuroscience; including concepts related to neurodevelopment, interpersonal neurobiology and the impact of trauma on the developing brain and nervous system. Some of the key concepts that have influenced play therapy and the newly associated neurobiological underpinnings are outlined below.

Play Therapy and Symbolism

Early psychoanalysts were among the first to highlight the importance of symbolism in early development. Psychoanalysts such as Melanie Klein and Anna Freud were among the first to use play therapeutically with children and viewed play as a window into the psyche and preoccupations of children. Winnicott (1953) further theorised about early symbol use between a mother and a child, and made a connection between symbolic play and the way children understand other minds. Successively Piaget (1962) highlighted the role of symbolic play in cognitive development. Piaget identified several stages of play including sensorimotor or practice play in infancy, which is followed by symbolic, socio-dramatic and rule-based play.

The symbolic nature of play is fundamental to play therapy practice as it provides a protective, safe, or symbolic distance between a child and the difficult experiences that he is attempting to address in therapy. Pretend play allows a child to use art, toys or imaginary characters to indirectly express their thoughts, feelings and experiences (Schaefer, 2012). In play children can express troubling experiences through a symbolic re-enactment, which aids in self-regulation, a sense of mastery, and a reduction in acting-out behaviours (Crenshaw & Hardy, 2007; Markese, 2007). It could be surmised that symbolic play allows for the expression of experiences that cannot be put into words because: (a) it's too developmentally demanding for a child to use words, (b) it's too overwhelming or anxiety provoking to directly communicate these experiences with words, (c) the experiences are of a traumatic nature and inaccessible to explicit memory and verbal recall, or (d) the experiences occurred in the pre-verbal period prior to the development of language. The symbolic nature of play is especially important when working with childhood trauma, as trauma is fundamentally a non-verbal phenomenon.

Considerable neurobiological evidence supports the idea that trauma memories are stored in the primitive implicit, affective and sensorimotor parts of the brain, rather than in the explicit memory and language-based parts of the brain. In situations of overwhelming stress the limbic system is activated and the language areas of the brain are deactivated, resulting in a decreased capacity for declarative memory and narrative recall (van der Kolk, 1996). In essence, the human brain stores traumatic experiences in a way that hinders verbal expression (Harris, 2009). Play is the language of the right hemisphere, which is made up of sensorimotor, kinaesthetic, visceral sensations and visual images. The right hemisphere is also the dominant hemisphere in the first three years of life (Schore, 2003). Thus play allows access to the earliest experiences of a child that lie outside of conscious awareness. In play therapy a child can play-out and transform implicit memories that are inaccessible to verbal language. With the help of a therapist a child can develop a more coherent narrative which aids in the integration of implicit and explicit memory systems, and a reduced activation of the stress response system (Kaplow et al., 2006). Panksepp and Biven (2012) postulate that play promotes the integration and organisation of complex affective information in the brain in a functionally similar way as dreaming does during REM sleep. Playing and dreaming both allow the evaluation of past events and the chance to test out new solutions to real-life problems; which results in more adaptive emotional and behavioural responses to real-life events (Panksepp & Biven, 2012).

Play Therapy and Pleasure

Winnicott observed that play was characterised by preoccupation and pleasure. He observed that even when play involved a degree of anxiety it was still satisfying and concluded that play itself was therapy (Winnicott, 1971). Erik Erikson (1963) also observed the healing power of play, commenting, "to play out is the most natural self-healing measure childhood affords" (p.22). Garvey (1977) identified specific features of play that separated it from other activities, including the fact that play is: spontaneous, voluntary, enjoyable, engaging and intrinsically rewarding. Neuroscientists have also observed that play is a naturally rewarding experience for the brain (Burgdorf et al, 2010; Panksepp, Sivily, & Normansell, 1984; Trezza, Baarendse, & Vanderschuren, 2010). Social play has also been found to activate neural growth in the frontal cortex and amygdala, areas of the brain that are key to regulating stress, developing empathy and understanding the emotional states of others (Goleman, 2006; Gordan et al., 2003; Pankseep & Biven, 2012). Panksepp identifies play as one of seven basic affective and motivational systems in the mammalian brain (Panksepp & Biven, 2012). Play has its own neural circuitry and all mammals have a genetically determined, innate urge to play (Panksepp & Biven, 2012). Panksepp likens this 'play urge' to a kind of hunger, where play is a naturally rewarding and stress-reducing experience that is accompanied by a feeling of wellbeing (Panksepp & Biven, 2012). Moreover play allows for heightened states of arousal or anxiety without activating the stress response system (Panksepp et. al., 1984; Pellis & Pellis, 2009; Porges, 2011; Trezza et al., 2010).

Play therapy relies on a child's natural play drive and the tendency for children to 'play out' their worries and concerns. Carroll (2002) in her study examining children's' experiences of play therapy found that having fun in therapy was one of the things children valued highly. Shared moments of laughter and joy in therapy may also mark significant moments of therapeutic effect (Panksepp & Biven, 2012). Research in memory reconsolidation indicates that negative affective experiences can be remoulded by positive affective experiences in therapy, which allows traumatic memories to be reconsolidated at a neurobiological level in a less troubling form (Panksepp & Biven, 2012).

Play Therapy and Attachment

Early psychoanalytic theorists were the first to observe the importance of a mother's attentiveness to her child. Winnicott (1971) saw a mother as providing a safe holding environment for her child. Similarly Bion (1962) described a mother providing a sense of containment, and Bowlby (1969, 1980) introduced the idea of a secure base. It became evident that the holding environment offered by a mother varied between dyads, which led to the idea of children developing a secure or insecure pattern of attachment. Bowlby (1969) proposed the idea of an internal working model as an inner template of attachment experiences.

> The internal working model, informs one's sense of self, others, what to expect and how to behave, particularly when distressed, that is, when the attachment systems is activated. The internal working model of attachment may be seen as the blueprint for survival, knowing if and to whom you can turn when upset, and whether and how to approach (Steele et al., 2010, p.27).

Secure and insecure patterns of attachment have been formalised by theorists such as Patricia Crittenden (2008) who developed the Dynamic Maturational Model of Attachment (DMM). It is now widely acknowledged that a secure attachment between an infant and caregiver, where the adult is responsive to the child's feeling states, is vital to the development of symbolic play, mentalising and empathy (Gerhardt, 2004; Perry & Szalavitz, 2010; Stern, 1998). Research has shown that maltreated children display insecure patterns of attachment and are less resilient than securely attached children (James, 1994; Baer & Martinez, 2006). A play therapist aims to provide a child with a secure relationship that mirrors what occurs within a healthy, secure, mother-child attachment (Whelan & Stewart, 2014). Therapy can provide a developmentally corrective experience of attachment for those children who've missed out on this early experience, where the therapist serves as a secondary attachment figure (Schore, 2003; Siegel, 1999). The establishment of a secure attachment in therapy makes it possible for children to face feeling states that would otherwise be overwhelming (Score, 2003; Siegel, 1999, 2007). This creates a new experience of attachment that in turn triggers changes in the brain (Cozolino, 2006).

As a result of neurobiological research, attachment theory has expanded to include a theory of regulation. Attachment plays a key role in shaping the regulatory and survival functions of the brain (Heller & LePierrer, 2012; Schore & Schore, 2008). A child's earliest attachment involves numerous experiences of rupture and repair where the child moves between states of autonomic dysregulation and regulation. In a secure attachment, when a child signals discomfort, an attuned caregiver helps the infant to return to a regulated state. When a mother soothes her baby she essentially soothes the baby's nervous system (Heller & LePierer, 2012). A child who does not experience having his nervous system soothed by a caregiver in times of stress, does not learn how to adequately regulate his emotions. This understanding of nervous system regulation is now an essential component of clinical practice and is leading to a new regulation theory of therapy (Heller & LePierre, 2012; Schore & Schore, 2008). Therapy must act on the stress response systems of the brain and nervous system and regulate a child's arousal if it is to be effective (Levine & Kline, 2007; Schore, 2001).

Furthermore it has been shown that a high quality relational partner reduces an individual's metabolic energy demands, and minimises the brains response to threat cues (Coan et al., 2006). Cozolino (2010) proposes that a high quality relational partner displays the characteristics identified by Rogers, namely empathy, congruence, and unconditional positive regard. A therapist ‘relationally regulates’ a child’s nervous system within therapy, which strengthens a child’s self-regulation over time (Geller & Porges, 2014). There is a ‘psychobiological core’ to the therapy relationship, where the therapist serves as an attuned nervous system regulator for her clients (Schore & Schore, 2008). For play therapy to be effective the nervous system of a child must detect features of safety in both the therapy environment and the therapist (Porges, 2017). Porges (2015, 2017) notes that feeling safe not only requires the absence of threat, but also the presence of safety cues discernible to the nervous system. When these safety cues are detected a down-regulation of involuntary defences (i.e. fight, flight or freeze) and an up-regulation of the vagally mediated social engagement system occurs to support health, growth, restoration and calm social interaction (Porges, 2011, 2015, 2017).

Play Therapy and Trauma

Spontaneous play only occurs when a child perceives that they are safe. In situations of extreme anxiety, stress or trauma, a child will not play (Landreth, 2012). In therapy a child may suddenly stop his play if he no longer feels safe. If a therapist pushes a child to confront traumatic material too soon, there is a risk of re-traumatisation and a loss of safety and trust (Crenshaw, 2007). There is a general consensus that there is an optimal level of stress necessary for therapeutic effect. Practitioners refer to a desired physiological arousal window, or ‘window of tolerance’ that best facilitates the safe processing of traumatic material (Ogden, Minton & Pain, 2006; Siegel, 1999), and creates the most favourable environment for neural plasticity and integration (Cozolino, 2010). A child who is over or under-aroused is unable to integrate his traumatic experiences. Although some children may have a smaller window of tolerance than others, and the challenge for a therapist is to keep a child within his unique window, where there is an optimal level of nervous system activation in which the re-working of trauma can best take place, so that they are neither disconnected nor overwhelmed by their experience of therapy (Cozolino, 2010). Thus the renegotiation of trauma must occur in a titrated fashion, so that the level of arousal increases at a similar rate as the development of a child's internal resources for managing stress (Levine, 1997), or the speed at which their window of tolerance expands. Once a child is able to tolerate a degree of stress within therapy, therapy can then address higher emotional and cognitive issues such as trauma narratives, meaning, guilt, shame, loss and identity (Steele & Malchoidi, 2012; Heller & LaPierre, 2012). Play also provides a means through which children can complete previously truncated acts of defence, which changes the meaning of these experiences and leads to feelings of mastery, pride and empowerment (Scaer, 2005; Norton, Ferriegel & Norton, 2011). The feeling of helplessness is one of the most disabling elements of trauma. The opportunity to overcome this feeling and replace it with a sense of mastery and control, even symbolically, is one of the keys to healing from trauma (Scaer, 2005). Through symbolic play children can experiment with alternative endings and build a sense of safety and mastery over their fears that can effect real change in their neurobiology (Norton et al., 2011). As Goodyear-Brown observes,

> Through the many repetitions of safe outcomes that are experienced through metaphoric play, the client begins to build an alternative script to the one of danger that has previously been rehearsed. In the same way that sensations of helplessness and terror can be conditioned through traumatic experiences, sensations of empowerment and security can be conditioned through repetitions of energized, experiential play (2010, p.65).

The Polyvagal Theory

The Polyvagal theory (Porges, 1995, 2001, 2007, 2011, 2017) is a relatively new theory central to the science of play therapy (Kestly, 2016) that provides therapists with a biological explanation of formerly intuitive therapy processes (Wagner, 2015). The theory offers a bio-behavioural framework that links attachment behaviours to the neural regulation of the autonomic nervous system (ANS) via the myelinated ventral component of the 10^{th} cranial nerve, the vagus nerve, a key component of the parasympathetic nervous system commonly referred to as the vagal brake. Put simply, the Polyvagal theory is a theory of how relationships regulate the autonomic fear response via the vagus nerve. The ANS is divided into two branches, the parasympathetic (PNS) and the sympathetic nervous system (SNS). The PNS decreases physiological activity and is responsible for states of rest and recovery in safe environments, while the SNS increases physiological activity and is responsible for states of mobilisation and fight, flight behaviours, in unsafe or challenging situations.

While early arousal theories focused on the sympathetic component of the ANS, the Polyvagal theory emphasises the role of relationships in modulating arousal via the parasympathetic component of the ANS (i.e. the vagus nerve), and presents a hierarchy of defence responses. The vagus nerve allows rapid engagement and disengagement with the environment and fine-tunes bodily reactions in social situations by aiding prompt, continuous feedback between the brain and multiple points in the body, including the heart, lungs, digestive system and muscles of the face, mouth and throat (Porges, 2005, 2007). The theory explains how physiological state influences behaviour and the ability to interact with others, and the mechanism by which perceived threat shifts physiological state from one that (a) supports social engagement (i.e. a PNS dominant state characterised by engagement of the vagal brake and inhibition of sympathetic activation); to (b) a state that promotes defensive fight, flight behaviours (i.e. a state characterised by removal of the vagal brake and increased sympathetic arousal); to (c) a state that promotes freeze behaviours (i.e. PNS shutdown driven by the primitive dorsal component of the vagus nerve) (Porges, 1995). The Polyvagal theory emphasises that feeling safe depends on an individual instinctively detecting via a process called ‘neuroception’ certain cues in the environment and his relationships that actively inhibit defence circuits and promote social communication and feelings of love and trust (Porges, 2011).

The Polyvagal theory contends that while the vagal system originally served as a neural circuit controlling the fight, flight stress response, it has become connected to other cranial nerves that mediate social behaviours such as facial expression, head turning, gesturing, listening and vocalisation; behaviours that are central to relational tasks such as maintaining eye contact, the use of rhythm and tone to convey emotion, and the ability to discern vocalisations, facial expression, affect and intent in others (Porges, 2007, 2011). It is this connection between the vagal system and the other cranial nerves that allows cardiac states to be influenced by one another’s nonverbal behaviours, such as vocal prosody or facial expression (Porges, 1997, 2011). In the absence of threat or challenge (i.e. when there is a neuroception of safety) the vagus works to foster calm states, enhance digestion, growth and social communication by actively inhibiting sympathetic arousal and the fight, flight response via the vagus nerve (i.e. the vagal brake is engaged) (Porges, 2007, 2011). Conversely, under conditions of threat or emotional or cognitive challenge, this inhibition is removed (i.e. the vagal brake is withdrawn). An optimal decrease in vagal activation via withdrawal of the vagal brake results in the mobilisation of physiological resources and a rapid increase in heart rate that aids self-regulation, sustained attention and engagement with the environment and the challenge at hand (Calkins, 1997; Porges, 2007). If the threat or challenge is ongoing, further removal of the vagal brake allows the SNS to increase arousal and mobilise defensive fight, flight behaviours. Once the vagal brake is removed an individual is less physiologically available for social connection and thus the vagal brake is quickly reinstated once a stressor has been managed, to reduce arousal and enable rest, recovery and a return to social engagement. If there is a neuroception of life threat the primitive dorsal component of the vagus nerve may be utilised as a final line of defence, resulting in states of low arousal, immobilisation or freeze (Porges, 2009, 2011).

Consequently, the vagus nerve plays a central role in modulating sympathetic arousal to regulate affect and maintain social engagement (Cozolino, 2010). A well-regulated and calm physiological state contributes to better control of facial expressions, vocalisation and social behaviours (Heliman et al., 2010). For example, effective vagal regulation allows an individual to experience negative emotion such as anxiety or anger without withdrawing or becoming aggressive (Cozolino, 2010). It is widely held that moderate autonomic reactivity in response to stress or challenge is the most adaptive response that reflects active coping and self-regulation (Beauchine, 2001; Calkins, 1997; Porges, 2007). Moreover, individuals who react to stress with optimal levels of vagal withdrawal and rapid reinstatement of the vagal brake have a greater capacity for flexible relating (Porges, 2011).

In light of this theory, children who present with behaviour and regulatory disorders would be expected to display atypical vagal regulation of the heart and difficulty fine-tuning their vagal brake. It could be conjectured that these children have not experienced an attachment relationship secure enough to shape an adaptive vagal system (Cozolino, 2010). There is growing evidence to suggest that vagal dysregulation plays a key role in the development of disruptive behaviour disorders (Beauchine, 2001). Studies have shown that children with behavioural difficulties have lower resting levels of vagal tone (i.e. low resting RSA), and difficulties regulating their vagal brake during social and cognitive challenges (Beauchine et al., 2001; Blair & Peters, 2003; Calkins, 1997; Calkins & Demond, 2000; Calkins & Keane, 2004; Dale, O'Hare, Keen & Porges, 2011; Porges, Doussard-Roosevelt, Portales & Greenspan, 1996). The

Polyvagal theory proposes that behavioural disorders ultimately result from difficulties regulating the neural circuits responsible for turning off defensive fight, flight or freeze reactions so that social engagement can occur (Porges, 2017). Children with insecure attachments are likely to have a compromised social engagement system and subsequent difficulties with the neural regulation of the muscles of their head, heart and viscera. They will be less able to fine-tune the vagus nerve so that positive social interaction can regulate their heart and display behaviours associated with defensive fight, flight or freeze reactions (Ogden et al., 2006).

A Polyvagal Perspective of Play

The Polyvagal theory proposes that social play is a distinct autonomic process that blends the parasympathetic social engagement system and the sympathetic system to allow states of heighted arousal during play without triggering a defensive fight, flight response (Porges, 2011). This blending of the two branches of the ANS requires the 'players' to unconsciously detect a neuroception of safety through a reciprocal face-to-face interaction that communicates that they are 'just playing' (Kestly, 2016). As Porges (2011) elaborates,

> Thus play shares with the defensive fight-or-flight behaviours a neurophysiological substrate that functionally increases metabolic output by increasing sympathetic excitation. Concurrent with the sympathetic excitation is a withdrawal of the myelinated vagal pathways that characterise the vagal brake. Just as the primitive mechanisms mediating immobilisation in response to life threat can be co-opted to support loving and nurturing processes, so can mobilisation mechanisms be involved to facilitate both defensive fight-or-flight behaviours and pleasurable 'play' (p. 276).

The Polyvagal theory provides a picture of how play presents in the autonomic nervous system (Kestly, 2016). According to the Polyvagal theory there are two exceptions to the fight, flight or freeze response: autonomic states characterised by *immobilisation without fear* or *mobilisation without fear* (Porges, 2011). In states of *immobilisation without fear* the dorsal vagal component of the parasympathetic system is co-opted by the social engagement system when there is a neuroception of safety, to support loving and nurturing behaviours necessary for tasks such as reproduction, childbirth and nursing. In states of *mobilisation without fear* the sympathetic system is co-opted by the social engagement system to support states of pleasurable play (Porges, 2011). Although sympathetic excitation is typically associated with defensive behaviours and aggression, in the case of play, sympathetic excitation provides increased metabolic output to support the motor activity of play and provides children with an opportunity for learning how to manage physiological states of high arousal (Kestly, 2014). Kestly (2014) proposes that the same may be true of low-arousal play states that co-opt the dorsal vagal branch of the parasympathetic nervous system, otherwise associated with states of collapse and immobilisation, so that a child can learn how to manage states of low arousal, for example when a child pretends to sleep, hide or die in play.

This type of social play requires face-to-face contact and the use of voice to ascertain that each member of the dyad is 'just playing' and is typically accompanied by play signals such as increased eye contact, physical proximity, a smiling mouth and eyes, giggles and laughter (Pankseep, 1998; Kestly, 2017). These play signals are unconsciously detected via the ventral vagus which sustains a neuroception of safety for the 'players' despite increasing or decreasing arousal. This unique Polyvagal play state is fundamental to play therapy practice as it provides a biological explanation of how play helps children process highly arousing and traumatic experiences without activating a re-traumatising fight, flight or freeze response; and provides a biological rationale for why play therapy is a fitting modality for the treatment of childhood trauma.

Post-Traumatic Play

When children engage in play therapy they demonstrate an innate tendency to play-out troubling experiences[1]. During this play children may also unwittingly re-evoke the emotional and physiological memories associated with the original traumas (van der Kolk, 2003). A goal of play therapy is to assist children to learn how to "physically respond to current stressors without recreating the traumatic past behaviourally, emotionally and biologically" (van der Kolk, 2003, p.311). Within the play therapy literature, therapists have repeatedly drawn attention to a problematic type of play called *stuck* or *stagnant post-traumatic play* (Gill, 2006; Goodyear-Brown, 2010; Levine & Kline, 2007). In this play children play compulsively, unaware of the presence of the therapist. There are fewer observed play signals and less face-to-face contact. This play also lacks imagination, joy, spontaneity, variety, and fails to bring relief (Gil, 2006; Levine & Kline, 2007). Stuck play is considered unhelpful and potentially re-traumatising, as it appears to be a re-living rather than a re-working of traumatic experiences. In essence it could be argued that stuck play is not really play at all as it lacks the defining features of play, largely joy in relationship. Alternatively, *dynamic post-traumatic play* allows for the re-working of trauma and is characterised by visible affect, variety, creativity, imagination, symbolism, joy and relief, and acknowledgement

[1] The author's own experience of working with a child stuck in post-traumatic play and the associated theory, the impetus for the present research, is attached in Appendix C - a published book chapter.

and interaction with the therapist (Gil, 2006). It is this type of dynamic play that a play therapist hopes to facilitate.

In light of the Polyvagal perspective of play, the phenomenon of stuck play likely occurs when a child does not detect a neuroception of safety and his autonomic defences are activated. This is consistent with the work of Pankseep who asserts that play has its own unique neural circuitry that can only be accessed when a child is feeling safe (Pankseep & Biven, 2012). Correspondingly, dynamic play is what Porges (2011) identifies as a Polyvagal play state, which is characterised by a neuroception of safety, sympathetic arousal and activation of the social engagement system; or as Kestly (2016) proposes it may also be characterised by a neuroception of safety, a co-opting of the dorsal vagus and activation of the social engagement system. Thus a Polyvagal perspective of play describes the biological mechanisms that underlie what play therapists have termed dynamic post-traumatic play. It is only when a child is in a state of dynamic or what could be termed Polyvagal play that they are able to rework and integrate traumatic experiences in play therapy without triggering a defensive fight, flight or freeze response. In dynamic play, states of sympathetic arousal or parasympathetic collapse are modulated through a child's active engagement with the therapist (i.e. the biological social engagement system of the therapist and child are online). Kestly (2014, p.35) surmises that dynamic play, according to the Polyvagal definition of play, requires:

- Face-to-face engagement to assess play intent
- Turn-taking
- Expressed empathy and concern for the well-being of the other player
- Activation of the sympathetic nervous system to support mobilised motor activity, followed by a reengagement of the vagal brake of the social engagement system to restrain mobilisation

- A neuroception of safety at all times to contain aggressive or defensive behaviours linked to sympathetic arousal

Taking Kestly's (2014) propositions into account this could be extended to include:

- Activation of the dorsal vagus to support states of low arousal, followed by a reengagement of the vagal brake of the social engagement system to restrain immobilisation
- A neuroception of safety at all times to contain dissociative or defensive behaviours linked to parasympathetic collapse

Thus the Polyvagal theory provides a biological explanation of social play, which depends on an accompanying neuroception of safety. If a socially engaged dyad begins to play, this extends the upper limits of arousal, so that an individual can activate the sympathetic nervous system to mobilise and engage in active play, without activating a defensive fight or flight response. Play may also extend the lower limits of arousal and allow children to experience states of low arousal, during loving or nurturing play, without activating a defensive immobilisation or shutdown response. Social play, by its very nature, expands a child's autonomic window of tolerance, allowing for the safe processing of traumatic experiences - illustrated conceptually in Figure 1. In this figure the light and dark green zones represent the autonomic states in which the safe processing of traumatic experiences can occur at a neurobiological level. It is propositioned that dynamic post-traumatic play occurs within this play-expanded zone of arousal.

Figure 1. Play Expanded Window of Tolerance. Play expands a child's window of autonomic tolerance to include higher and lower states of arousal than would otherwise be tolerated if the child were not at play. The upper limits of the play-expanded window of tolerance represent activation of the SNS along with the ventral vagal circuits of the social engagement system. The lower limits of the play-expanded window of tolerance represent the activation of the dorsal vagus and the ventral vagal circuits of the social engagement system.

Figure 2 illustrates a more detailed application of the Polyvagal theory to the concept of dynamic and stuck or defensive post-traumatic play. The light green zones delineate states of dynamic post-traumatic play that may be active or calm. Both states of dynamic play are accompanied by high social engagement (i.e. strong vagal regulation of the heart). Dynamic mobilised post-traumatic play requires activation of the SNS along with the ventral vagal circuits of the social engagement system, and is characterised by heightened arousal. Dynamic immobilised post-traumatic play requires activation of the dorsal vagus along with the ventral vagal circuits of the social engagement system, and is characterised by low states of arousal. The orange zones represent states of defensive (stuck) post-traumatic play. The diagram proposes that there are two types of defensive post-traumatic play that are mobilised or immobilised. Both types of stuck play are characterised by an inactive social engagement system (i.e. poor vagal regulation of the heart). The red zones indicate an activation of defences - mobilisation and the fight, flight response or immobilisation and freeze response. The goal of a play therapist is to keep a child within the green zone, where there is a neuroception of safety and an active social engagement system.

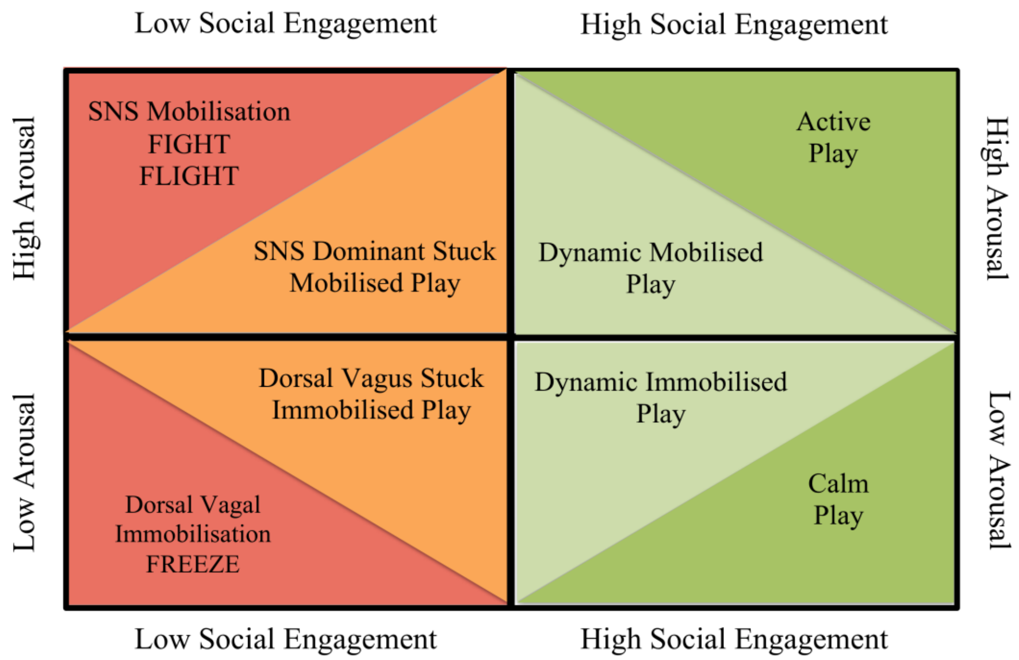

Figure 2. Conceptualisation of dynamic and defensive post-traumatic play through the lens of the Polyvagal theory.

Play Therapy Research

Play therapy research spans a period of 60 years with the majority of research originating in the United States. Both process and outcome research for play therapy is limited (Phillips, 2010). There is a lack of studies that have large sample sizes and statistical power, largely due to the difficulties in obtaining the number of participants necessary for empirically based research (Ray et al., 2006). Play therapy is also applied to a broad range of childhood problems, which makes it difficult to discern the specific mechanisms through which therapeutic change occurs (Ray et. al., 2006; Urquiza, 2010). In recent decades there has been a concerted effort to improve the recognition of play therapy. Two key meta-analytic reviews conducted by LeBlanc and Ritchie (2001) and Bratton, Ray, Rhine and Jones (2005) have shown effect sizes of medium to large. LeBlanc and Ritchie’s (2001) meta-analysis included 42 experimental studies conducted between 1947 and 1997, from multiple sources including journals, dissertations and unpublished studies. Play therapy yielded an overall positive effect size of .66 reflecting a moderate treatment effect. The authors also investigated characteristics of treatment that related to outcome success, such as the duration of therapy and level of parental involvement. The longer the therapy and the more parental involvement, the better the outcome. Studies that involved a parent conducting play sessions following training (e.g. Filial Therapy) resulted in a large positive treatment effect, with an effect size of .83.

Bratton and colleagues (2005) conducted a meta-analytic review of 94 outcome studies in the effectiveness of play therapy for children with emotional and behavioural difficulties. The meta-analysis revealed a large treatment effect, with an effect size of .80. The review concluded that the effectiveness of play therapy is equivalent to other forms of child and adult psychotherapy. Humanistic, non-directive approaches also yielded a significantly larger treatment effect size (.93), although they were represented in a larger portion of studies. Ray (2006) examined play therapy studies published in journals since 1990 and found 7 studies that met the criteria for a control or comparison group, a sample size of at least 20, and a detailed description of treatment and statistics. Within these seven studies, two examined the effectiveness of child-centred play therapy for childhood trauma, although only one examined interpersonal trauma. Kot, Landreth and Giordano (1998) studied child-centred play therapy with children in domestic violence shelters. Twenty-two children between the ages of 4 and 10 were assigned to the experimental group and participated in 12 sessions of play therapy over a 2-3 week period of intensive intervention. Eleven children were also assigned to a no-treatment control group. Children who participated in the treatment group exhibited significantly lower externalising behaviour problems and a significantly higher self-concept when compared to the control group post-intervention.

Despite the encouraging effect sizes in the meta-analytic reviews to date, little is known about the conditions that create a ‘curative alliance’ in child therapy (Schottelkorb et al., 2014). Even less is known about the role of play in treatment outcome and few studies measure play itself, despite the centrality of play, to play therapy practice (Phillips, 2010). Furthermore, there is a lack of scientific investigation into the play behaviours of children who’ve experienced developmental trauma (Findling et al., 2006). Current recommendations for the treatment of childhood trauma are based on an incomplete knowledge base. Advances in the theory and treatment of childhood trauma is thought to lag up to ten years behind similar advances for adults, which leaves child therapists adjusting adult models or simply relying on their own experience (Shelby & Felix, 2005). In an attempt to synthesise the existing literature and guide therapists, Shelby and Felix (2005) propose a prescriptive approach for choosing whether to utilise directive or non-directive play therapy in the treatment of childhood trauma, depending on the presenting problem behaviours. They identify child-centred approaches are the most relevant for children experiencing dissociation, extreme avoidance, poor social competence or traumatic grief.

Given the shortage of play therapy research, researchers point to the need to prioritise process research (Borchardt, et al., 2008; Philips, 2010; Ryan & Edge, 2011; Weingarten & Strauman, 2015) to establish a more detailed understanding of what actually happens when children engage in play therapy and how change occurs both within and across sessions (Borchardt, et al., 2008). Moreover there are no established classification schemes that aid in the identification of play themes, patterns of play, or patterns of interaction between therapists and children (Ryan & Edge, 2011). Thus it is reasoned that a focus on within-session 'micro-interventions' will lead to new insights and a better understanding of the 'active ingredients' of change in play therapy (Philips, 2010; Weingarten & Strauman, 2015), which may also bring play therapy toward one of the major goals of child therapy research: to identify what works for whom and when (Fonagy, et al., 2004; Ryan & Edge, 2011). The present exploratory studies are the first to incorporate physiological measures into play therapy process research with a view to gaining insight into what actually happens at the level of the heart when children engage in play and play therapy. These preliminary findings may then set a course for future biologically based play therapy research that may aid in a deeper understanding of the conditions that create a 'curative alliance' in play therapy.

Measuring Heart Rate Variability

The activity of the ventral vagus nerve can be measured by isolating the high-frequency band of heart rate variability associated with respiration, referred to in the literature as HRV, HF-HRV or more specifically respiratory sinus arrhythmia (RSA). RSA is sensitive to small changes in parasympathetic or vagal activity and is frequently used as an index of vagal tone and social-emotional regulation. RSA provides a measure of the flexibility of the autonomic nervous system and an individual's capacity for stress regulation and social engagement (Porges, 2011). There are several key theories that apply HRV to psychophysiological research (Shaffer et al., 2014). The Neurovisceral Integration Model (Thayer et al., 2009) and the Polyvagal theory (Porges, 1995) are the key theories to link HRV and interpersonal interaction. Both of these theories propose that strong vagal regulation of the heart allows rapid changes in heart rate that aids engagement and disengagement with the environment (Appelhans & Lueken, 2006). The Neurovisceral model links higher vagal tone (i.e. higher RSA) to better cognitive performance and emotion regulation (Thayer et al., 2009). The Polyvagal theory associates higher levels of RSA with better-regulated relationships and low levels of RSA with a reduced availability for social connection (Porges, 2007). RSA is typically studied in one of two states, resting vagal tone or dynamic vagal tone (i.e. vagal reactivity). The Polyvagal theory is the most influential model in differentiating between vagal tone at rest (i.e. baseline RSA) and vagal reactivity or regulation in response to environmental challenge.

Resting Vagal Tone

Heart rate varies with breathing, as an individual breathes in their heart beats faster to aid the flow of oxygenated blood around the body. As an individual breathes out, heart rate slows. This variability in heart rate is regulated by the vagus nerve, which is suppressed when an individual breathes in and active when an individual breathes out. The greater the difference in the speed of the heart between breathing in and breathing out the stronger the vagal activity and the higher an individual's vagal tone. The majority of studies to date have focused on measures of resting RSA or resting vagal tone (VT) (Hastings et al., 2008) typically collected during 2-5 minutes of ECG recorded in a supine or seated position. Since the vagus nerve is a central component of the PNS, measures of vagal tone reflect the degree of PNS activation at rest, which is indicative of an individual’s trait-like level of arousal, self-regulatory capacity, ability to maintain an organised behavioural state, and potential for social responsiveness (Beauchaine, 2001; Porges, 2007; Huffman et al., 1998).

Higher resting RSA (i.e. high vagal tone) corresponds with greater PNS control (i.e. a stronger vagal brake) and a greater dampening of sympathetic activation at rest. High resting vagal tone indicates physiological flexibility and a greater capacity to adaptively respond to changing environmental demands (Beauchine, 2001; Calkins, 1997; Porges, 2007; Thayer & Lane, 2009). Additionally, high resting vagal tone calms the heart so that an individual is more open to social connection and is associated with higher levels of positive social interaction and behavioural warmth (Badenoch, 2008; Diamond, Hicks & Otter-Henderson, 2011; Diamond & Cribbet, 2013). High resting RSA has also been associated with greater persistence and performance on cognitively demanding tasks (Hansen, Johnsen & Thayer, 2003; Porges, 1992; Segerstrom & Nes, 2007), more effective stress coping (Fabes & Eisenberg, 1997), better impulse control (Allen, Matthews & Kenyon, 2000), and a better recruitment of calming strategies (Calkins, 1997). High vagal tone has also been associated with greater levels of empathy, social competence, sociability and emotional regulation (Eisenberg et al., 1995; Fabes, Eisenberg & Eisenbud, 1993; Fabes et a., 1994).

Low resting vagal tone (i.e. low resting RSA) indicates reduced PNS control, a weak vagal brake and a heightened level of sympathetic arousal at rest. Individuals with low resting RSA have reduced autonomic flexibility, poor stress-regulation, tend to be hypervigilient, display high levels of anxiety, and are less available for social connection (Thayer & Lane, 2000; Badenoch, 2008; Beauchaine, 2001; Graziano & Derefinko, 2013; Light, Kothandapani & Allen, 1998; Thayer, Friedman & Borkovec, 1996). Research has associated low levels of resting vagal tone with poor attention and affect-regulatory problems such as anxiety (Friedman, 2007), depression (Chambers & Allen, 2007; Rottenberg, 2007) antisocial behaviours (De Vries-Bouw et al., 2011) and higher levels of negative emotions such as anger and sadness (Bacon et a., 2004; Horsten et al., 1999). Furthermore, low resting vagal tone (i.e. lower parasympathetic activity) has been identified as a potential stress indicator in children (Michels et al., 2013; Thayer & Brosschot, 2005; Mclaughlin et al., 2015) and a potential aftereffect of developmental stress and trauma (Scaer, 2001).

Vagal Reactivity

In recent years studies show an increased interest in dynamic changes in RSA in response to stress or challenge. Dynamic changes in RSA reflect the regulation of the vagal brake and an individual's capacity to appropriately engage and disengaged with the environment. High RSA reactivity has been linked to sustained attention, increased cognitive engagement during challenging tasks, emotion-regulation, self-regulatory effort and social competence (Blair & Perters, 2003; Calkins 1997; Doussard-Roosevelt et al., 2003; Graziano et al., 2007; Porges, 2007; Rottenberg et al., 2005; Salomon, 2005; Segerstrom & Nes, 2007; Suess, Porges & Plude, 1994; Thayer et al., 2000). Individual differences in vagal reactivity are indexed by baseline-to-challenge changes in RSA. RSA reactivity is typically described in terms of the direction of change from a baseline to a challenging condition. A decrease in RSA (i.e. a decrease in vagal tone) from baseline signifies a pattern of vagal withdrawal. An increase in RSA (i.e. an increase in vagal tone) from a baseline to a challenging task signifies a pattern of vagal augmentation.

Vagal Withdrawal

A decrease in RSA from baseline levels in response to a challenging task indicates a pattern of vagal withdrawal (i.e. a decrease in vagal tone), and a state of psychological stress that supports fight, flight mobilisation behaviours (Bernston et al., 1994). Vagal withdrawal indicates the withdrawal of parasympathetic influence or vagal inhibition to the heart (i.e. release of the vagal brake) that causes a rapid increase in HR and the mobilisation of metabolic resources to aid increased attention and active engagement with a stressor (Porges, 2007). In the face of mild to moderate stress vagal withdrawal is considered an adaptive response that allows mobilisation without activation of the SNS (Porges, 2007), and is thought to facilitate regulatory processes important for attention and behavioural control.

Research has shown that RSA withdrawal during attention-demanding, frustrating or stressful tasks is associated with better self-regulation, active coping, emotion regulation and the expression of negative affect (Beauchine, 2001; Degangi, Dipietro, Greenspan & Porges, 1991; Gentzler, Santucci, Kovacs & Fox, 2009; Huffman et al., 1998). However, it appears that there is an optimal degree of vagal withdrawal. RSA reactivity that is too high, or does not return to baseline levels following a stressor, may reflect a hyper-aroused system and a tendency toward hyper-vigilance, stress, anxiety and worry (Thayer & Lane, 2000; Santucci et al., 2008). Equally, very low levels of vagal withdrawal may also be problematic and have been associated with externalising behavioural problems such as aggression, hyperactivity and inattention (Beauchaine, 2001; Boyce et al., 2001; Calkins & Dedmon, 2000; Musser et al., 2011).

A meta-analysis of RSA reactivity in children (Graziano & Derefinko, 2014) found that children from clinical or at-risk samples had lower levels of baseline RSA and RSA withdrawal when compared with children from healthy community samples, which suggests that at-risk children have a reduced autonomic flexibility in response to stress or challenge. Furthermore, measures of vagal reactivity are not independent of baseline levels of vagal tone; hence these children are doubly disadvantaged as a low starting baseline limits the amount of vagal withdrawal available from the outset (Beauchaine, 2001; Calkins et al., 2008; Porges, 2007). A reduced capacity for withdrawal of the vagal brake means that these children are less able to evaluate risk in the environment and identify safe social cues (Heliman, 2010).

Vagal Augmentation

A physiological state of increased vagal influence (i.e. an increase in RSA or vagal tone from baseline) is a pattern of vagal regulation called vagal augmentation that supports social engagement and is typically observed in safe, low stress situations. Vagal augmentation has been associated with positive social emotions such as love and compassion, the capacity to self-sooth, and high levels of social engagement (Blandon et al., 2008; Geisler, Kubiak, Siewert & Weber, 2013; Holt-Lunstad, Uchino, Smith & Hicks, 2007; Kok & Fredrickson, 2010; McCraty et al., 1995; Matsunaga et al., 2009). Vagal augmentation signifies heightened parasympathetic activity, or on-going vagal inhibition to the heart (i.e. the vagal brake is engaged), which inhibits SNS input, slows heart rate and promotes calm behavioural states (Bernston et al., 1992; Porges 2001, 2007, 2009). Vagal augmentation is also observed following the successful resolution of a stressor, where the vagal brake is reinstated, returning the nervous system to a state of homeostasis and rest (Blandon et al., 2008).

However vagal augmentation has also been observed in some individuals in response to stress or challenge. In this context vagal augmentation is considered maladaptive and indicates a failure to adaptively engage with environmental demands via removal of the vagal brake. It is theorised that vagal augmentation in response to stress may reflect a state of psychological and physiological inhibition and an increased effort to regulate or suppress negative emotions such as anger or sadness (Butler, Wilhelm & Gross, 2006; Ingjaldsson, Laberg, & Thayer, 2003; Rainville et al., 2006; Skowron et al., 2011). In a study of interpersonal stress, children who displayed a pattern of vagal augmentation were observed to deal with stress in a more dysregulated manner than those children who showed vagal withdrawal (Beauchaine, 2001). Vagal augmentation has also been associated with a tendency to adopt passive and avoidant modes of coping with physiological arousal (Rainville et al., 2006).

It is proposed that vagal augmentation in response to stress is a greater indicator of physiological dysfunction than low levels of RSA withdrawal, and may identify a subgroup of children most at risk of serious behavioural and conduct disorders (Katz, 2007). Children living in homes characterised by domestic or family violence display lower levels of vagal regulation (Calkins et al., 1998; Hastings et al., 2008; Katz, 2007; Porter et al., 2003) and a propensity toward an augmented response to stress (Katz, 2007). These children are described as having a 'hostile attribution bias' that senses threat in the environment even when it is not present (Crick & Dodge, 1994). The Polyvagal theory similarly describes a distorted neuroception of danger that can develop in response to early relational trauma. It is proposed that vagal augmentation in response to stress may reflect a sensitised pattern of heightened parasympathetic activation and a hyper-vigilance to signals of interpersonal hostility (Katz, 2001, 2007).

However, it is argued that vagal augmentation may be adaptive depending on the context, as some goal-directed tasks may require the inhibition of emotion (Park, Vasey, Van Bavel & Thayer, 2014; Hastings et al., 2008). For example one study found that children encouraged to use cognitive emotional regulation strategies such as distraction or reappraisal during sad and scary film clips showed a stronger pattern of RSA augmentation, especially during the sad clips (Davis, et. al., 2016). Thus, researchers are encouraged to consider the environment the child is growing-up in, as well as the physical, cognitive, social or emotional nature of the stressor the child is responding to when RSA reactivity is observed (Obradovic et al., 2011). However the majority of research on RSA reactivity in children suggests that vagal augmentation or low levels of RSA withdrawal in response to stress puts children at risk of both internalising and externalising symptomology and makes them more prone to aggressive behaviours (Boyce, et al., 2001; Calkin et al., 2007; Calkins & Deadmon, 2000; Calkins & Keane, 2004; Kibler, Prosser & Ma, 2004).

Vagal Recovery

A final area of enquiry into vagal regulation is to examine RSA recovery following a stressor. Parasympathetic withdrawal during stress (vagal reactivity) followed by a return to baseline (vagal recovery), are key elements of parasympathetic emotion regulation (Porges, 2007; Beachine, 2001). While some individuals may display appropriate vagal reactivity, they may be unable to physiologically calm themselves following a stressor and remain in a hyper-arousal state. The ability to return to a homeostatic baseline is a further indicator of a robust and flexible nervous system that is able to adaptively deal with stress. Thus the most resilient individuals will have high resting RSA, an optimal decrease in RSA in response to challenge, and a quick recovery and return to baseline.

Heart Rate Variability and Child Therapy Research

Few studies have applied HRV to child therapy research. It has been suggested that resting levels of vagal tone may predict treatment responders and non-responders, with mixed results. A study by Beauchine, Gartner and Hagen (2000) studied 56 adolescent males with conduct disorder and found that low resting RSA was associated with an improved treatment response, which suggests that while these adolescents were more vulnerable to stress they were also more responsive to intervention. However those children with a comorbid diagnosis of conduct disorder and depression did not show the same improvement. On the contrary a similar study examined heart rate (not HRV) in 23 school-aged children (7-9 years) with disruptive behaviour disorders, pre and post an intensive cognitive behavioural intervention and found that heart rate was significantly lower in those children who did not profit from therapy (Stadler et al., 2008).

Only one study was found that examined HRV in play therapy research. This study examined RSA in a single case study following Parent-Child Interaction Therapy (PCIT), an approach in which a parent is trained in play therapy techniques. The study observed a mother and her almost 2-year-old child with significant externalising behaviour problems (Bagner, et al., 2010). Following intervention a decrease in child behaviour problems and improved vagal regulation was observed during an interactive mother and child play and clean-up task. In the pre-treatment assessment the child's vagal tone increased (i.e. a pattern of vagal augmentation) from the baseline to the stressor (the clean-up task), which was unexpected although observed to be consistent with research linking attenuated physiological responses to aggressive and antisocial behaviour. However in the post-treatment assessment, vagal tone decreased from the baseline to the stressor (i.e. a pattern vagal withdrawal) indicating improved emotion and behaviour regulation. This study was the first to use physiological data as an outcome measure following a play-based intervention, and the study concluded that vagal tone showed promise as a measure of treatment success (Bagner, et al., 2010). No studies were found that applied HRV analysis to play therapy process research.

Given the dearth of research incorporating measures of HRV in child therapy research the present thesis consists of two exploratory studies that apply measures of RSA to play therapy process research; to further conceptualise the theoretical and practical links between autonomic stress and play therapy. A combination of humanistic and scientific theory is leading to a growing interest the role of the nervous system and the lower stress regulatory parts of the brain in child therapy and the need for therapeutic interventions that are neurodevelopmentally-informed (Perry, 2008; Gaskill, 2008; Gill, 2006). It is anticipated that the inclusion of psychophysiological measures, such as RSA in play therapy research, will provide new knowledge that may enhance future play therapy practice.

Chapter 2

Methods and Procedures

This thesis presents two exploratory case-based studies examining the application of cardiac measures to play therapy research. The first study examines children's cardiac reactivity during the construction of play narratives, in response to a play-based assessment of attachment. The second study examines cardiac linkage between therapists and children within live play therapy dyads. The first study examines the individual cardiac physiology of 5 children; the second study examines the interpersonal physiology of 4 play therapy dyads. Cardiac measures of heart rate (HR) and heart rate variability (HRV), specifically respiratory sinus arrhythmia (RSA) were measured in both studies. HRV analysis appeals to psychotherapy research, as it is an accessible and non-invasive method that provides a quantitative marker of autonomic nervous system activity. Furthermore, it has the potential to provide new insights inaccessible to traditional methods such as self-report or observation, and is suited to populations with limited verbal or cognitive abilities, such as children.

Few studies have applied autonomic measures to play therapy research and the present studies were designed to gain further insight into the physiological mechanisms that may underlie play therapy through the lens of the Polyvagal theory (Porges, 1995, 2001, 2007, 2011, 2017). The Polyvagal theory is of interest to the field of play therapy given the theory's emphasis on the role of relationships in regulating stress via the vagus nerve, a key cranial nerve central to the parasympathetic nervous system. The Polyvagal theory provides a biological basis for attachment and social play and formulates how attachment relationships depend on parasympathetic or vagally mediated processes within the autonomic nervous system. It was anticipated that the live monitoring of cardiac physiology for children and therapists within these exploratory case studies would lead to further insights into the relevance of autonomic regulation to play therapy theory and practice, and set a direction for the inclusion of physiological monitoring in future play therapy research.

A large-n study was not feasible given the novelty of the research and the number of child participants available. However when an area of clinical research is in the early stages, an in-depth investigation of a small number of case studies is recommended (Kazdin, 1982). Historically clinical case studies have played an important role in the development of psychotherapy techniques and in conceptualising theory and practice (Kazdin, 1982). Autonomic measures have the potential to provide objective measures of within session processes and treatment outcomes and it's anticipated that physiological monitoring will become an increasingly important part of therapy research and practice; although at this point in time it is argued that basic idiographic, bottom-up research is first needed (Kleinbub, 2017). Moreover, there is an emerging interest in 'micro-intervention' studies utilising HRV to uncover new insights into the mechanisms of therapeutic change (Weingarten & Strauman, 2015).

A within-subject study designed was adopted, as this is recommended as the most appropriate method for examining heart rate variability due to the high inter-individual variations and the complex interactions that influence HRV (Quintana & Heathers, 2014). It is also proposed that within-subject changes in HRV are more meaningful than between subject group comparisons (Chow & Li, 2013). Nevertheless, there are a number of limitations to single-case designs, including limitations to the degree of experimental control possible. Within this thesis, study 1 and study 2 are outlined in detail in chapters 3 and 4. The following section provides an overview of the broader methodology that is applicable to both studies. The research for both studies was submitted for ethics consideration under the reference PSYC 14/113 and was approved under the procedures of the University of Roehampton's Ethics Committee on the 30.06.14.

Setting

The studies took place in a UK based therapeutic primary school for children with social, emotional and behavioural difficulties. The school had a predominantly male population. A large portion of the children had previously been excluded from mainstream school settings due to externalising behaviours, typically aggression. A number of children were engaged with child protection and mental health services. Many of the children had complex histories with multiple interpersonal traumas including physical or emotional abuse and neglect. There was a high prevalence of exposure to domestic, family and community violence. There were also regular instances of conflict and aggression between peers within the school environment. The school provided therapeutic intervention alongside a modified curriculum. Therapy services included drama, art and play therapy along with occupational and speech and language therapies. Physical restraint was routinely used to manage aggressive behaviours by teachers and support staff trained in restraint techniques. While staff commitment was high, the school proved to be a challenging environment, for both students and staff.

Therapy Rooms and Equipment

Study 1 involved the administration of a play-based narrative story stem assessment pre and post play therapy intervention. The story stem assessments were conducted in a small room within the school therapy wing that was equipped with a table and two small chairs. The toys used in the story stem assessment included wooden doll families, dollhouse furniture and animals consistent with story stem assessment protocol

(Farnfield, 2015a). Study 2 involved the monitoring of cardiac linkage within play therapy dyads within live play therapy. The play therapy sessions took place in a playroom equipped with a range of toys and materials consistent with those recommended by Landreth (2002) for child-centred play therapy. Play materials included: art and construction materials, play dough, puppets, dress-ups, a cash register, play money, play food, plates and cutlery, soft toys, baby dolls, a blanket, first aid kit, treasure chest, handcuffs, swords and shields, cars and emergency service vehicles, sensory squish toys, balls, bubbles, a doll house and figurines including doll families, wild and domestic animal families, dinosaurs, mythical and magical creatures and superheroes. The furniture in the playroom consisted of a small table, two small chairs, a large floor cushion, doll house, wooden stove, toy shelf and two blue plastic trays filled with sand. The children also had a small bottle of water available for play in the sand trays and pretend kitchen. The same toys, furniture and equipment were available each week and stored in the same location. Broken toys and consumable items such as play dough, glitter and bubbles were replaced between sessions. The room was only used for therapy and not accessed by children at other times.

Participants

Child Participants. A total of 6 child participants took part in the 2 studies, 5 boys and 1 girl, between the ages of 6 and 9 years. Three of the children were black British and 3 of the children Caucasian. The child participants were a sample of convenience, selected on the basis that they were not currently engaged in therapy and were in the care of a parent or caregiver who was able to provide informed consent. Five of the 6 children were from single parent families with the biological mother as the primary caregiver; one child lived with both biological parents. The families were from low-socioeconomic communities. The child participants had complex histories. All children experienced academic, social and emotional difficulties. The unifying features for the participants were: (1) poor self-regulation and associated externalising behavioural problems, especially aggression within the home and school environment that had resulted in placement in a specialist school, (2) exposure to some degree of violence whether physical abuse, domestic violence and/or community violence, and (3) relationship difficulties with parents, siblings or peers. A total of five case studies (4 boys and 1 girl) were included in study 1, one child was excluded due to an atypical ECG recording. Four case studies (4 boys) were included in the second cardiac linkage study. Within the present thesis the male pronoun is used for clients, unless specified, and the female pronoun is used for therapists, to simplify the text throughout. When referred to by name each child has been given a pseudonym to preserve confidentiality.

Caregiver Involvement. Written consent was obtained from the school, caregivers and children prior to commencement of the project. A primary caregiver for each child attended an initial face-to-face interview with the researcher on the school premises to explain the details of the study. All parents were given the opportunity to ask questions and refuse consent. Each consenting parent was then invited to attend a pre and post therapy review meeting and to complete several parent report measures. Following parent consent, each child participant attended a face-to-face meeting with the researcher, where the study was explained in a developmentally appropriate manner. Each child visited the playroom and was allowed to examine the heart rate monitor. It was explained that the researcher and a teaching assistant known to the child, would help apply the heart rate monitor before therapy each week. Following child consent, the child returned the following week to meet their trainee play therapist and experience wearing the heart rate monitor.

A total of 7 parents and children were approached to participate in the study. The consenting caregivers and children were aware that they could withdraw from all or part of the study at any time without repercussion; and all identifying information would remain confidential and video recordings stored securely. One child declined to participate and was allocated a therapist external to the project without repercussion. During the course of the project another child did not wish to wear the HR monitor for a number of sessions, although remained willing to be a part of the project and record his therapy sessions. The parents and children were informed that the researcher would write about her findings although no identifying information would be shared. An example of the caregiver and child consent forms can be found in Appendix A. In the pre-therapy caregiver appointment a semi-structured interview was conducted with each caregiver to further ascertain details about the child's early development, trauma history, relationships and current functioning.

Adult Participants. In study 1, two volunteer adult interviewers conducted a pre and post intervention narrative story stem assessment with each child participant. The interviewers were trained in narrative story stem assessment protocol and not known to the children. In study 2, four therapy-child dyads were observed. Two trainee play therapists volunteered to participate in the research project as part of their second practical placement, during the second and final year of a full-time clinical master-level training programme. The therapy hours accrued during the research project contributed to the total number of clinical hours required for course completion. Both student therapists were female with prior experience working with children. One therapist was Caucasian and the other black British. Both trainee therapists received weekly face-to-face supervision with a registered play therapy supervisor, in addition to their own personal therapy. An interviewer also conducted the Adult Attachment Interview (AAI) with each trainee therapist. The AAI was conducted on the university campus; all other interventions and assessments were conducted within the school setting. The story stem assessment and the AAI were designed to assess the attachment strategies of the child and adult participants respectively.

Classroom Observations

The researcher conducted classroom observations across the duration of the assessment period to observe the child participants in the school setting.

Physiological Monitoring

An electrocardiogram (ECG) recording was taken for each child during the story stem assessment for study 1. In study 2 the within session ECG for each therapist and child was recorded. ECG was recorded using an eMotion Faros 180° device. The Faros is a wireless, externally applied electrocardiograph recorder designed for scientific research, including HRV analysis. The Faros consists of a small recording and storage device and a cable set with leads for 2 electrodes. Large pre-gelled disposable electrodes (Ambu Blue Sensor VLC-00-S) recommended for use with children were applied prior to each session. The electrodes consisted of a soft sponge designed for sensitive skin that contained a highly conductive wet gel and a microporous material that adhered to the skin to provide the best possible contact for a stable ECG signal. The electrodes were placed in a bipolar configuration on opposite sides of the chest, directly onto the skin below the left rib and under the right clavicle as per the 2-electrode placement guidelines outlined in the Faros manual (eMotion Faros Series Manual, Mega Electronics Ltd., 2014). The electrocardiogram was sampled at a rate of 1000 Hz, which is recommended as the ideal rate for obtaining a high-resolution signal (Bernston et al., 1997; Task Force, 1996). The ECG recoding was then logged in EDF format and saved in separate data files for each child and therapist. Each ECG recording ran for approximately 60 minutes from the acclimatisation and baseline collection period until the end of each story stem assessment or 45-minute play therapy session.

Cardiac Measures

The study of physiological systems typically focuses on measuring states of rest, reactivity or recovery. Cardiac reactivity was the focus of the present studies. In study 1, changes in each child's cardiac reactivity during the construction of play narratives within a play-based attachment assessment was examined. In study 2 the linkage in dynamic changes between a child and therapist's HR and RSA was examined. Measures of HR provide an index of overall autonomic arousal, while measures of RSA provide a more specific index of parasympathetic processes and the functioning of the vagus nerve (Danvers & Shiota, 2017).

Heart Rate. Heart rate changes in response to physical, emotional or mental effort. The measurement of HR in beats per minute is a well-known concept. Yet insight into one's own heart reactivity is rudimentary and studies examining cardiac reactivity can provide data inaccessible to observation or self-report. The heart is innervated by the sympathetic and parasympathetic branches of the autonomic nervous system, which exert a regulatory influence on HR, by influencing the activity of the primary pacemaker of the heart, the sinoatrial node. Typically, increased sympathetic activity has an excitatory influence and produces physiological changes associated with the fight, flight response, such as increased heart rate, increased blood pressure and sweating. Increased parasympathetic activity (through the vagus nerve) has an inhibitory influence and is responsible for establishing homeostasis and the growth and restoration of internal organs, and produces physiological changes associated with relaxation such as decreased HR and decreased blood pressure.

An increase in HR may arise from an increase in sympathetic activity or a decrease in parasympathetic activity, or a combination of the two. Similarly, a decrease in HR may arise from a decrease in sympathetic activity, an increase in parasympathetic activity, or a combination of the two. The parasympathetic system causes rapid changes in HR, while changes in HR due to sympathetic activation occur more slowly. Effectively the two branches of the ANS regulate the length of time between consecutive heartbeats. A faster HR results from shorter inter-beat intervals and a slower HR results from longer inter-beat intervals. A high resting HR indicates an over-aroused, hyper-responsive ANS, while a low resting HR indicates an under-aroused, hypo-responsive ANS. An increase in HR has been associated with turning inward to filter out distracting stimuli to enhance cognitive performance, and defensive responses related to the fight, flight response (Ruff & Rotherbart, 1996). Feelings of fear, anxiety, anger, joy and excitement have also been associated with increased HR (Cacioppo & Sandman, 1978). A decrease in HR has been associated with states of highly focused attention and is perceived as an orienting response and directing attention outward to external events, and is also associated with the freeze response (Ruff & Rotherbart, 1996; Lacey & Lacey, 1974; Lang & Bradley, 2010).

Heart Rate Variability. HRV operates outside the awareness of an individual and reflects the ability of the heart to quickly respond to changing events within the internal or external environment. Broadly, HRV is an indicator of the flexibility and adaptability of the ANS. Resting HRV is a considered a trait-like measure of an individual's autonomic flexibility. A high resting HRV is considered 'healthier' and is linked to greater autonomic flexibility, better self-regulation, better physical and psychological health, and a greater range of psychological and behavioural flexibility (Porges, 2010). Low resting HRV is a marker of stress vulnerability and reduced autonomic, behavioural and emotional flexibility (Porges, 2010).

RSA is a specific component of HRV that is entirely mediated by the PNS (Berntson et al., 1997). RSA is a portion of heart rate variability that occurs in the high-frequency range of HRV that is associated with respiration and is governed by the myelinated component of the vagus nerve, the ventral vagus (Task Force, 1996; Porges, 1995). Thus RSA is an estimate of parasympathetically mediated HRV (Appelhans & Luecken, 2006) and an index of vagal tone (Porges, 2010). Resting RSA or resting vagal tone reflects the activity of the PNS at rest and the ability of an individual to sustain attention, regulate emotion and engage in social communication (Porges, 2007). Vagal reactivity refers to changes in RSA from a baseline condition to a challenging condition, and may be characterised as vagal withdrawal, also called vagal suppression (i.e. a decrease in RSA from baseline) or vagal augmentation (i.e. an increase in RSA from baseline). Vagal withdrawal accelerates HR and increases metabolic output and typically reflects the mobilisation of physiological resources to actively cope with an environmental challenge (Fox & Calkins, 2003; Porges, 2007). Vagal augmentation decelerates HR and is typically associated with states of rest and social engagement in states of safety (Porges, 2011).

Difference Scores and Residual Scores. Researchers generally use difference scores (also called delta, change or gain scores) and/or residual scores to examine physiological reactivity in children (Burt & Obradovic, 2012). A benefit of difference scores is that they can be conceptually interpreted in terms of the Polyvagal theory. For example, when examining RSA, difference scores reflect different patterns of vagal reactivity from a baseline to a task condition, where the baseline score is subtracted from the challenge score (i.e. RSA challenge score minus RSA baseline score). A positive difference score indicates an increase in parasympathetic activity from the baseline to challenge (i.e. a pattern of vagal augmentation). A negative difference score indicates a decrease in parasympathetic activity from baseline to challenge (i.e. a pattern of vagal withdrawal). However, the use of difference scores has been criticised as they do not take into account differing levels of baseline arousal between study participants, and there are no established guidelines for what constitutes high or low reactivity (Obradovic et al., 2011).

Recent guidelines suggest that researchers also include residual scores (Laborde, Mosley & Tahyer, 2017), as residual scores remove baseline variability and indicate whether a participant's observed reactivity is more or less than expected in comparison to the rest of the sample (Cronbach & Furby, 1970). High or low reactivity is determined by the relative deviation from predicted values calculated by regressing the sample's challenge scores on the baseline scores (Manuck, Kaspowicz & Muldoon, 1990). A positive residual score represents a challenge score that is smaller than expected given the samples regression line. A negative residual score represents a challenge score that is larger than expected given the samples regression line. A disadvantage of residual scores is that they do not allow for a direct comparison of 'raw reactivity' between studies and they cannot be interpreted as vagal augmentation or vagal withdrawal as their meaning depends on the regression line particular to each sample (Obradovic et al., 2011). The benefit of residual scores is that they provide specific information on whether a child's reactivity is relatively higher or lower than the other children in the sample for the challenge studied (Obradovic et al., 2011). Study 1 reports the difference scores and residual scores for each participant in response to the challenge of the child attachment and play assessment.

Cardiac Data Analysis

One of the challenges in incorporating HRV into play therapy research is the wide variation in how HRV is calculated, reported and interpreted, and there is considerable debate over the methodology best suited to the measurement of RSA as an estimate of vagal tone, especially for children (Allen, Chambers & Towers, 2007; Denver, Reed & Porges, 2007; Grossman & Taylor, 2007). RSA may be quantified in a number of ways such as via time-domain peak valley analysis, spectral analysis or the Porges adaptive polynomial filter method. The present studies quantified RSA using the Porges method (Porges, 1985; Porges & Bohrer, 1990), which has been validated in a number of studies (e.g. Dellinger, Taylor & Porges, 1987; Jansen & Dellinger, 1988). The Porges method derives the high frequency (HF) component of HRV associated with respiration, called respiratory sinus arrhythmia (RSA), and measures the amplitude of RSA as an index of cardiac vagal tone (Izard et al., 1991).

Following collection, the ECG recordings were analysed by the Brain-Body Centre at the University of Illinois. All data was visually inspected prior to analysis and manually edited for abnormal or missing heart beats using MXedit software (CardioEdit Software, Brain-Body Center, University of Illinois at Chicago, 2007). The editing process involved the use of integer arithmetic (i.e. dividing intervals when detections are missed or adding intervals when invalid detections occur) (Heliman et al., 2012). Measures of HR and RSA were then derived from the edited heart period data with a program called CardioBatch Plus (Brain-Body Center for Psychophysiology and Bioengineering, University of North Carolina, Chapel Hill, 2016), which employs the Porges method (Porges, 1985; Porges & Bohrer, 1990). The Porges method applies a time-frequency algorithm to quantify the amplitude of RSA with age-specific parameters sensitive to the maturational shifts in the frequency of spontaneous breathing. The RSA data for the adult therapists was calculated with the adult parameters that define RSA across a band of frequencies associated with spontaneous breathing in adults (i.e. 0.12-0.40 Hz). The RSA for the child in the study were defined by adolescent parameters used with datasets that include individuals 7 years and older (i.e. 0.12 -1.00 Hz). The final estimates of RSA were generated in 30-second epochs.

Study 1 examined RSA reactivity in 2-minute epochs. Study 2 examined RSA linkage in sequential 30-second epochs.

Study 1 Story Stem Assessment Procedures

Study 1 consisted of the administration of the Child Attachment and Play Assessment (CAPA) (Farnfield, 2015b). The assessment identifies a child's pattern of attachment learnt through interactions with adult attachment figures together with unresolved trauma and depression. The play-based assessment was administered on two occasions before and after a block of child-centred play therapy. Each assessment lasted approximately 45 minutes and consisted of 6 to 7 stories depicting an attachment stressor. The first interviewer conducted a story stem assessment with all 6 participants at the beginning of the data collection period. The second interviewer completed the same procedure, with some variation in the story stems chosen, at the end of the research project.

Prior to the assessment two 'vanilla' baseline measurements were obtained. The vanilla baselines were not true resting baselines, but comparable to the assessment task condition as recommended by Quintana and Heathers (2014) and supported by the research of Jennings and colleagues (1992), who suggest that baselines utilising a mildly demanding task are more stable than true resting baselines. In the first baseline the child interacted with a storybook read by the researcher prior to the assessment. The second baseline was a set-up baseline where the child chose a doll family and helped the interviewer set-up for the story stem assessment. The children were encouraged to remain seated during the assessment to keep movement levels similar. In the final analysis story stems were excluded where the child stood or significant movement was observed.

Study 2 Play Therapy Procedures

Play therapy sessions were conducted on a weekly basis during term time across an academic year. Each trainee therapist attended the school one morning a week and conducted individual play therapy sessions between 9:30am and 12:30pm. Children attended therapy on the same day and at the same time each week. Children did not receive therapy during school holidays or when absent from school. Each child attended a total of 15-25 play therapy sessions. Each therapist applied her own HR monitor at the beginning of the school day. The researcher accompanied each child to and from the classroom and therapy room. Teaching support staff assisted in applying the heart rate monitor for the child participants. Two adults were present for every application of the monitors in concordance with the ethical procedures approved for the study. The child independently removed the electrodes and monitor at the end of each session.

Video Recording

Each assessment and therapy session was video recorded with a camcorder. The physiological data and the video footage were manually synchronised for the analysis of the data. The monitors were turned on in front of the camera, to establish the starting time or time zero, for each assessment or therapy session.

Issues in HRV Measurement

HRV measurement is complicated by the influence of a number of potentially confounding variables. There is much debate in the literature regarding what variables should and should not be controlled for, although the most debated variable is the degree to which respiration and related variables including speech and movement impact on HRV, especially RSA. The issues relevant to the present studies include:

Respiration. Some authors argue that the effect of respiration should be controlled for (e.g. Grossman, Karemaker & Wieling, 1991; Grossman & Taylor, 2007) through the use of respiration monitoring or paced breathing. However paced breathing is an artificial means of controlling for respiration unsuitable for research that aims to look at the spontaneous activity of the system in response to real world events. It is also near impossible to control the breathing rate of infants and children (Bar-Haim, Marshall & Fox, 2000). More commonly researchers attempt to account for respiration through simultaneously measuring HRV and respiration, although respiration-recording devices are better suited to laboratory-based research, as they can be cumbersome and impractical in real world settings. Furthermore, a number of researchers argue that respiration does not sufficiently influence HRV and the use of normative estimates of respiration, via frequency bands, in the calculation of HRV is sufficient, and provides an accurate measure of vagal tone (Denver et al., 2007; Graziano & Derefinko, 2014; Houtveen et al., 2002; Patwardhan, et al., 2001). It has also been observed that the spontaneous respiration rates for children naturally fall within the high frequency band of HRV and therefore do not need to be controlled for (Wallis et al., 2005). Furthermore a meta-analysis by Graziano and Derefinko (2014) found that there was no clear difference between studies that measured respiration for children and those that used frequency bands for the calculation of RSA. They concluded that while the monitoring of respiration may lead to more pure measures of RSA, it is more practical to use normative rates of respiration in research, especially for child participants. Accordingly, the present studies utilised the Porges method and normative rates of respiration (i.e. frequency bands) in the calculation of RSA.

Activity Level. Body position and activity level also influence measures of HRV (Sloan et al., 1994). It is recommended that HRV research be designed so that movement is kept to a minimum. An unambiguous interpretation of the physiological mechanisms underlying HRV is only possible without physical activity, although when relevant some studies may perform ambulatory measurements while controlling for respiration and physical activity (Grossman et al., 2004). In study 1 the baseline and assessment task was conducted in a seated position. Story stem tasks were excluded from the final analysis if a child stood or made a significant change in posture or activity level. Study 2 involved the monitoring of live play therapy dyads in an ambulatory setting. Sessions were chosen where the child and therapist engaged in longer sequences of seated play. Where possible activity levels were kept as similar as possible across conditions so that respiration rates would not differ between conditions. Although due to the nature of play it was not possible to control for movement in the second study and future studies may include a measure of accelerometry to better control for activity levels within live therapy.

Speech. Speech is another variable linked to respiration. There is some evidence to indicate that speaking can increase HRV although Porges and Byrne (1992) found no difference between speech and non-speech episodes. They conclude that it is not necessary to correct for speech, especially when it is infrequent or persists for short durations and where the purpose of the study is to determine the global state of the participants via measures of RSA.

Age. Within adults resting levels of HRV has been shown to be relatively stable across time, although resting vagal tone may improve in response to therapeutic intervention. Several studies have examined the reproducibility of HRV recordings in adults at 2, 6 and 24 months and have found that HRV was similar and reproducible across short and long-term timeframes (Kowalewski & Urban, 2004; Pitzalis et al., 1996). Although for children, resting HRV naturally increases across childhood (Calkins & Keane, 2004; Finley, Nungent & Hellenbrand, 1987; Goto et al., 1997). Although it is less clear how RSA reactivity changes across time.

Sex. A sex difference has been observed for HRV in adult studies. Studies on sex differences in children have mixed results. Michel et al. (2013) found that frequency domain measures were higher in boys 5-10 years of age. Other studies have observed a sex difference only from 9 years onwards (Galeev et al., 2002). Although most studies have found that boys and girls exhibit similar levels of baseline RSA and RSA reactivity or withdrawal (e.g. Gentzler et al., 2012; Graziano et. al., 2007; Goto et al., 1997; Seppala et al., 2013). A meta-analysis by Graziano and Derefinko (2014) did not find any significant associations between child age or gender and RSA reactivity or withdrawal. Furthermore Seppela et al. (2013) attempted to define reference values for HRV for a large sample of children between 6 to 8 years of age and concluded that age, maturity, height, weight, and BMI had weak if any association with HRV parameters and suggested that these variables did not confound measures of RSA.

Race. The present studies examined a mixed race sample. Some studies have suggested that there are racial differences in HRV although there are limited studies examining HRV and race, especially in children. It is currently unclear if race impacts on measure of HRV or RSA (Reed et al., 2005).

Other factors. Few studies are able to control for all the possible variables that may impact on HRV. Other factors, not controlled for in the present study, include the ambient temperature of the therapy room, medication, the prior consumption of food or water, and the use of stimulants such as caffeine. The therapy sessions were conducted at the same time each week and the therapy environment was kept as consistent as possible to limit extraneous variables. The within-subject study design also functions to minimise the impact of individual factors such as medication use (Quintana & Heathers, 2014).

An examination of the literature reveals that HRV analysis is complicated and caution must be used in how it is applied to real world therapy due to the number of variables that cannot be controlled for in this environment. HRV analysis in children is especially complex given the natural maturation of the autonomic nervous system and the limited amount of literature analysing HRV in children. There are a number of confounding variables in the present studies. Nevertheless, these studies provide an initial exploratory look into the application of physiological monitoring to real world play therapy research. A number of recommendations and suggestions for future research have been included at the end of each study chapter to improve the reliability of future findings.

The following chapter (Chapter 3) presents the findings of Study 1. Study 1 investigates the individual cardiac reactivity of 5 children during the construction of play narratives in response to a pre and post-intervention assessment of attachment security. The study examines differences in the cardiac reactivity that accompanies the play narratives of children with insecure Type A+ strategies of attachment and children with insecure Type C+ strategies of attachment.

Chapter 4 presents the findings of Study 2. Study 2 investigates interpersonal cardiac reactivity and the presence of within session synchrony for HR and RSA for 4 therapy dyads. The two studies are presented separately as they use distinctly different methods to examine physiological reactivity. Study 1 examines individual reactivity through the use of change scores, while Study 2 examines cardiac linkage between a therapist and child using path diagrams generated by a structural equation modelling of the dynamic p-technique. The same children are examined in each study. In study 1 the cardiac reactivity of 5 children is examined (4 boys and 1 girl). The second study examines the

4 boys in therapy. The one girl was excluded from the second study to simplify the analysis and reduce the influence of gender variables.

Chapter 3

Study 1

Vagal Regulation of the Heart during Children's Play Narratives

"One sees clearly only with the heart. Anything essential is invisible to the eyes." The Little Prince

INTRODUCTION

Purpose: To examine cardiac reactivity during the construction of play narratives within the Child Attachment and Play Assessment (CAPA) in a small sample of 5 primary school children with behavioural difficulties pre and post play therapy intervention.

In recent decades there has been a growing interest in investigating behavioural difficulties in children in light of attachment theory, given the role that attachment plays in the psychobiological regulation of emotion, especially fear, anger and anxiety (Fonagy et al., 1995). Early attachments play a key role in shaping the autonomic nervous system, with secure attachments reflecting an optimal balance between sympathetic and parasympathetic nervous system arousal (Schore, 1994). A secure attachment indicates that an individual has learnt to utilise relationships to modulate fear and arousal. An insecure attachment implies that an individual has had insufficient experience of having his arousal regulated in an attuned attachment relationship, which is reflected in a less resilient nervous system, long-lasting over or under arousal throughout the body and brain, less adaptive behavioural responses to stress, and a vulnerability to psychopathology (Cozolino, 2010; Burgess et al., 2003).

The present exploratory case-based study examined a small clinical sample of at-risk children who displayed elevated behavioural difficulties including aggression. Each child's representation of attachment security was assessed and coded pre and post play therapy intervention with the Child Attachment and Play Assessment (CAPA) (Farnfield, 2015a), a play-based narrative story stem assessment centred on the Dynamic Maturation Model of Attachment and Adaptation (DMM) (Crittenden, 2006). During the assessment each child's ECG was simultaneously recorded in real-time and processed off-line to extract measures of heart rate (HR) and a measure of high frequency heart rate variability, respiratory sinus arrhythmia (RSA), a commonly used measure of parasympathetic nervous system activity that provides a window into the vagal regulation of the heart.

Diamond (2001) reasons that research examining the links between attachment theory and the functioning of the parasympathetic branch of the autonomic nervous system is pertinent, given the strong emphasis on the role of attachment in regulating affect and arousal, a homeostatic function directly related to the PNS. The Polyvagal theory (Porges, 1995, 2001, 2007, 2011, 2017) proposes that the vagal system is central to social emotion regulation throughout life and utilises RSA as a measure of emotion regulation and social engagement. In essence the Polyvagal theory is "the preamble to attachment" (Porges, 2017, p.72) as it describes the neural pathways on which attachment processes occur, a collection of vagal pathways called the social engagement system (Porges, 2017). In the present study each child's HR and RSA reactivity in response to the CAPA was examined with a view to gaining insight into the physiological processes that may underlie the production of children's play narratives. Heart rate was utilised as a measure of overall autonomic arousal and RSA as a measure of parasympathetic functioning.

The Child Attachment and Play Assessment

The Child Attachment and Play Assessment (CAPA) is a doll-play story stem procedure and manualised coding system that assesses attachment, play and mentalising in children between 3 and 11 years of age (Farnfield, 2015a). The CAPA is the only narrative story stem assessment to use Crittenden's Dynamic Maturational Model of Attachment and Adaptation (DMM; 2006) in the analysis of children's story stems. The DMM is a developmental model that classifies self-protective attachment patterns learnt in infancy through interaction with adult caregivers (Crittenden, 2006). Within this model self-protective attachment strategies are categorised as secure (Type B), insecure anxious avoidant (Type A) or insecure ambivalent or preoccupied (Type C). Type B categories are classified B1 through B5, Type A strategies are classified A1 through A8, and Type C strategies C1 through C8 (see Figure 1). However, not all strategies are evident in school-aged children and higher strategies tend to develop in adolescence and adulthood. Typically strategies B1 through B5, A1 through A4, and C1 through C6 are identifiable in school-aged children (see Figure 2) (Farnfield, 2015a). Notably, the DMM differs from the ABCD model of attachment (Main & Solomon, 1986), as it does not have a disorganised Type D category. Most of the Type D behaviours are reconfigured as organised responses to developmental trauma: strategies for gaining some measure of safety or comfort in a dangerous environment, labelled A+ and C+. The plus symbol denotes an insecure attachment pattern more extreme than a more normative A1-2 or C1-2 pattern (Farnfield, 2015a).

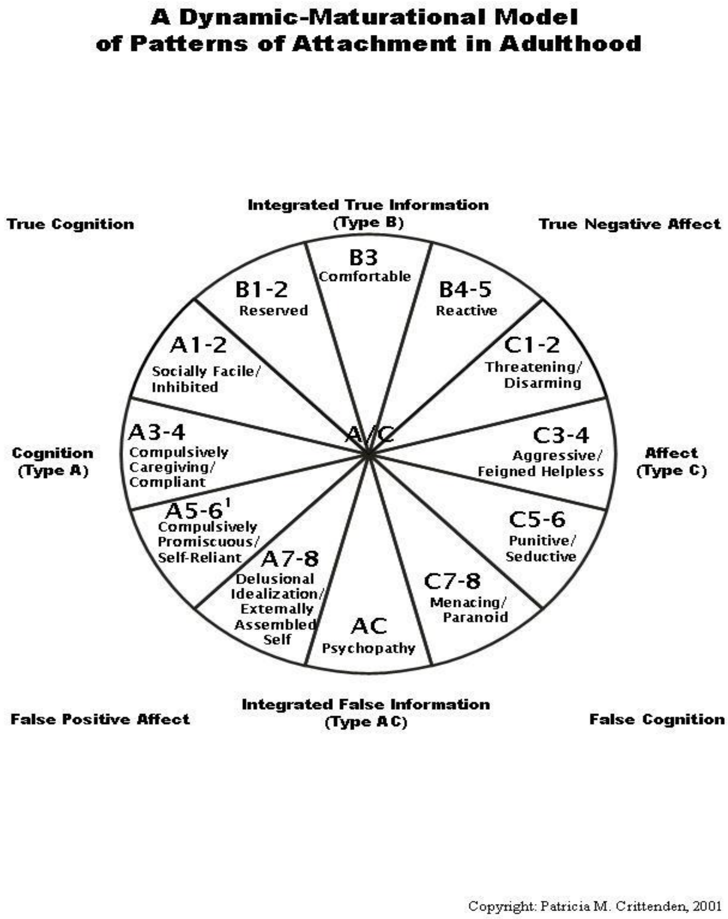

Figure 1. The adult DMM categories of attachment. Reprinted from the CAPA coding manual by Farnfield, 2015a. Copyright 2001 by Patricia Crittenden.

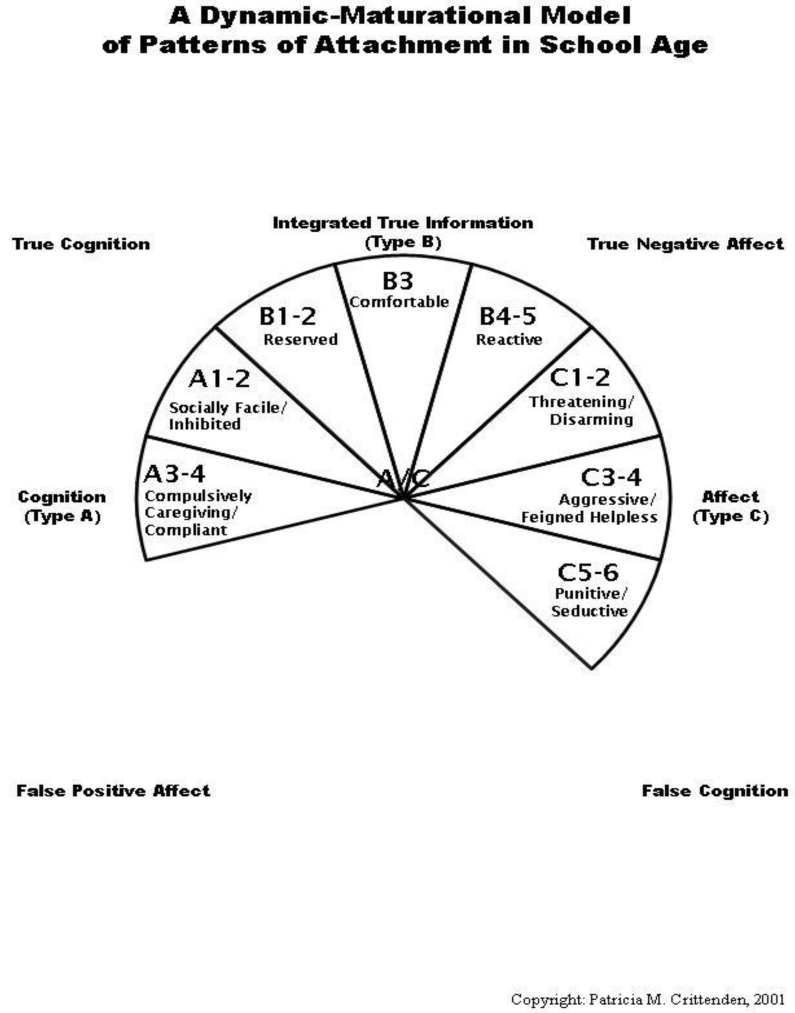

Figure 2. The DMM school age strategies. Reprinted from the CAPA coding manual by Farnfield, 2015a. Copyright 2001 by Patricia Crittenden.

Type B Securely Attached. Children coded by the CAPA as Type B1 through B5 are securely attached. These children tend to have predictable parents who are able to provide comfort and protection. These children are free to show their parents how they feel as they have caregivers who accept, validate and respond to their feelings. However, children with a Type B strategy can also call on a range of Type A or Type C defences if threatened (Farnfield, 2015a). Type B3 is the archetype of attachment security, described as comfortable. Children in the Type B1-2 category take initiative in play or conversation, although they are reserved and display less affect than children in the Type B3 category. Conversely, children coded Type B4-5 (reactive) display more affect and physical proximity than children in the B1-2 category. Children in the Type B4 category need more reassurance than Type B3, and children in the Type B5 category tend to be feistier than children with a Type B3 attachment (Farnfield, 2015a). Overall children with a Type B strategy have a moderate level of controlled arousal during the CAPA. They assume a playful approach to the assessment, trust the interviewer and take responsibility for managing their own affect (Farnfield, 2015a).

Type A Defended Strategies. Children whose behaviour is classified as A1-2 tend to have inconsistent caregivers and may be protected but not necessarily comforted. A Type A1-2 attachment is considered a normative form of insecurity. Children with an A1-2 attachment tend to inhibit negative affect and a desire for comfort and show low levels of proximity seeking, while being attentive to the needs of their attachment figure. Children in the Type A1 category are emotionally inhibited and over-emphasises doing the right thing. Children in the Type A2 category are socially facile and present with a bright over the top manner (Farnfield, 2015a).

Children in the Type A3 category often have fragile, depressed caregivers who are unable to provide comfort; a common strategy for neglected children. These children take a compulsive caregiving role, where the child becomes the psychological parent for the caregiver. These children inhibit a desire for comfort and display false positive affect (Farnfield, 2015a). An A4 strategy is a defence that may arise from physical abuse where the child fears the consequence of doing the wrong thing. These children suppress their anger and do not show the false positive affect of the lower A attachment strategies and may appear robotic, hyper-vigilant and depressed (Farnfield, 2015a).

Further Type A+ strategies may develop in adolescence and adulthood. Type A5 refers to social or sexual promiscuity. A Type A6 strategy reflects a compulsive self-reliance, whereby an individual gives up attempts to engage adults for protection or comfort, often resulting in depression. Type A7 emerges when there is a delusional idealisation of a dangerous attachment figure, and Type A8 describes an externally assembled self - a strategy that is often found in looked after children.

Type C Coercive Strategies. Children whose behaviour is classified as C1-2 usually have inconsistent and unpredictable caregivers who tend to reinforce negative rather than positive behaviours. Children in the Type C categories use displays of affect to regulate the attention of their caregivers (Farnfield, 2015a). Central to the coercive strategy is the use of coy and disarming behaviours to neutralise aggression. A Type C1-2 category is considered a normative form of insecurity. Children in the Type C1 category use threatening behaviour, children in the C2 category use disarming behaviour, children in the Type C3 category utilise aggression, and children in the Type C4 category utilise feigned helplessness, in an attempt to have their attachment needs met. Children with a Type C3 strategy tend to exhibit challenging behaviours and are often referred for conduct problems. These children express high levels of anger toward attachment figures in their play narratives that often includes murder and exaggerated, cartoonish sequences of violence (Farnfield, 2015b). A Type C5 strategy, punitive revenge, may also develop in the school years. These children have been exposed to more serious threat than those children in the C3-4 category. A C5 strategy has a cooler, less obviously angry approach than in C3. These children deploy deception and conceal their true intentions (Farnfield, 2015a). They have an obsession with revenge and dismiss vulnerably in themselves and others and may refuse to co-operate with the CAPA. Type C7 (menace) and Type C8 (paranoia) are strategies that develop in adulthood where there has been a high degree of exposure to unpredictable danger involving deception, where comfort has preceded abuse (Farnfield, 2015a).

In addition to the conceptual framework of the DMM, the CAPA examines the role of play in the development of mentalising from the perspective of Winnicott's model of the potential space (1971) and Fonagy's work on the development of mentalising through play. Mentalising is the awareness that our own internal experiences are different form the internal experience of others (Fonagy et al., 2002). Mentalising allows children to integrate internal and external realities and play about difficult experiences in a way that makes them more manageable (Farnfield, 2015b). Child-centred play therapy capitalises on the natural inclination that children have for play and their ability to use play to process and master difficult experiences (Landreth, 2002). Within this study the CAPA was utilised as a novel outcome measure for play therapy intervention and a tool for detecting shifts in attachment security and play-based mentalising, principally a child's capacity to mentalise and play about difficult interpersonal experiences. Children with secure patterns of attachment tend to exhibit high-level mentalising, evident in a playful integration of their inner and outer realities, whereas children with insecure attachment strategies tend to favour one reality and dismiss the other (Farnfield, 2015b). Broadly, a Type A strategy is described as an avoidant or affect suppressing strategy that develops when a child has a caregiver who is insensitive to his needs, which drives the child to become overly self-reliant, compulsively attune to the needs of his caregiver, inhibit his own feelings and desires, and mask his distress with false-positive affect, in an attempt to garner a caregiving response. Children with Type A strategies prioritise the outer reality and dismiss their inner feelings. They over-rely on self-regulation as they have learnt that other people do not help with emotion regulation. Children with a Type C strategy prioritise their inner reality and are driven by their feelings. They keep a close eye on their unpredictable caregivers and use exaggerated displays of emotion and negative affect to elicit and maintain a caregiving response (Farnfield, 2015a; Goldberg et. al., 1994).

Attachment and Autonomic Regulation

Ogden and colleagues (2006) contend that the different strategies of attachment reflect different patterns of autonomic dominance. A secure attachment (Type B) is thought to reflect an optimal balance in sympathetic and parasympathetic arousal (Schore, 1994). A securely attached child can utilise relationships to help regulate, can quickly and accurately evaluate safety or danger, and adaptively shift arousal states in response to stress. Children with Type A attachment strategies have a tendency to over-regulate their autonomic nervous system in the absence of an attuned caregiver. These children tend toward energy-conserving states of parasympathetic dominance (Cozolino, 2002; Schore 2012) and have difficulty modulating their arousal and shifting out of low arousal states, which results in a reduced capacity to express and experience both positive and negative affect (Schore, 2003). Children with a Type A strategy have a bias toward 'parasympathetic affects' such as shame, disgust, helplessness, hopelessness and despair (Schore, 2012).

Children with insecure Type C attachment strategies under-regulate their nervous system and tend towards sympathetic dominance and energy-expending states of high-arousal, hypervigilance, exaggerated negative affect and emotional reactivity (Cozolino, 2002; Schore, 2012; Ogden et al., 2006). High arousal interferes with a child's capacity to socially engage and while these children seek out interactive regulation they are not readily soothed by relationships (Schore, 2012). Children with a Type C strategy have a bias toward 'sympathetic-dominant affects' such as panic, terror, anger and pain (Schore, 2012). Thus, in response to stress, it is theorised that children with a Type A strategy deactivate their attachment system, over-regulate their nervous system, and display states of parasympathetic hypo-arousal reflected in a decreased HR and increased vagal tone (i.e. increased RSA). Children with a Type C strategy hyper-activate their attachment system, under-regulate their nervous system, and display states of sympathetic hyper-arousal reflected in an increased HR and decreased vagal tone (i.e. RSA withdrawal) (Abtahi & Kerns, 2017; Ogden et al., 2006; Schore, 2012). Consequently, the different strategies of attachment may be conceptualised as consisting of cognitive, affective, behavioural and psychobiological dimensions (Diamond, 2001).

Attachment and Vagal Reactivity

Existing infant research indicates that sensitive parenting contributes to the development of optimal patterns of physiological reactivity and adaptive behavioural responses to stress; while less sensitive parenting leads to autonomic profiles marked by under or over-arousal (Cozolino, 2010; Burgess, Marshall, Rubin & Fox, 2003). Attuned mother infant dyads have similarities in heart rate and increased infant RSA (i.e. vagal augmentation) during mother-child interaction has been linked to social engagement and positive maternal care (Feldman, Singer & Zagoory, 2010; Hastings et al., 2008; Moore & Calkins, 2004). Laboratory tasks that interrupt social interaction between a mother and infant, such as the Still Face procedure, or the Strange Situation, typically result in a decrease in infant RSA (i.e. vagal withdrawal) (Conradt & Ablow, 2010; Hill-Soderlund et al., 2008; Moore, et al., 2009). A meta-analysis of 18 studies examining vagal tone (i.e. HRV or RSA) during dyadic social interaction between mothers and infants (e.g. the Still-Face procedure, the Strange Situation, dyadic teaching tasks and parent-child free play) in children with and without psychopathology, found that social engagement tasks did not necessarily increase HRV relative to baseline (Shahrestani et al., 2014). However social disengagement was associated with a significant decrease in HRV relative to baseline (i.e. a pattern of vagal withdrawal) for typically developing children, while reunion (social re-engagement) returned HRV to baseline levels. At-risk children or those with a diagnosis of psychopathology failed to show a significant change in HRV for either social engagement or disengagement (Shahrestani, et. al., 2014). Furthermore, Moore and Calkins (2004) found that infants who did not decrease HRV in response to their mother's still-face showed less positive affect, greater reactivity, and less synchrony with their mothers during free play. Conversely, the analysis compared these results to a non-dyadic social stress test, the Trier Social Stress Test, which involves public speaking and mental arithmetic in front of an audience and found a significant decrease in HRV for children with and without psychopathology. This suggests that the reduced autonomic reactivity of at-risk groups is specific to dyadic interaction rather than a general failure to respond.

The meta-analysis concluded that social disengagement followed by re-engagement produces a distinct pattern of vagal withdrawal (i.e. a decrease in HRV or RSA) followed by a return to baseline levels in typically developing children. Atypical HRV responses that do not follow this pattern are a potential marker for social dysfunction and psychopathology in children (Shahrestani et al., 2014). A further meta-analysis examining dyadic social interaction in adolescents and adults across 13 studies, found that both social interaction and stress tasks caused a significant reduction in HRV, although this was moderated by the valence of the social task (Shahrestani et al., 2015). When the dyadic tasks were categorised as positive, negative or neutral, typically developing participants showed a significant reduction in HRV in response to the negative tasks, while positive and neutral social tasks had little effect on HRV relative to baseline. Similar to the meta-analysis for children, adult participants with a diagnosis of psychopathology failed to show significant differences in HRV across any of the social tasks, irrespective of valance (Shahrestani et al., 2015).

Vagal Reactivity and Behaviour

Laboratory-based studies have associated children's RSA or vagal reactivity with general measures of adaptive functioning. Vagal withdrawal in response to moderate stress is associated with better emotion regulation, sustained attention, fewer behavioural problems and fewer internalising symptoms (Calkins & Demon, 2000; Calkins & Keane, 2004; Hastings et al., 2008; Porges, 1996; Suess et al., 1994). A longitudinal study found that 2-year-old children who showed a pattern of RSA withdrawal during a challenging task, were later rated by their mothers as better regulated and more socially skilled at 4.5 years than those children who showed less pronounced RSA withdrawal at 2 years (Calkins & Keane, 2004). A meta-analysis of cardiac control and children's adaptive functioning found that children from clinical or at-risk samples tended to display lower levels of baseline RSA and lower levels of RSA withdrawal (Graziano & Derefinko, 2013). However, excessive vagal withdrawal has also been associated with behavioural dysregulation and a mixed profile of externalising and internalising behaviours, the over-control of emotions, emotional liability and the fight, flight response in anxious children (Beauchine, 2001).

Studies have also linked RSA augmentation in response to stress (i.e. increased vagal cardiac control and a failure to withdraw vagal/parasympathetic influences) with a higher risk of internalising and externalising behaviours (Calkins & Dedmon, 2000). Studies that have utilised frustration-inducing laboratory tasks with children have also found associations between externalising symptom severity and RSA augmentation in response to stress (Hinnant & El-Sheikh, 2009). Thus, there is a growing amount of literature linking reduced parasympathetic or vagal control to aggression and the dysregulation of emotion (Beauchaine, 2001; Gottman & Katz, 2002). In response to a peer provocation task Katz (2007) linked vagal augmentation to an increased prevalence of conduct problems and a greater exposure to domestic and family violence, and proposed that an augmented response to stress reflects social hyper-vigilance. Children with ADHD have also been observed to display elevated parasympathetic activity (i.e. RSA augmentation) during an emotion task in comparison to typically developing children, leading to the conclusion that childhood ADHD is also associated with abnormal parasympathetic mechanisms involved in regulating emotion (Musser, et al., 2011).

However some studies have proposed that enhanced parasympathetic influence over the heart (i.e. vagal augmentation) is an adaptive response to stress and is evident during the use of cognitive emotion regulation strategies. Davis et al. (2016) examined a sample of 101 (5 and 6-year old) children assigned to one of three cognitive emotion regulation conditions: control, distraction or re-appraisal. The children viewed several fear and sadness emotion-eliciting film clips for each condition. The study found that those children who used cognitive emotion regulation strategies did show differences in the parasympathetic regulation of sadness and fear in response to the films. Within this study patterns of RSA withdrawal were linked to experiencing fear and sadness, while RSA augmentation was viewed as evidence that the cognitive emotion regulation strategies (i.e. distraction and reappraisal) were effective in lessening negative emotion. Similar results have been found for adults, where pairs of adult women viewed and discussed an upsetting film. Those women who were instructed to suppress or reappraise her emotional experience during the conversation showed greater vagal augmentation (Butler, Wilhelm & Gross, 2006). The varied findings suggest that there is likely an optimal degree of vagal regulation that is associated with a constructive engagement with environmental challenge and stress (Calkins et al., 2007) although this may be contextually sensitive. The biological sensitive of context theory proposes that high reactivity is protective in low-stress contexts, while low reactivity is protective in high-stress contexts (Blandon, Calkins, Keane & O’Brien, 2008; Obradovic, Bush, Stemperdahl, Adler & Boyce, 2010). Thus, individuals with high RSA reactivity may benefit more from enriched environments, but are more affected by adverse environments (Gatzke-Kopp, Greenberg & Bierman, 2015). Correspondingly, individuals with low RSA reactivity are less affected by adverse environments, but may benefit less from enriched environments, including therapy.

Vagal Reactivity and Narrative Story Stems

The story stem procedure is a social, emotional and cognitive challenge that is designed to induce a degree of attachment anxiety. It involves a child creating personal play narratives in response to a story stem depicting a relational stressor, while interacting with the interviewer, a stranger to the child. Story stems differ from most laboratory tasks as they require interpersonal interaction and elicit personally relevant threat, rather than attempting to evoke a specific emotion. Therefore they may be more effective at inducing physiological changes than laboratory task that do not elicit personally relevant material (Fortunatoe, et al., 2013). Yet few studies have examined RSA reactivity in response to children's narrative story stems and no study has examined vagal tone during administration of the CAPA. Bar-Haim, Fox, VanMeenan & Marshall (2004) examined the vagal tone of 58 children (7 years of age) in response to the MacArthur Story Stem Battery. Significant decreases in vagal tone (i.e. vagal withdrawal) were found between the baseline (an emotionally neutral story stem) and the presentation of the story stem by the experimenter, likely due to the cognitive effort involved in listening to the story. Stories identified as "emotionally-laden" (e.g. those that contained themes of parent separation and reunion) showed a greater decrease in vagal tone (i.e. vagal withdrawal) during the presentation of the stem. During the production of a narrative response to the story stem, children showed patterns of vagal withdrawal and vagal augmentation. Children identified as 'suppressors' (28 children) showed a pattern of vagal withdrawal and had more coherent and adaptive play narratives, with less negative emotion and anxiety than those children identified as 'augmenters' who showed a pattern of vagal augmentation (30 children). The study did not report the attachment strategies of the children, nor attempt to associate the different patterns of vagal reactivity with the different strategies of attachment, such as whether children with a Type C strategy were more likely to be 'suppressors' and children with a Type A strategy 'augmenters' as theory suggests.

A more recent study examined RSA reactivity in children during a laboratory-based social stress tasks and correlated this with measures of attachment (Abtahi & Kerns, 2017) for 99 children between 9 and 11 years of age. Each child's attachment security was assessed via a narrative story stem assessment and vagal tone was measured during a speech task. Vagal regulation was not assessed during the story stem task itself. Securely attached children (Type B) showed less negative affect and higher baseline HRV (RSA) indicating greater emotional flexibility. Children with a Type A strategy showed less reactivity and recovery of negative affect, suggesting a dampened emotional response, while children with a Type C strategy showed more reactivity and recovery of negative affect. Significant changes in vagal regulation were only evident for children with an ambivalent Type C attachment, who, contrary to the initial hypothesis, showed less vagal withdrawal during the speech stress task (Abtahi & Kerns, 2017). This indicates that in this study children with a Type C strategy showed a flattened physiological response to the speech task.

In summary there are diverse and sometime contradictory findings related to RSA reactivity in children, although a clear distinction is made between challenging tasks that do and do not require interpersonal interaction. Typically a pattern of vagal withdrawal, which indicates a decrease in parasympathetic control (i.e. a decrease in RSA), has been shown to accompany challenging tasks that demand cognitive attention and/or elicit an emotional response. For challenging tasks that require social interaction, a pattern of vagal withdrawal is commonly observed for social tasks that have a negative valance and following experimental ruptures in relationships, with a return to baseline levels following relationship repair. However a different pattern of reactivity has been observed in children, adolescents and adults identified as at-risk or with psychopathology. While these individuals appear to show a pattern of vagal withdrawal in response to non-dyadic stress tests, they demonstrate a lack of responsiveness to dyadic stress tests and reduced vagal withdrawal relative to baseline, indicating a reduced autonomic flexibility in relationship.

An augmented response (i.e. an increase in parasympathetic control/vagal inhibition) to stress has also been observed in at-risk groups, especially among children exposed to domestic violence. It is theorised that an augmented response to stress is linked to social hyper-vigilance and the inhibition of negative emotion, and develops in adverse conditions where high reactivity may increase vulnerability. In certain contexts vagal augmentation may also be an adaptive response to challenge and reflect cognitive self-regulation. In safe or low stress situations vagal augmentation is associated with positive social engagement, positive emotion and social affects such as love and compassion. Few studies have examined vagal reactivity during children's narrative story stem assessments; the foremost study to date found that children displayed a pattern of vagal withdrawal while listening to story stems, although during the construction of play narratives the children equally displayed patterns of vagal augmentation and vagal withdrawal.

Research Questions and Hypotheses

Within this study ECG was recorded with a view to simultaneously examining each child's pattern of attachment and vagal regulation in response to the challenge of the CAPA. An understanding of a child's attachment strategy and vagal regulation in response to the CAPA may prove helpful in forming conceptual links between a child's psychological and physiological coping during the construction of play narratives. Furthermore, a pre and post-treatment assessment of vagal reactivity provides a means for determining whether play therapy intervention has the capacity to alter physiological functioning at the level of the vagal brake. The present study examined within-subject individual-differences in vagal reactivity during the administration of the CAPA, before and after a block of play therapy intervention for a small sample of children with extreme behavioural and regulatory difficulties. Within each assessment a child's pattern of attachment (i.e. DMM Type A, B or C) and the direction of RSA reactivity from baseline (i.e. vagal withdrawal or vagal augmentation) was assessed during each child's response to several story stem tasks. Due to the number of variables that can impact on a child's physiology, researchers are advised to first code behaviour and then extract physiology measures for points of interest (Fox et al., 2012). In light of this, research questions and hypotheses included:

1. Do the different categories of insecure attachment show different patterns of vagal regulation during the construction of play narratives within the CAPA? Attachment strategies may indicate an individual's learned pattern of defence (Wagner, 2015). According to the Polyvagal theory (2010) individuals display either social engagement behaviours, mobilised flight-fight behaviours or immobilised shutdown behaviours in response to stress or challenge. Employment of the social engagement system during states of rest and a tendency toward moderate vagal withdrawal during stress are conjectured markers of a secure attachment.

1.1 An increase in vagal tone in response to a challenging task (i.e. RSA augmentation) has been related to increased effort to regulate one's emotions and inhibit negative affect (Butler et al., 2006; Ingjaldsson et al., 2003; Skowron et al., 2011). Individuals with an insecure Type A attachment strategy tend to use cognition as a way of coping with challenging situations and display psychological inhibition, and minimise, mask or suppress negative emotion (Crittenden, 1995). Children in the A+ cluster use extreme psychological inhibition to minimise their subjective awareness of difficult feelings. Schore (2003) proposes that Type A attachment strategies have a bias towards a pattern of over-regulation and parasympathetic dominance. Shaver and Mikulincer (2007) similarly propose that the distancing behaviours and self-reliant coping strategies of avoidant attachment strategies (Type A) are designed to shutdown activation, reflected in parasympathetic shutdown and a bias toward the immobilisation and freeze response. It was hypothesised that children displaying psychological inhibition, coded Type A or A+ by the CAPA, would also display physiological inhibition during the construction of play narratives, reflected in a failure to withdraw the vagal brake evident in a pattern of vagal augmentation (i.e. an increase in RSA from baseline).

1.2 On the other hand individuals with a Type C or C+ attachment pattern tend to hyper-activate their attachment system and exaggerate their experience of negative affect, especially fear and anger, to cope with stress (Crittenden, 1995). A decrease in RSA (i.e. decrease in vagal tone or RSA withdrawal) in response to a challenging task is associated with psychological stress (Berntson et al., 1994) and the expression of negative emotion (Beauchaine, 2001). Schore (2003) proposes that Type C attachment strategies tend towards under-regulation of the autonomic nervous system and sympathetic dominance. It was hypothesised that children coded Type C or C+ would display an over-reactive physiology profile and a tendency toward activation of the sympathetic fight-flight response (i.e. a tendency toward vagal withdrawal or a reduction in RSA) during the construction of play narratives within the story stem challenge.

2. Is there a distinct physiological profile associated with the play narratives classified by the CAPA as unresolved loss or trauma? An unresolved coding in the CAPA indicates that loss or trauma has temporarily disrupted a child's strategy of attachment. It was hypothesised that segments of play containing markers for unresolved trauma or loss would show greater physiological dysregulation and a tendency towards either marked vagal augmentation, reflecting a higher degree of inhibition, or higher levels of vagal withdrawal, reflecting a potential activation of mobilised fight-flight behaviours.
3. Can the CAPA be used to inform play therapy or utilised as an outcome measure for play therapy intervention to detect shifts in a child's strategy of attachment, or shifts in a child's ability to use play narratives to express difficult or traumatic interpersonal experiences? Are these shifts reflected in changes in vagal reactivity during the construction of play narratives?

3.1 It was anticipated that the behaviourally disturbed children in the present study would show evidence of insecure patterns of attachment and poor vagal regulation. The Polyvagal theory proposes that behavioural difficulties ultimately stem from difficulty turning off defences so that social engagement can occur (Porges, 2017). It was hypothesised that a reorganising pattern of attachment coded by the CAPA, would correspond to an adaptive shift in vagal reactivity (i.e. moderate removal of the vagal break) during the construction of play narratives.

METHOD

Participants. The study consisted of 6 children between 6-9 years of age who attend a specialist therapeutic primary school. All of the children experienced academic, social, emotional and behavioural difficulties including aggression. All of the children were from disadvantaged backgrounds and had been exposed to some form of violence such as physical abuse, family or domestic violence and/or community violence. One child was excluded from the final analysis due to atypical heart rate variability, possibly due to a chromosomal abnormality. The final analysis consists of 5 children, 4 boys and 1 girl.

Story Stem Procedure. Story stem assessments are designed to activate attachment behaviours and elicit a child's representation of attachment relationships (Farnfield, 2015a). They are an advantageous means of assessment as they do not require direct questioning about a child's family and allow for the verbal and nonverbal expression of experiences stored in explicit and implicit memory systems (Steele, Hodges, Kaniuk, & Steele, 2010). The story stem assessments took place in the same room for the pre and post-intervention assessment. The room was equipped with a small table and two chairs. A selection of dollhouse furniture, black and white dolls, a car and domestic and wild animals were available for the story stem tasks. Two independent interviewers trained in story stem assessment protocol conducted the pre and post-intervention assessments. The assessment procedure consisted of 6-10 narrative story stems (listed in Appendix B) drawn from the CAPA (Farnfied, 2015a) and MacArthur Story Stem Batteries

(Bretherton, Oppenheim, Buchsbaum & Emde, 2003). Several pre-school aged story stem tasks were included in the assessment, as these were deemed developmentally appropriate for the children in this study. Each story stem depicts a mild stressor, for example the interviewer dramatizes a story where a child spills his juice and upsets his mother at which point the child is asked to, “Show and tell me what happens next?” The interviewer may ask questions such as, “Does anything else happen?” to facilitate a child’s narrative. The interviewer may also ask the child to name the feelings of the characters at the end of each story.

Story Stem Coding. The assessment was videorecorded and coded according the CAPA by the manual’s author (Farnfield, 2015a). A second coding was conducted by a trainee working party with a high level of agreement. An insecure attachment is coded Type A or Type C. The strategies are further coded numerically C1 through C8 and A1 through A8. The higher the number the more insecure and extreme the strategy. Type A+ and Type C+ are used to indicate a strategy higher than a more normative A1-2 or C1-2 strategy that develop in response to more dangerous home environments. Coding depends on the function of observed behaviours and each individual story is analysed according to six key constructs. The final attachment coding is based on the overall attachment pattern observed across the entire assessment (Farnfield, 2015a; 2015b). The key assessment constructs include:

1. The child’s relationship with the interviewer (e.g. is it reserved, cooperative or controlling).
2. The child’s observed level of arousal (e.g. is the child’s arousal expressed, inhibited, high, low, moderate or oscillating).
3. Discourse (i.e. the fluency and coherence of the play narrative and speech).

4. Play-based mentalising (i.e. is it externally generated, internally generated, or integrated).
5. Content makers or signifier behaviours that assist in assigning a DMM attachment strategy (e.g. Type A markers include holding awkward body positions, sitting on hands, scratching, and mismatched stated and expressed affect. Type C markers include coy behaviours and body positions such a tummy protrusion and head cocking, aggressive body positing such as bared teeth, intrusions into the interviewer's space and exaggerated affect).
6. The final category includes modifiers such as intrusions of forbidden negative affect (e.g. fear, rage or a desire for comfort), expressed somatic symptoms, disorientation and indicators of attachment reorganisation and depression. Markers for depression include a lack of eye contact and connection with the interviewer, low arousal, zoning out, a lack of play or exploration, a sense of futility or sadness, a lack of self-agency and repetition of words or actions and a sense of stuckness in the play narratives.

Coding for Unresolved Trauma. The CAPA has working criteria for coding unresolved trauma and loss, coded as preoccupied or dismissed. Preoccupied trauma is a story that has to be told. Dismissed trauma is a story the child actively avoids telling (Farnfield, 2015a). Trauma is considered unresolved when it temporarily disrupts the primary strategy of attachment. Markers of unresolved trauma or loss include:

- Hyper-vigilance (e.g. startles to noise, asks if someone is outside).
- The discourse of speech or play becomes dysfluent to the point where it disrupts the A+ or C+ strategy.
- There is a repetition of trauma themes within or across stories and/or a sense of urgency that indicates that the story has to be told.
- The child is unable to use the play or the relationship with the interviewer to find any relief or solution.

- There is a sense that the child is depicting his own real experience. These passages may be told in a matter-of-fact manner with little or flat affect, have chillingly real details, bizarre themes, odd statements or somatic markers of expressed pain (e.g. tapping or protecting a body part during an enacted play sequence).

It is important to note that the presence of violence in a child's play narrative may or may not be coded for unresolved trauma. Securely and insecurely attached children both depict violence in their play narratives. Within the CAPA the coder assesses the function of the violence, not merely its presence. Children with Type C attachment strategies tend to display higher levels of violence in their play narratives. Violence in the more extreme Type C+ attachment strategies may serve the function of: increasing arousal, motivating action, controlling the story, gaining the attention of the interviewer, or efforts to deceive or shock the interviewer. Violence that does not serve one of these functions may be coded as Utr (unresolved trauma) in a Type C+ attachment strategy (Farnfield, 2015a). For a Type A+ strategy, unresolved trauma is queried when violent themes suddenly emerge, or where violence is portrayed in a flat or matter-of-fact manner that does not function to deflect interest to or away from the self (Farnfield, 2015a). To aid in coding and the examination of the function of violence in children's play narratives, interpersonal violence was coded as either present or absent for each of story stem tasks examined in this study. The story stem assessment was administered before and after a block of school-based, child-centred play therapy provided by two volunteer student therapists.

Baseline Conditions. To study vagal reactivity, two baseline conditions were established prior to the assessment. The first baseline was a seated, resting baseline where the child was encouraged to relax while listening to a storybook read by the researcher, who was known to the child. The children were permitted to interact with the researcher and comment on the story as they might naturally, thus the first baseline was a low talking seated baseline. The second seated baseline was collected during the setup period where the child assisted the interviewer, a stranger to the child, in arranging the dollhouse furniture and selecting a doll family prior the initial story stem. Neither baseline is a true resting baseline but rather a comparison task or ‘vanilla baseline’ (Jennings et al., 1992) which attempted to capture a steady state condition that involved comparable levels of movement and attention, but without the emotional or cognitive challenge of generating a response to a story stem. In the final analysis the storybook baseline was chosen as the comparison baseline as it was the least challenging baseline that best approximated a ‘resting’ state, given that the child was interacting with a known adult. The setup baseline involved the additional stress of interacting with an unfamiliar adult that could potentially mobilise the nervous system so the child was no longer in a relaxed state.

Cardiac Measures. Two-minute epochs of ECG were isolated from the mid-section of each baseline condition and from the child’s initial 2-minute play response to each story stem following the interviewer’s direction to, “Show me and tell me what happens next.” Where the child’s response was less then 2-minutes in duration, the end portion of the telling of the story stem by the interviewer was also included. To ensure movement levels were consistent across conditions, story stems were excluded from the final analysis if the child stood or made a significant postural adjustment during the story stem task that may have impacted on cardiac measures. The setup period and total of 4 story stem responses free of significant motor movement were identified for each child for analysis. The ECG data was processed by the Brain Body Center at the University of Illinois, to produce measures of HR and RSA (see Methods). The CardioBatch Plus software (Brain-Body Center for Psychophysiology and Bioengineering, University of North Carolina) utilised 15 seconds of ECG data at the beginning and end of each 2-minute segment for calibration, RSA and HR were then averaged for each 30-second epoch. The final RSA and HR average is the mean of all epoch values, a total of 90-seconds for each story stem task analysed.

Cardiac Reactivity. RSA and HR reactivity (i.e. an increase or decrease from baseline) for each story stem response was examined via both task difference scores and residual change scores. Difference scores are the most commonly used index of vagal regulation in psychophysiological studies and are suited the present case study analysis as they provide a meaningful interpretation of vagal reactivity, through the identification of patterns of vagal augmentation or vagal withdrawal in response to each story stem task. In this study RSA and HR task difference scores were calculated by subtracting the average level of RSA and HR during each story stem task from the average during the baseline storybook condition (i.e. the 90-second story stem task average minus the 90-second storybook baseline average). The pattern of vagal reactivity (i.e. whether RSA increased or decreased from the baseline level) in response to the stressor of each story stem task was observed. An increase in RSA from baseline (i.e. positive raw difference score) indicated a pattern of vagal augmentation. A decrease in RSA from baseline (i.e. negative raw difference score) indicated a pattern of vagal withdrawal. The greater the difference scores the greater the increase or decrease in RSA.

As recommended (Obradovic et al., 2011; Laborde et al., 2017) RSA and HR reactivity were also examined via residual change scores to aid comparisons of high and low reactivity between the children in the sample. Although without a control group, comparisons were confined to the other at-risk children within the current study. Residual change scores reflect the degree to which a child's RSA and HR responses deviate from the regression line for the entire sample (Manuck et al., 1990). In this study a positive residual score represents lower reactivity (i.e. a challenge score that is smaller than expected based on the individual's baseline level and the sample's regression line). A negative residual score represents higher reactivity (i.e. a challenge score that is larger than expected).

RESULTS

Attachment Coding. Table 1 depicts the attachment coding for each child pre and post play therapy intervention. All of the children displayed highly insecure patterns of attachment. Three children showed Type A+ patterns of attachment and 2 children Type C+ patterns. Overall the children's attachment strategies remained relatively consistent between the pre and post-intervention CAPA. No child showed an improved or reorganising pattern of attachment. Modifiers including Uloss (unresolved loss), Utr (unresolved trauma), Dp (depression) and Ina's (intrusions of negative affect) were also recorded.

Table 1

Pre and post-play therapy intervention CAPA coding

Case Study	Pre-Therapy CAPA		Post-Therapy CAPA	
	Attachment Coding	Modifiers	Attachment Coding	Modifiers
Eli	A+ [A1, A3]	Dp, Uloss	A+ [A3-4]	Dp, Uloss
Billy	A+ [A3-4]	Dp, Utr	A+ [A3-4]	Utr, Ina
Lizzie	A+ [A3, 5 (8)]	Dp, Utr, Ina	A+ [A5, 8]	Utr, Ina

Tyler	C+ [C5 (7-8)]	n/a	C+ [C5]	n/a
Josh	C+ [C5-6]	Utr	C+ [C7-8]	Utr

Baseline Physiological Measures. The ‘vanilla’ comparison (storybook) baseline averages for RSA and HR for each case study participant is presented in Table 2 and Figures 3 and 4, for the pre and post-intervention story stem assessment. Billy and Josh show an increase in parasympathetic activity (i.e. higher baseline RSA and lower baseline HR) from the pre to the post-intervention assessment. The remaining children (Eli, Lizzie and Tyler) show a decrease in baseline parasympathetic activity.

Table 2

Pre and post-assessment baseline averages for RSA (ms^2) and HR (bpm)

Case Study	Pre-Therapy Baseline RSA	Post-Therapy Baseline RSA	Pre-Therapy Baseline HR	Post-Therapy Baseline HR
Eli	7.84	7.54	68.96	84.04
Billy	3.56	4.72	129.34	118.25
Lizzie	6.83	5.19	99.14	116.61
Tyler	6.56	6.18	90.87	90.30
Josh	7.24	8.12	95.53	93.19

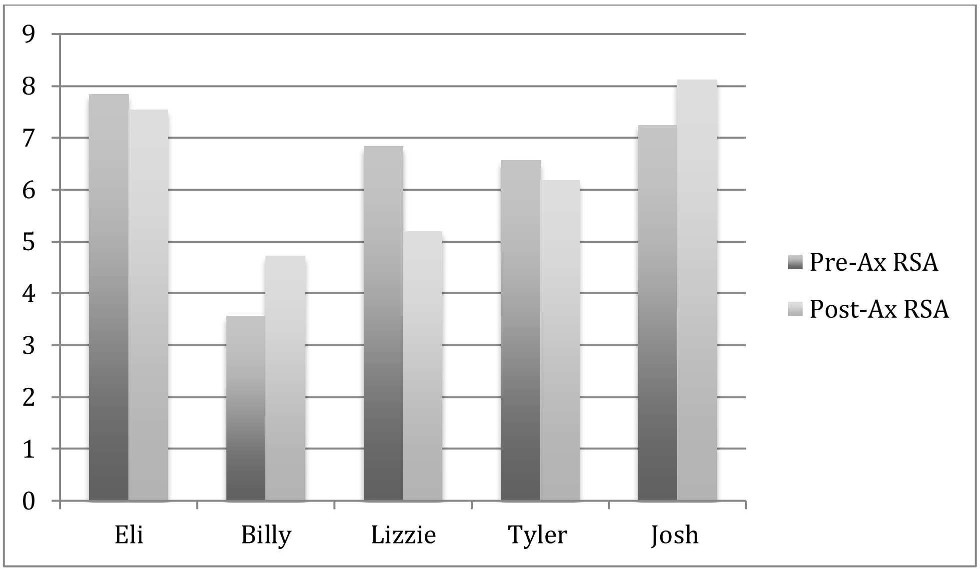

Figure 3. Pre and post-play therapy intervention storybook baseline averages for RSA (ms^2) prior to administration of the CAPA. Billy and Josh show an increase in baseline RSA measures, while the remaining children show a decrease in baseline measures.

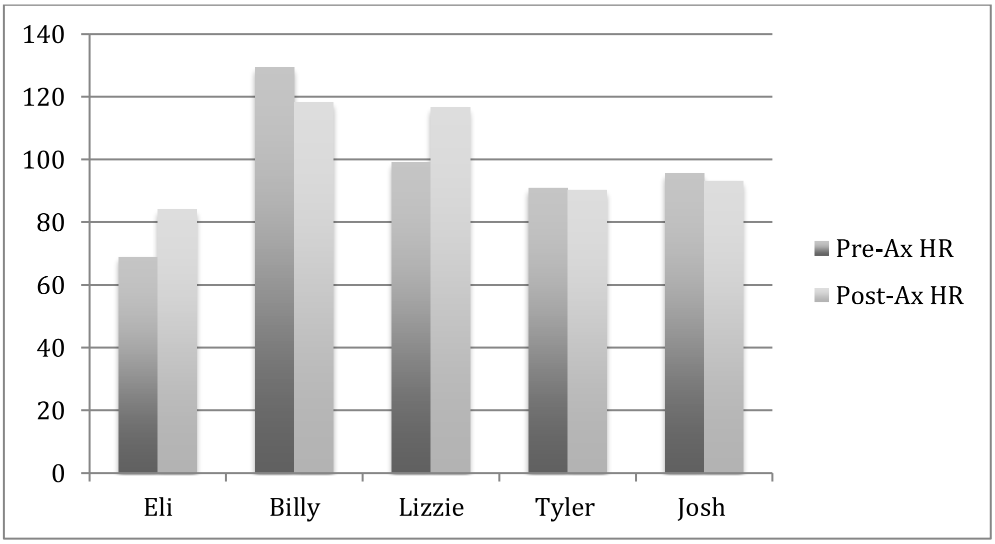

Figure 4. Pre and post-play therapy intervention storybook baseline averages for HR (bpm) prior to the administration of the CAPA. Billy and Josh show a slight decrease in HR. The remaining children show an increase in baseline measures of HR.

Vagal Reactivity and Heart Rate Reactivity. Given the small sample size it was not possible to perform a robust statistical analysis, rather a descriptive analysis of the patterns of vagal reactivity and heart rate reactivity in response to the CAPA was conducted for each child. The observed changes in RSA and HR are discussed in turn for each case study below.

Case Study 1: Eli

Pre-Therapy Assessment Results. Table 3 shows the RSA and HR averages for Eli's pre-therapy narrative story stem assessment for the storybook baseline and 4 story stem conditions. Table 4 shows the RSA and HR raw reactivity scores, residual change scores, the dominant attachment strategy, makers of unresolved trauma or loss, and the presence of modifiers such as depression (Dp), intrusions of negative affect (Ina) and the presence of interpersonal violence within each child's play.

Table 3

Pre-Therapy Assessment Metric Averages Eli

Story Stem Task	RSA Average	HR Average
Storybook BL	7.84	68.96
Setup Baseline	7.85	68.71
Spilt Juice	7.79	70.38
Departure	8.46	71.37
Hot Gravy	8.06	72.12
Stomping Elephant	7.88	76.48

Note: RSA ($msec^2$) and HR (bpm) scores were averaged over 90-seconds for each condition.

Table 4

Pre-Therapy Assessment RSA, HR Reactivity & Coding Eli

Story Stem	RSA DS	RSA RS	HR DS	HR RS	Coding	Utr	Modifiers	Violence
Setup	0.01 Augmentation	-0.01	-0.25	0.21				
Spilt	-0.05	0.26	1.42	2.79	A+		Dp	

Juice	Withdrawal							
Parent Departure	0.62 Augmentation	0.40	2.41	1.42	A+	Uloss	Dp	
Hot Gravy	0.22 Augmentation	0.30	3.16	0.31	A+		Dp	
Stamping Elephant	0.04 Augmentation	0.04	7.52	2.74	A+		Dp	Present

*Note***.** Initial story stem assessment results for Eli including raw difference scores (DS) and residual change scores (RS). Depression (Dp) is coded as a modifier across the assessment. The ‘Parent Departure’ stem is coded for unresolved loss.

Figure 5 illustrates the direction of reactivity for RSA and HR in response to each story stem task. In the initial assessment Eli was coded with an overall anxious avoidant Type A+ attachment strategy (i.e. A1, A3) with depression modifiers. Eli’s play-based mentalising was externally generated. Within the assessment Eli displayed a tendency toward a pattern of vagal augmentation (i.e. an increase in RSA from baseline to the play narrative). RSA augmentation in response to a stressor has been associated with the inhibition of negative affect, a tendency to adopt passive and avoidant modes of coping with physiological arousal and hyper-vigilance to interpersonal threat (Katz 2007; Rainville et al., 2006). This is an atypical reactivity profile that indicates a blunted vagal response and a lack of autonomic flexibility, evidenced by a failure to adaptively withdraw the vagal brake in response to the story stem challenge. The residual change scores for HR and RSA in response to each of the story stem challenges are positive (Table 4), which indicates that Eli has smaller challenge scores than expected based on the samples regression line. Eli’s RSA and HR are less reactive than the other children in the sample during the construction of play narratives.

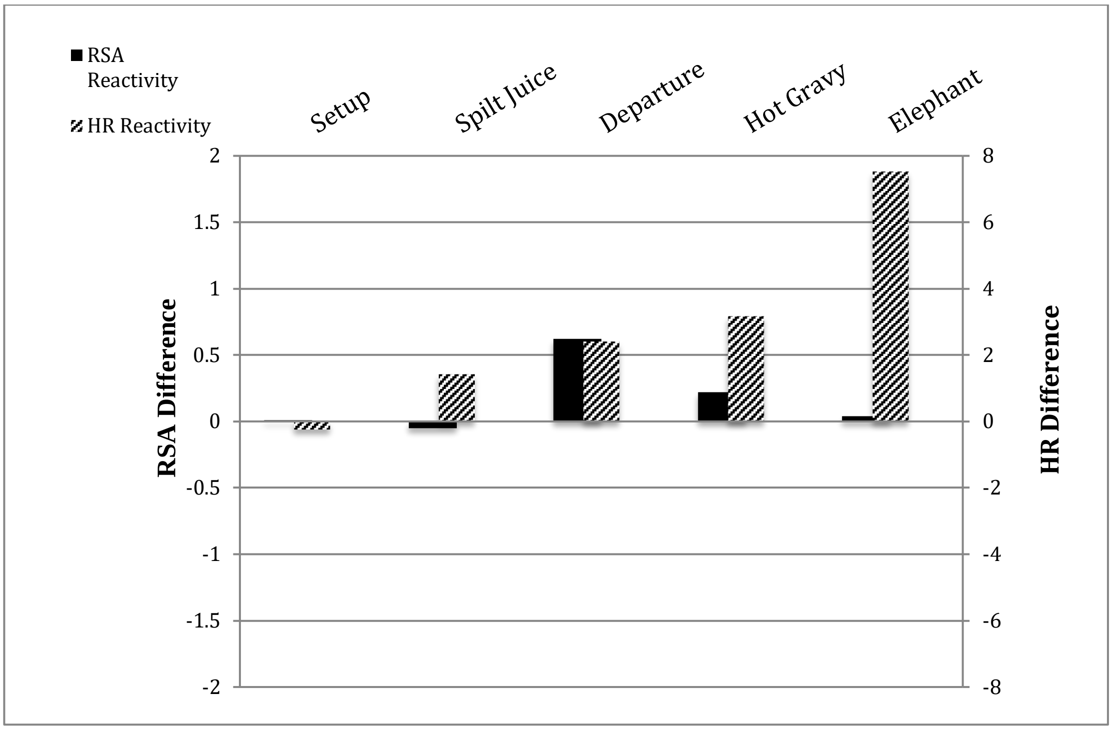

Figure 5. Raw difference scores for the initial story stem for Eli. The graph has two vertical axes. The first axis depicts RSA in msec². The second vertical axis depicts HR in beats per minute. Columns below 0 indicate a decrease in HR or RSA (a pattern of vagal withdrawal) relative to baseline; columns above line 0 indicate an increase in HR or RSA (vagal augmentation). Eli shows a predominant pattern of vagal augmentation during the construction of play narratives and an increase in HR across the assessment.

The 'Parent Departure' story was the sole narrative coded for unresolved loss and was accompanied by the highest degree of vagal augmentation (i.e. the largest increase in RSA from baseline) (Figure 5). This play narrative is significant in the context of Eli's early history. Eli's father was murdered while Eli was away on holiday with a family friend while his mother was pregnant. Eli was told of his father's death two weeks following on his return. In this story stem, the interviewer dramatizes a story where the children's parents leave for a trip and the children are left in the care of their grandparents. In Eli's moving play narrative response (Appendix D.1) the children are unable to find their lost father for two weeks. Schore (2003) proposes that Type A strategies are accompanied by a tendency to over-regulate with a bias towards parasympathetic dominance and increased vagal tone in response to stress. Eli's A+ strategy of attachment with depression is predominantly coupled with low reactivity and pattern of vagal augmentation, which is consistent with Schore’s proposition. A defining feature of a Type A+ attachment strategy is the tendency to avoid negative affect, which as hypothesised, is reflected in a pattern of vagal augmentation that is most obvious during the play narrative coded for unresolved loss. This indicates that Eli was exerting more self-regulatory effort to suppress or avoid the negative feelings and arousal evoked during this unresolved play narrative. Depression has also been associated with atypical RSA reactivity and a disengaged or passive physiological response, rather than the mobilisation of the resources necessary to appropriately respond to challenge (Hamilton & Alloy, 2016). An increase in RSA (vagal augmentation) typically corresponds with a decrease in HR, although an inefficient vagal brake is less able to attenuate sympathetic influences, which may account for the observed increase in HR despite the prevailing pattern of vagal augmentation, especially for the unresolved loss narrative. The vagal brake, despite being engaged, has failed to suppress an increase in HR arousal.

The ‘Stamping Elephant’ narrative depicts the highest degree of HR reactivity for Eli, with slight vagal augmentation. This story is the only story to depict interpersonal violence in the pre-intervention assessment, although the violence is consistent with the interviewer’s introduction to the story. The elephant scares the children and Eli has the adult animals repeatedly knock down the Elephant to show him, “Who’s the boss.” The increase in HR in this play narrative may reflect the expression of anger in this play, as an increase in HR with little change in RSA has been linked to sympathetic activation and the expression of anger (Rainville et al., 2006). This is consistent with the findings of Brenning and Braet (2013) who note that children with a Type A strategy tend towards anger dysregulation and sadness suppression in response to stress. It may be that the ‘Parent Departure’ narrative depicts Eli’s grief and suppressed sadness, reflected in a higher degree of RSA augmentation, while the ‘Stamping Elephant’ stem depicts a more dysregulated physiological profile and increased HR reactivity, which may reflect the expression or intrusion of negative affect, specifically anger. It appears that strong feelings of sadness are more actively inhibited than the expression of anger in Eli's play narratives. Thus, for the pre-intervention assessment there appears to be a failure to adaptively withdraw the vagal brake during the construction of play narratives for Eli. Rather Eli shows elevated parasympathetic activity during the construction of play narratives, which may reflect a passively avoidant response to the story stem challenge and an attempt to inhibit negative affect, which is most apparent during the play narrative coded for unresolved loss. Yet despite an increase in vagal inhibition, Eli's HR also increases from baseline, indicating an inefficient attempt at arousal inhibition.

The pre-intervention assessment for Eli indicates that a Type A+ strategy may be associated with an augmentation response to stress (i.e. increased vagal inhibition of the heart) as hypothesised. This pattern of augmentation was heightened during the narrative coded for unresolved loss, which supports the hypothesis that unresolved loss or trauma narratives have a distinct pattern of cardiac reactivity.

Post-therapy Assessment Results. Following 20 sessions of play therapy intervention Eli completed a follow-up story stem assessment. Table 5 lists the post-therapy assessment averages for RSA and HR. Table 6 shows the RSA and HR reactivity and CAPA coding.

Table 5

Post-therapy Assessment Metric Averages

Story Stem Task	RSA Average	HR Average
Storybook BL	7.54	84.04
Setup Baseline	6.65	86.16
Spilt Juice	7.63	86.54
Hurt Knee	7.36	88.33
Hot Gravy	7.17	86.70
Noise in the Night	6.93	86.03

Note: Post-therapy story stem metric averages during baseline and story stem conditions for Eli. RSA values are in milliseconds squared (ms^2) and HR in beats per minute (bpm).

Table 6

Post-therapy Assessment RSA & HR Reactivity & Coding

Story Stem	RSA Diff.	RSA Res.	HR Diff.	HR Res.	Coding	Utr	Modifiers	Violence
Setup	-0.89 Withdrawal	0.00	2.12	-0.78				
Spilt Juice	0.09 Augmentation	0.67	2.50	-2.20	A+		Dp	
Hurt Knee	-0.18 Withdrawal	0.35	4.29	-1.16	A+		Dp	Present
Hot Gravy	-0.37 Withdrawal	0.46	2.66	-0.38	A+			
Noise in the Night	-0.61 Withdrawal	-0.03	1.99	-0.09	A+	Uloss	Dp	

*Note***.** Post-therapy story stem assessment results for Eli including raw difference scores and residual change scores.

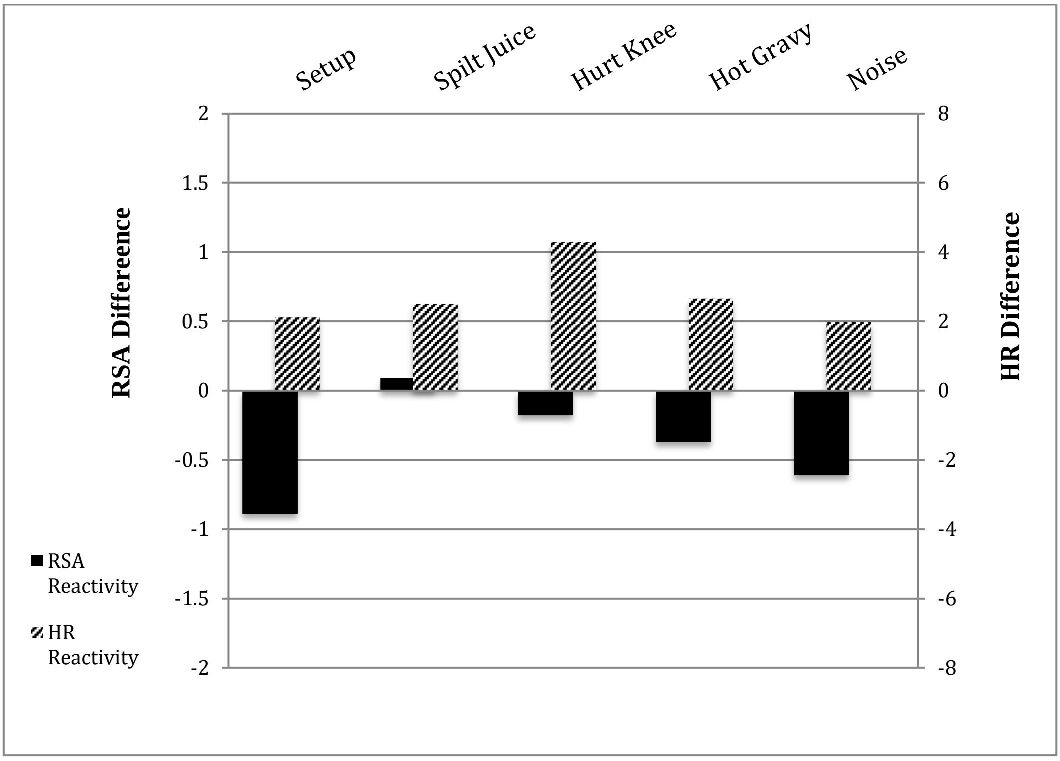

Figure 6. Raw difference scores for the post-therapy story stem for Eli. The graph has two vertical axes. The first axis depicts RSA in $msec^2$. The second vertical axis depicts HR in beats per minute. Columns below 0 indicate a decrease in HR or RSA (vagal withdrawal) relative to baseline; columns above line 0 indicate an increase in HR or RSA (vagal augmentation). Eli shows a predominant pattern of vagal withdrawal in the follow-up assessment.

Eli was again coded with an overall insecure A+ attachment in the follow-up assessment. In the pre-intervention assessment Eli showed elements of an A1 and A3 strategy, in the follow-up assessment this had shifted to a predominantly A3-4 strategy, which indicates a reduction in attachment security. Several narratives were also coded for depression, marked by flat affect and a lack of connection with the interviewer. While Eli's overall attachment strategy had not re-organised several positive shifts were noticed in Eli's play-based mentalising. His play narratives were longer, more complex, and he showed an increased ability to take the perspective of the self and other (i.e. his mentalising was more integrated). Eli's vagal reactivity in the follow-up assessment showed a different pattern from the pre-intervention assessment (Figure 6). In the pre-intervention CAPA Eli's HR ranged from 68.9 to 76.5 during the construction of his play narratives and his RSA from 7.8 to 8.5. In the post-intervention assessment Eli's HR ranged from 84.0 to 88.3 and his RSA from 6.7 to 7.6. This indicates that Eli was more aroused in the follow-up assessment (i.e. higher HR and lower RSA). The RSA task difference scores show a shift towards a pattern of vagal withdrawal (i.e. a decrease in RSA from baseline). A pattern of vagal withdrawal is considered an adaptive response to stress or challenge and suggests that Eli is potentially relying on less physiological inhibition in the follow-up assessment, which may indicate that there has been an adaptive shift in the functioning of the vagal brake in response to the stress of the story stem assessment. It was hypothesised that a positive shift in vagal regulation would accompany a positive shift in attachment security, however this was not supported by the case study 1 as a shift in vagal regulation was observed despite a weakening of attachment security.

The residual change scores for the follow-up assessment indicate that Eli has a lower RSA reactivity and a higher HR reactivity in comparison to the rest of the sample, with the exception of the ‘Noise in the Night’ narrative during which Eli showed higher RSA and higher HR reactivity (i.e. negative residual change scores). The highest degree of vagal withdrawal was noted for the setup task, which may reflect Eli’s anticipatory anxiety prior to the repeat assessment. The initial ‘Spilt Juice’ stem is the only narrative to show a pattern of vagal augmentation (i.e. an increase in RSA), which was the dominant pattern of vagal reactivity in the pre-intervention assessment. The ‘Spilt Juice’ narrative was characterised by a display of false positive affect, as the dad in the play narrative brought the food to the table. The children didn’t like the food but when questioned Eli responded that the dad felt happy. As in the pre-intervention assessment, the expression of false positive affect or the inhibition of negative affect appears linked to a pattern of vagal augmentation.

The ‘Hurt Knee’ narrative showed the largest increase in HR. This narrative portrayed seemingly real details of community violence and described a group of children fighting in the park and throwing rocks at a window. As for the pre-intervention assessment the portrayal of interpersonal violence in the play narrative was coupled with a greater mobilisation of HR. The most poignant story, ‘Noise in the Night’ (Appendix D.2) was coded for unresolved loss. This narrative contained similarly high levels of negative affect and themes of loss as the ‘Parent Departure’ story in the pre-intervention assessment, although Eli’s play narrative showed more integrated mentalising and the expression of negative feelings including shame, disappointment and anger towards an absent father figure. In addition to more integrated mentalising, the ‘Noise in the Night’ story is distinct from the other narratives as it shows a greater reactivity for HR and RSA (i.e. negative residual scores) in comparison to the rest of the sample. This may reflect more adaptive vagally driven changes in HR for this play narrative, and indicate that Eli is potentially re-working his feelings about the traumatic loss of his father within this narrative.

It is speculated that a shift from vagal augmentation in the pre-intervention assessment to vagal withdrawal in the post-intervention assessment, indicates improved vagal regulation and a more adaptive response to stress. A similar pre and post-intervention change from a pattern vagal augmentation to vagal withdrawal during a parent-child play task was observed in a case study by Bagner and colleagues (2010) following a parent-child intervention, which was associated with improved emotional and behavioural regulation. However, for Eli a shift in vagal regulation has not been accompanied by a shift in attachment security. While Eli continues to operate from a self-reliant A+ strategy of attachment there appears to be less inhibition of negative affect within his play narratives and the presence of more integrated, play-based mentalising. Since there is no shift in attachment security the observed shift in the pattern of vagal reactivity may be due to other factors, such as the expression, rather than the inhibition of negative emotions such as shame. Overall Eli appears to show an improved ability to play about and express negative emotions with less affective and physiological inhibition in the follow-up CAPA.

Case Study 2: Billy

Pre-therapy Assessment Results. Table 7 shows the RSA and HR averages for Billy's pre-intervention narrative story stem assessment for the storybook baseline and 4 story stem conditions. Table 8 shows the RSA and HR reactivity scores for each condition.

Table 7

Pre-therapy Assessment Metric Averages

Story Stem Task	RSA Average	HR Average
Storybook BL	3.56	129.34
Setup Baseline	3.93	133.09
Noise in the Night	4.75	132.93
Parent Departure	4.64	130.67
Hot Gravy	5.23	127.35
Lost Pig	4.69	128.10

Note: Pre-therapy story stem metric averages for Billy. RSA ($msec^2$) and HR (bpm) scores were averaged over 90-seconds for each condition.

Table 8

Pre-therapy Assessment RSA & HR Reactivity & Coding

Story Stem	RSA Diff.	RSA Res.	HR Diff.	HR Res.	Coding	Utr	Modifiers	Violence
Setup	0.37 Augmentation	0.06	3.75	1.11				

Noise in the Night	1.19 Augmentation	0.11	3.59	3.24	A+		Dp
Parent Departure	1.08 Augmentation	0.15	1.33	2.12	A+		
Hot Gravy	1.67 Augmentation	0.19	-1.99	1.70	A+	Utr	
Lost Pig	1.13 Augmentation	0.13	-1.24	3.26	A+		Dp

*Note***.** Pre-intervention story stem assessment results for Billy with raw difference scores and residual change scores. The 'Hot Gravy' narrative is coded for unresolved trauma.

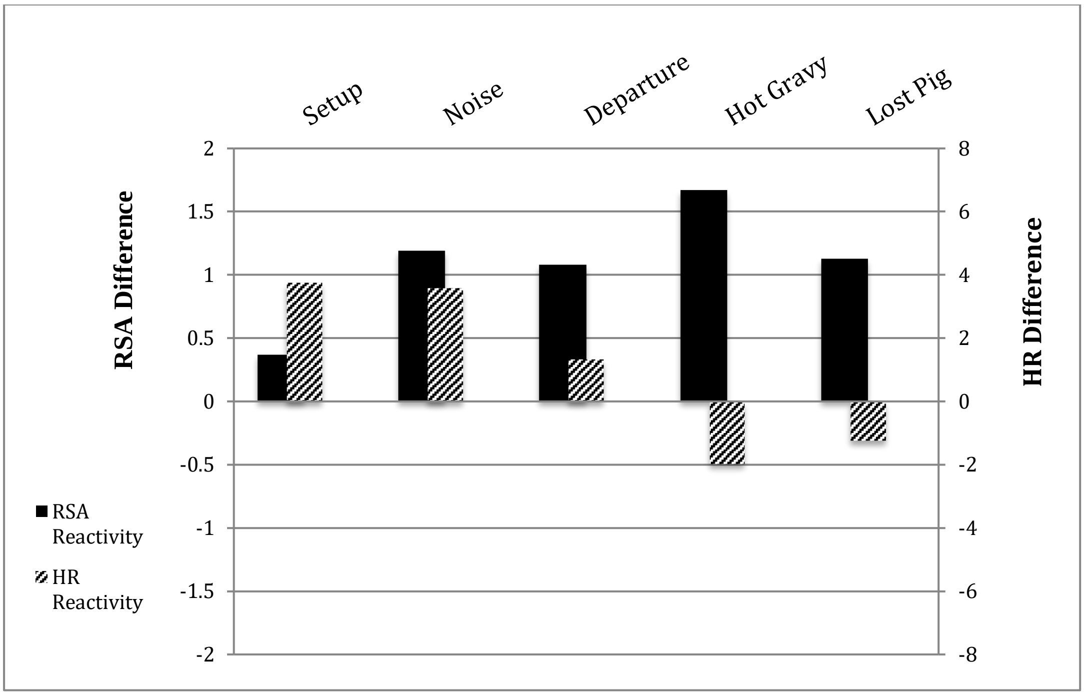

Figure 7. Raw difference scores for the initial story stem for Billy. The graph has two vertical axes. The first axis depicts RSA in msec^2. The second vertical axis depicts HR in beats per minute. Columns below 0 indicate a decrease in HR or RSA (vagal withdrawal) relative to baseline; columns above line 0 indicate an increase in HR or RSA (vagal augmentation). Billy shows a pattern of vagal augmentation across the assessment.

In the initial assessment Billy was coded with a Type A+ attachment (A3-4) with depression modifiers. Billy displayed characteristic Type A traits such as high levels of expressed false positive affect, inhibition of a desire for comfort and avoidance of negative affect. At the outset Billy had the lowest levels of baseline RSA and the highest resting HR in comparison to the other children (Table 2) indicating a potentially over-aroused resting autonomic profile and a reduced capacity for withdrawal of the vagal brake. Consistent with these observation Billy showed lower levels of RSA and HR reactivity during the construction of play narratives in comparison to the other children in the sample (i.e. positive residual scores for HR and RSA) and a pattern of vagal augmentation (i.e. an increase in RSA from baseline) (Figure 7), which indicates a failed attempt at vagal regulation and a compromised ANS, which has been linked to the inhibition of negative affect, a key characteristic of an A+ strategy of attachment.

The 'Hot Gravy' narrative is the sole narrative coded for unresolved trauma and shows the highest level of vagal augmentation for this assessment (Figure 7), which implies that Billy was exerting more self-regulatory effort to supress the negative feelings evoked by this story stem. This play narrative depicts a suppressed desire for comfort and the absence of a caring parental response to a child's burnt hand (Appendix D.3). During the narrative Billy beats on his hand as if it is injured, an example of a somatic trauma marker, which is accompanied by several instances of mismatched stated and expressed affect, with Billy smiling during this demonstration of pain. Thus for the pre-intervention assessment the play narrative coded for unresolved trauma displayed the most distinct pattern of vagal augmentation, suggesting that Billy was using a greater degree of physiological inhibition during the telling of this story which supports the hypothesis that unresolved trauma narratives have a distinct physiological profile.

The 'Noise in the Night' narrative (Appendix D.4) also showed a high level of vagal augmentation. The children wake up and scream, but quickly return to bed despite feeling scared. Defensive sleeping could be interpreted as an enacted avoidance as the children return to bed as a resolution to strong negative affect, a common theme across Billy's play narratives. Defensive sleeping is commonly observed in Type A play narratives. A study by Field and Reite (1984) found that children separated from their mothers tended to sleep for longer periods and described this as conservation withdrawal. Sleeping as a way to deal with stress is associated with the parasympathetic shutdown response, which is why it may appear more frequently in A+ play narratives as children with a Type A+ strategy utilise conservation withdrawal as a primary means of managing stress. However, despite an increase in RSA (i.e. vagal augmentation) during the 'Noise in the Night' play narrative, the expression of fear in this story is coupled with an increase in HR, which suggests a poorly functioning vagal brake that despite remaining engaged has failed to inhibit overall cardiac arousal, which may indicate that sympathetic mobilisation has potentially overridden a parasympathetic inhibition of heart rate.

Post-therapy Assessment Results. Following 15 sessions of play therapy intervention Billy completed a follow-up story stem assessment. Table 9 lists the post-therapy assessment averages for RSA and HR. Table 10 shows RSA and HR reactivity and the post-intervention CAPA coding.

Table 9

Post-therapy Assessment Metric Averages

Story Stem Task	**RSA Average**	**HR Average**
Storybook BL	4.75	118.25
Setup Baseline	5.34	114.88
Spilt Juice	5.70	115.24
Hurt Knee	6.51	109.65

Picture Home	5.92	118.20
Hot Gravy	5.47	123.52

Note: Post-therapy story stem metric averages for Billy. RSA ($msec^2$) and HR (bpm) scores were averaged over 90-seconds for each condition.

Table 10

Post-therapy Assessment RSA & HR Reactivity & Coding

Story Stem	**RSA Diff.**	**RSA Res.**	**HR Diff.**	**HR Res.**	**Coding**	**Utr**	**Modifiers**	**Violence**
Setup	0.59 Augmentation	0.53	-3.37	0.27				
Spilt Juice	0.95 Augmentation	0.41	-3.01	1.76	A+			
Hurt Knee	1.79 Augmentation	0.49	-8.6	1.69	A+	Utr		Present
Picture Home	1.17 Augmentation	0.67	-0.05	2.91	A+		Dp	
Hot Gravy	0.72 Augmentation	0.13	5.27	6.72	A+			

*Note***.** Follow-up story stem assessment results for Billy including HR and RSA raw difference scores and residual change scores. The ‘Hurt Knee’ narrative is coded for unresolved trauma.

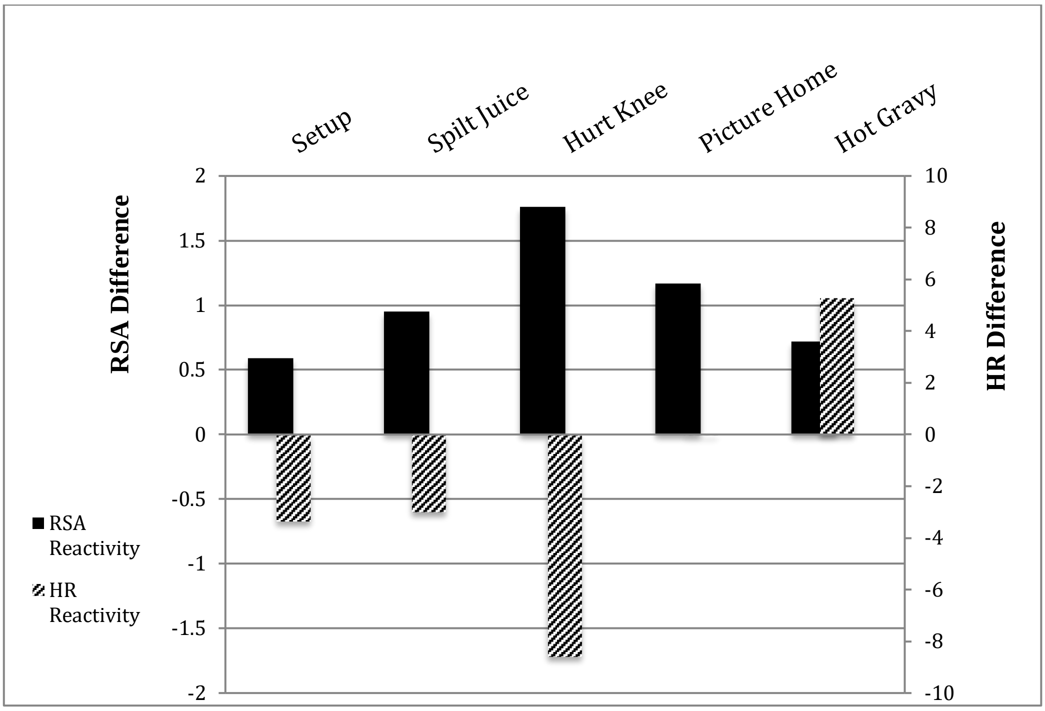

Figure 8. Raw difference scores for the follow-up story stem for Billy. The graph has two vertical axes. The first axis depicts RSA in msec^2. The second vertical axis depicts HR in beats per minute. Columns below 0 indicate a decrease in HR or RSA (vagal withdrawal) relative to baseline; columns above line 0 indicate an increase in HR or RSA (vagal augmentation). Billy shows a pattern of vagal augmentation across the assessment.

Billy showed a similar pattern of attachment and vagal regulation in the pre and post-intervention assessment. In the post-intervention assessment Billy was again coded with a Type A+ (A3-4) strategy of attachment with markers for depression. The play narratives were again accompanied by a pattern of vagal augmentation (Figure 8). The positive residual change scores indicate that Billy's HR and RSA reactivity was again smaller than expected when compared to the other children in the sample. Thus in the post-intervention assessment Billy continued to show a weak vagal brake. The 'Hurt Knee' narrative depicts anger expressed by the children towards their father figure that is abruptly cut-off and avoided (Appendix D.5). This is also the sole narrative coded for unresolved trauma and as evident in the pre-intervention assessment, this narrative was accompanied by the highest degree of vagal augmentation. In the pre and post-intervention assessment Billy showed the same tendency toward a pattern of vagal augmentation, indicating a preference for passive PNS dominant states, which was hypothesised for a child with a Type A+ strategy. While Billy expressed more negative affect in the post-intervention assessment this was often followed by cut-off and avoidance. It is possible that the play therapy intervention did enhance Billy's ability to name and express negative affect in his play, although it remained inhibited and has not been accompanied by a change in the pattern of vagal regulation. Clinically this suggests that the naming of negative emotion in a child's play may not be associated with a change vagal regulation of the heart. It is likely that the ability to mentalise or think about expressed emotion is more important in re-organising and processing interpersonal trauma at both a psychological and physiological level.

The 'Picture Home' narrative (Appendix D.6) was coded for depression and contained a high degree of expressed negative affect, although it was again accompanied by a pattern of vagal augmentation with a negligible change in heart rate. The final 'Hot Gravy' narrative also shows a pattern of vagal augmentation that fails to suppress HR, which again may reflect sympathetic activation due to a poorly functioning vagal brake. The child is sent to bed and feels angry, "Because he got told off." When asked how mum feels Billy notes, "Very, very angry." As for Eli the expression of anger in the play narrative appears to be linked to an increase in HR. Shortly after this narrative Billy promptly announced, "The end!" and jumped out of his seat and crashed onto a beanbag at the end of the room, possibly in response to his increasing arousal and an attempt to physically avoid further engagement with the task.

Across the pre and post-intervention CAPA Billy showed the same A+ pattern of attachment (A3-4) and as hypothesised this was accompanied by a dominant pattern of vagal augmentation during the construction of his play narratives, which suggests physiological inhibition and a failure of the vagal brake to mobilise and appropriately respond to the challenge of the assessment. This inability to shift autonomic state could be attributed to a 'ceiling effect' given Billy's high resting arousal, describe by Heliman et al. (2012) as a 'sluggish vagal brake.' As hypothesised the play narratives coded for unresolved trauma showed the most dysregulated physiology and the greatest failure of the vagal brake, with higher levels of vagal augmentation. Those narratives coded for depression showed little change in HR, while those narratives expressing fear or anger appeared to mobilise HR, despite a pattern of vagal augmentation, indicating that feelings of sadness may be more easily suppressed than those related to anger or fear for children with an A+ strategy. Thus, case study 2 provides support to the hypothesis that a pattern of vagal augmentation accompanies the play narratives of children with a Type A+ strategy of attachment, which is heightened during unresolved trauma play narratives.

Case Study 3: Lizzie

Pre-therapy Assessment Results. Table 11 shows the RSA and HR averages for Lizzie's pre-therapy narrative story stem assessment for the storybook baseline and 4 story stem conditions. Table 12 shows the RSA and HR reactivity scores for each condition.

Table 11

Pre-therapy Assessment Metric Averages

Story Stem Task	RSA Average	HR Average

Storybook BL	6.83	99.14
Setup Baseline	6.63	97.24
Spilt Juice	6.92	92.27
Hurt Knee	6.91	92.68
Parent Reunion	7.55	92.38
Hot Gravy	7.11	93.13

Note: Pre-therapy story stem metric averages for Lizzie. RSA ($msec^2$) and HR (bpm) scores were averaged over 90-seconds for each condition.

Table 12

Pre-therapy Assessment RSA & HR Reactivity & Coding

Story Stem	RSA Diff.	RSA Res.	HR Diff.	HR Res.	Coding	Utr	Modifiers	Violence
Setup	-0.20 Withdrawal	-0.29	-1.9	-2.99				
Spilt Juice	0.09 Augmentation	0.07	-6.87	-6.36	A+			
Hurt Knee	0.08 Augmentation	-0.31	-6.46	-6.56	A+		Dp	
Parent Reunion	0.72 Augmentation	0.43	-6.76	-6.34	A+	Utr	Ina Rage	Present
Hot Gravy	0.28 Augmentation	0.04	-6.01	-6.16	A+	Utr Abandonment		

***Note*.** Initial story stem assessment results for Lizzie including RSA raw difference scores and residual change scores.

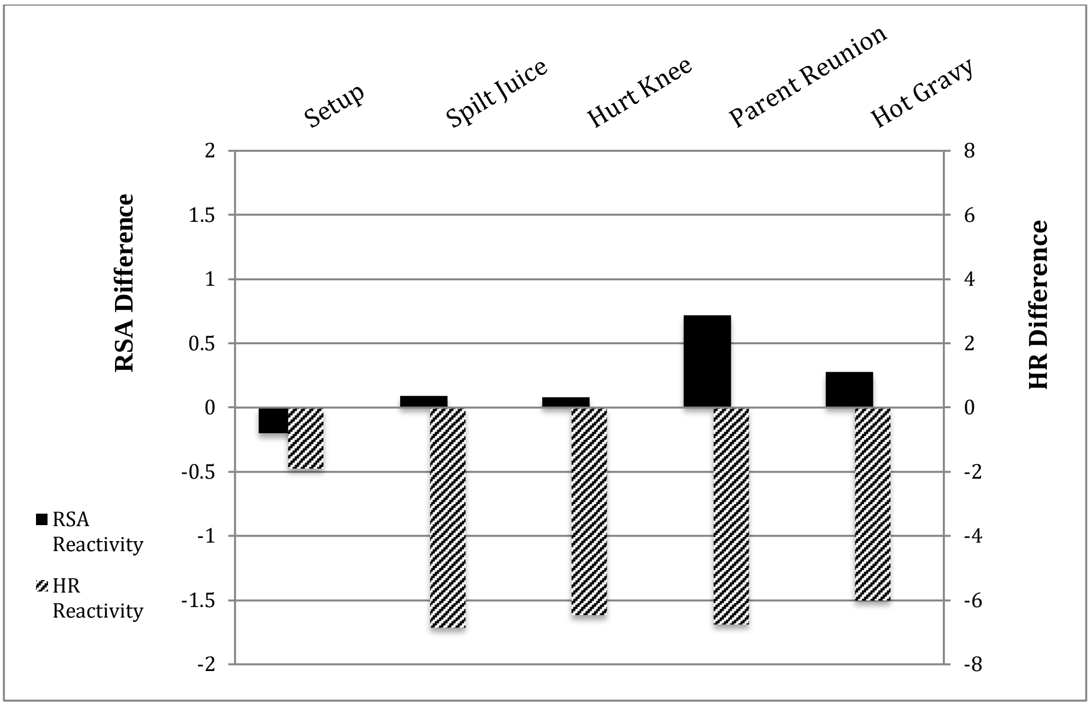

Figure 9. Raw difference scores for the initial story stem for Lizzie. The graph has two vertical axes. The first axis depicts RSA in msec^2. The second vertical axis depicts HR in beats per minute. Columns below 0 indicate a decrease in HR or RSA (vagal withdrawal) relative to baseline; columns above line 0 indicate an increase in HR or RSA (vagal augmentation). Lizzie shows a predominant pattern of vagal augmentation.

In the pre-intervention story stem assessment Lizzie was coded with an insecure A+ pattern of attachment (A3, 5(8)) and displayed an overly bright affect, alternating with plummets of low arousal. Lizzie displayed the least secure Type A+ strategy and her play narratives contained a greater number of stories coded for unresolved trauma. This is consistent with Lizzie's early history, which was marked by documented occasions of physical abuse by her father in infancy. Each of the play narratives in the pre-intervention assessment showed a clear pattern of vagal augmentation and an accompanying decrease in HR (Figure 9). The residual change scores (Table 12) showed a lower RSA reactivity than expected in comparison to the rest of the sample (i.e. positive residual scores). Conversely Lizzie's HR reactivity was larger than expected based on the rest of the sample for all narratives (i.e. negative residual score), which may indicate that Lizzie was more successful at inhibiting her heart rate via vagal influences than the other children in the sample. The play narratives coded for unresolved trauma, ‘Parent Reunion’ and ‘Hot Gravy’ displayed the most prominent patterns of vagal augmentation in the pre-intervention assessment. The ‘Parent Reunion’ story (Appendix D.7) was also coded for intrusions of rage and had the highest degree of augmentation, which suggests that Lizzie was exerting greater self-regulatory effort to supress feelings of anger during this play narrative. An intrusion describes a strong feeling that a child is unsuccessful in suppressing, which is not surprisingly accompanied by a strong pattern of vagal augmentation. During the enactment of violence in the ‘Parent Reunion’ narrative Lizzie appeared absorbed by her play and largely unaware of the interviewer, looking to her at the very end of the story seemingly shocked by her own play. The play has features of stuck post-traumatic play, namely a lack of acknowledgement of the interviewer and an intense driven-quality to the play. The ‘Hot Gravy’ narrative (Appendix D.8) was also coded for unresolved trauma with themes of abandonment and was also accompanied by vagal augmentation.

It was hypothesised that children with A+ strategies tend toward PNS dominant states, which Lizzie exemplifies in a pattern of vagal augmentation in response to the stress of the story stem assessment. Lizzie also experienced several intrusions of rage as she played out her response to the stems. Several trauma specialists link trauma, rage and shame to the dissociative, freeze response of the parasympathetic nervous system (Scaer, 2005; Levine, 1996; Terr, 1991). When a child’s aggressor is someone more powerful they have little option but to call on an immobilisation survival response, which can later manifests as feelings of shame and rage (Scaer, 2005). It has also been proposed that play narratives that contain themes of playing dead, hiding, and disappearing, such as in Lizzie’s narratives are a symbolic expression of the experience of low arousal states associated with the freeze response (Norton et al., 2011). This is consistent with the pattern of vagal augmentation or increased parasympathetic control evident in Lizzie's cardiac reactivity, especially for those stems coded for unresolved trauma.

Post-therapy Assessment Results. Following 25 sessions of play therapy intervention Lizzie completed a follow-up story stem assessment. Table 13 lists the post-therapy assessment averages for RSA and HR. Table 14 shows the RSA and HR reactivity and the post CAPA coding.

Table 13

Post-therapy Assessment Metric Averages

Story Stem Task	**RSA Average**	**HR Average**
Storybook BL	5.19	116.61
Setup Baseline	4.71	113.13
Crying Outside	5.29	109.90
Hurt Knee	6.02	105.04
Picture Home	4.91	110.72
Hot Gravy	5.69	108.08

Note: Post-therapy story stem metric averages for Lizzie. RSA ($msec^2$) and HR (bpm) scores were averaged over 90-seconds for each condition

Table 14

Post-therapy Assessment RSA & HR Reactivity & Coding

Story Stem	RSA Diff.	RSA Res.	HR Diff.	HR Res.	Coding	Utr	Modifiers	Violence
Setup	-0.48 Withdrawal	-0.41	-3.48	-0.16				
Crying Outside	0.10 Augmentation	-0.28	-6.71	-2.40	A+			
Hurt Knee	0.83 Augmentation	-0.17	-11.57	-2.04	A+	Utr	Ina Rage	Present
Picture Home	-0.28 Withdrawal	-0.58	-5.89	-3.22	A+	Utr DV		Present
Hot Gravy	0.50 Augmentation	0.07	-8.53	-7.15	A+	Utr Abandonment		Present

*Note***.** Follow-up story stem assessment results for Lizzie including RSA raw difference scores and residual change scores.

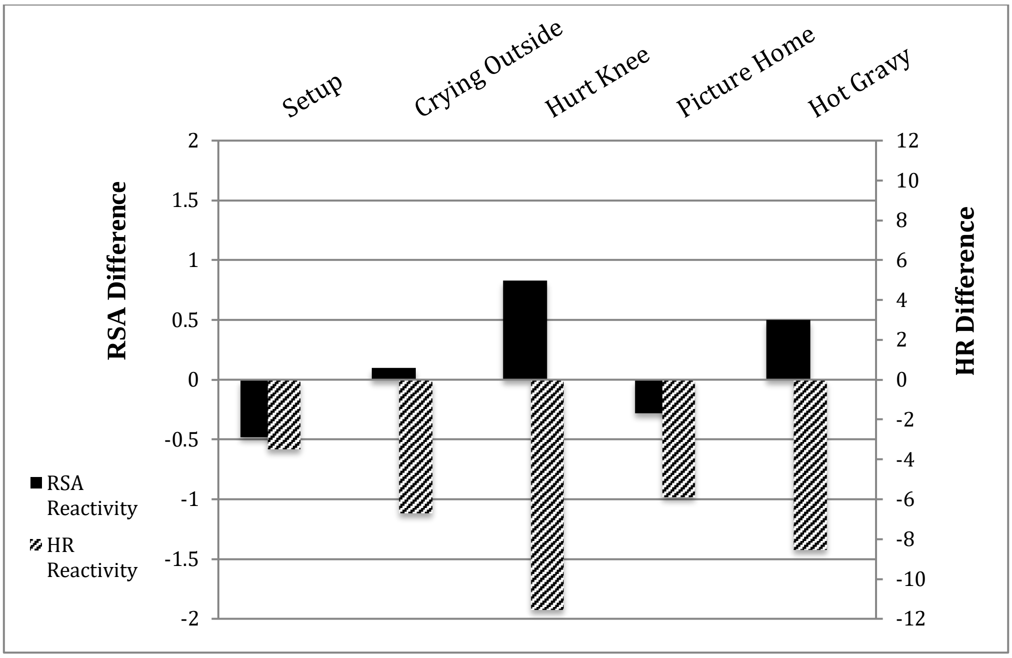

Figure 10. Raw difference scores for the follow-up story stem for Lizzie. The graph has two vertical axes. The first axis depicts RSA in msec^2. The second vertical axis depicts HR in beats per minute. Columns below 0 indicate a decrease in HR or RSA (vagal withdrawal) relative to baseline; columns above line 0 indicate an increase in HR or RSA (vagal augmentation). Lizzie shows a mixed pattern of vagal withdrawal and augmentation, but a consistent pattern of HR suppression for all narratives.

In the follow-up assessment Lizzie's attachment shifted towards a more extreme A5+ strategy characterised by imitation or mimicry, where a child begins to import their persona from the outside world. Vagal regulation was mixed with patterns of vagal augmentation and vagal withdrawal, although HR was suppressed across the assessment

(Figure 10). There was an increased portrayal of anger, rage and violence in the post-intervention assessment. Three play narratives were coded for unresolved trauma with themes of abuse and domestic violence. ‘Hurt Knee’ was coded for unresolved trauma and intrusions of rage. As for the pre-intervention assessment a combination of unresolved trauma and suppressed anger was accompanied by the highest degree of vagal augmentation. For the residual change scores Lizzie’s HR and RSA reactivity was larger than expected based on the rest of the sample (i.e. negative residual scores for RSA and HR). In the pre-intervention assessment Lizzie’s HR difference scores ranged from -1.9 to -6.9 and in the post-therapy assessment from -3.4 to -11.6. Thus a shift toward a higher A+ strategy is possibly associated with a more inhibited physiological profile. The ‘Hurt Knee’ play narrative (Appendix D.9) was coded for unresolved trauma and intrusions of rage and showed the highest degree of vagal augmentation. Thus, for Lizzie higher levels of vagal augmentation in the pre and post-intervention assessment accompanied violent narratives coded with intrusions of rage.

The ‘Picture Home’ narrative was also coded for unresolved trauma, with a portrayal of violence between the parent figures that appears to be a recounting of domestic violence (Appendix D.10). This play narrative is physiologically distinct from the other narratives. Unlike ‘Hurt Knee’ it was not coded for intrusions of rage and shows a pattern of vagal withdrawal, indicating less inhibition and an increase in arousal, although HR does not rise above baseline levels. Lizzie is less inhibited psychologically and physiologically and more aroused during the telling of this story, which may indicate that this play narrative has a dynamic rather a stuck post-traumatic quality. The final story coded for unresolved trauma, with themes of abandonment, was ‘Hot Gravy’ (Appendix D.11) and this narrative was again accompanied by the suppression of negative affect and a pattern of vagal augmentation.

Lizzie's play showed more markers for unresolved trauma in the follow-up assessment and there was a marked increase in the expression of negative affect with well-articulated and seemingly literal portrayals of domestic violence. Lizzie appeared driven to use play as a means of communication, which may be an outworking of therapeutic intervention, although at a physiological level Lizzie continued to show a dominant pattern of vagal augmentation indicating ongoing physiological inhibition. An exception to the observed pattern of vagal augmentation was the 'Picture Home' narrative. The enacted domestic violence in this narrative was accompanied by withdrawal of the vagal brake, although this was unsuccessful in raising her HR above baseline. This could be viewed as a more physiologically adaptive response and a shift toward a more adaptive, dynamic expression of trauma in this narrative. Overall, as hypothesised, an A+ attachment strategy for Lizzie was primarily accompanied by a pattern of vagal augmentation in the pre and post-intervention CAPA. Narratives co-coded with unresolved trauma and intrusions of rage showed the greatest degree of vagal augmentation. This is unsurprising as an intrusion of negative affect as coded by the CAPA indicates that a child has unsuccessfully attempted to inhibit negative affect. Unresolved trauma and intrusions of negative affect both appear to be characterised by vagal inhibition for children with Type A+ strategies in the present study. However, Lizzie has the least secure Type A+ strategy and unlike the other children with a Type A+ strategy (i.e. Eli and Billy) vagal augmentation is accompanied by a decrease in HR from baseline, indicating that Lizzie is potentially more successful at vagal inhibition. Thus a more extreme strategy of insecure attachment for the Type A+ cluster may be linked to more successful maladaptive inhibition at the level of the vagal brake in response to stress – which may prove an interesting avenue for future research enquiry.

Case Study 4: Tyler

Pre-therapy Assessment Results. Table 15 shows the RSA and HR averages for Tyler's pre-intervention narrative story stem assessment for the storybook baseline and 4 story stem conditions. Table 16 shows the RSA and HR reactivity scores for each condition.

Table 15

Pre-therapy Assessment Metric Averages

Story Stem Task	**Average RSA**	**Average HR**
Storybook BL	6.56	90.87
Setup Baseline	6.49	96.10
Spilt Juice	6.27	92.80
Parent Departure	6.74	93.43
Parent Reunion	5.92	96.96
Stamping Elephant	6.15	95.53

Note: Pre-therapy story stem metric averages for Tyler. RSA ($msec^2$) and HR (bpm) scores were averaged over 90-seconds for each condition.

Table 16

Pre-therapy Assessment RSA & HR Reactivity & Coding

Story Stem	**RSA Diff.**	**RSA Res.**	**HR Diff.**	**HR Res.**	**Coding**	**Utr**	**Modifiers**	**Violence**
Setup	-0.07 Withdrawal	-0.18	5.23	4.56				Present
Spilt Juice	-0.29 Withdrawal	-0.40	1.93	2.68	C+			Present
Parent Departure	0.18 Augmentation	-0.26	2.56	2.22	C+			Present
Parent Reunion	-0.64 Withdrawal	-1.03	6.09	5.61	C+			
Stamping Elephant	-0.41 Withdrawal	-0.71	5.06	3.24	C+			Present

*Note***.** Initial story stem assessment results for Tyler including raw difference scores and residual change scores.

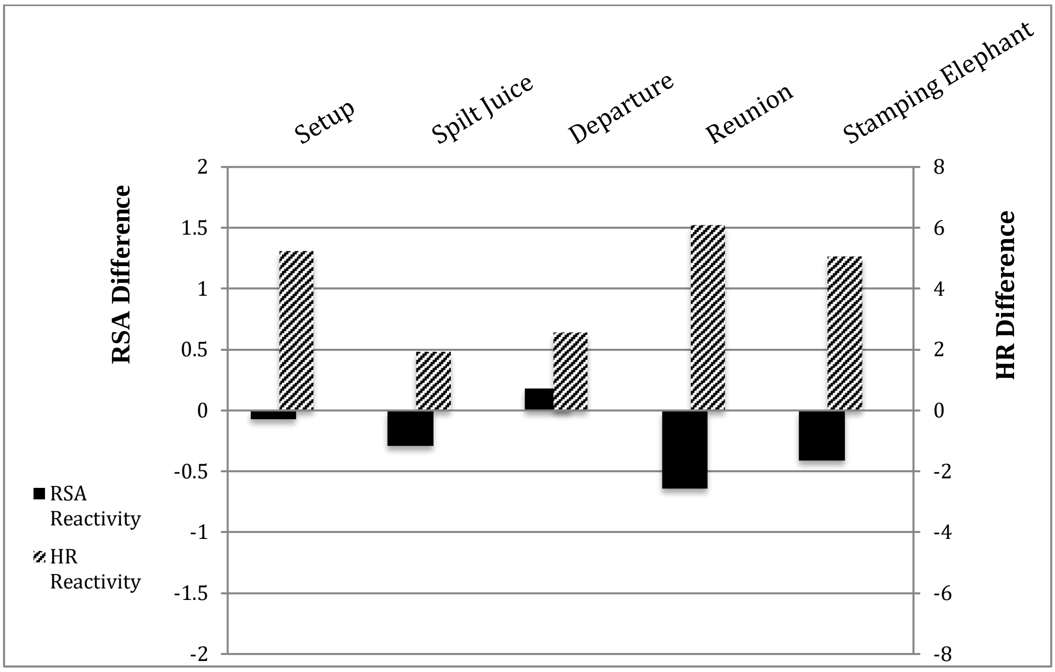

Figure 11. Raw difference scores for the pre-intervention story stem assessment for Tyler. The graph has two vertical axes. The first axis depicts RSA in msec^2. The second vertical axis depicts HR in beats per minute. Columns below 0 indicate a decrease in HR or RSA (vagal withdrawal) relative to baseline; columns above line 0 indicate an increase in HR or RSA (vagal augmentation). Tyler shows a dominant pattern of vagal withdrawal.

Tyler was coded in the pre-intervention assessment with a highly insecure Type C+ strategy (C5 (7-8)). Type C+ attachment strategies are characterised by the expression of behavioural conflict and negative affect and tend to develop in homes where caregiving is unpredictable. The higher the C pattern the greater the exposure to unpredictable danger and deception. Tyler presented as a child who was big for his age, who looked frightened at times, with an inconsistent stutter and fragmented speech. As the assessment progressed Tyler increasingly became caught in a struggle with the interviewer, which translated into escalating conflict and violence in Tyler's play and an increase in HR. As hypothesised for a Type C+ strategy, a predominant pattern of vagal withdrawal accompanied Tyler's play narratives (Figure 11).

Elements of interpersonal violence were portrayed from the set-up period, where the father doll stamped on the baby doll, "Look-lo-loo-loo-look the daddy is stepping on the baby and making him cry" and continued into the subsequent play narratives. In the 'Spilt Juice' stem (Appendix D.12) the interviewer and Tyler argue over who spilt the juice in the story and the tension continues into the 'Parent Reunion' narrative (Appendix D.13), which was accompanied by the highest degree of vagal withdrawal as Tyler struggles to reunite the children and the parents within the narrative. The final 'Stamping Elephant' narrative (Appendix D.14) also showed a high level of vagal withdrawal and a further escalation in violence of a sexualised nature. Rainville and colleagues (2006) propose that suppressed anger is reflected in increased vagal tone (augmentation) and expressed anger with decreases in vagal tone (withdrawal). The expressed anger in Tyler's narratives is accompanied by a pattern of increasing vagal withdrawal across the story stem assessment. The residual change scores show that Tyler's RSA reactivity was larger than expected (i.e. negative residual change score), although his HR was less reactive (i.e. positive residual score) than expected based on the rest of the sample. This may indicate that Tyler was using his vagal brake to manage his cardiac arousal more than the other children in the present sample. It was hypothesised that a Type C+ strategy would be accompanied by a pattern of vagal withdrawal due to the expression, rather than the suppression of negative affect, which is supported the pattern of vagal withdrawal observed within Tyler's play narratives.

Post-therapy Assessment Results. Following 25 sessions of play therapy intervention Tyler completed a follow-up story stem assessment. Table 17 lists the post-therapy assessment averages for RSA and HR. Table 18 shows the RSA and HR reactivity and post-CAPA coding.

Table 16

Post-therapy Assessment Metric Averages

Story Stem Task	**Average RSA**	**Average HR**
Storybook BL	6.18	90.30
Setup Baseline	5.46	95.50
Birthday Cake	5.66	96.02
Crying Outside	5.83	94.69
Picture Home	5.56	92.56
Hot Gravy	5.87	92.32

Note: Post-therapy story stem metric averages for Tyler. RSA ($msec^2$) and HR (bpm) scores were averaged over 90-seconds for each condition.

Table 18

Post-therapy Assessment RSA & HR Reactivity & Coding

Story Stem	**RSA Diff.**	**RSA Res.**	**HR Diff.**	**HR Res.**	**Coding**	**Utr**	**Modifiers**	**Violence**
Setup	-0.72 Withdrawal	-0.30	5.2	3.50				
Birthday Cake	-0.52 Withdrawal	-0.50	5.72	2.75	C+			
Crying Outside	-0.35 Withdrawal	-0.70	4.39	1.82	C+			Present
Picture Home	-0.62 Withdrawal	-0.44	2.26	0.32	C			
Hot Gravy	-0.31 Withdrawal	-0.32	2.02	0.60	C+			Present

*Note***.** Follow-up story stem assessment results for Tyler including RSA raw difference scores and residual change scores.

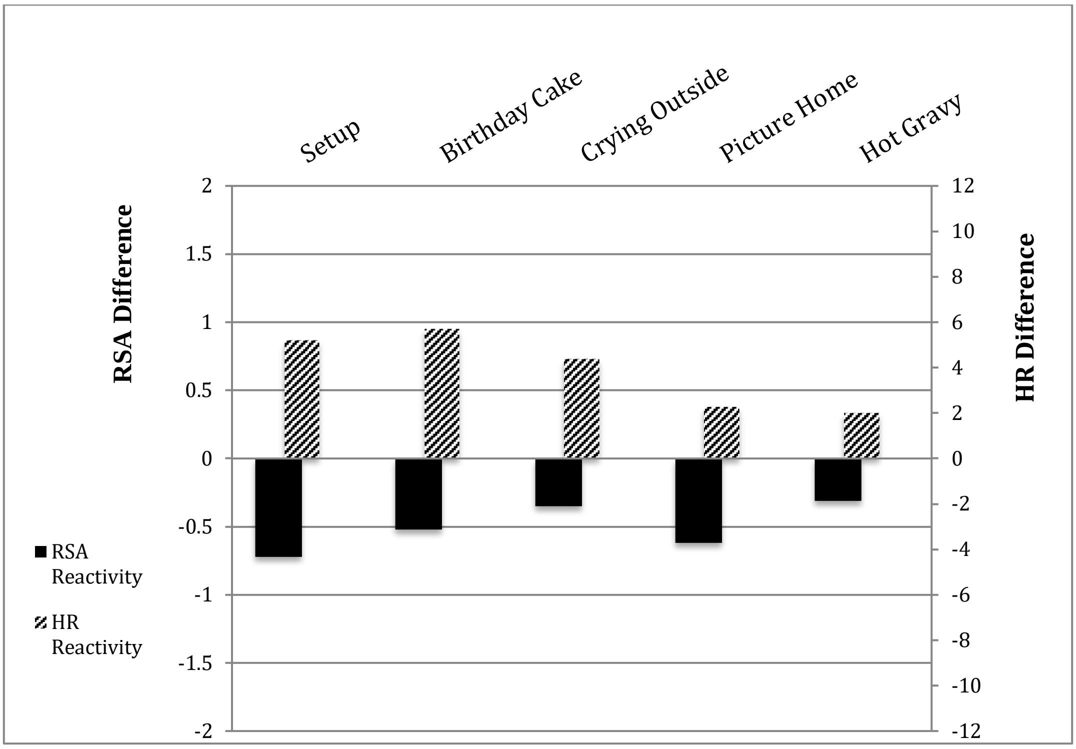

Figure 12. Raw difference scores for the follow-up story stem assessment for Tyler. The graph has two vertical axes. The first axis depicts RSA in msec^2. The second vertical axis depicts HR in beats per minute. Columns below 0 indicate a decrease in HR or RSA (vagal withdrawal) relative to baseline; columns above line 0 indicate an increase in HR or RSA (vagal augmentation). There is a clear pattern of vagal withdrawal across all narratives.

For the post-intervention assessment Tyler showed an overall C+ (C5) strategy of attachment and a consistent pattern of vagal withdrawal (Figure 12). As for the pre-intervention assessment the residual change scores showed a larger RSA reactivity and a lower HR reactivity in comparison to the other children. However, the follow-up assessment portrayed less violence than the pre-intervention assessment and there was less conflict in the relationship with the interviewer, with moments of playfulness. In the follow-up assessment the highest level of withdrawal was noted for the ‘Birthday Cake’ (Appendix D.15) and ‘Picture Home’ narratives (Appendix D.16), which unlike previous play narratives showed expressions of positive affect. The ‘Crying Outside’ and ‘Hot Gravy’ narratives showed the lowest amount of vagal withdrawal. These narratives were more typical C+ stories with attempts to shock and engage the interviewer. Tyler deflected the 'Crying Outside' story toward an examination of girl doll's 'bum' (Appendix D.17) whereas the 'Hot Gravy' narrative showed a playful account but an absence of caregiving (Appendix D.18).

In the pre-intervention assessment the expression of conflict and violence in the play narratives followed conflict in Tyler's relationship with the interviewer, and was accompanied by vagal withdrawal and increased HR. In the follow-up assessment there were fewer instances of aggressive and violent play, less conflict with the interviewer and a greater depiction of positive affect in his play narratives. There was a pattern of vagal withdrawal and increased HR in the pre and post-intervention assessment, although it is possible that the post-intervention assessment depicts a more adaptive degree of vagal withdrawal and a more adaptive play state, which is supported by the presence of positive affect and less disturbing play themes. Overall a Type C+ strategy for Tyler was characterised by the exaggeration of negative affect and a pattern of vagal withdrawal as hypothesised. No play narratives were coded for unresolved trauma or loss. Future studies require a control group to assess the degree of vagal withdrawal that is most indicative of adaptive regulation during the construction of play narratives.

Case Study 5: Josh

Pre-therapy Assessment Results. Table 19 shows the RSA and HR measures for Josh's pre-intervention CAPA. Table 20 shows the RSA and HR reactivity scores and CAPA coding for each task. Figure 13 illustrates the raw difference scores for HR and RSA.

Table 19

Pre-therapy Assessment Metric Averages

Story Stem Task	RSA Average	HR Average
Storybook BL	7.24	95.53
Setup Baseline	7.17	93.55
Birthday Cake	7.08	92.55
Noise in the Night	7.59	96.54
Hot Gravy	7.49	94.22
Lost Pig	7.88	93.15

Note: Pre-therapy story stem metric averages for Josh. RSA ($msec^2$) and HR (bpm) scores were averaged over 90-seconds for each condition.

Table 20

Pre-therapy Assessment RSA & HR Reactivity & Coding

Story Stem	RSA Diff.	RSA Res.	HR Diff.	HR Res.	Coding	Utr	Modifiers	Violence
Setup	-0.07 Withdrawal	0.41	-1.98	-2.89				
Birthday Cake	-0.16 Withdrawal	-0.04	-2.98	-2.36	C			
Noise in the Night	0.35 Augmentation	0.03	1.01	0.80	C+	Utr		Present
Hot Gravy	0.25 Augmentation	0.11	-1.31	-1.28	C+	Utr		Present
Lost Pig	0.64 Augmentation	0.50	-2.38	-3.08	C+	Utr		Present

***Note*.** Initial story stem assessment results for Josh including RSA raw difference scores and residual change scores.

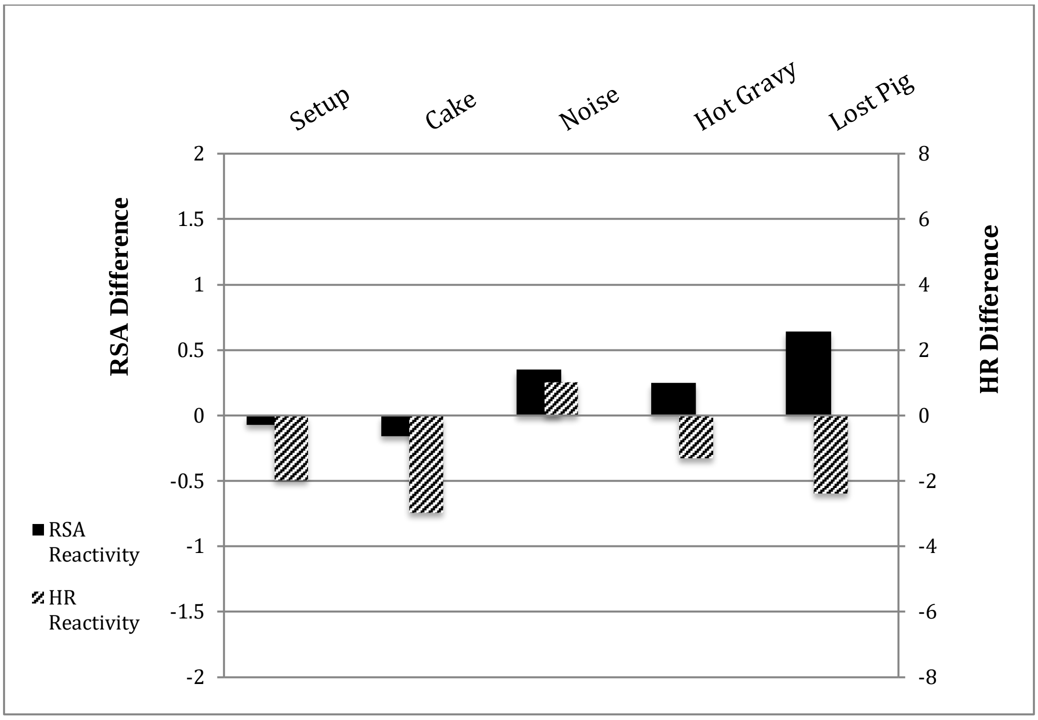

Figure 13. Raw difference scores for the pre-intervention story stem assessment for Josh. The graph has two vertical axes. The first axis depicts RSA in msec^2. The second vertical axis depicts HR in beats per minute. Columns below 0 indicate a decrease in HR or RSA (vagal withdrawal) relative to baseline; columns above line 0 indicate an increase in HR or RSA (vagal augmentation). Josh shows a mixed pattern of vagal withdrawal and vagal augmentation.

In the pre-intervention story stem assessment Josh was coded with a C+ strategy (C3 (5,6)) with a mixed pattern of vagal withdrawal and augmentation across the assessment (Figure 13). The residual change scores show a smaller RSA reactivity and a larger HR reactivity than expected based on the rest of the sample, with the exception of the 'Noise in the Night' narrative, which shows a lower reactivity for both HR and RSA. The play narratives of children with a C3 strategy are typically characterised by the appearance of high arousal, aggressive and controlling play themes, expressed anger toward parental figures and displays of charm and deception. For Josh a pattern of slight vagal withdrawal accompanied the initial setup and 'Birthday Cake' story, which was coded as a normative C narrative (Figure 13). However, a pattern of vagal augmentation accompanied the final three stems, which were coded for unresolved trauma, with depictions of high levels of interpersonal violence and themes of secrecy and deception. Vagal augmentation in response to a stressor is linked to social hyper-vigilance and the inhibition of negative affect. A pattern of vagal augmentation was not hypothesised for a C+ strategy, although it could be speculated that play narratives depicting unresolved trauma may be characterised by vagal augmentation or parasympathetic inhibition irrespective of a Type A+ or C+ strategy of attachment.

The ‘Noise in the Night’ narrative (Appendix D.19) depicts a sequence of family violence and was accompanied by a low level of cardiac reactivity, indicating that Josh was under-aroused, despite the arousing and violent play themes. The story begins with the mother and policeman catching an intruder, who it eventuates, is the mother’s son. The son is placed in prison, the mother visits and the son attacks the mother and baby The ‘Hot Gravy’ narrative (Appendix D.20) showed a more typical pattern of vagal augmentation with a decrease in HR (Figure 13). The child burns her hand on the stove and Josh continues the story with the child putting her hand under a running tap. The story finishes with themes of deception and physical abuse as the mother destroys the house in anger. The ‘Lost Pig’ narrative (Appendix D.21) contained the highest degree of vagal augmentation for the story stems observed. This narrative also contained themes of secrecy and deception. Josh began the story with the mummy pig searching for her lost baby, asking the other animals, “Have you seen my baby?” The story ends with the daddy goat eating the mummy cow while the children cows wail and look for their mother. These three play narratives are coded with unresolved trauma for a child with a Type C+ strategy of attachment and are accompanied by some level of vagal augmentation, which is associated with social hyper-vigilance and the inhibition of negative affect. The narratives also depict high levels of interpersonal violence and unlike Type A+ play narratives they also contain themes of secrecy and deception. A question for future research would be to further explore the links between deception in C+ strategies of attachment and vagal regulation. It was initially hypothesised that children with a Type C+ strategy would show a pattern of vagal withdrawal due to the tendency of these children to exaggerate negative affect. However Josh shows a mixed pattern of vagal reactivity that does not support the original hypothesis. It is possible that the mixed pattern of vagal reactivity for Josh may reflect autonomic instability and an alternating pattern of sympathetic arousal and parasympathetic inhibition, a pattern that has been linked to posttraumatic symptomology (Scheeringa, Zeanah, Myers, & Putnam, 2004). Thus, the pattern of RSA reactivity observed for Josh may reflect a more concerning, dysregulated physiological profile than the other children in the sample.

Post-therapy Assessment Results. Following 20 sessions of play therapy intervention Josh completed a post-intervention story stem assessment. Table 22 shows the RSA and HR reactivity scores and CAPA coding for each task. Figure 14 illustrates the raw difference scores for HR and RSA.

Table 21

Post-therapy Assessment Metric Averages

Story Stem Task	**RSA Average**	**HR Average**
Storybook BL	8.17	93.19
Setup Baseline	7.24	91.52
Birthday Cake	7.04	95.45
Spilt Juice	7.27	94.13
Hurt Knee	6.92	95.00
Lost Keys	7.49	94.22

Note: Post-therapy story stem assessment metric averages for Josh. RSA ($msec^2$) and HR (bpm) scores were averaged over 90-seconds for each condition.

Table 22

Post-therapy Assessment RSA & HR Reactivity & Coding

Story Stem	RSA Diff.	RSA Res.	HR Diff.	HR Res.	Coding	Utr	Modifiers	Violence
Setup	-0.93 Withdrawal	0.18	-1.67	-2.82				
Birthday Cake	-1.13 Withdrawal	-0.30	2.26	0.09	C+			
Spilt Juice	-0.90 Withdrawal	0.04	0.94	-0.30	C+			
Hurt Knee	-1.25 Withdrawal	-0.11	1.81	0.37	C+	Utr		Present Sadistic
Lost Keys	-0.68 Withdrawal	0.15	1.03	-0.08	C+	Utr		Present Sexualised

*Note***.** Post-therapy story stem assessment results for Josh including HR and RSA raw difference scores and residual change scores.

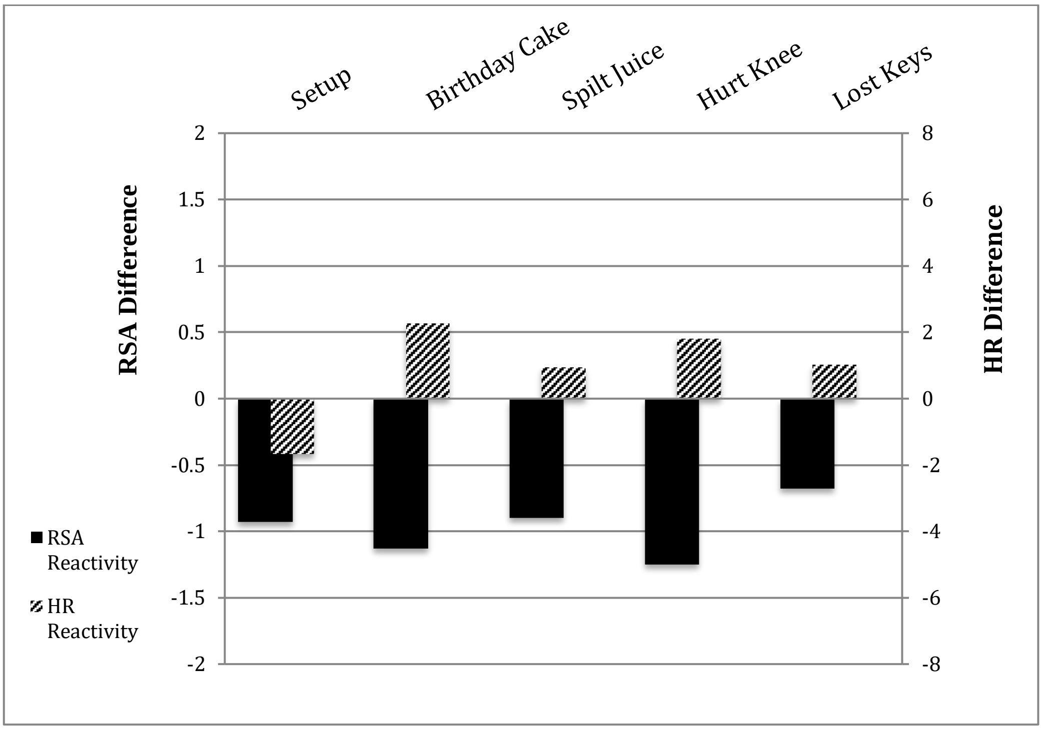

Figure 14. Raw difference scores for the post-therapy story stem for Josh. The graph has two vertical axes. The first axis depicts RSA in msec^2. The second vertical axis depicts HR in beats per minute. Columns below 0 indicate a decrease in HR or RSA (vagal withdrawal) relative to baseline; columns above line 0 indicate an increase in HR or RSA (vagal augmentation). Josh shows a pattern of vagal withdrawal across the assessment.

In the follow-up assessment Josh's attachment strategy was coded as a higher, less adaptive Type C+ strategy (C3-5) with an accompanying pattern of vagal withdrawal for each of the play narratives analysed (Figure 14). The residual change scores show a mixed pattern of higher and lower reactivity in comparison to the rest of the sample. Several narratives were coded for unresolved trauma with interpersonal violence that was expressed in a cool and sadistic manner. The ‘Birthday Cake’ and ‘Hurt Knee’ story show the highest level of vagal withdrawal, with a small increase in HR (Figure 14). The ‘Hurt Knee’ narrative shows the greatest degree of vagal withdrawal with high levels of interpersonal violence (Appendix D.22) as the children kick the pregnant mother in the belly so hard that she beings to bleed. The ‘Lost Keys’ narrative (Appendix D.23) also depicts interpersonal violence with elements of deception and the expression of anger towards parental figures, and an accompanying pattern of vagal withdrawal.

The pre-intervention assessment for Josh depicted a low C pattern of attachment with a mixed pattern of vagal withdrawal and augmentation during the construction of play narratives. In the follow-up assessment Josh showed a higher, less adaptive Type C+ pattern of attachment, which coincided with a more consistent pattern of vagal withdrawal, including those play narratives coded for unresolved trauma. A pattern of vagal withdrawal accords with the original hypothesis which anticipated that children with Type C strategies would show a propensity toward vagal withdrawal during their play narratives. The post-intervention assessment also portrayed a higher degree of interpersonal violence of a troubling and sometimes sadistic nature. It is more difficult to assess whether the violence in these narratives is an expression of unresolved trauma, or whether it functions as a strategy of attachment. While children with a Type A+ strategy appear to cope with trauma through inhibition, children with a Type C+ strategy appear to mobilise in response to stress.

Discussion and Clinical Implications

The present study examined HR and RSA reactivity in 5 children during the construction of play narratives during a pre and post-intervention story stem assessment, the CAPA. HR and RSA reactivity were calculated by generating change scores by subtracting the mean level during the construction of a play narrative from the baseline level. The raw reactivity or change scores for RSA allowed an examination of patterns of vagal withdrawal or vagal augmentation during the construction of play narratives in response to each story stem task. Residual change scores were also generated by regressing the average levels from the baseline to the stem task phase to provide an indication of reactivity for each participant in comparison to the rest of the sample. All of the children were coded by the CAPA with deeply insecure strategies of attachment. No child in the study showed evidence of an improved or reorganising strategy of attachment in the post-intervention assessment although several children were observed to show improved play-based mentalising and more complex play narratives.

As anticipated the insecurely attached children in this small clinical sample showed atypical patterns of vagal reactivity during the construction of play narratives during administration of the CAPA. The observed disruptions in the functioning of the vagal brake are consistent with other studies that have associated poor vagal regulation of the heart with social, behavioural, self-regulation and attachment difficulties (see Gatzke-Kopp, Greenberg & Bierman, 2015). The findings in this study demonstrate that measures of HRV may lead to new insights into the physiological processes that take place during the construction of children's play narratives and may help delineate differences in the autonomic regulation that accompanies deeply insecure Type A+ and Type C+ strategies of attachment, and potentially aid in the identification of unresolved trauma play narratives.

Each of the initial research questions and findings are discussed in turn below:

1. Do the different categories of insecure attachment show different patterns of vagal regulation during the construction of play narratives in the CAPA?

Within the present study the different strategies of attachment do appear to be associated with different patterns of vagal reactivity. As hypothesised those children with a Type A attachment strategy (i.e. Eli, Billy and Lizzie) tended towards a pattern of vagal augmentation (i.e. an increase in RSA from baseline) indicating increased parasympathetic inhibition or vagal control during the construction of play narratives. In non-threatening situations vagal augmentation is a sign of social engagement, although vagal augmentation in response to a stressor or challenge is considered to reflect a failure of the vagal brake and has been linked to social hypervigilance and the suppression of negative affect, key features of a Type A+ strategy of attachment.

Of those children coded with a Type A strategy, Eli showed a shift in vagal regulation in the repeat assessment, with a shift from a pattern of vagal augmentation in the pre-intervention assessment to a predominant pattern of vagal withdrawal in the post-intervention assessment. A moderate degree of vagal withdrawal is considered an adaptive response to stress and it is possible that a shift from a pattern of vagal augmentation to vagal withdrawal reflects a positive shift in vagal regulation for a child with a Type A+ attachment in response to the story stem assessment. Eli's play narratives appear to substantiate a positive shift with a greater degree of integrated mentalising (i.e. a greater ability to perceive and express his own mental state and the mental states of others) observed within Eli's play narratives, although there was no indication of a re-organising strategy of attachment. The ability to mentalise is a necessary component of effective trauma processing and may indicate the beginning of a positive shift in cognitive, emotional and physiological regulation for Eli. Bar-Haim and colleagues (2004) found that children who showed a pattern of vagal withdrawal during the construction of play narratives had more coherent narratives. It is likely that an optimal degree of vagal withdrawal is associated with a greater capacity for integrated play-based mentalising, which is necessary for the processing of trauma in play.

The remaining children with a Type A+ attachment (i.e. Billy and Lizzie) showed a predominant pattern of vagal augmentation in the pre and post-intervention assessment. While both children appeared to have greater access to and expression of negative feelings in the follow-up assessment, they continued to display a pattern of vagal augmentation, indicating ongoing physiological inhibition. These observations suggest that the expression of negative affect in and of itself may not be sufficient to reorganise autonomic arousal at the level of the vagal brake. This aligns with Russ (2004) who argues that the expression of emotion in therapy may not be as useful as play therapists believe. Rather the quality and organisation of a child's pretend play, and a child's ability to integrate affect and cognition is more important. It is only through the construction of emotionally coherent play narratives, that emotional and behavioural regulation can be improved (Slade, 1994); or equally in attachment terms, the construction of play narratives that are no longer preoccupied or avoided, but rather integrate a child's internal and external reality. Similarly, van der Kolk (1996) argues that trauma resolution depends on the ability to develop trauma narratives that no longer trigger defensive responding.

Those children with a Type C+ strategy of attachment (i.e. Tyler and Josh) exaggerated negative affect and expressed a greater degree of anger, violence, aggression and deception in their play narratives, than those children coded with a Type A+ attachment. Vagal withdrawal is associated with the expression of negative affect and as hypothesised the children coded Type C+ tended towards a pattern of vagal withdrawal during the construction of play narratives. A pattern of moderate vagal withdrawal is considered an adaptive response to stress; although for the children in this study it was not possible to compare the degree of withdrawal with a normative sample to determine whether the observed withdrawal was adaptive or maladaptive (i.e. too high or too low). Given the complexity of the children in the present sample, it is likely that the degree of withdrawal was sub-optimal, as previous studies have found lower levels of RSA withdrawal in at-risk children in comparison to children from healthy community samples (Graziano & Derefinko, 2014). Tyler showed the most consistent pattern of vagal withdrawal in the pre and post-intervention assessment. No play narratives for Tyler were coded for unresolved loss or trauma, which may account for the consistently clear pattern of vagal withdrawal during the play assessment for Tyler.

2. Is there a distinct physiological profile associated with play narratives classified by the CAPA as unresolved loss or trauma?

When trauma or loss disrupts a child's strategy of attachment this is coded as unresolved. The present exploratory study suggests that there is a distinct physiological profile associated with play narratives coded for unresolved loss or trauma. For the children coded Type A+, the play narratives coded for unresolved loss or trauma showed a heightened pattern of vagal augmentation, indicating a higher degree of vagal inhibition during these narratives and the greatest failure of the vagal brake to regulate arousal. For the children with a Type C+ attachment, only Josh displayed play narratives coded for unresolved trauma. In the pre-intervention assessment the play narratives coded with unresolved trauma for Josh also showed a pattern of vagal augmentation, and a plausible hypothesis is that unresolved trauma play narratives are associated with vagal inhibition irrespective of the type of attachment. However in the follow-up assessment a pattern of vagal withdrawal accompanied Josh's unresolved trauma narratives. It is possible that some of the unresolved trauma narratives were miscoded, given that C+ play narratives are typically accompanied by high levels of interpersonal anger, aggression and violence that make it difficult to distinguish between violent narratives that are traumatic and those that are a strategic attempt to manage attachment needs and/or autonomic arousal. Thus the pattern of vagal reactivity The use of autonomic measures may prove useful in better identifying unresolved trauma in C+ play narratives and in identifying the links between vagal augmentation and unresolved trauma narratives.

While children with a Type A+ strategy appear to organise around the suppression of arousal, children with a Type C+ strategy potentially organise around the mobilisation of arousal. Strong arousal-escalating feelings such as anger or rage are difficult for children with a Type A+ strategy to supress, thus they may intrude, resulting in an unresolved trauma narrative. Whereas children with a Type C+ strategy seek out arousal-escalating affect, possibly in an attempt to regulate against uncomfortably low levels of arousal. The potentially different reactivity profiles for children with A+ and C+ strategies of attachment is clinically relevant, as this will influence how a therapist responds to a child and his play behaviours. If a child's strategy of attachment is linked to a child's autonomic reactivity profile, the CAPA has the potential to be a useful tool in informing therapy at both a psychology and physiological level.

3. Can the CAPA be used to inform play therapy, or as an outcome measure for play therapy intervention to detect shifts in a child's strategy of attachment, or shifts in a child's ability to use play narratives to express difficult or traumatic interpersonal experiences?

While no positive shifts were observed in the attachment security of the children in the present study the CAPA, with its focus on attachment, play and mentalising has the potential to be a valuable tool in informing and evaluating play therapy intervention. At its biological core an insecure strategy of attachment is likely accompanied by a poorly functioning vagal system, which makes it difficult for these children to maintain calm, socially engaged states and detect cues of safety in the environment and other people, including therapists. As hypothesised, a Type A+ strategy appears to be associated with a pattern of vagal augmentation during the construction of play narratives in response to the CAPA and a Type C+ strategy appears to be linked to a pattern of vagal withdrawal, although a much larger sample is need to confirm these initial findings. If larger scale studies also find that the different categories of insecure attachment are indeed associated with a bias for different patterns of autonomic defence during the construction of play narratives within the CAPA, the CAPA may prove a useful tool in treatment planning.

At an autonomic level play therapy intervention for a child with a Type A+ strategy needs to address the tendency for these children to over-regulate their autonomic nervous system and preference parasympathetically or vagally driven shutdown or immobilisation behaviours. Interventions for children with a Type C+ strategy must address the tendency for these children to under-regulate their autonomic nervous system and preference sympathetically driven fight, flight mobilisation behaviours. As maintained by Porges (2011, 2012) therapeutic intervention must first turn off or dampen defensive reactions if a child is to use a relationship therapeutically. For a child with a Type C+ strategy this may involve damping sympathetic defences, and for Type A+ child this may involve dampening parasympathetic defences. It could be further conjectured that the greatest need for a child with a Type A+ strategy is to experience co-regulation during states of negative affect and heightened arousal within therapy, rather than self-regulating and inhibiting arousal and negative affect. A child with an A+ strategy needs to experience what it feels like to be safe in a mobilised state, or to mobilise without fear. Conversely, a child with a Type C+ strategy needs to experience interactive regulation during states of low arousal, or to immobilise without fear.

While no child in the current study showed improvement attachment security in the follow-up assessment, the children with A+ strategies showed a greater expression of negative affect. It is possible that the child-centred play therapy intervention played a role in assisting these children to express negative feelings in their play narratives, although this is speculative and further studies with a control group are needed. Although an increased expression of negative affect may only be therapeutic if it is also accompanied by improved mentalising. It could be argued that when working with complex children, such as those in the present study, the goal of therapy in not to reorganise a child's strategy of attachment, but to rather stop past trauma from interfering with a child's strategy of attachment and activating a child's autonomic defences. Once the trauma has been processed and a child's autonomic reactivity stabilised, then a child may move onto re-organising their attachment as a secondary treatment goal, where the child's home environment supports the reorganisation of attachment. In the past therapists have tended to focus on the reduction of sympathetically driven anxiety and aggression, although the present study highlights the role of parasympathetically driven experiences such as shame and rage, especially for children with a Type A+ strategy of attachment. The study raises questions as to what modality of play therapy is best suited to the different categories of attachment. It is possible that nondirective or child-centred play therapy, as examined in this study, is better suited to children experiencing parasympathetic affects (i.e. Type A+) and children experiencing sympathetic affects (Type C+) may benefit from a more directive approach to play therapy intervention.

Limitations and Recommendations for Future Research

This study examined individual changes in cardiac reactivity during the administration of the CAPA. The study is novel, as it looks at within-subject dynamic changes in RSA during a self-relevant relational stress task, in a naturalistic setting in a sample of at-risk children. The limitations of the study and directions for future research include:

- The present study utilised a within-subject study design. The study examined individual changes in HR and RSA in response to the CAPA on a case-by-case basis for 5 children. The study serves as an initial exploratory or pilot study into the application of HRV analysis to children's play narratives as there is little existing research in this area. The study has a number of limitations including the inability to conduct statistical analysis due to the small sample size and a lack of a control group and non-blind study design that limits its generalizability. A within-subject study design was used as this is considered the most appropriate method for HRV analysis due to the high inter-individual variations that influence HRV and the present findings suggest that further testing with a larger sample and a control group that includes individuals with secure Type B and less disturbed insecure Type A1-2 and C1-2 strategies of attachment will help further clarify the disruptions in vagal regulation that accompany insecure strategies of attachment and confirm whether children with Type A strategies do show a preference for patterns of vagal augmentation and children with Type C strategies a preference for vagal withdrawal during the construction of play narratives, as the theory and findings in the present study suggest. To appropriately detect differences between these groups future studies would need to consider a sample size of 30 to 77 as recommended by Pinna and colleagues (2007).

Residual changes scores (i.e. a group comparison of higher and lower reactivity) could also be more meaningfully applied to a larger, more diverse sample. Additionally, patterns of vagal withdrawal and vagal augmentation occur across a continuum with larger and smaller changes occurring from baseline. In the present study it was not possible to assess the degree of withdrawal or augmentation as it relates to a comparison control group and whether the observed changes in vagal tone were statistically significant. Moderate vagal reactivity in response to challenge is considered the most adaptive response (Beauchaine, 2001; Porges, 2007), although there is a need for a normative sample to aid in the identification of what constitutes a normal or adaptive degree of vagal withdrawal during the construction of children's story stem narratives as no current guidelines exist. Moreover, there is a normative increase in HRV across childhood (Brornstein & Suess, 2000). Without a control group is it not possible to establish whether changes in HRV were due to intervention or maturation effects. In future research the allocation of an age or maturation stage-matched control participants, as recommended by Leicht and Allen (2008) would control for possible age-related changes in HRV.

- The present study utilised a seated vanilla baseline to generate change scores and did not include a true resting or supine baseline. The addition of a true resting baseline in future studies would establish a child's capacity for vagal reactivity in response to the challenge of the story stem assessment. A supine resting baseline would also allow for a comparison with the few studies that have attempted to provide reference values for HRV in children. For example Michels and colleagues (2013) provide age and sex specific reference values for time and frequency domain measures of HRV (in resting supine) for a large sample of children between 5 and 10 years. Seppala and colleagues (2014) also established reference values for time, frequency and nonlinear measure of HRV, under controlled conditions for a large population of children between 6 and 8 years. No reference values exist for measures of RSA for children as determined by the Porges' adaptive polynomial filter method used in the present study. Studies utilising time or frequency methods would be best able to make comparisons with the above reference values.

- The present study focused primarily on RSA reactivity and parasympathetic functioning. Additional physiological measures of sympathetic nervous system activity (e.g. skin conductance or cardiac pre-ejection period) could be incorporated in future studies to further examine the balance between parasympathetic and sympathetic nervous system activity during the construction of play narratives to provide a more complete picture of ANS functioning.

- The present study did not examine recovery scores. Future studies could examine the baseline pattern, the reactivity response and the ability to recover and return to baseline. This would provide a more complete picture of the course of autonomic reactivity for each child. The inclusion of PNS (and SNS) recovery scores following each challenging task through the addition of a 'neutral' recovery task or an end-task resting baseline, may provide a more global picture of autonomic functioning and help distinguish between children who demonstrate high reactivity and recover quickly (i.e. highly adaptive ANS functioning) from those who maintain high levels of arousal and struggle to return to resting levels (i.e. a less adaptive ANS). Moreover, there may be a 'spill-over' effect in the current study due to the lack of a recovery or baseline phase following the completion of each story stem task. It is possible that a change in arousal triggered by the traumatic stress of one story stem may have intruded into subsequent narratives. The inclusion of recovery baselines between each story stem task could control for this order effect. Furthermore, the addition of a non-dyadic stress tests may also help clarify if the atypical autonomic regulation observed is specific to the dyadic story stem assessment or an overall failure of the vagal brake.

- The current study did not distinguish between story stems tasks and treated each story stem as a comparable self-relevant stressor. Although it is possible that some story stems are more emotionally evocative than others. Bar-Haim and colleagues (2004) found that story stems containing parent separation and reunion themes were more evocative than other stems. Although, equally, each child and his context is unique and it is impossible to predict which story stems may or may not trigger a stress response for a child. Therefore an on-going focus on a child's response to the story stem rather than the nature of the story stem itself is advisable. This approach is affirmed by Fox and colleagues (2012) who recommend that researchers first code behaviour and then extract the accompanying physiology, especially in light of the number of variables that impact on a child's physiology. The present study indicates that comparing play narratives coded with and without intrusions of negative affect, or with and without unresolved trauma, are valid lines of on-going investigation. Future research might also consider how facial-coding procedures, vocal prosody and other social features regulated by the vagal system might be incorporated, to examine the physiology that accompanies phenomenon such as false positive affect and whether this is accompanied by physiological inhibition as proposed in the current study.

- RSA is a quantitative measure and it was not possible to control for a number of variables that impact on RSA measurement in a naturalistic setting. The study did not control for respiration, although the effect of respiration on RSA is debated. Respiration may have an influence on measures of RSA that are independent of vagal influence, although it is argued that respiration only needs to be measured in highly active contexts and respiration frequency has little impact on RSA in seated participants (Houtveen, et al., 2002; Denver et al., 2007). A meta-analysis by Graziano and Derefinko (2014) did not find any difference in the degree of association between RSA withdrawal and adaptive functioning outcomes between studies that measured respiration and those that used normative levels, such as the Porges' adaptive polynomial filter method used in the present study.

Given that the children in the present study were seated, and story stems excluded from the final analysis if a child demonstrated a significant postural adjustment, it is unlikely that the changes in RSA were primarily driven by changes in respiration. Furthermore, the effect of respiration is more problematic when examining differences in RSA between participants rather than within subject changes in RSA (Danvers & Shiota, 2017) as in the present study. However, it is also possible that the exclusion of story stem tasks that contained movement has created a selection bias as the children have likely moved in an attempt to regulate their autonomic arousal and manage the stress of the assessment.

The inclusion of measures of respiration or accelerometry may help control for these variables, although current respiration recording is cumbersome and not well suited to child populations. Measures of accelerometry are less invasive and would allow for comparisons between story stem responses that contain similar degrees of movement. More simply movement could be classified as low, high or very high to correct for the effect of movement intensity, as in a study by Schuengel and colleagues (2009). Nevertheless there is a much wider range of dynamic responses in ‘real world’ studies and there is a need for a real world database for RSA/vagal tone applicable to play therapy practice. Vagal tone has the potential to be used as a diagnostic tool or a measure of treatment effect, although further research is needed to develop clear guidelines as to what constitutes healthy vagal tone and vagal reactivity in children (Kok & Fredrickson, 2010).

CONCLUSION

The present study examined vagal regulation of the heart in a small clinical sample of children with behaviour regulation difficulties during a pre and post-play therapy intervention story stem assessment. Children were evaluated for cardiac vagal tone regulation (i.e. whether the vagal brake was withdrawn during the construction of play narratives). Each child displayed a highly insecure pattern of attachment as coded by the CAPA. An insecure strategy of attachment indicates that a child has a challenged social engagement system. As hypothesised children with highly insecure Type A+ and Type C+ strategies of attachment showed a preference for different patterns of vagal reactivity. Those children with an A+ strategy, characterised by a tendency to inhibit negative feelings and suppress displays of arousal, showed a tendency toward an atypical pattern of vagal augmentation and increased PNS inhibition during the construction of play narratives, indicating a failure to adaptively withdraw the vagal brake in response to the stress of the story stem assessment. Those children with a Type C+ strategy, characterised by dysregulated arousal and a tendency to exaggerate the expression of negative affect, showed a tendency toward a pattern of vagal withdrawal in response to the story stem assessment. Thus, within this study, the suppression of negative affect in an A+ strategy tended to increase RSA or vagal tone (i.e. a pattern of vagal augmentation), while the expression and exaggeration of negative affect in a C+ strategy tended to decrease vagal tone (i.e. a pattern of vagal withdrawal). A possible exception is unresolved trauma, which may be accompanied by increased vagal inhibition for both Type A+ and Type C+ strategies of attachment. It was hypothesised that play narratives coded for unresolved trauma or loss would have a distinct cardiac reactivity. Support for this hypothesis was found for those children with a Type A+ strategy who showed a marked profile of vagal inhibition during unresolved trauma narratives. For the children with a Type C+ strategy the pattern of vagal reactivity during unresolved trauma narratives was less consistent and warrants further investigation. If a pattern of increased vagal inhibition of the heart is shown to accompany unresolved play narratives this has clinical implications for play therapist and may help further delineate between the features that distinguish between dynamic and stuck post-traumatic play.

While the present study should be considered exploratory in view of the small and complex sample of children to which it was applied, it is possible that measures of vagal tone could be used in the future as an adjunct to attachment coding methods such as the DMM to clarify clinical observations, inform treatment and as a measure of outcome. The findings in the present study support the notion that children with Type A+ and Type C+ strategies of attachment have different underlying patterns of autonomic reactivity and therefore different therapeutic needs. Children with a Type A+ strategy may need a therapist to promote activation of the social engagement system for shared regulation during states of heightened arousal, rather than the child's default mode of over-control and arousal inhibition. Children with a Type C+ strategy may need a therapist to promote activation of the social engagement system for shared regulation during states of lowered arousal, rather than the child's default mode of arousal escalation and a loss of regulatory control. The present findings suggest that a greater understanding of a child's unique strategy of attachment and pattern of autonomic reactivity may better clarify the therapeutic needs of children who display extreme behavioural difficulties in the context of developmental trauma.

This study provides a unique contribution to knowledge as it the first study to look at RSA reactivity during administration of the CAPA in children with insecure strategies of attachment. The study also provides empirical support to the hypothesis that insecure A+ strategies of attachment are associated with both psychological and physiological inhibition. There is also evidence to suggest that child's play narratives that are identified in the CAPA as displaying unresolved loss or trauma, display a distinct physiological profile and a greater degree of inhibition, especially for children within the A+ cluster. These findings have implications for play therapy practice and highlight the importance of autonomic arousal regulation when working with children addressing trauma themes within their play. Play therapists need to work with a child so that they are in an optimally aroused state and not excessively inhibiting their arousal (Type A+) or under-regulating their arousal (Type C+). Play narratives that are accompanied by an ideal level of vagal withdrawal are likely to be the most adaptive, although further research is needed to establish the ideal degree of vagal withdrawal that accompanies adaptive or dynamic trauma play narratives.

In summary, Study 1 examined differences in the individual cardiac reactivity of children with insecure Type A+ and Type C+ strategies of attachment during the construction of play narratives and found evidence to support the hypotheses that children with insecure Type A+ strategies show greater vagal inhibition, while children with insecure Type C+ strategies show reduced vagal inhibition. Play narratives coded for unresolved trauma also appear to be accompanied by a greater degree of inhibition for the Type A+ strategies. The following chapter outlines Study 2, which examines cardiac reactivity from an interpersonal perspective and the interactions between the attachment strategy and the cardiac physiology of 4 therapy dyads for evidence of HR and RSA synchrony. The study examines 4 children from Study 1 (Eli, Billy, Josh and Tyler) and introduces two trainee therapists, Therapist A and Therapist B.

Chapter 4

Study 2

Cardiac Linkage in Child-Centred Play Therapy Dyads

"My heartbeat is saying that I'm still protected…your one is still protected. Protected from no baddies!" – Tyler

INTRODUCTION

Purpose. To examine the relationship between a therapist and child's cardiac physiology (i.e. HR and RSA) during play therapy to determine if there is a physiological linkage (or synchrony) in the context of the Polyvagal theory.

This case study analysis examined the real-time linkage for heart rate (HR) and respiratory sinus arrhythmia (RSA) in 4 therapist-child dyads. This exploratory study is the first to my knowledge to incorporate measures of heart rate and heart rate variability into play therapy process research and the first to examine cardiac linkage within play therapy dyads. The study was designed to gain further insight into the physiological mechanisms that underlie play therapy through the lens of the Polyvagal theory (Porges, 1995, 2001, 2007, 2011, 2017). The Polyvagal theory emphasises the role of relationships in regulating the stress response via the vagus nerve. The functioning of the vagus nerve is indexed by RSA, the high frequency component of heart rate variability. RSA is deemed a measure of autonomic arousal and parasympathetic (or vagal) regulation in social relationships (Porges, 2007; 2011). The Polyvagal theory's union of the stress response system, the social engagement system and social play to the functioning of the vagus nerve, is especially relevant to child-centered play therapy, given the modality's unique emphasis on the therapeutic power of a play relationship between a therapist and child. The Polyvagal theory (Porges, 2003, 2007, 2011) emphasises that when a client's nervous system unconsciously detects features of safety in a therapist and a therapy environment, via a process termed neuroception, a client's autonomic defenses are down regulated to create a physiological state that aids optimal arousal, positive social interaction and effective therapy (Ogden et al., 2006).

Child-centered play therapy was founded on Carl Rogers' person-centered core relationship conditions of empathy, unconditional positive regard and congruence (1951, 1955). Common factors research has since established that the therapeutic relationship is the most powerful agent of change across therapies (Lambert & Barley, 2001), a perspective that has also gained support from the field of neuroscience (Steele

& Malchiodi, 2012). Cozolino (2010) affirms that Rogers' relationship conditions likely describe the ideal interpersonal environment for facilitating states of optimal arousal that aid brain growth and development. Current theorists have expanded on Carl Rogers' person-centered conditions and use concepts such as 'therapeutic presence' or moments of 'present-centred engagement' (Crenshaw & Kenny-Noziiska, 2014; Gellar & Porges, 2014) to describe the psychophysiological relationship that exists between a therapist and a client, whereby a therapist simultaneously attunes to and regulates her own and a client's autonomic defence systems (Geller & Porges, 2014). From a neurobiological perspective it could be reasoned that a fundamental goal of therapy is to assists clients to enhance parasympathetic functioning and re-tune their autonomic defenses, so that they build a more resilient nervous system and calm those parts of the brain that process fear, anxiety and stress (Scaer, 2005). However, despite a growing interest in the relevance of the autonomic nervous system to clinical theory and practice, few studies have incorporated autonomic measures into play therapy research.

The present study aimed to investigate the autonomic mechanisms that may underlie play therapy practice through the real-time measurement of cardiac physiology within therapy. The use of physiological measures in play therapy research has the potential to provide timely evidence into the effectiveness of play therapy and identify the mechanisms through which play therapy impacts on the dysregulated stress physiology of child clients, especially those who've experienced early adversity and relational trauma. Since psychophysiological responses are not directly observable they may also provide new insights into therapy processes and lead to more effective interventions (Kleinbub, 2017). In addition, the use of psychophysiological measures in clinical research is advantageous, as unlike self-report measures they are outside of an individuals conscious awareness and free of self-report bias and pertinent to children, who may not have the cognitive or language abilities necessary for self-report measures (Mclaughlin et al., 2015). Moreover, it is anticipated that physiological monitoring will become increasingly integral to therapy research and practice and may be used to aid clinical diagnosis, to measure outcome, as a form of biofeedback intervention, and a means of deepening the therapeutic alliance and a therapist's empathetic awareness (Marci & Riess, 2005).

The Polyvagal Theory, Attachment and Therapy Dyads

It is proposed that an individual's pattern of cardiovascular activity may be a function of his most important relationships (Cacioppo, 1994). The Polyvagal theory (Porges, 2011) conceptualises the biology behind attachment theory and articulates how social interactions regulate physiological stress, including cardiac activity. The Polyvagal theory advocates that an individuals preferred mechanism for regulating defensive fight, flight or freeze reactions is via the social engagement system as governed by the vagus nerve. It is only when the social engagement system fails that an individual will resort to defensive fight, flight or freeze reactions (Porges, 2011). Attachment theory categorises attachment relationships as secure or insecure. An individual's pattern of attachment begins in infancy and is shaped by the quality of the early caregiving relationship. An infant with a secure strategy of attachment experiences responsive caregiving and a physiological co-regulation that organises the autonomic nervous system, including the vagal system, so that a child is able to maintain an optimal balance between sympathetic and parasympathetic arousal (Champagne, 2008; Schore, 1994). Securely attached individuals can utilise relationships to regulate their physiological arousal, and it is a preference for the social engagement system in response to stress that likely defines a secure attachment (Wagner, 2015). Insecurely attached individuals have typically experienced inconsistent caregiving as infants and are less able to utilise relationships to regulate their physiological arousal. They are less able to fine-tune their vagus nerve to facilitate positive social interaction and display behaviours associated with defensive fight, flight or freeze reactions (Ogden et al., 2006).

Attachment theory further classifies insecure attachment as Type A (anxious avoidant) or Type C (ambivalent or preoccupied) (Crittenden, 2006). At a physiological level these different categories of insecure attachment may indicate a bias for different patterns of autonomic defence (Ogden et al., 2006). An insecure Type A strategy is a self-reliant strategy where an individual deactivates his attachment system, inhibits his affect, and potentially over-regulates his nervous system, with a preference for parasympathetic states of low arousal and a tendency towards defensive states of immobilisation. An individual with an insecure Type C strategy, hyper-activates his attachment system, exaggerates his affect, and potentially under-regulates his nervous system, with a preference for sympathetic states of high arousal and a tendency towards defensive sates of mobilisation (i.e. fight, flight) (Abtahi & Kerns, 2017; Cozolino, 2002; Ogden, et al., 2006; Schore, 2012). Thus an insecure strategy of attachment hinders a healthy co-regulation of autonomic state within dyads and defensively organises social engagement behaviours; so that individuals with insecure Type C attachments show a bias for sympathetic mobilisation defences, and individuals with insecure Type A attachments show a bias for parasympathetic shutdown defences.

Attachment theory provides an important framework for thinking about the therapy relationship. A therapy relationship is akin to an attachment relationship. Ideally a play therapist aims to provide a child with a secure relationship that mirrors what occurs in a healthy, secure mother-child attachment (Whelan & Stewart, 2014), in the hope of providing a child with a developmentally corrective attachment experience that may ultimately rewire the stress response system of child clients (Cozolino, 2016; Schore, 2003). Moreover, the establishment of a secure attachment in therapy enables children to better regulate their arousal in response to feelings or memories that would otherwise be overwhelming (Schore, 2003; Siegel, 2007). However, the ability of a therapist to provide a child with the experience of a secure, arousal-regulating attachment may be influenced by her own strategy of attachment, given that mother-infant synchrony has been shown to largely depend on the parent due to the immaturity of the child (Field, 2007). In adult research Dozier and colleagues (1994) found that insecure case managers, as coded by the Adult Attachment Interview (AAI), were more likely to be pulled into a client's hyper-activating or deactivating attachment strategies, whereas secure case managers were more able to facilitate a corrective relationship experience. However Dinger and colleagues (2009) found that clinicians with insecure and secure strategies of attachment were equally successful in establishing therapeutic alliances within an inpatient setting, although the experience of the therapists may have outweighed the influence of the therapist's attachment security (Marmarosh et al., 2014). Other studies have found that a therapist's insecure strategy of attachment can have a negative impact on session depth (Dozier, Cue & Barnett, 1994), therapist empathy (Rubino et al., 2000), emotional closeness (Mikulincer & Shaver, 2005), and countertransference reactions (Ligero & Gelso, 2002).

If a therapist is to facilitate a secure therapy relationship she must operate out of her social engagement biology to attune to and regulate her clients. When a therapist is operating out of her social engagement biology she can detect a client's distress through his breathing patterns, facial expressions, vocal tones, and movement, without becoming distressed herself (Wagner, 2015). Moreover, the therapist is able to flexibly respond and use her own facial expression, vocal tone, prosody and movement to intuitively sooth a child (Wagner, 2015). However, if a therapist has an insecure strategy of attachment it may be more difficult for her to consistently maintain a socially engaged state and she may be more prone to defensive reactions within therapy than a securely attached therapist. A therapist with an insecure avoidant or dismissing Type A strategy may try to avoid a client's emotional distress, and have a bias toward distancing behaviours related to the parasympathetic shutdown response (Shaver &

Mikulincer, 2007) such as passivity, unresponsiveness, sleepiness, tuning-out, daydreaming and a flattened affect, resulting in an emotionally disengaged relationship (Marmarosh et al., 2014). A therapist with an insecure ambivalent or preoccupied Type C strategy may over-identify with a client's distress (Morgan & Morgan, 2005) and have a bias toward controlling behaviours related to sympathetic mobilisation, resulting in an emotional over-engagement, where the therapist and child's feelings become blurred and the therapist fears for her autonomy (Siegel, 2010). Thus a therapist's attachment insecurity and the associated defence bias may impact on a therapist's ability to consistently operate from her social engagement biology, resulting in less regulated and less connected therapy dyads.

Cardiac Linkage in Dyads

It is widely held that biological systems are designed to operate interdependently rather than independently (Hughes et al., 2012; Schore, 2012). A psychobiological co-regulation, where two individuals reciprocally influence each other's physiological state is foundational to attachment relationships (Field, 1985, 1994; Hofer, 1994). A linkage between the biological states of two individuals is most commonly referred to as synchrony. The presence of a physiological linkage between interacting individuals indicates the presence of a coordinated moment-by-moment match in physiology that reflects a dynamic regulation or co-regulation of arousal (Feldman, 2012). Physiological synchrony may be further identified as simultaneous or lagged. A simultaneous linkage indicates that the physiological of each member of the dyad moves in the same direction at the same time, reflecting co-regulation or attunement within the dyad. A lagged synchrony suggest that the physiology of each member of the dyad moves in the same direction, but not at the same time, as one member of the dyad follows the other, which indicates that there is an arousal regulating function to the synchrony. Thus, a simultaneous synchrony may reflect attunement and a lagged synchrony regulation.

Physiological synchrony has been observed between mothers and infants, romantic partners, child peers and therapists and clients. Furthermore, physiological synchrony does not reliably occur between acquaintances, for example close preschool friend pairs showed a greater concordance of play behaviours and heart rate than acquaintance pairs (Goldstein, Field & Healy, 1989), which suggests that this phenomenon is intrinsic to close relationships (Field, 2012; Hazan, Campa, & Gur-Yaish, 2006; Sbarrra & Hazan, 2008). The most commonly studied dyads are mother-child dyads. When the physiological responses of a mother and child occur in tandem they are said to exhibit a positive synchrony. Healthy mother-infant dyads have been shown to display coordinated heart rhythms with a lag of less than one second, with a greater concordance during episodes of behavioural synchrony and face-to-face play (Feldman et al., 2011). Sensitive mothers who are responsive to the needs of their infant have been shown to synchronise their heart rate with their infant's heart rate, leading to a decrease in HR for the mother and the child (Field, 1977). However, less sensitive mothers who overstimulate their children may also show HR synchrony, but with an increase in HR for the mother and child (Field, 2007; Papousek, 2007). Thus HR synchrony in mothers-infants dyads may promote regulation or escalate arousal depending on the sensitivity of the mother.

There is also evidence to suggest that mother-child synchrony is weakened by maternal depression. Depressed mothers are observed to be less sensitive to their infant's behaviour and show less synchronous HR in comparison to non-depressed mother-infant dyads (Field, Healy & LeBlanc, 1989). Woody and colleagues (2016) also found evidence that maternal depression disrupts parasympathetic processing or RSA synchrony in mother-child dyads. The study measured RSA during positive and negative discussions between mothers and children 7-11 years of age and compared RSA linkage between mothers with and without a history of major depression. A positive within-dyad synchrony for RSA was observed during the negative discussion for the non-depressed mother-child dyads, indicating that on a moment-by-moment basis, non-depressed mothers and their children exhibited congruent dynamic changes in RSA across the negative discussion. However, dyads with a maternal history of depression showed a negative synchrony in dynamic changes in RSA during the negative discussion, where an increase in RSA in one member of the dyad was accompanied by a decrease in RSA in the other member, and vice versa. Furthermore, those dyads with high levels of negative synchrony also showed higher levels of sadness for both the mother and child. High levels of positive synchrony during the negative discussion were associated with lower levels of sadness. Conversely, during the positive discussion task there was no evidence of a within-dyad RSA synchrony for the depressed or non-depressed dyads (Woody et al., 2016).

RSA synchrony has only been observed during challenging conditions where members of a dyad are actively interacting. In resting conditions linkage has been observed for HR but not RSA (Bornstein & Suess, 2000; Creaven et al., 2014). Mother-child physiological synchrony is also disrupted by a child's externalising behaviours. A study by Lunkenheimer and colleagues (2015) examined co-regulation of RSA between parents and their pre-school children. Overall the mother-child dyads showed a positive co-regulation of RSA, where changes in the mother's RSA predicted changes in the same direction in the child's RSA and vice versa. Although when a child's externalising behaviours were higher, co-regulation was negative so that changes in a mother and child's RSA showed a divergent rather than a positive concordance (Lunkenheimer et al., 2015). Research has shown that children with externalising behaviours have a dysregulated physiology and poor vagal regulation (Calkins et al., 2007), which may contribute to this disruption in parent-child co-regulation of RSA (Lunkenheimer et al., 2015).

A divergent pattern of responding or negative synchrony has also been found in experiments that induce a rupture in the mother-child relationship. For example Moore and colleagues (2009) found that during the still face experiment infants showed a decrease in RSA (RSA suppression), while parents showed an increase in RSA (RSA augmentation). Hence there is evidence to show that mothers and children co-regulate heart rate and parasympathetic processes as measured by RSA, but this co-regulation may be positive or negative depending on the goal of the interaction and presence of risk factors such a poor maternal sensitivity, maternal depression or child externalising behaviours. While HR linkage is evident during challenging and rest conditions, RSA linkage is only typically observed during challenging interactive tasks.

Studies have also examined cardiac linkage or co-regulation in adult romantic partners; both high and low relationship quality has been associated with cardiac linkage. Helm, Sbarra and Ferrer (2014) found that couples reporting higher relationship satisfaction showed a significantly stronger RSA synchrony. In another study, marital satisfaction was reported to be lower among couples with high physiological linkage, but only when the linkage was measured during the discussion of high conflict problems (Levenson & Gottman, 1983). A further study found that physiological linkage was positively associated with empathy and the correct identification of negative emotional states, during a task where one spouse was asked to watch a videotaped discussion and rate the feelings of their spouse (Levenson & Ruef, 1992). Thus, as for mother-infant dyads, synchrony between adult dyads may be adaptive or maladaptive.

To explain this phenomenon two different types of synchrony have been identified, morphastatic and morphogenic synchrony (Butler, 2011; Butler & Randall, 2013). Morphastatic synchrony describes a linkage between members of a dyad, where the dyad up and down-regulate their physiology, stabilising around a set point to promote optimal regulation. For example, sensitive mothers in the study by Field (1977) show a morphastatic synchrony as the heart rate of the mother and child stabilise around a lower average HR (Helm et al., 2014). This type of synchrony is defined as co-regulation and is associated with greater relationship quality, satisfaction and sensitivity. In morphogenic synchrony, partners continue to up-regulate each other, leading each other away from an optimal set point towards physiological dysregulation. For example overstimulating mothers show a morphogenic synchrony as the HR of the mother and child continues to increase (Helm et al., 2014). Partners with low relationship satisfaction in high conflict discussions, as in the study by Levenson & Gottman (1983), may also be demonstrating a morphogenic synchrony.

A further distinction is made between sympathetic and parasympathetic linkage. Helm and colleagues (2014) associate cardiac linkage in couples with higher quality relationships and propose that couples with low-relationship satisfaction may show a linkage for sympathetic measures such as blood pressure, cardiac pre-ejection period (PEP) or skin conductance, while couples with high-relationship satisfaction may show a linkage for parasympathetic measures such as RSA. This perspective is supported by a number of studies that assert that higher quality relationships down-regulate sympathetic stress and enhance parasympathetic or vagal activity, which is associated with a greater connectedness. For example a secure strategy of attachment predicts higher levels of individual resting vagal tone or RSA (Diamond & Hicks, 2005), women cohabiting with a partner show higher RSA than those living alone (Horsten et al., 1999), and depressed adults have been shown to display increased vagal activity (i.e. higher RSA) when socialising with friends or family in comparison to socialising with a stranger, colleague or when alone (Schwerdtfeger & Friedrich-Mai, 2009). Repeated interaction with a close companion also increases vagal tone (Holt-Lunstad et al., 2007; Kok & Fredrickson, 2010). Behavioural synchrony is also associated with increased vagal activity, for example mother-infant and father-infant gaze synchrony has been associated with increased vagal activity in infants (Feldman & Eidelman, 2007).

Cardiac Linkage in Therapy Dyads

A recent systematic review by Kleinbub (2017) identified 19 studies that explored physiological linkage within therapy dyads. The majority of studies examined skin conductance concordance with five studies examining cardiac linkage. Typically studies associate a similarity in psychophysiological responses within therapy dyads with social closeness and positive relationship features such as empathy, attunement and rapport (Kleinbub, 2017). Notably, several studies found evidence to suggest that skin conductance concordance is associated with client-perceived therapist empathy (Marci & Orr, 2006; Marci et al., 2007; Kleinbub et al., 2012; Messina et al., 2013). Skin conductance synchrony within therapy dyads has also been associated with significantly more positive social and emotional interactions between therapists and clients (Marci et al., 2007). Those studies that have examined cardiac linkages are small case-based studies that measure linkage via correlation or a graphical comparison of physiological activity in time. The earliest studies observed a HR synchrony where the therapist's HR followed the client's HR in a similar but less pronounced manner (Coleman, Greenblatt & Solomon, 1956; Di Mascio et al., 1955; Hahn, Stanek & Mayer, 1973).

Studies have also observed that episodes of HR concordance and discordance appear to be associated with session content. Di Mascio and colleagues (1957) observed that a therapist and client's HR moved in a similar direction during moments of 'tension' and in an opposite direction during moments of client 'antagonism' during which the therapist's heart rate tended to decrease and become more variable. Hahn and colleagues (1973) similarly observed HR concordance and discordance to relate to the content of therapy conversations. The most recent study to incorporate cardiac measures referenced in the review by Kleinbub (2017), examined HRV and skin conductance in a single couple therapy case study (Seikkula et al., 2015). Skin conductance was used to examine synchrony and HRV to identify the highest point of within session stress for the husband and wife. It was observed that the highest arousal occurred not during the client's own narrative but while listening to the other partner or the therapist's reflections. No study in the review examined RSA synchrony within therapy dyads and no study examined physiological linkage within therapist-child dyads.

In their 2009 study Ham and Tronick theoretically applied their findings from the mother and infant still face experiment to therapy dyads. They likened therapy to the repair episode of the still face experiment. Skin conductance concordance (i.e. sympathetic concordance) is higher during the more stressful repair episode in comparison to the less stressful face-to-face play episode. During the repair episode the mother actively soothes her infant and it is conjectured that physiological concordance is most likely to occur when one member of the dyad is actively attending to the other, or when both members of the dyad are working to co-ordinate their physiology and behaviour (Ham & Tronick, 2009). While cardiac measures were not used to measure linkage in this study, positive infant behaviours were correlated with a lower infant HR and a higher RSA, while negative infant behaviours were only correlated with a higher HR (Ham & Tronick, 2009). Maternal RSA was negatively correlated with an infant's negative engagement behaviours during the face-to-face play episode, but positively correlated with an infant's negative engagement during the repair. In this instance it was speculated that during the repair episode a mother activates her own parasympathetic system to calm herself in order to calm her infant. In a similar fashion it could be postulated that a therapist is actively involved in regulating a child's ANS through the regulation of her own autonomic nervous system, which is likely a crucial component of successful therapy.

Overall there is a small body of literature examining cardiac linkage within dyads and results at times appear contradictory. Within interacting dyads there are several possible physiological linkages. A positive correlation or synchrony is typically associated with higher relationship quality, empathy and co-regulation in instances where the synchrony functions to facilitate homeostasis (i.e. morphastatic linkage). However a positive linkage may be negative if it fails to facilitate homeostasis and instead escalates arousal (i.e. an arousal-escalating or morphogenic linkage). In therapy a maladaptive linkage in autonomic arousal may occur if a therapist's shared experience of a child's distress causes the therapist to over-activate her own autonomic defenses (Yamanda & Decety, 2009; Muraven & Baumeister, 2000). A negative correlation or linkage, where the physiology of one partner moves in the opposite direction of the other, is primarily associated with poor-quality relationships in mother-infant dyads and is attributed to risk factors such as maternal depression and child externalizing behaviours. However, it is also postulated that in some instances a discordant linkage may serve an arousal-compensating function if one member of the dyad changes their arousal in the service of regulation of the other member of the dyad, to maintain physiological homeostasis (Gates et al., 2015) as observed in the Still Face Experiment. Accordingly, it could be argued that physiological linkage is an adaptive phenomenon when it functions to preserve homeostasis and keep each member of the dyad within an optimal zone of arousal, or within his or her window of autonomic tolerance.

Research Questions and Hypotheses

Cardiac linkage within dyads assesses the degree to which moment-by-moment changes in arousal in one member of the dyad are matched by moment-by-moment changes in arousal in the other member of the dyad. The primary aim of this study was to evaluate the possible existence of physiological linkage for heart rate (HR) and respiratory sinus arrhythmia (RSA) in play therapy dyads. The present study examined cardiac linkage in 4 dyads. The primary research question was:

> Do therapists and children exhibit a moment-by-moment linkage (or synchrony) in dynamic changes in HR and RSA within play therapy?

The study was designed to examine simultaneous and lagged linkages within play therapy dyads and it was proposed that 3 different linkages may be evident between a therapist and child's cardiac data within play therapy.

1. *Simultaneous linkage*. The HR and RSA of the therapist and child may show a similar direction of reactivity within therapy (i.e. the HR and/or RSA of the therapist and child moves in the same direction at the same time, across time). This could be viewed as evidence of a simultaneous cardiac linkage or synchrony that suggests that the therapist and child are attuned and mutually responsive to changes in each other's cardiac physiology.

2. *Therapist-driven linkage*. The HR and RSA of the therapist and child may show a similar direction of cardiac reactivity, but not at the same time (i.e. there may be a delay or lag in the cardiac reactivity of one member of the dyad; with one member 'driving' the interaction more than the other). This could be viewed as a lagged or responsive synchrony. If a change in the therapist's cardiac physiology is followed by a similar direction of change in the child's cardiac physiology, this indicates a therapist-driven linkage and suggests that the child is responding to changes in the adult's physiology and mirroring this in his own cardiac physiology, indicating a therapist-led regulation.

3. *Child-driven linkage*. Likewise, the child may 'drive' the interaction in instances where a change in the child's cardiac physiology is followed by a similar direction of change in the therapist's cardiac physiology. This suggests that the therapist is responding to the child's physiology and mirroring this in her own cardiac physiology, which may indicate therapist empathy.

Additionally, each of the above linkages may prove positive or negative. A positive linkage suggests that the HR or RSA of the child and therapist move in the same direction on a moment-by-moment basis across a therapy session in a simultaneous or lagged fashion, with the lag driven by the therapist or the child. A negative linkage is a divergent synchrony and suggests that when the HR or RSA of one member of the dyad moves in one direction, the HR or RSA of the other member of the dyads moves in the opposite direction in a simultaneous or lagged fashion. Several hypothesis were generated for the present study:

A. *It was hypothesised that play therapy dyads would show evidence of positive linkages for HR and RSA.*

A therapist-child relationship is designed to mimic the qualities of an attuned attachment relationship and it is postulated that therapist-child dyads would show characteristics similar to the more widely researched mother-child dyads. It was hypothesised that play therapy dyads would show evidence of positive linkages for HR and RSA given the presence of positive cardiac linkages in parent-child dyads (e.g. Feldman et al., 2011; Woody et al., 2016). A positive synchrony for HR has been observed at rest and challenge for mother-child dyads, while a positive RSA synchrony has been shown to be a healthy response to interpersonal challenge (Woody et al., 2016). Given that therapy is a highly interactive and challenging interpersonal experience, play therapy dyads are expected to show linkage for HR and RSA. In parent-child research negative linkages are typically associated with relationship ruptures and disrupted co-regulation, while positive linkages are associated with a healthy co-regulation of arousal (Feldman, 2007; Lougheed and Hollenstein, 2016). It was therefore hypothesised that a positive linkage for HR and RSA in play therapy dyads would indicate attunement, co-regulation and a positive interaction between a play therapist and child.

A positive cardiac linkage may also be a physiological indicator of an empathetic relationship. It has been long held that empathy may be “an autonomic nervous system state which tends to stimulate that of another person” (Ax, 1964, p.12). A therapist may show empathy through a physiological synchrony, whereby she experiences the emotions and sensations of the client in her own body, although to a lesser degree (Gallese, Eagle & Migone, 2007). Therapist empathy is considered foundational to effective therapy at a neurobiological level as it inhibits the amygdala, the fear centre of the brain (Scaer, 2012) and helps maintain a client within his window of tolerance (Badenoch, 2008). A positive therapist-driven linkage may also work to keep a client within his window of tolerance, if the therapist leads the interaction to regulate a child’s biology, in the same way that a mother may activate her parasympathetic tone to regulate a distressed child (Ham & Tronick, 2009). If a child were overly dysregulated it would be unhelpful for the therapist to wholly match a child’s dysregulated state and more therapeutic to regulate the child’s biology by leading the child towards a more adaptive physiological state. Ham and Tronick (2009) propose that therapists who are able to activate their parasympathetic tone in therapy (i.e. increase RSA) will be better at managing conflict and ruptures in the therapy alliance. It could be conjectured that an increase in a therapist’s RSA, followed by an increase in a child’s RSA (i.e. a therapist-driven linkage for RSA) may evidence a therapist exerting a calming or regulating influence on a child’s cardiac physiology.

B. *It was hypothesised that a co-occurring positive linkage for HR and RSA would be the most desirable linkage.*

It was further hypothesised that a coinciding positive linkage for HR and RSA would be the most adaptive and desirable linkage for play therapy dyads. A dual linkage suggests that a dyad is utilizing more adaptive and flexible parasympathetic processes to co-regulate the stress of the therapy encounter, via changes in vagal tone (RSA) and associated changes in HR. It has been proposed that a linkage for parasympathetic measures such as RSA may be associated with higher quality relationships, given that high quality relationships down-regulate sympathetic stress and enhance PNS (vagal) activity, which is associated with greater connectedness (Helm et al., 2014). Given the theoretically links between the parasympathetic (or vagally) mediated social engagement system and states of social play (Porges, 2011) RSA linkage may be a key biological mechanism underlying play therapy intervention. Effective play therapy must facilitate a pleasurable play state in which autonomic states of high and low arousal can be safely experienced within a play relationship (i.e. there is a neuroception of safety that enables the social engagement system to remain engaged despite increases or decreases in autonomic arousal). A coinciding linkage for RSA and HR may thus indicate that a child and therapist are in a socially engaged state of Polyvagal play or what play therapists call dynamic play.

C. *It was hypothesised that RSA linkage would increase across the course of play therapy indicating an increasingly positive social connection.*

According to the Polyvagal theory cardiac vagal tone (i.e. RSA) is elevated during security-enhancing interactions but not during interactions with unfamiliar people (Diamond & Hicks, 2005; Porges, 2001). It is also reasoned that repeated contact with a rewarding individual leads to a conditioned response that associates that individual with physiological homeostasis and psychological security (Sharra & Hazan, 2008). Similarly, over time, weekly therapy with a rewarding and familiar play therapist may become associated with psychological and physiological security and stability. Thus it is anticipated that the frequency of RSA linkage will increase across the course of therapy as a therapist and child build an alliance, indicating an increasingly positive social connection and parasympathetic engagement between a therapist and child.

D. *It was hypothesised that the complex dyads (i.e. trainee therapists and dysregulated children) in the present study may also show examples of negative synchrony or an absence of synchrony.*

A negative linkage indicates that when the HR or RSA of one member of the dyad moves in one direction, the HR or RSA of the other member of the dyads moves in the opposite direction in a simultaneous or lagged fashion. For example when one member of the dyad increases RSA, a pattern associated with increased levels of calm social engagement, the other member decreases RSA, a pattern associated with increased physiological arousal, especially during social conflict (Woody et al., 2016). In mother-infant dyads negative linkages are associated with relationship ruptures and disrupted co-regulation caused by factors such as reduced maternal sensitivity, maternal depression, high levels of sadness within the dyad, and child externalising difficulties. Furthermore, individuals with psychopathology have been observed to show atypical RSA reactivity during social interactions (Porges, 2003). Since the sample of children in this study displayed externalising behaviours and insecure strategies of attachment (see Chapter 3) they are more likely to have a distorted social engagement system and an atypically functioning vagal brake that may compromise the formation of cardiac linkages, especially for RSA. In addition, the therapist's sensitivity and the quality of the therapist-child relationship will likely impact on the formation of cardiac linkages, which will likely be influenced by the degree of therapist experience and the therapist's own attachment security. A negative linkage or an absence of linkage was hypothesised to indicate a failure to co-regulate arousal within the dyad.

METHOD

Participants

Cardiac output was simultaneously recorded for a therapist and child across 4 therapy dyads, comprised of 2 female trainee play therapists and 4 male children between 7 and 9 years of age. The child participants were recruited from a specialist primary school for children with extreme behavioural disturbances. The trainee therapists were recruited from the final year of a master's of play therapy program. All of the children displayed social, emotional and behavioural difficulties in the context of developmentally adverse experiences including exposure to family violence.

Procedure

Each therapist conducted weekly individual play therapy sessions with 2 children. Each child attended 15-25 weekly sessions of play therapy during term time. For each dyad 3 play therapy sessions were chosen for quantitative analysis, one from the initial, early and latter stage of therapy. Sessions were chosen where the cardiac data was available and where the child was engaged in seated play for the majority of the session, in an attempt to limit movement variables. One therapy session was excluded due to an inconsistency in the formatting of the cardiac data. A total of 11 play therapy sessions were analysed.

Heart rate (HR) and Respiratory Sinus Arrhythmia (RSA) was averaged in running 30-second epochs across the course of each therapy session. RSA is typically averaged between 1 and 5-minutes, with the Task Force (1996) suggesting a minimum of 60-seconds. However, when examining dynamic changes in RSA within dyads across multiple sequential epochs, 30-seconds has been utilized as an appropriate length of time for valid RSA extraction (e.g. Bernston et al., 1997; Fortunato et al., 2013; Fracasso et al., 1994; Lunkenhimer et al., 2015; Helm et al., 2014; Woody et al., 2016). Therapy sessions varied in length with 28 to 40 minutes of data analysed per session, resulting in 56 to 80 (30-second) epochs per therapy session. Sessions were shorter where the child or therapist ended the session early. If a child or therapist was missing an item of data, this epoch was excluded from the analysis and only pairs of available data were analysed.

A within-dyad analysis was used to examine dynamic synchrony as this is recommended as the most appropriate method for exploring HRV due to the high inter-individual variations and the complex interactions that influence HRV (McAssey et al., 2011; Quintana & Heathers, 2014; Woody et al., 2016). Within-dyad analysis also provides information about the temporal course of synchrony and whether moment-by-moment changes in a therapist's HR or RSA correspond to shifts in a child's HR or RSA and vice versa. Conditions were kept as consistent as possible across the intervention period. The weekly play therapy sessions took place in the same room, with the same equipment, on the same day, at the same time each week during term time.

Play Therapy Intervention. The play therapy intervention was child-centred. Child-centred play therapy was originally developed by Virginia Axline (1947, 1964, 1969). Axline applied Carl Rogers' (1951, 1955) humanistic person-centred approach and the core relationship conditions of unconditional positive regard, empathy and congruence to child therapy and developed eight play therapy propositions that encouraged therapists to: build rapport, accept the chid unconditionally, establish a permissive relationship, reflect the child's feelings, respect the child, allow the child to lead, don't rush the child, and establish limits when necessary. The play therapy room was set up using toys and equipment as recommended by Landreth (2012). The trainee therapists utilised basic child-centred play therapy techniques as outlined by Ray (2004) including:

- Tracking the child's play behaviour
- Reflecting the content of the child's verbalisation and play
- Reflecting the child's feelings
- Facilitating the child's decision making

In their interaction with the child, the therapists were trained to display therapeutic skills such as (Ray, 2004):

- Maintaining an open posture and leaning forward
- Showing an interest in the child
- Appearing comfortable and relaxed
- Matching the child's affect through tone and rate of speech
- Conveying a sense of genuineness by matching words and affect

Instruments

Attachment Measures. The child's primary strategy of attachment was assessed using the Child Attachment and Play Assessment (CAPA) (Farnfield, 2015a). The CAPA is a doll-based narrative story stem procedure and manualised coding system that assesses attachment, play and mentalising in children between 3 and 11 years of age. The assessment utilises Crittenden's Dynamic Maturational Model of Attachment and Adaptation (DMM; 1995, 2006, 2008) to classify self-protective attachment patterns learnt in infancy through interaction with adult caregivers (Crittenden, 2006). A secure attachment strategy is coded Type B, and an insecure attachment is coded Type A or

Type C. Insecure strategies are further coded numerically C1 to C8 and A1 to A8. The higher number the more insecure and extreme the strategy. Type A+ and Type C+ are used to indicate a strategy higher than more normative A1-2 or C1-2 strategies, that typically develop in response to more dangerous home environments. Further details of the administration of the CAPA can be found in Chapter 3.

The therapist's primary attachment strategy was assessed using the Adult Attachment Interview (AAI) a semi-structured 1-hour interview. The interviews were conducted in a private room on the university campus by an interviewer unfamiliar to the therapist, trained in the administration of the AAI. During the interview the adult was asked to recall childhood memories of her relationship with her primary attachment figures. The interviews were transcribed and single-coded by a certified AAI coder who examined the therapist's ability to reflect on her own childhood experiences and the internal coherence, consistency and completeness of the narrative discourse. Self-protective attachment strategies were again coded according the DMM (Crittenden, 1995, 2006, 2008).

Therapy Relationship. The relationship between a child and therapist was also descriptively analysed from the video footage for each session analysed. No observational measures were found that could code the relationship between a therapist and child in terms of attachment theory or attachment security. A description of the pattern of interaction between the therapist and child was based on a modified version of the CARE-Index (CI). The CARE-Index is dyadic assessment based on the dynamic-maturation model of attachment and adaptation (DMM) designed to assess mother-infant interaction with infants between 0 and 2-years of age (Crittenden, 2005). The assessment does not code for attachment but assesses dyadic characteristics that are associated with attachment during a short, videotaped play interaction of 3-5 minutes. It primarily assesses affective attunement and adult sensitivity, in essence a mother's ability to boost an infant's comfort and engagement and reduce an infant's distress and disengagement (Crittenden, 2005). Notably, the measure of sensitivity does not reflect an individual trait of the mother but is specific to the relationship, so that the same mother may display a different degree of sensitivity with a different child (Crittenden, 2005). In a similar way a therapist may also display a different degree of sensitivity with different children. The behaviour of the mother is assessed on three scales: sensitivity, control and unresponsiveness. Infant behaviour is assessed for cooperativeness, compulsivity, difficultness and passivity.

For the therapy sessions 3-5 minutes of seated play between the therapist and child was randomly sampled for each session and single coded by a certified CARE-Index coder, the author's supervisor. Therapist behaviour was coded as either: sensitive, controlling or unresponsive. Child behaviour was coded as either: co-operative, compulsive (compliant or avoidant) or difficult (oppositional or passive). The most adaptive pattern is a sensitive therapist and a co-operative child. A sensitive therapist is both cognitively and affectively attuned to the child, while an insensitive therapist may be controlling and over-engaged or unresponsive and under-engaged. Ideally a therapist's sensitivity is not dependent on the child as a therapist aims to be sensitive during interactions with cooperative, compulsive or difficult children. A compulsive child will follow the demands of the therapist to either please or avoid the therapist and will use false positive affect to inhibit negative affect. Difficult children tend to exaggerate negative affect and may boss the therapist around, argue, try to trick or deceive the therapist and be passively or overtly aggressive.

Cardiac Measures. The sympathetic and the parasympathetic branches of the autonomic nervous system innervate the heart. The sympathetic branch increases physiological arousal and speeds HR. The parasympathetic branch decreases physiological activity and slows HR. Thus HR is an organ level measure that indexes the overall activity of the ANS and cannot be used to distinguish between the sympathetic or parasympathetic components of the ANS (Bernston, Cacioppo & Quigley, 1991). RSA is a more specific measure of ANS function that reflects PNS activity alone. Theoretically RSA indexes several psychobiological processes including emotion regulation and social engagement (Porges, 2007). Within the study ECG was continuously recorded using an eMotion Faros 180^{o} device. Two disposable self-adhesive electrodes were placed in a two-lead configuration on the chest of the therapist and child. The ECG data was visually inspected and edited off-line to remove artifacts using CardioEdit software developed by the Brain-Body Centre at the University of Illinois, Chicago. The data was then analysed with CardioBatch Plus (Brain-Body Centre, University of Illinois, Chicago) a program that employs the Porges adaptive polynomial filter method (1985) to quantify HR and the amplitude of RSA within age-specific parameters sensitive to the maturational shifts in the frequency of spontaneous breathing (see Chapter 2). Respiratory data was not obtained for the study, thus the RSA values are estimates of RSA based on the respective frequency bands for children and adults. HR and RSA were then averaged for each sequential 30-second epoch across each therapy session.

Data Analysis

The relationship between the child and therapist's cardiac measures was examined using Pearson's correlations and a structural equation modeling (SEM) of the dynamic p-technique. The nature of physiological measures can make statistical analysis challenging as physiological data consists of a series of dependent observations that may or may not assume a normal distribution. Pearson's correlation with bootstrapped 95% confidence intervals (CIs) was the first method of analysis followed by the p-technique with bootstrapped CIs. The dynamic p-technique provides a more robust analysis of physiological measures than correlation alone, as it controls for the dependency between repeated measures. Previous studies examining cardiac linkage in clinical dyads often fail to test the methodological assumptions associated with the use of linear models (Kleinbub, 2017). In this study PACF plots and LOESS smoother curves were generated to see if the p-technique SEM was a good model to fit the data (see Appendix E).

Pearson's Correlations. Concurrent and lagged correlations for HR and RSA between participants of each dyad were examined using Pearson's correlation coefficient with bootstrapped confidence intervals. A Pearson's correlation coefficient is denoted by r and measures the strength of a linear relationship between paired data. A positive value indicates a positive linear correlation; a negative value denotes a negative linear correlation. The closer the value is to +1 or -1 the stronger the linear correlation. A bootstrapping method was used to calculate 95% confidence intervals generated from 10,000 resampled data sets. Confidence intervals are reported with a lower limit (LL) and upper limit (UL), for example, 95% CI [LL, UL]. Like p-values confidence intervals can be used to determine the statistical significance of a result. If a CI does not pass through zero, a statistically significant relationship has been established equivalent to a probability of less than .05 ($p<.05$). If the limits include zero the correlation is not significant. The width of the confidence interval also indicates the precision of the data: the smaller the CI the more precise the results.

Dynamic P-technique. A limitation of utilizing running correlations to assess physiological relatedness between members of a dyad is that repeated physiological measures are not truly independent. For each member of the dyad there are autocorrelations (e.g. each measure of HR is influenced by the previous measure) that must be controlled for (Levenson & Gottman, 1983). The dynamic p-technique is one approach that can be used to control for autocorrelation and determine the significance of concurrent and lagged correlations within a dyad. The dynamic p-technique is a mathematical model that can quantify the relationship between dynamic constructs, such as repeated physiological measures for an individual, dyad or small group of individuals over time. It is well suited to paediatric, clinical and case-based research (Nelson, Aylward & Rausch, 2011). The p-technique allows a detailed examination of patterns of variability over time and may provide insights inaccessible to large-group analysis (Hawley & Little, 2003). It is useful in the early stages of research as it can aid the development of theories about the interplay between constructs and inform larger-scale investigations (Nelson et al., 2011). It is considered one of the best techniques for studying therapeutic processes (Russell, Jones & Miller, 2007).

The dynamic p-technique derives its statistical power from the number of repeated observations (Little et al., 2006). There are no exact guidelines for the number of measurements required although analysis may be possible for 50 observations for simple models (Molenaar, 1985), although typically a minimum of 100 occasions is recommended as a guide (Cattell, 1963). More complex models require a greater number of observations: as a general principle the greater the number of observations the greater the statistical power. In the present study the dynamic p-technique was modeled with structural equation modeling (SEM). The model was a simple single-lagged structure and the number of observations varied between 56 and 80 per play therapy session. The focus of the study was to examine the dynamic interplay between HR and RSA for each therapy dyad. The dynamic p-technique generates a lagged covariance matrix that incorporates both synchronous and time-lagged information displayed in a path diagram (e.g. see Figure 2). This makes it possible to examine multiple ways in which the cardiac physiology of a therapist and child may connect. Within the unit of the dyad, this method allows an examination of three key effects:

1. Autoregressive covariance effects or loadings. These describe how the same variable relates to itself over time. For example how the child's HR at time (t) relates to the child's HR at time-1 (t-1), t-2 and so forth. The therapist and child have independent autoregressive loadings and the correlation between each time point is assumed to be stationary.

2. Within-lag covariance. This describes how different variables relate to each other at the same time. For example how the child and therapist's HR relate to each other at t, and then at t-1, t-2, t-3 etc. This examines whether each member of the dyad is similarly responsive within the same epoch of time. A significant within-lag covariance could be interpreted as evidence of simultaneous cardiac synchrony between a therapist and child.

3. Cross-lagged covariance or regression effects. This describes how one variable relates to another variable across time. For example, the therapist's HR at t-1 is matched to the child's HR at t-2, the therapist's HR at t-2 with the child's HR and t-3, and so forth. This provides a child-led lag where the therapist's data is plotted lagging behind the child. When the child's data at t-1 is matched to the therapist's data at t-2 and so forth, a therapist-led lag is observed. An analysis of the lagged relationships shows if one member of the dyad is 'driving' the interaction (i.e. whether the child leads and the therapist follows, or whether the therapist leads and the child follows, or neither). A significant cross-lagged regression could be interpreted as evidence of a therapist-driven cardiac synchrony or a child-driven cardiac synchrony within the dyad depending on who leads the lag.

The strength of the dynamic p-technique is that it mathematically separates these 3 effects so that it's possible to isolate key relationships of interest, namely effect 2 and 3 for this study: whether there is evidence of synchrony indicated by a match in the direction of change that is immediate, or a lagged or responsive synchrony.

Assumptions of the model and goodness of fit. LOESS smoother plots and PACF plots were generated to see if the p-technique SEM was a good model to fit the data and to test 2 basic assumptions:

1. That there is some linear or monotonic relationship between the therapist and child variables, explored with the LOESS curves.
2. That a lag=1 (i.e. a lag of one 30-second epoch) is sufficient, explored with the PACF plots.

RESULTS

An overview of the cardiac data is present below. Following this each of the 4 therapy dyads are discussed in turn. The Pearson's correlation results, path diagrams for the p-technique SEM, bootstrapped 95% confidence intervals and a discussion of the fit (i.e. PACF plots and LOESS curves) are presented for each case study. The attachment coding and the CARE-Index patterning for each dyad is also examined in light of the linkages observed. Each case study concludes with a discussion of the results. The chapter concludes with a discussion of the findings, potential clinical implications, the limitations of the present study and recommendations for future research.

Children's Cardiac Data. Table 1 provides a summary for each child's HR data for all sessions combined, Table 2 a summary for RSA. Typically, a higher HR and lower RSA indicate greater physiological arousal and a reduced capacity for social engagement, while a lower HR and higher RSA indicates lower physiological arousal and a state that supports positive social engagement. Billy has the highest within session average HR (118.6) and the lowest within session RSA (5.3). This indicates that overall Billy has the most aroused autonomic profile of the 4 children. Eli shows the least aroused autonomic profile with the lowest overall average within session HR (88.7) and the highest within session average RSA (7.1). A further analysis by session is summarised in Table 3 (HR) and Table 4 (RSA). Billy and Tyler's HR is highest (127.1 and 113.0) and RSA lowest (4.6 and 5.2) in the initial therapy session. Eli and Josh's HR is highest (99.3 and 113.8) and RSA lowest (6.6 and 5.8) in the early session. This indicates that the initial or the early sessions are the most arousing sessions for the children, with a reduced capacity for social engagement as indicated by a higher HR and lower mean RSA. Each child's RSA was highest for the late therapy session, potentially indicating that the capacity for positive social engagement was greater in the latter stage of therapy for all children.

Table 1

Overall HR summary for all session per child

Child	n	mean	sd	median	min	max	range	skew	kurtosis
Eli	218	88.7	14.1	83.4	67.5	133.5	66.0	1.2	0.4
Billy	147	118.6	11.2	119.4	94.5	139.4	44.9	-0.2	-1.2
Tyler	240	101.1	15.2	97.0	80.3	177.2	96.9	2.2	6.6

Josh	210	106.8	8.7	105.7	87.9	135.8	48.0	0.7	0.9

Table 2

Overall RSA summary for all sessions per child

Child	n	mean	sd	median	min	max	range	skew	kurtosis
Eli	218	7.14	1.00	7.37	2.67	9.26	6.59	-1.77	4.35
Billy	147	5.27	1.05	5.31	3.01	7.49	4.48	-0.07	-0.94
Tyler	240	5.53	1.02	5.69	1.64	7.59	5.95	-1.56	3.55
Josh	210	6.22	0.86	6.23	3.97	8.26	4.29	-0.06	-0.24

Table 3

Summary data, children's HR, by child and phase

Child	Phase	n	mean	sd	median	min	max	range	skew	kurtosis
Eli	first	80	86.4	10.3	82.4	74.5	116.2	41.8	1.3	0.5
Eli	early	80	99.3	14.7	92.8	80.1	133.5	53.4	0.6	-1.1
Eli	later	58	77.3	3.9	77.1	67.5	86.0	18.5	0.0	-0.2
Billy	first	80	127.1	5.8	127.5	115.3	139.4	24.2	-0.3	-0.8
Billy	later	67	108.4	6.8	107.6	94.5	126.0	31.5	0.4	0.0
Tyler	first	80	113.0	19.0	108.7	87.5	177.2	89.6	1.5	2.0
Tyler	early	80	96.4	7.7	95.7	82.6	123.9	41.3	0.8	1.1

Tyler	later	80	93.7	7.5	92.3	80.3	126.8	46.5	1.5	4.0
Josh	first	66	105.0	4.9	104.0	96.3	120.1	23.8	0.7	0.1
Josh	early	72	113.8	8.1	111.9	96.6	135.8	39.2	0.8	0.2
Josh	later	72	101.4	7.1	101.5	87.9	124.1	36.2	0.6	0.6

Table 4

Summary data, children's RSA, by child and phase

Child	Phase	n	mean	sd	median	min	max	range	skew	kurtosis
Eli	first	80	7.41	0.70	7.53	4.68	8.81	4.13	-1.47	2.90
Eli	early	80	6.58	1.21	6.96	2.67	8.23	5.56	-1.34	1.50
Eli	later	58	7.55	0.58	7.67	6.40	9.26	2.86	0.13	-0.04
Billy	first	80	4.58	0.78	4.55	3.01	6.80	3.79	0.31	-0.26
Billy	later	67	6.08	0.67	6.20	4.07	7.49	3.42	-0.43	0.09
Tyler	first	80	5.24	1.47	5.60	1.64	7.59	5.95	-1.01	0.26
Tyler	early	80	5.59	0.67	5.63	3.37	6.80	3.43	-0.31	0.17
Tyler	later	80	5.75	0.64	5.78	3.19	7.29	4.10	-0.75	2.20

Josh	first	66	6.34	0.64	6.38	4.97	7.59	2.62	-0.17	-0.59
Josh	early	72	5.82	0.78	5.81	4.03	7.35	3.32	-0.17	-0.76
Josh	later	72	6.52	0.96	6.53	3.97	8.26	4.29	-0.18	-0.48

Therapist's Cardiac Data. Table 5 shows the overall averages for HR for each therapist, Table 6 the overall averages for RSA. Therapist A conducted individual therapy with Eli and Billy, Therapist B with Tyler and Josh. Therapist A shows a similar within session mean HR for each child: 84.4 beats per minute for Eli and 84.8bpm for Billy. The overall average RSA is lower for Eli (4.5) than Billy (5.5). A lower RSA for Eli may indicate that Therapist A has a higher degree of parasympathetic withdrawal (i.e. is more physiologically aroused and less socially engaged) during therapy with Eli. Therapist B shows a similar level of arousal for each child with an overall mean HR for Tyler of 86.4bpm and 83.8bpm for Josh, with a similar RSA for Josh (4.5) and Tyler (4.6).

Table 7 and 8 provide a comparison across the phases of therapy. For the three phases examined for Eli, Therapist A has the highest HR (98.3) and lowest RSA (4.0) for the later session (session 13), indicating that this session was the most arousing for the therapist. This differs from Eli who appears the least aroused by the later session (HR 77.3, RSA 7.6) and the most physiologically aroused in the early session (HR 99.3, RSA 6.58). For Billy, Therapist A's arousal is highest in the initial session (HR 85.5 and RSA 5.4) and this session is also the most arousing session for Billy (HR 127.1, RSA 4.6). Similarly, for Tyler, Therapist B's arousal is highest for the initial session (HR 89, RSA 4.4) and this is also the most arousing for Tyler (HR 113, RSA 5.2). For Josh, Therapist B has a higher autonomic arousal in the later session (HR 88, RSA 3.7), which is the least arousing session for Josh (HR 101.4, RSA 6.5). Thus the therapists' autonomic arousal varies with each dyad. For Therapist A and Billy and Therapist B and Tyler, the therapist and child both show a similar pattern of heightened physiological arousal for the initial therapy session. For Therapist A and Eli and Therapist B and Josh, there is an opposing pattern of arousal where the children show a heightened arousal in the early session and the therapists show a heightened arousal in the later session of therapy. A higher therapist arousal may reflect a higher degree of emotional or mental effort and attention to the process of therapy for these sessions.

Table 5

Therapist's overall HR data, by child

Child	n	mean	sd	median	min	max	range	skew	kurtosis
Eli	217	84.4	9.3	80.8	71.1	109.9	38.8	0.9	-0.3
Billy	156	84.8	5.1	83.6	75.7	106.1	30.4	1.1	1.8
Tyler	240	86.4	6.7	85.7	75.5	126.0	50.5	2.0	7.3
Josh	208	83.8	6.8	82.8	71.3	108.0	36.7	0.8	0.7

Table 6

Therapist's overall RSA data, by child

Child	n	mean	sd	median	min	max	range	skew	kurtosis
Eli	217	4.94	0.82	5.10	2.65	6.83	4.18	-0.48	-0.10
Billy	156	5.50	0.62	5.54	3.87	6.90	3.03	-0.32	-0.03
Tyler	240	4.58	0.79	4.62	1.82	6.51	4.69	-0.37	0.50

Josh	209	4.50	0.92	4.58	1.37	6.67	5.30	-0.27	-0.15

Table 7

Summary data, therapist's HR, by child and phase

Child	Phase	n	mean	sd	median	min	max	range	skew	kurtosis
Eli	first	80	80.9	3.4	80.8	72.9	88.4	15.5	-0.1	-0.5
Eli	early	80	78.1	3.9	77.3	71.1	92.2	21.1	1.6	3.3
Eli	later	57	98.3	5.3	98.6	86.9	109.9	23.0	0.0	-0.5
Billy	first	80	85.5	5.2	84.8	77.1	100.0	22.9	0.9	0.4
Billy	later	76	84.0	4.9	83.2	75.7	106.1	30.4	1.4	4.0
Tyler	first	80	89.1	8.6	87.5	77.0	126.0	48.9	1.7	4.0
Tyler	early	80	87.6	3.2	87.4	80.9	97.1	16.2	0.4	0.4
Tyler	later	80	82.6	5.2	81.4	75.5	109.7	34.2	3.2	13.5
Josh	first	64	84.1	5.5	82.3	75.0	97.5	22.6	0.7	-0.4
Josh	early	72	79.4	5.5	78.9	71.3	108.0	36.7	2.0	8.2
Josh	later	72	88.0	6.1	87.2	79.2	103.6	24.5	0.8	-0.1

Table 8

Summary data, therapist's RSA, by child and phase

Child	Phase	n	mean	sd	median	min	max	range	skew	kurtosis
Eli	first	80	5.06	0.59	5.12	3.70	6.52	2.82	-0.28	-0.10
Eli	early	80	5.45	0.52	5.45	4.38	6.83	2.45	0.25	0.13
Eli	later	57	4.05	0.70	4.06	2.65	5.94	3.29	0.22	-0.40
Billy	first	80	5.44	0.54	5.47	4.05	6.85	2.80	-0.22	0.04
Billy	later	76	5.57	0.69	5.61	3.87	6.90	3.03	-0.46	-0.21
Tyler	first	80	4.38	0.79	4.31	1.88	6.04	4.16	-0.34	0.37
Tyler	early	80	4.36	0.66	4.42	2.79	5.77	2.98	-0.26	-0.61
Tyler	later	80	4.99	0.74	5.07	1.82	6.51	4.69	-0.93	3.13
Josh	first	65	4.49	0.61	4.61	3.01	5.60	2.59	-0.43	-0.48
Josh	early	72	5.29	0.65	5.35	2.85	6.67	3.82	-0.80	1.80
Josh	later	72	3.73	0.70	3.79	1.37	5.03	3.66	-0.54	0.51

Case Study 1: Eli and Therapist A

A silent child

Sessions Analysed. Play therapy sessions 1, 4 and 13 were selected for physiological analysis for Eli and Therapist A. For session 1 (first phase), 80 matched 30-second epochs of HR and RSA for the therapist and child were available for analysis, 80 match epochs were available for session 4 (early phase) and 57 matched epochs for session 13 (late phase). Session 13 ended early on the part of the child and therefore had a smaller number of epochs available for analysis.

Child History and School Observations. Eli was a sporty, 9-year old boy of black British descent. Eli's father was murdered when Eli was 6 years of age, after which Eli's behavioural issues escalated resulting in his placement in a specialist primary school. Eli was away on holiday with a family member and was not told of his father's death until he returned one week following. Eli attended the funeral and the family received short-term bereavement counselling. Experiences of interpersonal and community violence were common for Eli and his family. Eli's mother reported that Eli would frequently get into fights and had been beaten up by other children in the local park. Following a short exclusion for violence towards a peer, Eli's mother had protested that her son was being punished for being the winner. In class Eli alternated between states of over and under-arousal. At times he was observed to be quiet and withdrawn and would spend long moments staring into space. At other times he appeared agitated, unable to focus, frequently leaving his seat and roaming around the room. At times Eli was chatty and jovial and the joker amongst his peers although his jesting could have dark undertones, for example he touched another student on his eyelids and remarked to the teacher, "Can you get me a spoon. I'm digging out his eyes." Eli would provoke other children to fight and during an altercation with another student he was teased about his father's death, with the peer chanting, "Your dad is dead. I'm going to spit on his grave. I'm so lucky my dad's not dead." Not long following Eli re-enacted a similar scenario when another younger student's father died from a long-term illness, Eli sought out this child, said "Suck your dead dad!" and slapped him across the face. However, Eli did not like getting into trouble and tried to manage his behaviour and please the teaching staff, although he rarely accepted responsibility for his part in any classroom disturbance and was quick to protest. Eli found transitions from the classroom to therapy difficult and he would often provoke other children on his way to therapy, calling out names, gesturing aggressively or charging into classrooms. At times he refused to attend, or attend for a shorter duration, although he would often seek out confirmation of his therapy and was overheard to proudly show another student the therapy room. On entering the therapy room Eli's demeanour quietened and he no longer displayed the false bravado as he did in the playground.

Therapy Overview. Within therapy Eli presented as a depressed and silent child. Eli proved difficult for the trainee therapist to engage. He avoided face-to-face contact and physical proximity with the therapist and rarely expressed affect, either positive of negative. Eli primarily engaged in independent ball play, sand play and drawing at the art table. He did not engage the therapist in his play. The most symbolic play occurred in the sand tray where Eli was observed to repeatedly enact a fight and funeral burial scene seemingly related to the death of his father, although Eli's play was observed to be repetitive, compulsive and joyless, features associated with stuck post-traumatic play. The longest sequence of symbolic sand and funeral play occurred in session 13, which coincided with the anniversary of the death of Eli's father. Eli often followed sequences of sand play with active ball play or long periods drawing at the art table, either as a way to regulate after his more intense periods of symbolic play, or potentially as a means of avoiding further psychological work. Eli was limited in his ability use play or the relationship with the therapist to bring about any sense of relief or release. The trainee therapist utilised basic play therapy techniques, she was attentive and tracked Eli's play behaviour, although the volume of her speech was low and she was observed to be cognitively sensitive but affectively distant in her reflections. Both members of the dyad displayed a flattened affect and low levels of arousal across the course of therapy.

Attachment Measures. Therapist A and Eli were both coded with a similar avoidant Type A+ strategy of attachment outside a normative A1-2 pattern of attachment. Therapist A was coded by the adult attachment interview (AAI) with an A7 strategy of attachment following a failed attempt to adopt an A3-4 strategy. Eli was coded by the CAPA, prior to therapy, with an A1, A3 strategy of attachment with modifiers including depression and unresolved loss. Eli's strategy of attachment was again assessed following therapy and had shifted towards a less secure A3-4 strategy of attachment.

The shared Type A+ strategy for Eli and Therapist A implies that they both have a tendency toward deactivating parasympathetically dominant states of low arousal and a tendency to inhibit negative feeling states. It has been conjectured that a client and therapist with an avoidant strategy will rely less on each other for emotional or physiological co-regulation and will tend toward an emotionally disengaged relationship (Marmarosh et al., 2014). For each session analysed, a 2-5 minute segment of therapy was observed and the relationship between the therapist and child described using CARE-Index patterning. Therapist behaviour was coded as sensitive, controlling or unresponsive. Child behaviour was coded as co-operative, compulsive (compliant or avoidant) or difficult (oppositional or passive). In this case study Therapist A was coded as unresponsive and Eli as difficult (passive) across all three sessions analysed.

First Phase (Session 1)

Heart Rate

Distribution of Heart Rate. Figure 1 shows the heart rates for the therapist and child for session 1. Eli's HR ranged from 74.46 to 116.22 with a mean HR of 86.45 (SD 10.3). The therapist' HR ranged from 72.89 to 88.38 with a mean HR of 80.94 (SD 3.4).

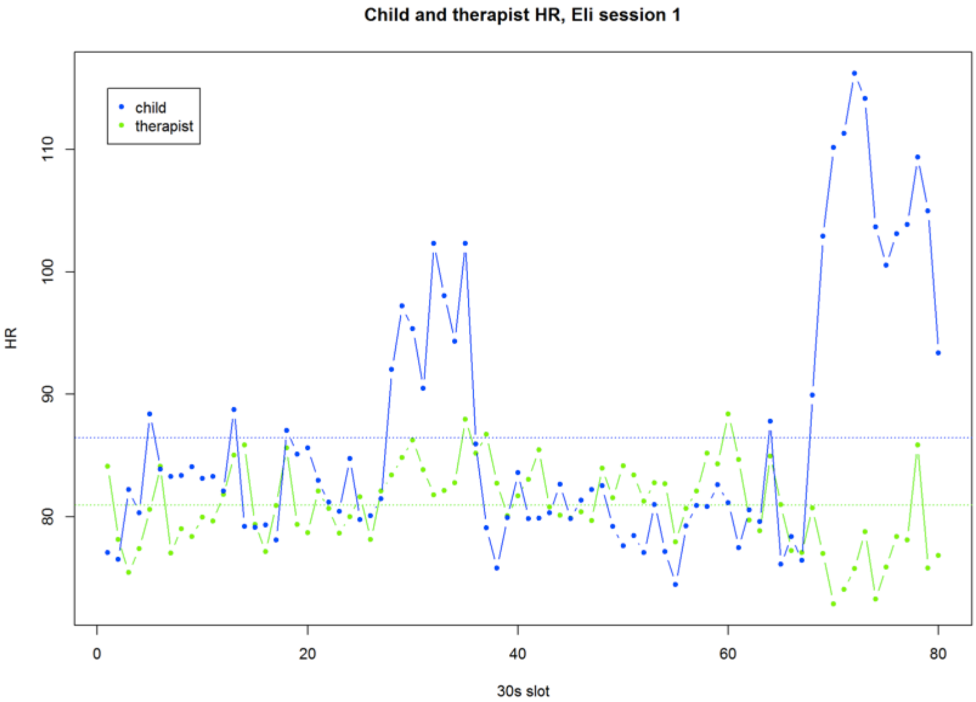

Figure 1. Heart rate for Eli and Therapist A, session 1. The child's HR is in blue and the therapist's HR is in green. The high peaks for the child reflect epochs of active play.

Pearson's Correlation Coefficients. Table 9 displays the Pearson's correlation coefficients for HR. The correlation coefficient is denoted by r and measures the strength of the linear relationship between paired data. A positive value indicates a positive linear correlation; a negative value denotes a negative linear correlation. The closer the value is to +1 or -1 the stronger the linear correlation. The accompanying confidence interval (CI) shows whether the correlation is significant. If the lower and upper limit of the confidence interval does not contain zero the correlation is significant. The correlations reveal that Eli's HR is significantly correlated with his HR in the previous 30-second epoch (r=0.86; 95% CI (0.78, 0.92)). Likewise, the therapist's HR is significantly correlated with her HR in the previous 30-second epoch (r=0.51; 95% CI (0.31, 0.65)). This positive serial correlation from one epoch to the next is expected, given that each measure of HR is dependent on the previous measure (i.e. there is an inherent autocorrelation for HR). However, the degree of autocorrelation is higher for the child, which suggests that the child's HR changes more slowly across this session than the therapist's HR.

When examining the relationship between the child and therapist's HR within the same epoch of time, a non-significant negative simultaneous correlation is evident (r=-0.26; 95% CI -0.50, 0.04)). Finally, the lagged correlation between the therapist's HR and Eli's HR in the next 30-second epoch is higher (r= -0.40; 95% CI (-0.59, -0.16)) than the lagged correlation between Eli and the therapist's HR in the next 30-second epoch (r=-0.25; 95% CI (-0.50, 0.02)). The child-led cross correlation is negative and non-significant. The therapist-led cross-correlation is negative and significant, revealing a negative lag effect from the therapist to Eli (i.e. a rise in the therapist's HR is followed by a decrease in the child's HR in the following 30-second epoch, while a decrease in the therapist's HR effects an increase in the child's HR in the following 30-seconds). For the session overall, there appears to be a therapist-driven, negative lagged synchrony in the HR dynamics of the dyad. This relationship is further tested with the p-technique SEM.

Table 9

Pearson's correlation coefficients for HR and lagged HR for the therapist and child session 1

	thHR	thLagHR	chHR	chLagHR
thHR	1.00	0.51	-0.26	-0.25
thLagHR	0.51	1.00	-0.40	-0.26
chHR	-0.26	-0.40	1.00	0.86
chLagHR	-0.25	-0.26	0.86	1.00

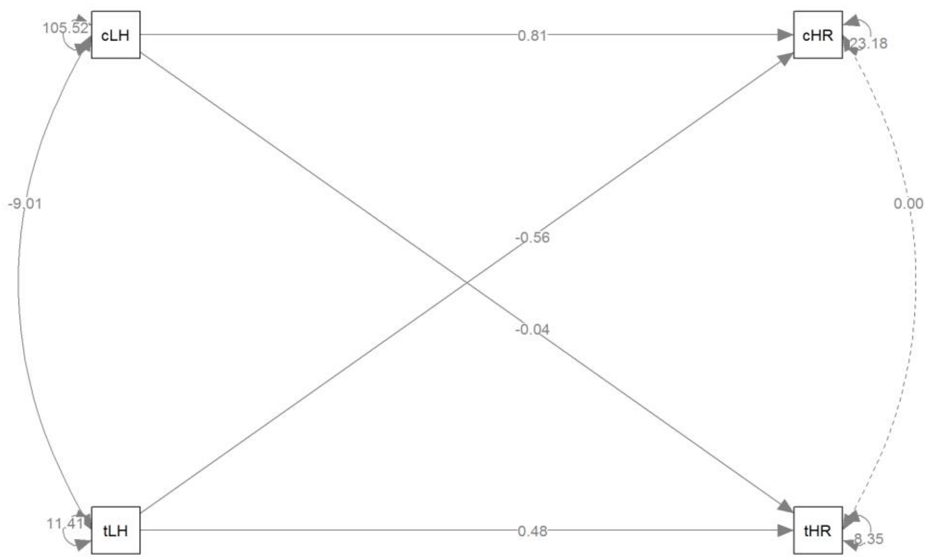

Figure 2. Path diagram for the therapist and child's HR for a single lagged analysis, session 1. Significant effects are evident for the therapist and child's autoregressive pathways (top and bottom horizontal path) and the therapist-led cross-lagged regression (tLH to cHR diagonal path).

P-technique SEM. Results are illustrated as a path diagram (Figure 2). This diagram illustrates autoregressive covariance effects (i.e. the equivalent of autocorrelations in the Pearson's correlations), within-lag covariance effects (simultaneous synchrony) and cross-lagged regression effects (lagged or responsive synchrony) between the HR of the therapist and child. Similar to the simple correlations, the diagram shows the effect of Eli's last HR on his next (0.81; 95% CI (0.7, 0.9)) is higher than the corresponding HR stability for the therapist (0.48; 95% CI (0.3, 0.7)). Again, this indicates that the child's HR is more similar from epoch to epoch than the therapist's HR. These autoregressive effects are illustrated by the top straight line of the path diagram (i.e. the relationship between measures of the child's HR across time) and bottom straight line (i.e. the relationship between measures of the therapist's HR across time). Both the child and therapist demonstrate a highly significant positive effect for independent measures of HR across time.

The simultaneous linkage between the therapist's and child's HR within the same epoch of time (i.e. the within-lag covariance) is illustrated by the curved line on the left-hand side of the path diagram (-9.01) and as for the correlations this relationship is not significant (95% CI (-19.5, 1.3)). The lagged effects are represented by the diagonal lines at the center of the diagram: the effect of Eli's HR on the therapist's HR in the next 30-second epoch (-0.04) is much lower than the effect of the therapist's HR on Eli's HR in the next epoch (-0.56). The overall effect of Eli's HR on the therapist's HR is not statistically significant (95% CI (-0.1, 0.0)). However, the effect of the therapist's HR on the child's HR is significant (95% CI (-0.9, -0.2)). As evident in the correlations, the therapist's HR drives the child's HR pattern much more than the child drives the therapist's pattern. The therapist's HR has a significantly negative effect on the child's HR with a latency of about 30-seconds across the therapy session. For session 1 a decreased HR in the therapist affects an increase in Eli's HR in the following 30-s epoch, while an increase in the therapist's HR affects a decrease in Eli's HR in the following 30-s epoch. Thus session 1 shows a significant negative therapist-driven synchrony for HR.

LOESS Smoother Plots. Pearson's correlations and the p-technique are based on linear models. To examine whether the simultaneous and lagged relationships between the therapist and child's HR fits a linear relationship or whether it involves a more complex, curvilinear relationship, default LOESS plots were generated (see Appendix E). The LOESS is a non-parametric method for drawing a smooth line between two variables on a scatter diagram. The method is suitable for data with noise or outliers, as it makes no assumption about the form or strength of the relationship between the variables (Cleveland, 1979). For session 1, the default LOESS smoother confirmed a linear relationship for the significant therapist-driven lag (Appendix E. Figure 4). Conversely the LOESS plots for the simultaneous correlation (Appendix E. Figure 3) and the non-significant child-led lag (Appendix E. Figure 5) indicate a possible curvilinear relationship between the child and therapist data not represented by the p-technique SEM.

PACF Plots. To confirm that a lag of one 30-second epoch was the most meaningful lag for the cardiac data, partial autocorrelation function plots (PACF) were generated (Appendix E. Figure 6). Each of these plots show a number of vertical lines representing the partial correlations at 30 seconds (lag=1), 60 seconds (lag=2), 90 seconds (lag=3) and so forth. The plot shows the "partial correlations" for each lag. For example when you look at lag=3 the plot partials out the previous lag=1 and lag=2 so that each lag is independent of the previous lags. The dotted horizontal blue line represents the 95% "significance bounds". If a partial line crosses the blue line this indicates that the partial correlation is statistically significant at that lag at the conventional criterion of .05.

The first plot (top left) (Appendix E. Figure 6) is the therapist's autocorrelation and the bottom right is the child's autocorrelation. The lags run from left to right from lag 1 to lag 16. Both of these plots show that the first partial line (lag=1) is the only line to cross the horizontal blue line indicating significance. Thus the only significant lag for the autocorrelations for both the therapist and child is lag=1. All other lags fail to reach significance. The top right plot is the child-led cross-correlation. No lags prove significant for this plot. The bottom left plot is the therapist-led cross-correlation. For this plot the initial lag=1 is significant. Lag=2, 3, 4 etc. do not reach significance. At higher lags (e.g. at 10, 13, 14 and 15) there is again a significant effect although due to the small number of observations and lag count for this study, only lags less than 5 can be reliably interpreted as significant. Higher lags, with the number of observations available, no longer obey a binomial distribution as they would with a high *n* and are likely artefactual as the lag becomes longer and approaches the total number of observations. Thus for the purpose of this study the PACF plots are used to confirm smaller lags less than lag=5. The PACF plots for HR for Eli session 1 confirm that a lag of one 30-second epoch is the most meaningful lag for the data, with a strong linear negative lag=1 effect evident from the therapist to the child.

RSA First Phase

Distribution of RSA. Figure 7 shows the distribution of RSA for Therapist A and Eli for session 1. The therapist's RSA ranged from 3.7 to 6.5 with a mean RSA of 5.06 (SD 0.6). Eli's RSA ranged from 4.7 to 8.8 with a mean RSA of 7.41 (SD 0.7).

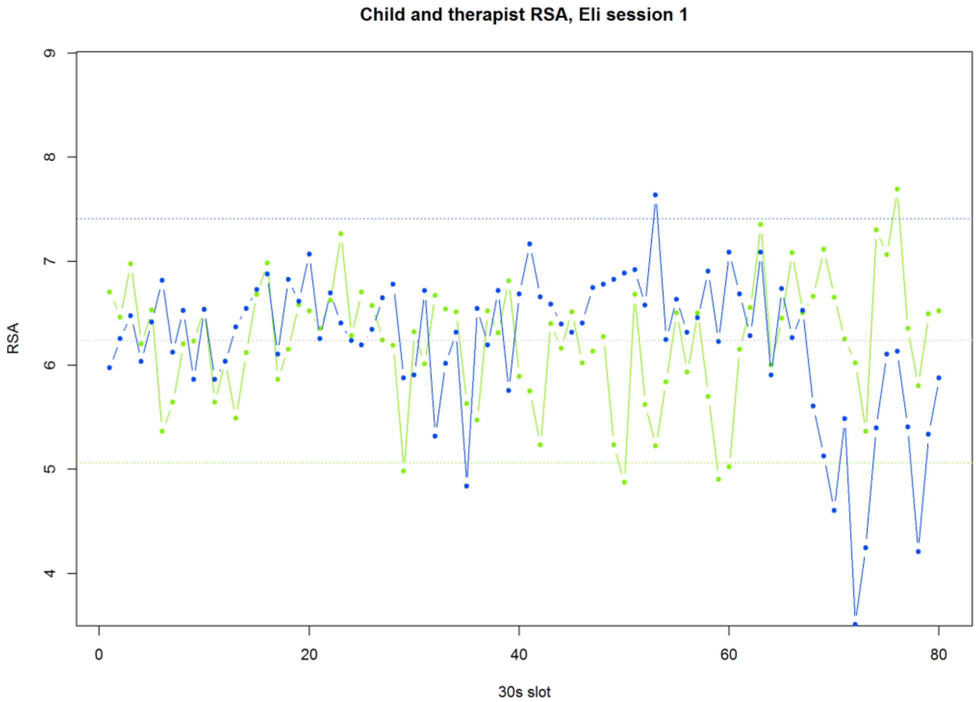

Figure 7. RSA for Eli and Therapist A for session 1, the child's RSA is in blue and the therapist's RSA is in green.

Pearson's Correlation Coefficients. Table 10 displays the Pearson's correlation coefficients for RSA for session 1. The independent correlations show that Eli's RSA is significantly correlated with his RSA in the previous 30-seconds epoch (r=0.51; 95% CI (0.33, 0.68)). Likewise, the therapist's RSA is significantly correlated with her RSA in the previous 30-second epoch (r=0.30; 95% CI (0.08, 0.49)). As for HR, the degree of autocorrelation for RSA is higher for the child than the therapist, which suggests that RSA changes more slowly for the child than the therapist. When examining the synchronous relationship between the child and therapist's RSA within the same epoch across time, there is a non-significant negative correlation between Eli and the therapist's RSA (r=-0.08; 95%, CI, (-0.32, 0.16)). The lagged correlations shows that the correlation between the therapist's RSA and Eli's in the next 30-second epoch is higher (r=-0.21) than the lagged correlation between Eli and the therapist (r=-0.15). The child-led lag is not significant (95% CI (-0.38, 0.14)) while the therapist-led lag is significant (95% CI (-0.40, -0.03)). Similar to HR, this indicates that there is a potential negative lag effect for RSA from the therapist to the child. To control for the effect of the autocorrelations the linkages are further tested by the p-technique SEM.

Table 10

Pearson correlation coefficients between RSA and lagged RSA for the therapist and child session 1

	thRSA	thLagRSA	chRSA	chLagRSA
thRSA	1.00	0.30	-0.08	-0.15
thLagRSA	0.30	1.00	-0.21	-0.08
chRSA	-0.08	-0.21	1.00	0.51
chLagRSA	-0.15	-0.08	0.51	1.00

P-technique SEM. Results are illustrated as a path diagram (Figure 8). Both the therapist and child show a positive autoregression in measures of RSA across time, which is statistically significant for both the therapist (95% CI (0.0, 0.5)) and the child (95% CI (0.3, 0.7)). The autoregressive effect of Eli's RSA on his next RSA (0.50) is higher than the corresponding effect for the therapist (0.29). The simultaneous relationship between the therapist and child's RSA shows a non-significant effect (-0.03; 95% CI (-0.1, 0.1)). The therapist-led lag (-0.21; 95% CI (-0.4, 0.0)) is greater than the child-led lag for RSA (-0.11; 95% CI (-0.3, 0.1)) although both lags fail to reach significance. Thus the p-technique fails to confirm the negative therapist-led lag observed in the correlations for RSA.

LOESS Plots. The default LOESS smoother plots for the simultaneous (Appendix E. Figure 9) and cross-correlations (Appendix E. Figure 10 and 11) confirm a linear relationship between the therapist and child's cardiac data.

PACF Plots. The PACF plots (Appendix E. Figure 12) identify a lag=1 as the best fit for the therapist (top left plot) and child's data (bottom right). No significant lag effects were evident for the child-led lag (top right) or the therapist-led lag (bottom left). The PACF plots indicate that outside of the autocorrelations there are no significant concurrent or 30-second lagged relationships between the RSA data for therapist or child. A lag=1 is the most significant lag for the autocorrelations.

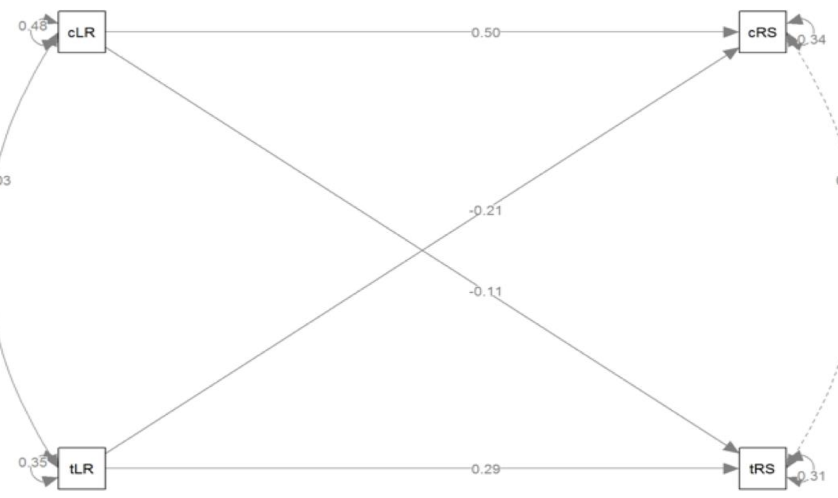

Figure 8. Path diagram for dynamic p-technique SEM for therapist and child's RSA for a single lagged analysis session 1. Significant effects are evident for the therapist and child's autoregressive pathways (top and bottom horizontal path).

Early Phase (Session 4)

Heart Rate

Distribution of HR. Figure 13 shows the heart rates for the therapist and child for session 4. Eli's HR ranged between 80.1 and 133.5 with a mean HR of 99.26 (SD 14.7). The therapist's mean HR ranged between 71.1 and 92.2 with a mean HR of 78.05 (SD 3.9).

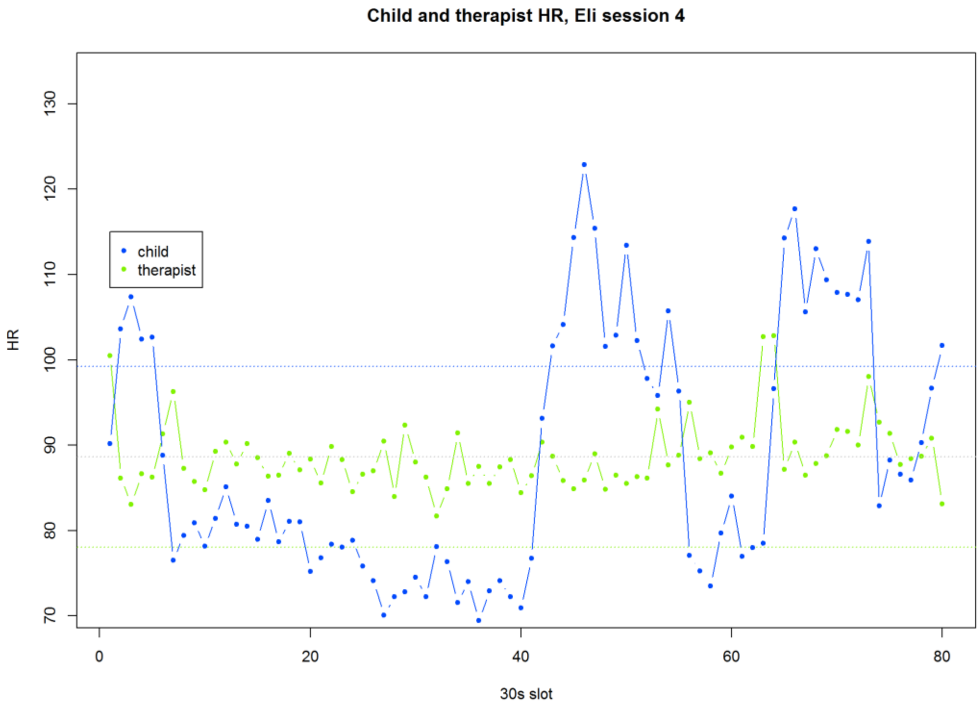

Figure 13. Heart rate for Eli and Therapist A, session 4. The child's HR is in blue and the therapist's HR is in green. The high peaks for the child coincide with sequences of active play.

Pearson's Correlation Coefficients. Table 11 displays the Pearson's correlation coefficients for heart rate for session 4. As per the initial session both the therapist (r=0.28; 95% CI (0.04, 0.62)) and child (r=0.86; 95% CI (0.76, 0.91)) show significant positive autocorrelations for HR. Again the degree of autocorrelation is higher for the child, indicating that the child's HR changes more slowly across time. The simultaneous relationship between the HR of the child and therapist shows a non-significant positive correlation (r=0.00; 95% CI (-0.20, 0.22)). The therapist-led lagged correlation is higher (r=0.12; 95% CI (-10, 0.35)) than the child-led lagged correlation (r=0.02; 95% CI (-0.16, 0.26)) although neither lagged correlation is significant. For session 4 there is no evidence of any significant concurrent or lagged correlations between the HR of the therapist and child.

Table 11

Pearson's correlation coefficients for HR and lagged HR for the therapist and child session 4

	thHR	thLagHR	chHR	chLagHR
thHR	1.00	0.28	0.00	0.04
thLagHR	0.28	1.00	0.12	0.02
chHR	0.00	0.12	1.00	0.86
chLagHR	0.04	0.02	0.86	1.00

P-technique SEM. The path diagram (Figure 14) confirms that the autoregressive pathways for the child (0.87; 95% CI (0.7, 1.0)) and therapist (0.27; 95% CI (0.0, 0.6)) are positive and significant and the degree of autoregression is higher for the child. The simultaneous relationship between the therapist and child's HR is not significant as reflected in the curved arc on the left (1.2; 95% CI (-10.2, 12.5)). Moreover, the therapist-led cross-lagged correlation (0.38; 95% CI (-0.3, 1.1)) and the child-led cross-lagged correlation (0.01; 95% CI (0.0, 0.1)) are non-significant. The p-technique confirms that there are no significant simultaneous or lagged linkages evident between the therapist and child's HR for session 4.

LOESS plots. The LOESS smoother plots confirm a linear relationship for the simultaneous (Appendix E. Figure 15) and lagged relationships (Figure 16 and 17) between the therapist and child's cardiac data.

PACF Plots. The PACF plots (Appendix E. Figure 18) confirm a significant lag=1 effect for the autocorrelations and the cross-lagged correlation from the therapist to child. The child-led cross-correlation shows no significant lag effects.

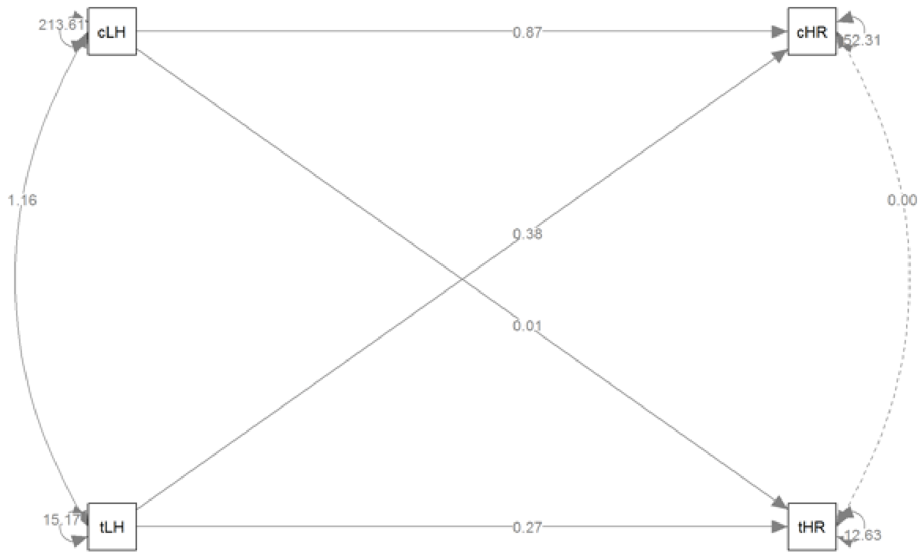

Figure 14. Path diagram for the dynamic p-technique SEM for the therapist and child’s HR for a single lagged analysis session 4. Significant effects are evident for the autoregressive pathways for the therapist and child (top and bottom horizontal paths).

RSA Early Phase

Distribution of RSA. Figure 19 shows the distribution of RSA for the therapist and Eli for session 4. Eli's RSA for session 4 ranged from 2.7 to 8.2 with a mean of 6.58 (SD 1.2). The therapist's RSA ranged from 4.4 to 6.8 with a mean RSA of 5.45 (SD 0.5).

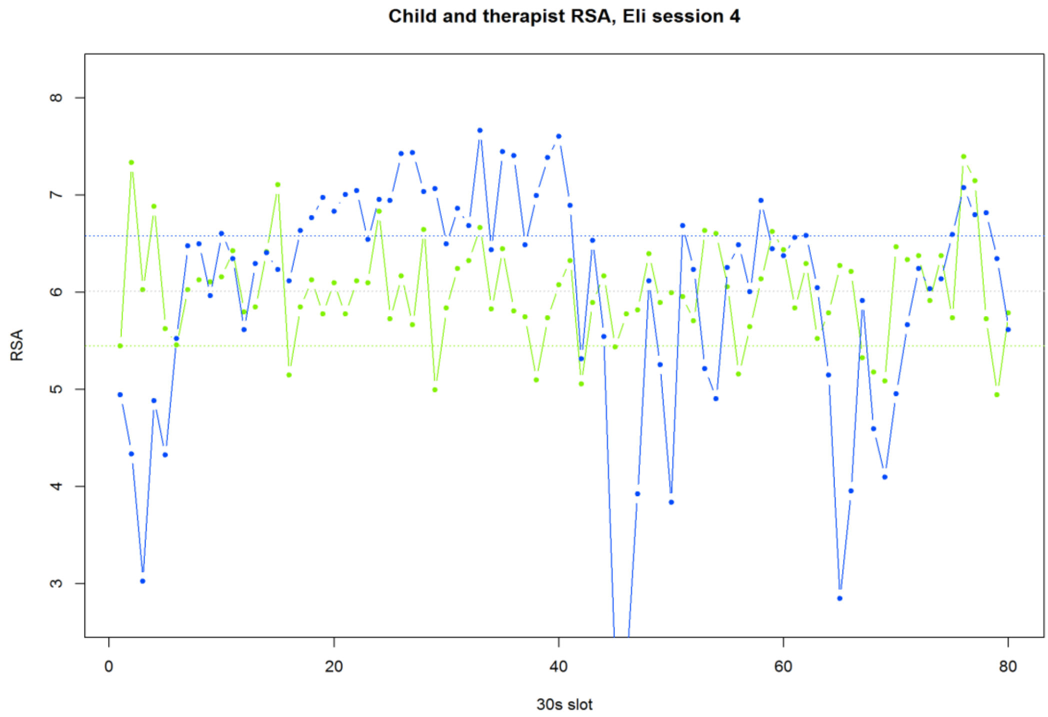

Figure 19. RSA for Eli and Therapist A for session 4. The child's RSA is in blue and the therapist's RSA is in green.

Pearson's Correlation Coefficients. Table 12 displays the Pearson's correlation coefficients for RSA for session 4 for the therapist and Eli. The correlations show that Eli's RSA is significantly correlated with his RSA in the previous 30-seconds (r=0.68; 95% CI (0.5, 0.8)) although atypically, the therapist's autocorrelation for RSA is not significant (r=0.04; 95% CI (-0.2, 0.3)). The autocorrelation is higher for the child than the therapist and thus the child's HR changes more slowly over time. The concurrent relationship between the child and therapist's RSA shows a non-significant positive intercorrelation (r=0.10; 95% CI (-0.1, 0.3)). Furthermore, the lagged correlations show a non-significant negative therapist-led lag (r=-0.02; 8=95% CI (-0.26, 0.24)) and a non-significant child-led lag (r=0.03; 95% CI (-0.24, 0.18)). The simple correlations show a significant autocorrelation for the child's RSA. All other correlations are non-significant for RSA session 4.

Table 12

Pearson correlation coefficients between RSA and lagged RSA for the therapist and child session 4

	thRSA	thLagRSA	chRSA	chLagRSA
thRSA	1.00	0.04	0.10	-0.02
thLagRSA	0.04	1.00	0.03	0.11
chRSA	0.10	0.03	1.00	0.68
chLagRSA	-0.02	0.11	0.68	1.00

P-technique SEM. The p-technique results are illustrated in the path diagram (Figure 20). Similar to the correlations the child's autoregressive pathway is higher that the therapist's and significant (0.68; 95% CI (0.5, 0.9), while the therapist's autoregressive pathway is atypically not significant (0.04; 95% CI (-0.2, 0.3)). All other effects fail to reach significance including the concurrent synchronous relationship between the therapist and child (0.07; 95% CI (-0.1, 0.2)), the child-led lag (-0.01; 95% CI (-0.1, 0.1)) and the therapist-led lag (-0.09; 95% CI (-0.5, 0.3)). The p-technique confirms that the only significant pathway is the autoregressive pathway for the child for RSA.

LOESS Plots. The LOESS smoother plots confirm a linear relationship for simultaneous correlation (Appendix E. Figure 21) and the therapist-led and child-led lags (Appendix E. Figure 22 and 23).

PACF Plots. The PACF plots (Appendix E. Figure 24) show few significant lag effects. There is a highly significant lag=1 for the child's autocorrelation. No other significant lag effects are evident for RSA for session 4.

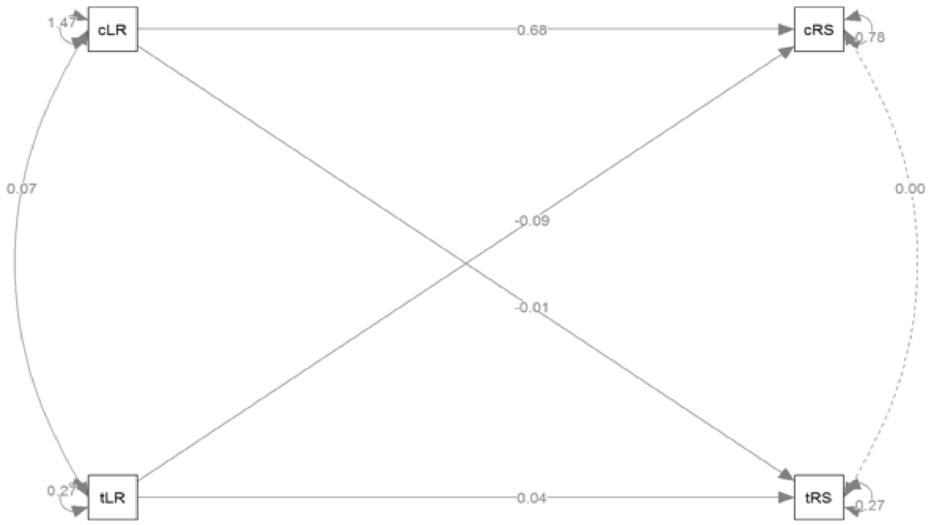

Figure 20. Path diagram for dynamic p-technique SEM for the therapist and child's RSA for a single lagged analysis session 4. A significant effect is evident for the autoregressive pathway for the child (top horizontal path).

Late Phase (Session 13)

Heart Rate

Distribution of HR. Figure 25 shows the distribution of HR. Eli's HR ranged from 67.5 to 86.0 with a mean HR of 77.26 (SD 3.9). The therapist's HR ranged from 86.9 to 109.9 with a mean HR of 98.27 (SD 5.3).

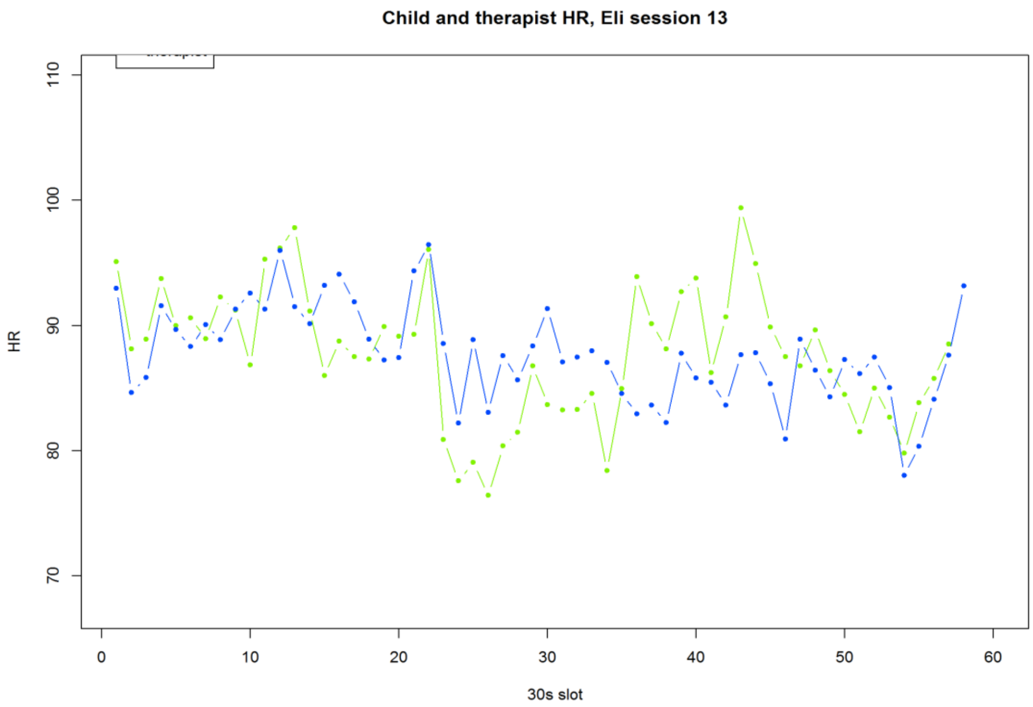

Figure 25. Heart rate for Eli and Therapist A for session 13. The child's HR is in blue and the therapist's HR is in green.

Pearson's Correlation Coefficients. Table 13 displays the Pearson's correlation coefficients for HR for session 13. The therapist (r=0.63; 95% CI (0.38, 0.76)) and child (r=0.54; 95% CI (0.34, 0.69)) show significant positive autocorrelations. Contrary to previous sessions, the degree of autocorrelation is higher for the therapist

than the child, indicating that the therapist's HR changes more slowly than the child's for this session. The concurrent relationship between the child and therapist shows a significant positive correlation (r=0.41; 95% CI (0.18, 0.60)). This is the first session to show evidence of a positive synchronous relationship between Eli and the therapist's HR. This indicates that the HR of the therapist and child is similarly responsive on a moment-by-moment basis across the session. The therapist-led cross-correlation is also significant (r=0.32; 95% CI (0.11, 0.51)). The child-led lagged correlation (r=0.19; 95% CI (-0.11, 0.44)) is non-significant. The correlations indicate that the HR of the therapist and child has a concurrent synchrony, with the therapist driving the interaction more than the child.

P-technique. The path diagram (Figure 26) confirms that the therapist's autoregressive pathway is higher (0.66; 95% CI (0.5, 0.9)) than the child's (0.48; 95% CI (0.3, 0.7)). Both autoregressive pathways are significant. A per the simple correlations, the concurrent lagged covariance is also significant (8.67; 95% CI (3.3, 14.3)); although contrary to the correlations the therapist-led lag fails to reach significance (0.08; 95% CI (-0.1, 0.2)). The child-led lag is also non-significant (-0.13; 95% CI (-0.5, 0.2)). Thus the p-technique confirms significant autoregressive pathways and a significant positive synchronous linkage for HR for the therapist and child. This indicates that the HR responses of the therapist and child occur in synchrony across session 13.

LOESS Plots. The LOESS smoother plots confirm a linear relationship for the simultaneous correlations (Appendix E. Figure 27) and the therapist and child-led lags for HR for session 13 (Appendix E. Figure 28 and 29).

PACF Plots. The PACF plots (Appendix E. Figure 30) show a strong lag=1 effect for the autocorrelations for the therapist (top right plot) and child (bottom left). No significant lag effects are evident for the child or therapist-led lags.

Table 13

Pearson correlation coefficients for heart rates and lagged heart rates for the therapist and child session 13

	thHR	thLagHR	chHR	chLagHR
thHR	1.00	0.63	0.41	0.19
thLagHR	0.63	1.00	0.32	0.43
chHR	0.41	0.32	1.00	0.54
chLagHR	0.19	0.43	0.54	1.00

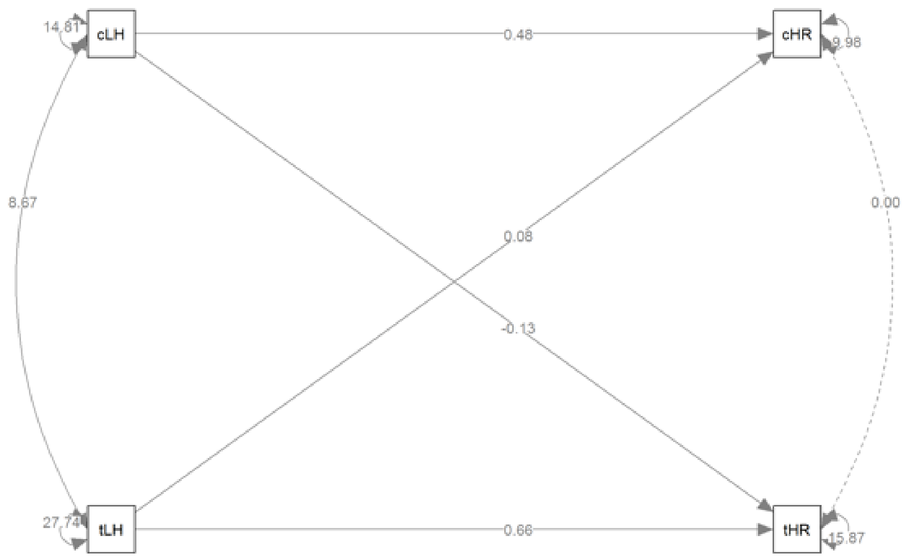

Figure 26. Path diagram for the dynamic p-technique SEM for therapist and child's HR for a single lagged analysis session 13. Significant effects are evident for the autoregressive pathways for the therapist and child (top and bottom horizontal paths) and for the concurrent within lag covariance between the therapist and child (left arc).

RSA Late Phase

*Distribution of RSA***.** Figure 31 shows the distribution of RSA, Eli's RSA for session 13 ranges from 6.4 to 9.3 with a mean RSA of 7.55 (SD 0.6). The therapist's RSA ranges from 2.6 to 5.9 with a mean RSA of 4.05 (SD 0.7).

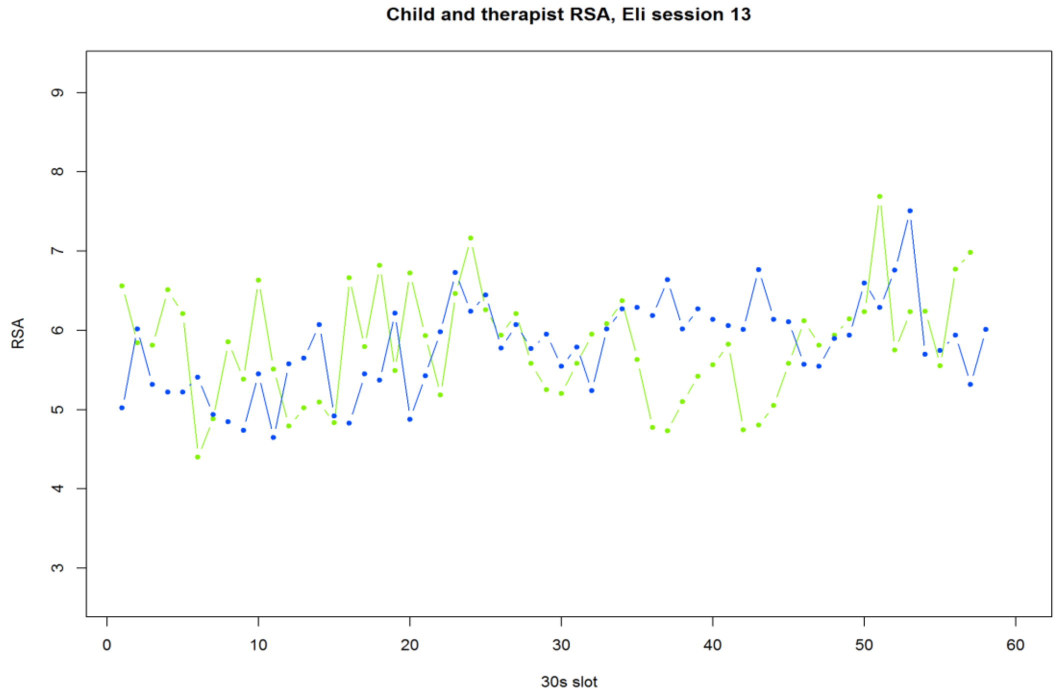

Figure 31. RSA for Eli and Therapist A for session 13. The child's RSA is in blue and the therapist's RSA is in green.

Pearson's Correlation Coefficients. Table 14 displays the Pearson's correlation coefficients for RSA for session 13. The therapist (r=0.35; 95% CI (0.11, 0.54)) and the child (r=0.51; 95% CI (0.29, 0.67)) show significant positive autocorrelations for RSA. The degree of autocorrelation is higher for the child than the therapist. All other correlations fail to reach significance. The intercorrelation (r=-0.01; 95% CI (-0.29, 0.25)) shows a negative non-significant correlation. The child-led (r=0.10; 95% CI (-0.19, 0.36)) and therapist-led cross correlation (r=0.10; 95% CI (-0.22, 0.39)) show positive, non-significant relationships.

Table 14

Pearson correlation coefficients for RSA and lagged RSA for the therapist and child session 13

	thRSA	thLagRSA	chRSA	chLagRSA

thRSA	1.00	0.35	-0.01	0.10
thLagRSA	0.35	1.00	0.10	-0.01
chRSA	-0.01	0.10	1.00	0.51
chLagRSA	0.10	-0.01	0.51	1.00

P-technique SEM. The p-technique results are illustrated on the path diagram (Figure 32). The diagram confirms that the child's autoregressive pathway is higher (0.51; 95% CI (0.2, 0.8)) than the therapist's (0.35; 95% CI (0.1, 0.6)). Both autoregressive pathways are significant. The lagged covariance is not significant (-0.00; 95% CI (-0.1, 0.1)). The child-led lag (0.12; 95% CI (-0.2, 0.4)) and the therapist-led lag (0.08; 95% CI (-0.1, 0.3)) are also non-significant. The p-technique confirms that the only significant linkages for RSA are for the autoregressive pathways for the therapist and child for session 13.

LOESS Plots. The LOESS smoother plots confirm a linear relationship for the simultaneous correlation (Appendix E. Figure 33) and the therapist and child-led lags for RSA for session 13 (Appednxi E. Figure 34 and 35).

PACF Plots. The PACF plots (Appendix E. Figure 36) confirm a significant lag=1 effect for the therapist and child autocorrelations. No significant lag effects are evident for the child or therapist-led lags.

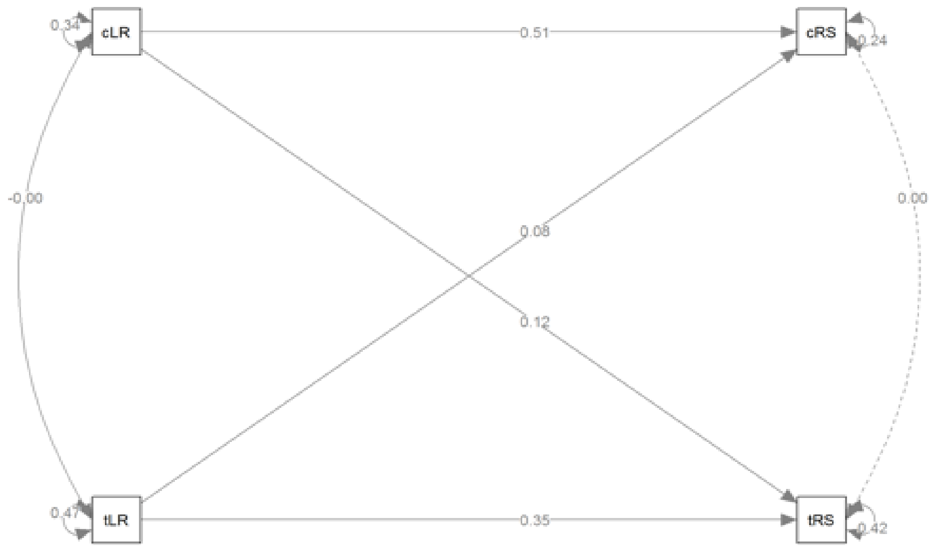

Figure 32. Path diagram for the dynamic p-technique SEM for the therapist and child's RSA for a single lagged analysis session 13. Significant effects are evident for the autoregressive pathways for the therapist and child (top and bottom horizontal paths).

Case Study 1 Summary and Interpretation

In examining the evidence for cardiac linkage between Therapist A and Eli, linkages were observed for HR for the initial and late session. During the initial session the therapist-child dyad displayed a negative therapist-driven linkage for HR. Early studies in HR synchrony (Di Mascio et al., 1995) also observed a negative correlation between a client and therapist's HR physiology that occurred when the client was antagonistic toward the therapist. It is possible that the trainee therapist interpreted the child's silent presentation in the initial session as antagonistic, causing her to increase her arousal in response to a despondent child; however in this instance the therapist drives the interaction. A further possible explanation is that the child and therapist are reacting to the stress of the initial session in a different way, with the child displaying inhibition, an atypical response to stress. For example when the therapist increases her arousal (increases HR) possibly due to the difficulty in forming a connection with a silent child, the child responds to the therapist's increased stress by inhibiting his arousal (decreasing HR) in the next epoch. When the therapist relaxes, decreasing her arousal (decreasing HR) the child decreases his inhibition resulting in an increase in HR.

The early session (session 4) was the least synchronous session as no linkages were observed for HR or RSA. In this session Eli continued to display negative engagement behaviours and remained silent and withdrawn. During this session Eli sat with his back to the therapist, and avoided eye contact and close proximity with the therapist. He rarely acknowledged the therapist's presence and engaged in independent and repetitive play sequences that appeared to function to avoid or block out the therapist. In the late session (session 13) the therapist-child dyad displayed a positive simultaneous within-dyad HR synchrony, which indicates that on a moment-by-moment basis the therapist and Eli exhibited congruent dynamic changes in HR across the session. A positive-linkage for HR is associated with attunement and co-regulation and suggests that of the three sessions analysed for Eli and Therapist A this session was the most adaptive. For this session Eli remained silent and engaged in a long sequence of apparent funeral play that could be described as post-traumatic play, followed by a long sequence of drawing at the art table. The therapist was observed to show spikes of increased effort in tracking Eli's play behaviour, followed by periods of unresponsiveness, as Eli remained silent. Ham and Tronick (2009) propose that physiological synchrony is more likely to occur when one member of the dyad is actively attending to the other. The presence of a positive linkage in this session may reflect the therapist's increased efforts to attune and empathise with Eli.

The shift from a negative therapist-driven linkage in the initial session, to no linkage in the early session, to a positively synchronous linkage for HR in the late session, may suggest a positive shift and an increase in cardiac synchrony across the course of therapy. However it was not possible to assess the degree of linkage and whether it was a co-regulating or arousal-escalating form of HR linkage for the later session. The therapist's HR was highest during the later session with a mean HR of 98.27 in comparison to the 80.94 in the initial session and 78.05 in the early session. Unlike prior sessions, the autocorrelation was also higher for the therapist than the child in the later session, indicating that the therapist maintained a consistently high and stable HR for the duration of this session. Furthermore a positive linkage is solely observed for HR and not RSA. Given that RSA reflects the functioning of the parasympathetic nervous system, a lack of RSA linkage may suggest that the mutually synchronous changes in HR for the dyad are potentially sympathetically rather than parasympathetically driven, for one or both members of the dyad. Given that HR reflects a mixture of sympathetic and parasympathetic influences future research would need to incorporate additional sympathetic measures to further investigate such speculations. The lack of control for movement in this study is a significant limitation that also confounds the interpretation of results given the links between sympathetic arousal and physical activity.

It was initially hypothesised that RSA linkage or the co-regulation of parasympathetic processes would be central to play therapy processes. Yet for case study 1 no linkage for RSA was observed for any session outside of the autocorrelation or autoregressive effects. The degree of autocorrelation for RSA was higher for the child than the therapist for all sessions analysed. This suggests that the child had a lower degree of variability in measures of RSA across time in comparison to the therapist, which may reflect underlying differences in the functioning of the vagal brake. A greater degree of heart rate variability (i.e. RSA in this study) is considered an adaptive response to stress or challenge and may indicate that the therapist is more physiologically responsive within therapy, whereas the child displays a less responsive physiological profile in comparison. Research has shown that children with externalising difficulties have a dysregulated physiology and poor vagal regulation (Calkins, et al., 2007), which may contribute to the observed disruptions in therapist-child co-regulation of HR and RSA. Individuals with insecure Type A attachment strategies have a potential preference for parasympathetic states of low arousal and a bias toward 'parasympathetic affects' of shame, helplessness, hopelessness and despair (Schore, 2012). The shared insecure avoidant Type A+ attachment for the therapist and child in this dyad implies that a therapist using a Type A+ strategy is more likely to be drawn into affectively flat, hypo-aroused states, which was consistent with the CARE-Index patterning where the therapist was observed to be unresponsive and the child difficult (passive) across all three sessions. The matched A+ strategy of the therapist and child may have contributed to a lack of active engagement and shared pleasurable play states, which appears to be reflected in an absence of cardiac linkage, especially for RSA for case study 1.

Case Study 2: Billy and Therapist A

"I've got a smile!" – Billy

Sessions Analysed. Play therapy session 1 (first phase) and session 12 (late phase) were chosen for physiological analysis for Billy and Therapist A. No early session was available as the data for this session was processed in a different format and excluded from the final analysis. 80 matched epochs were available for analysis for session 1 and 76 matched epochs for session 12.

Child History and School Observations. Billy was a 7-year old boy of white British descent. He presented as a round-faced, smiley, slightly chubby child. He had a floppy posture and often looked tired, with a pale complexion and dark circles under his eyes. In the classroom he appeared lethargic, yawning and often and staring into space. He was slow moving and clumsy, often tripping over items and frequently bumping into furniture or other students. Billy was observed to be a compliant child although he needed constant support to maintain his focus on any task. On occasion he was observed to lash out at other students with or without provocation and impulsively squeal, grab or push at other children. During play times he was often in his own world and made clumsy attempts to interact with other children, for example he was observed to run around the school making grunting noises with his arms outstretched like a Zombie, rushing at others in an attempt to invite them into his game. Prior to his placement within a specialist provision Billy had multiple exclusions due to violent behaviour directed toward staff and students. Billy's mother reported that Billy was aggressive towards her and his older brother, who on one occasion he had threatened to stab with a butter knife. Billy's mother also reported that Billy disliked leaving the house on the weekend and was upset by any change, such as his mother's new glasses. Billy also had a number of sensory process difficulties and disliked loud noises, touching food and walking barefoot. Billy had been assessed for autism and it was decided that he did not meet the criteria and was identified as having borderline learning difficulties. Billy's mother reported that she separated from Billy's father during her pregnancy. It was extrapolated that the relationship was domestically violent. Billy's father still visited on occasion. Billy's birth was traumatic and he was delivered by forceps and separated from his mother for several days following birth.

Therapy Overview. Billy readily engaged in play therapy and looked forward to attending therapy each week. In the early sessions Billy's play was largely exploratory and low in symbolism. He primarily explored the room and the toys, engaging in brief segments of cooking play or sword fighting and giggling over the noisy putty. Billy's dialogue was limited and he would communicate with gestures, sounds, and short or single word exclamations. As therapy progressed Billy's play became more symbolic and was accompanied by greater dialogue. Billy most frequently engaged in hide-and-seek type games such as surprising the therapist with toy snakes or slime. Session 12 was the most playful and joyful session observed for both the therapist and child. Billy engaged in a jack-in-the box game, hiding from the therapist and then poking his head out to make silly or scary faces. The play was marked by play signals including face-to-face contact, frequent eye contact, reciprocal similes, close physical proximity and shared laughter. As Billy hid in the box, the therapist made exclamations such as:

"Oh, where is that jack-in-the box gone?"

"He's a fun jack-in-the-box, sometimes he gives me a fright if he jumps out when I'm least expecting it…I wonder what he's going to do next time…"

Attachment Measures. Therapist A and Billy both exhibited a similar avoidant Type A+ strategy of attachment outside a normative A1-2 pattern of attachment. Therapist A was coded by the AAI with an A7 strategy of attachment. Billy was assessed by the CAPA, prior to therapy, with an A3-4 strategy of attachment. This suggests that both Therapist A and Billy have a tendency toward deactivating parasympathetically dominant states of low arousal and a tendency to inhibit negative feeling states. In the follow-up assessment Billy was again coded with an A3-4 strategy of attachment indicating that his strategy of attachment had remained constant across the course of therapy. Using

CARE-Index descriptors Therapist A's behaviour was coded as sensitive and Billy's within session behaviour as compulsive (compliant) for the initial session. For session 12 Therapist A's behaviour was coded as sensitive and Billy's behaviour as cooperative.

First Phase (Session 1)

Heart Rate

Distribution of Heart Rate. Figure 37 shows the heart rates for therapist and child for session 1. Billy's HR ranged from 115.3 to 139.4 beats per minute with a mean HR of 127.11 (SD 5.82). The therapist's HR ranged from 77.1 to 100 with a mean HR of 85.54 (SD 5.22).

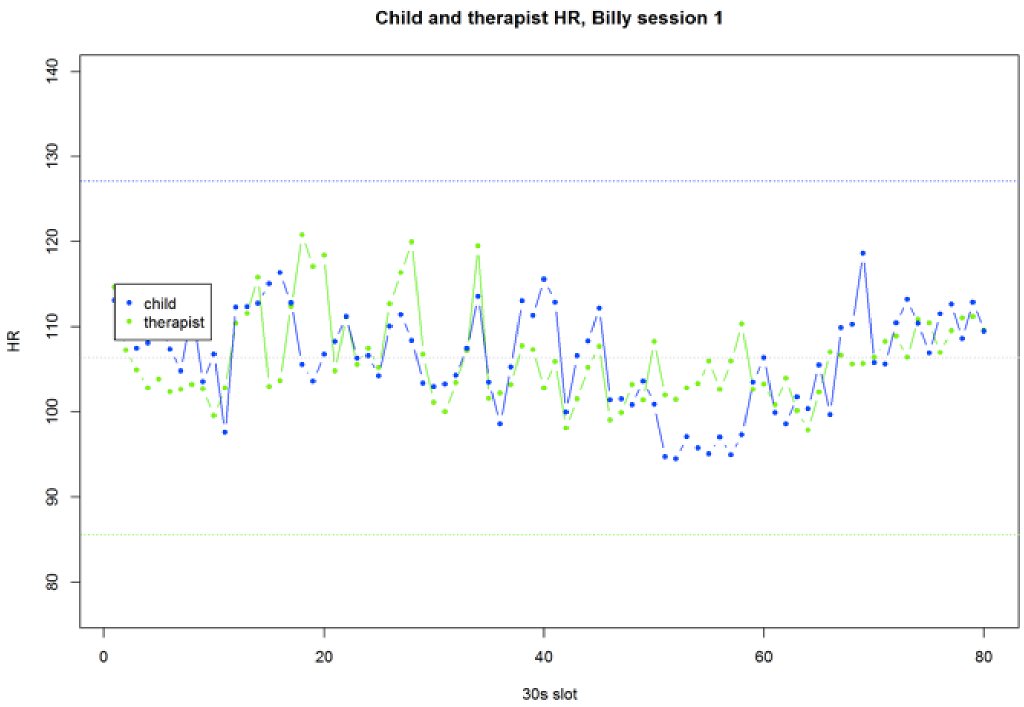

Figure 37. Heart rate for Billy and Therapist A for session 1. The child's HR is in blue and the therapist's HR is in green.

Table 15

Pearson correlation coefficients for HR and lagged HR for the therapist and child for session 1

	thHR	thLagHR	chHR	chLagHR
thHR	1.00	0.50	0.40	0.29
thLagHR	0.50	1.00	0.27	0.41
chHR	0.40	0.27	1.00	0.62
chLagHR	0.29	0.41	0.62	1.00

Pearson's Correlation Coefficients. Table 15 displays the Pearson's correlation coefficients for HR for session 1. The therapist (r=0.50; 95% CI (0.28, 0.67)) and the child (r=0.62; 95% CI (0.43, 0.74)) both show significant positive autocorrelations for HR. The degree of autocorrelation is higher for the child than the therapist, which indicates that the child's HR changes more slowly across time than the therapist's. The intercorrelation (r=0.40; 95% CI (0.22, 0.54)) is also significant indicating a positively synchronous linkage between the HR of the therapist and child. The child-led cross correlation (r=0.29; 95% CI (0.09, 0.45)) is similar to the therapist-led cross correlation (r=0.27; 95%N CI (0.09, 0.43)). Both relationships are significant. The correlations show a highly synchronous relationship for session 1 that appears to be mutually driven by both the therapist and child. These relationships are further tested with the p-technique SEM.

P-technique SEM. The p-technique results are illustrated in a path diagram (Figure 38). The diagram confirms that the child's autoregression is higher (0.60; 95% CI (0.4, 0.8)) than the therapist's autoregressive pathway (0.45; 95% CI (02, 0.7)). Both autoregressive pathways are significant. The within-lag covariance is also significant (12.31; 95% CI (7.4, 17.5)). Although contrary to the simple correlations the child-led lag (0.09; 95% CI (-0.1, 0.3)) and therapist-led (0.03; 95% CI (-0.2, 0.2)) lag fail to reach significance. Thus the p-technique supports the findings of significant autoregressive pathways and the presence of a significant positive, mutually synchronous relationship in the HR of the therapist and child.

LOESS Plots. The default LOESS smoother plots confirm a linear relationship for the simultaneous correlation (Appendix E. Figure 39) and the child's cross-lagged correlation (Appendix E. Figure 41). Although the therapist's cross-lagged effect (Appendix E. Figure 40) has a potential curvilinear rather than linear relationship that is not well represented by the correlations or the p-technique SEM.

PACF Plots. The PACF plots (Appendix E. Figure 42) identify a strong lag=1 as the most significant lag for the autocorrelations. No other significant lag effects are evident.

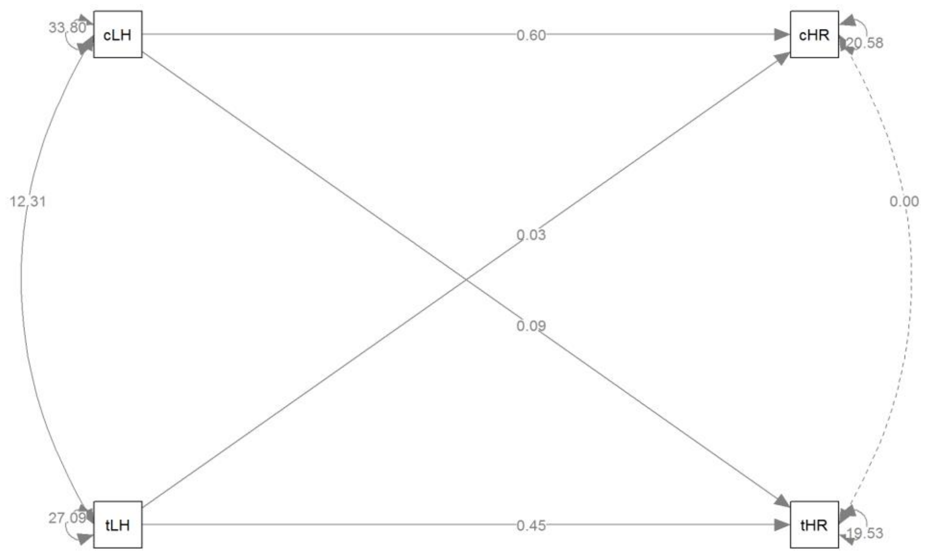

Figure 38. Path diagram for dynamic p-technique SEM for therapist's HR (tHR) and child's HR (chHR) for a single lagged analysis for session 1. Significant effects are evident for the therapist and child's autoregressive pathways (top and bottom pathway) and the within-lag covariance (left arc).

RSA First Phase

Distribution of RSA. Billy's RSA ranged from 3 to 6.8 with a mean RSA of 4.58 (SD 0.78). The therapist's RSA ranged from 4 to 6.8 with a mean RSA of 5.44 (SD 0.54) (Figure 43).

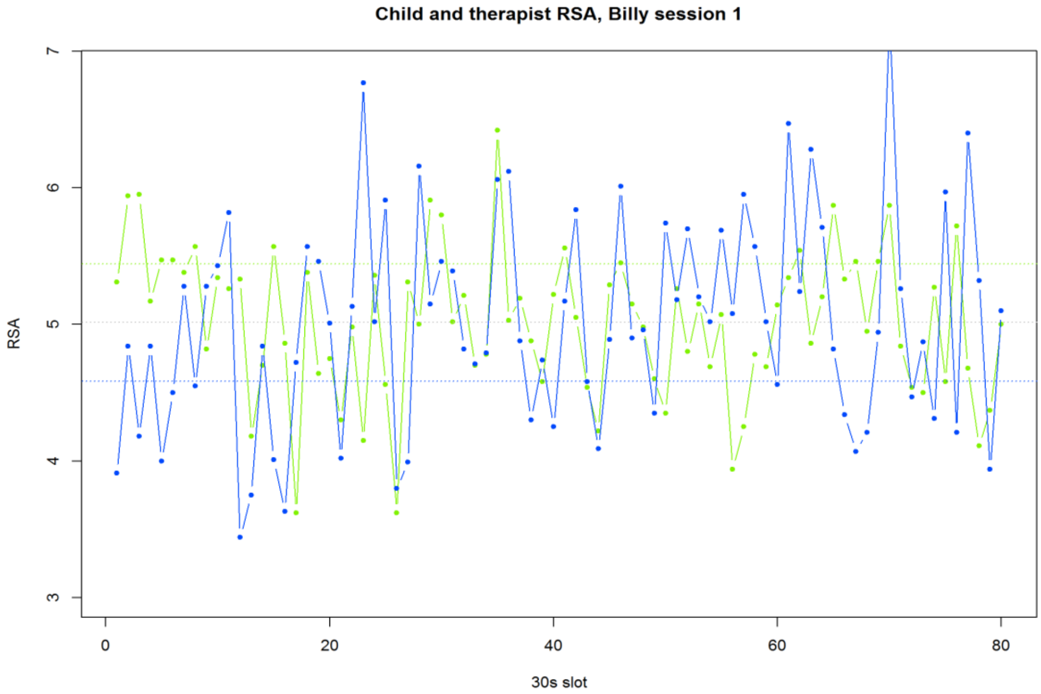

Figure 43. RSA for Billy and Therapist A for session 1. The child's RSA is in blue and the therapist's RSA is in green.

Pearson's Correlation Coefficients. Table 16 displays the Pearson's correlation coefficients for RSA for session 1. The correlations show that the therapist's RSA is significantly correlated with her RSA in the previous 30-second epoch (r=0.19; 95% CI (0.01, 0.38)). Atypically there is no significant autocorrelation for the child's RSA (r=0.12; 95% CI (-0.07, 0.30)). The intercorrelation is also non-significant (r=0.07; 95% CI (-0.18, 0.32)), as is the lagged correlations for the child-led lag (r=0.04; 95% CI (-0.19, 0.28)) and the therapist-led lag (r=0.16; -0.06, 0.38)).

Table 16

Pearson correlation coefficients between RSA and lagged RSA for the therapist and child session 1

	thRSA	thLagRSA	chRSA	chLagRSA
thRSA	1.00	0.19	0.07	0.04
thLagRSA	0.19	1.00	0.16	0.06
chRSA	0.07	0.16	1.00	0.12
chLagRSA	0.04	0.06	0.12	1.00

P-technique SEM. The path diagram (Figure 44) confirms that the only significant pathway for session 1 is for the therapist's autoregressive pathway (0.19; 95% CI (0.0, 0.4)). All other pathways are non-significant including the child's autoregressive pathway (0.11; 95% CI (-0.1, 0.3)), the concurrent within-lag covariance (r=0.03; 95% CI (-0.1, 0.1)), the child-led lag (0.02; 95% CI (-0.1, 0.2)), and the therapist-led lag (0.22; 95% CI (-0.1, 0.5)).

LOESS Plots. The LOESS smoother plots confirm a linear relationship for the simultaneous, therapist-led and child-led RSA data (Appendix E. Figure 45, 46 and 47).

PACF Plots. The PACF plots (Appendix E. Figure 48) show no significant lag effects. No lag effect is evident for the child or therapist's autocorrelation or for the child-led lag. The therapist-led lag shows a possible lag=2 effect.

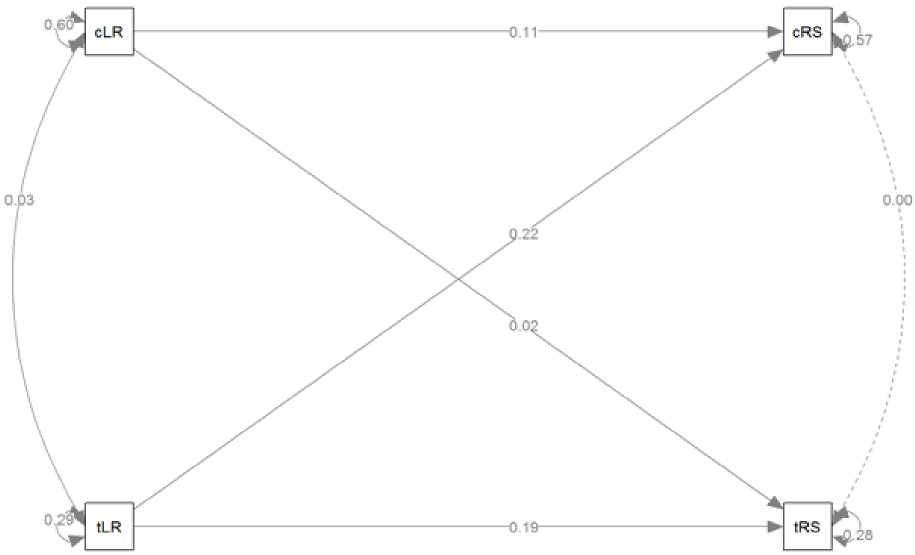

Figure 44. Path diagram for dynamic p-technique SEM for therapist and child's RSA for a single lagged analysis session 1. A significant pathway is evident for the autoregressive effect for the therapist (bottom horizontal path).

Session 12 (Late Phase)

Heart Rate

Distribution of HR. Billy's HR ranges from 94.5 to 126.0 with a mean HR of 108.39 (SD 6.75). The therapist's HR ranges from 75.5 to 106.1 with a mean HR during the session of 83.99 (SD 4.93) (Figure 49).

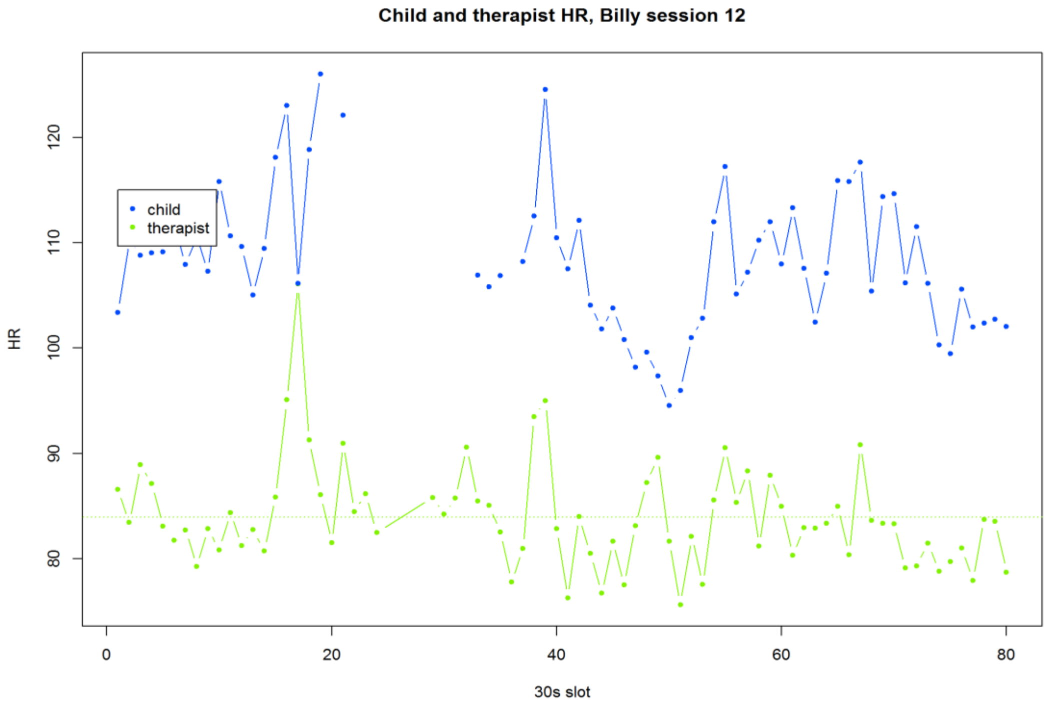

Figure 49. Heart rate for Billy and Therapist A for session 12. The child's HR is in blue and the therapist's HR is in green. Several epochs of data are missing for Billy due to a poor ECG reading for this period.

Pearson's Correlation Coefficients. Table 17 displays the Pearson's correlation coefficients for HR for session 12. The therapist (r=0.44; 95% CI (0.20,0.62)) and the child (r=0.57; 95% CI (0.36, 0.73)) show significant positive autocorrelations for HR. The degree of autocorrelation is higher for the child than the therapist, which indicates that the child's HR changes more slowly than the therapist's HR. The intercorrelation (r=0.42; 95% CI (0.14, 0.65)) is also significant, indicating a mutually synchronous relationship between the HR of therapist and child. The cross-correlations are also significant with the child-led cross-correlation slightly higher (r=0.40; 95% CI (0.15, 0.64)) than the therapist-led cross-correlation (r=0.31; 95% CI (0.02, 0.52)). The correlations show linkages across all effects with a highly mutually synchronous relationship for session 12 that appears to be driven more by the child than the therapist.

P-technique SEM. The path diagram (Figure 49) confirms that the child's autoregressive pathway (0.57; 95% CI (0.2, 0.8)) is higher that the therapist's pathway (0.34; 95% CI

(0.1, 0.6)). Both autoregressive pathways are significant. The lagged covariance is also significant (12.97; 95% CI (3.7, 22.9)) in addition to the child-led lag (0.23; 95% CI (0.0, 0.5)). Contrary to the correlations the therapist-led lag is not significant according to the p-technique (0.12; 95% CI (-0.3, 0.6)). The p-technique confirms significant autoregressive pathways and the presence of a significant mutually synchronous relationship in the cardiac data that is driven by the child.

LOESS Plots. The default LOESS smoother plots for the cross-correlations (Appendix E. Figure 52 and 53) confirm a linear relationship for both the child and therapist-led data with a possible curvilinear relationship for the simultaneous correlation (Appendix E. Figure 51).

PACF Plots. The PACF plots (Appendix E. Figure 54) confirm a lag=1 as the best fit for the therapist and child autocorrelations. The cross-correlations show a possible lag=2 effect for the therapist-led data.

Table 17

Pearson correlation coefficients for HR and lagged HR for the therapist and child session 12

	thHR	thLagHR	chHR	chLagHR
thHR	1.00	0.44	0.42	0.40
thLagHR	0.44	1.00	0.31	0.41
chHR	0.42	0.31	1.00	0.57
chLagHR	0.40	0.41	0.57	1.00

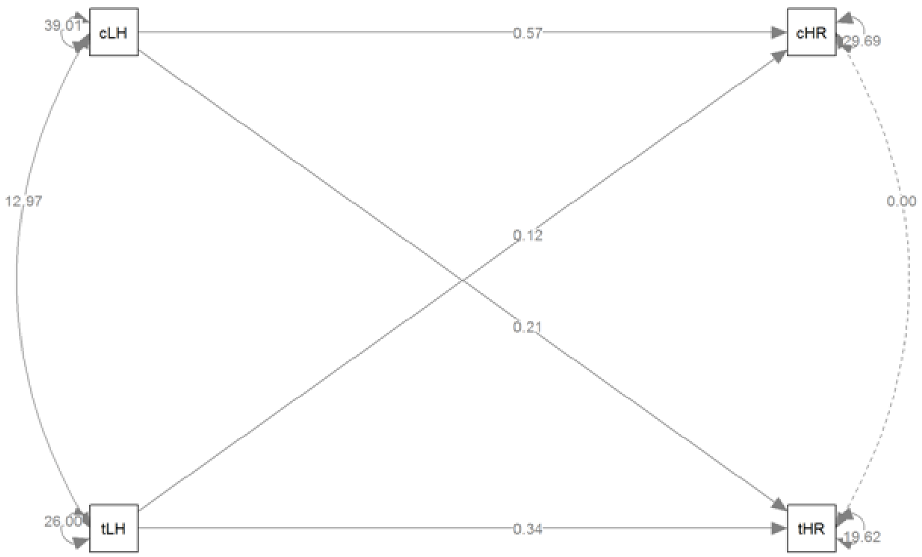

Figure 50. Path diagram for dynamic p-technique SEM for therapist and child's HR for a single lagged analysis for session 12. A significant effect is evident for the autoregressive pathways for the therapist and child (top and bottom horizontal paths), the within-lag covariance (left arc) and the child-driven lag (cLH to tHR diagonal path).

RSA Late Phase

Distribution of RSA. Billy's RSA ranges from 4.1 to 7.5 with a mean RSA of 4.58 (SD 0.78). The therapist RSA ranges from 3.9 to 6.9 with a mean RSA of 5.44 (SD 0.54) (Figure 55).

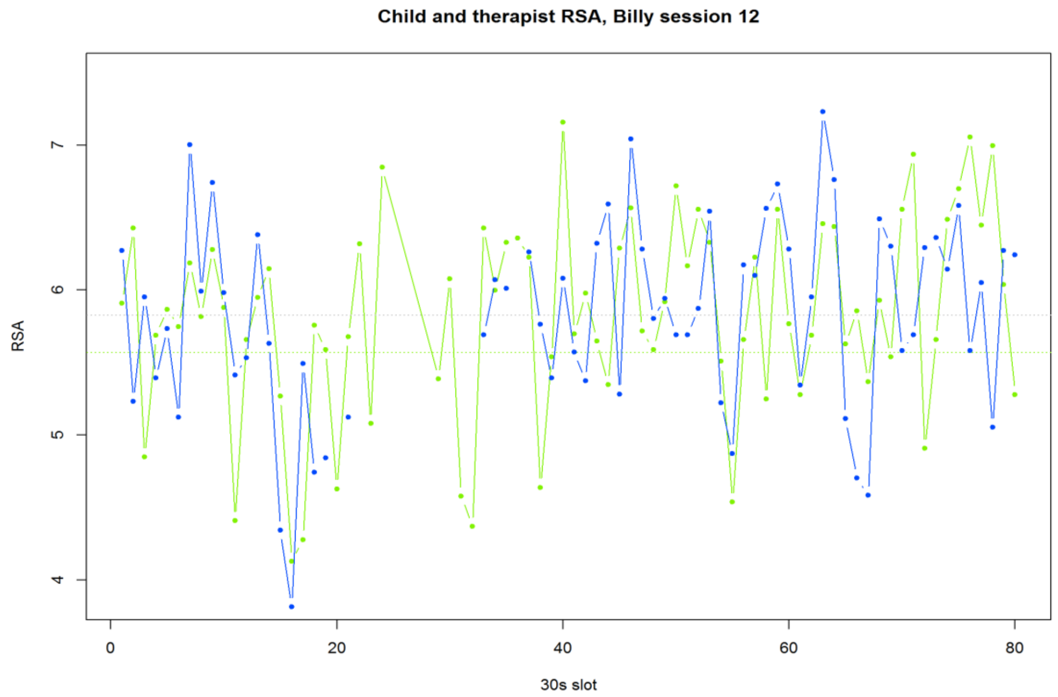

Figure 55. RSA for Billy and Therapist A for session 12. The child's RSA is in blue and the therapist's RSA is in green. Several epochs of data are missing for Billy due to poor quality ECG recording for this period.

Pearson's Correlation Coefficients. Table 18 displays the Pearson's correlation coefficients for RSA for session 12. The correlations show that the therapist's RSA is significantly correlated with her RSA in the previous 30-seconds (r=0.24; 95% CI (0.01, 0.47)). The child's RSA is also significantly correlated with his RSA in the previous epoch (r=0.26; 95%CI (0.00, 0.52)). Both the therapist and child show a similar degree of autocorrelation. The intercorrelation between the therapist and child is also significant (0.36; 95% CI (0.13, 0.59)). The child-led cross-correlation (r=0.30; 95% CI (0.05, 0.56)) is significant and higher than the therapist-led cross-correlation (r=0.20; 95% CI (0.00, 0.39)) which is also significant.

P-technique SEM. The path diagram (Figure 56) shows that the child's autoregressive pathway (0.22; 95% CI (-0.1, 0.5)) is higher than the therapist's autoregressive pathway (0.15; 95% CI (-0.1, 0.4)) although atypically neither pathway is significant. However the within-lag covariance or concurrent synchrony between the RSA of the therapist and child is significant (0.16; 95% CI (0.0, 0.3)). The child-led lag is also significant (0.25; 95% CI (-0.1, 0.2)) whereas, unlike the correlations, the therapist-led lag is not significant (0.12, 95% CI (-0.1, 0.4)). Thus the p-technique confirms the presence of a simultaneous and child-driven linkage for RSA indicating a mutually synchronous relationship between the RSA of the therapist and child in which the child drives the interaction more than the therapist. This is the first session to show a linkage for both HR and RSA for the therapist and child, which it was hypothesized would accompany the most playfully attuned sessions. The presence of a linkage for both cardiac measures may indicate that the dyad is more parasympathetically driven and socially engaged in this session in comparison to the initial session.

LOESS Plots. The LOESS smoother plots confirm a linear relationship for the simultaneous and lagged therapist and child's RSA data (Appendix E. Figure 57, 58 and 59).

PACF Plots. The PACF plots (Appendix E. Figure 60) show an absence of lag effects for all correlations including the autocorrelations for the therapist and child.

Table 18

Pearson correlation coefficients between RSA and lagged RSA for the therapist and child session 12

	thRSA	thLagRSA	chRSA	chLagRSA
thRSA	1.00	0.24	0.36	0.30
thLagRSA	0.24	1.00	0.20	0.36
chRSA	0.36	0.20	1.00	0.26
chLagRSA	0.30	0.36	0.26	1.00

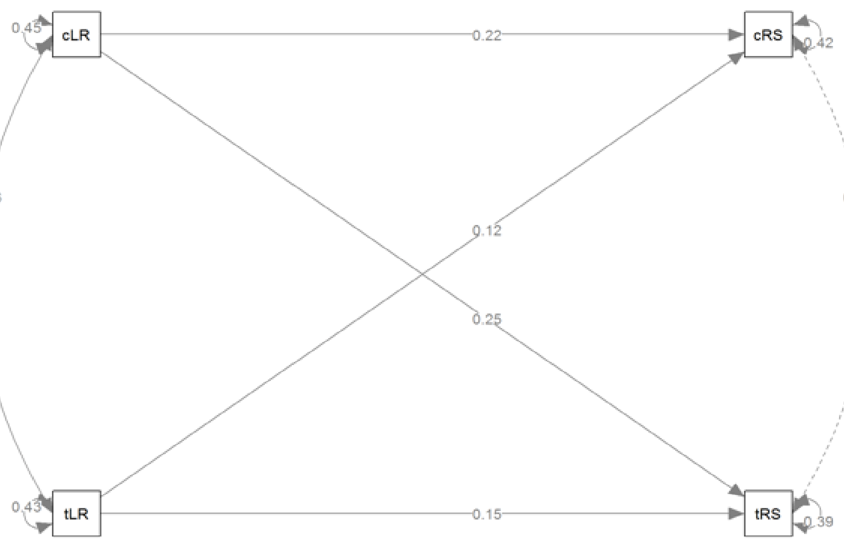

Figure 56. Path diagram for the dynamic p-technique SEM for the therapist and child's RSA for a single lagged analysis session 12. Significant effects are evident for within-lag covariance (left arc) and the child-led lag (cLR to tRS diagonal path).

Case Study 2 Summary and Interpretation

Cardiac linkage was evidenced in both sessions analysed for Billy and Therapist A. A positive simultaneous and child-driven linkage for HR was observed for the initial session, indicating that on a moment-to-moment basis the therapist and child exhibited congruent dynamic changes in HR across time, which were largely driven by the child. No significant linkages were evident for RSA for session 1. During this session Billy primarily engaged in non-symbolic exploratory play. Billy narrated his play with sound effects and a few short verbal statements. The session focused on a game where Billy surprised or frightened the therapist by having her close her eyes as he held various toys such as a snake, shark and fake poo in front of her face, or placed them into her hands. Billy instructed the therapist to open her eyes and giggled at her pretend fright, although he appeared cautious and was careful to keep a safe distance from the therapist. The therapist was attentive and utilised basic play therapy techniques such as tracking the child's play behaviour and verbalising the child's feelings. The relationship between the therapist and child was coded using CARE-Index descriptors. For session 1 Therapist A's behaviour was coded as sensitive and Billy's behaviour as compulsive (compliant), indicating that Billy's co-operation was driven by attempts to please the therapist.

Session 12 showed a greater number of cardiac linkages with a simultaneous and child-driven linkage evident for HR and RSA. Thus the therapist's cardiac physiology similarly responds and mirrors the child's physiology for both HR and RSA across the course of the session. It was hypothesised that a dual linkage for HR and RSA would be the most desirable and adaptive cardiac linkage given the links between RSA, positive social engagement and states of pleasurable play. Session 12 was dominated by a game in which Billy pretended to be a jack-in-the-box. He sat in a box, covered his head with a swath of material and pretended to sleep. The therapist wondered where the jack-in-the box had gone, to which Billy responded by popping out his head, to pull various happy, funny, serious or scary faces at the therapist. The play was marked by play signals that are indicative of an active play system (Panksepp, 1998) including face-to-face contact, frequent eye contact, reciprocal similes, close physical proximity and shared laughter. Both the therapist and child appeared to genuinely enjoy the play.

Porges (2011) identifies shared joy as a central to a pleasurable Polyvagal play state, which is marked by activation the parasympathetically mediated social engagement system and a co-opting of the sympathetic nervous system. The Polyvagal theory also contends that play is a ‘neural exercise’ that turns on and off vagal influences to the heart, fine-tuning the vagal brake and aiding in the co-regulation of physiological state (Porges, 2017). Neural exercises that consist of momentary disruptions and repairs of physiological state during social interaction, such as games of peek-a-boo, or the jack-in-the-box game above, depended on an awareness of each other’s social engagement system and promote greater physiological resilience (Porges, 2017). In CARE-Index terms the therapist’s behaviour was coded as sensitive and Billy’s as cooperative. A sensitive-cooperative dyad is the most desirable and secure relationship pattern. Therefore the results give some support to the notion that a concurrent linkage for RSA and HR may indicate that a dyad is positively and playfully attuned.

Case Study 3: Tyler and Therapist B

“You and I are going to stick together and turn taller.” - Tyler

Sessions Analysed. Play therapy session 1 (first phase), session 11 (early phase) and session 17 (late phase) were selected for analysis for Tyler and Therapist B. 80 matched epochs were available for analysis for each session.

Child History and School Observations. Tyler was a lanky 8-year old boy of black British descent with bulbous eyes. He was easily excited and displayed sudden shifts between extreme states of arousal. At play times he was observed to run around in a haphazard and hyper-aroused state spitting, spluttering, squealing and banging into other children. He showed little control over his body and posture and threw himself around in an uncoordinated, jerky manner. He voice was loud and unmodulated. He would often stutter, especially when anxious. He would talk and laugh to himself, often making derogatory statements, for example on arrival at school he was observed to be walking around the room repeating to himself, "Dumb, dumb, dumb, dumb…" He was observed to have some minor disagreements with peers and was often frustrated by others, on one occasion exclaiming to a peer, "My teeth are almost falling out because of you!" He made clumsy attempts at befriending others, for example when observing that another student was upset he asked, "What happened? Tell me. I'll deal with them. I'm going to make them cry." He was overly amused by words like poo and would provoke other students, calling them "bum" or "poo-poo head." He constantly sought attention from teaching staff and required constant assistance to sustain his focus on school tasks. He was observed to be anxious about making mistakes and was easily discouraged and would frequently sulk or complain when he found work difficult. He was curious about the classroom animals and made several threats to hurt or scare the animals. One day, seemingly out of context he mused, "If you put a pencil in a guinea pig's eye, would it hurt?" On several occasions he expressed a desire to harm his own face. He would ask teaching staff, "Do I look ugly? My face is ridiculous. I wish I could change it everyday." Tyler's parents experienced significant mental health and physical health difficulties. His mother had recently been admitted for post-natal depression with psychosis and Tyler was often in the care of his aunt or grandmother. Tyler had been exposed to domestic violence and had previously disclosed physical abuse by his father. Tyler was also reported to have been washed out to sea when he was 6-years of age.

Therapy Overview. In therapy Tyler presented as an over-excited, talkative child. He would flip quickly between out-of-control, over-aroused, frenetic states to being sober and still. He showed an inconsistent stutter and his play was often bizarre, fragmented and difficult to follow. Tyler enthusiastically attended therapy and readily engaged the therapist in his play. In the days following therapy he would ask teaching staff how many sleeps until his next therapy day. He delighted in play scenarios in which the therapist was instructed to be afraid or cry in pain. For example in the initial session Tyler pretended to hurt the therapist, exclaiming, "Look, its giving you pain!" You're supposed to be crying…more, more, more…even worse!" In response to the therapist's pretend distress Tyler became increasingly excited, laughing and prompting the therapist to increase her distress even more. Tyler alternated between expressing strong positive and negative affect for the therapist. In session 10 he exclaimed, "My mum is not very good at looking after me. But you are…because she bites me. She thinks I'm a turkey or something."

In later sessions, as therapy drew closer to an end, Tyler increasingly directed anger and hostility toward the therapist, for example in session 18 he exclaimed, "I'm really upset with you. Go away! I'm never going to see you ever again!" In the same session he exclaimed, "I'm going to rip you to pieces (*toy*) – especially you (*therapist*)!" In session 20 in response to a limit on licking sand, he responded, "I'm going to tell my friends to kills {sic} you for not letting me lick…kill you to death." When the therapist continued to set further limits Tyler escalated his threats, "I'm going to break your head!" Play themes related to physical abuse and domestic violence also increased across the course of therapy. Tyler depicted terrible content with flat affect. In session 14 he commented, "I wonder what happened to make him die? I was beating him too much. Beating him.

He bled to death." In session 21 Tyler engaged in a long sequence of play where the baby doll was beaten. He begun by stating that the baby doll needed some armour then violently smashed the baby against the dollhouse and exclaimed, "Oh look – there's a mark on him…Oh you got some blood." The baby responded, "Aw don't hurt me. I thought I was your baby." The session ended with a feeling of hopelessness as Tyler exclaimed that the characters in his play were, "In danger forever…this world is bad forever because of him. We are dead forever." Tyler also directed anger at himself, for example in session 24, in response to the therapist's limit setting on throwing sand Tyler responded:

Tyler: I don't want to be safe. I want to be killed.

Therapist: Why do you want to be killed?

Tyler: Because I hate my face…Do I have a lovely face or a bad face (*stutters*)? Just say it. Tell the truth. Is it good of not? Because I think it's not good. Do you agree?

Attachment Measures. Tyler and Therapist B shared an insecure Type C strategy of attachment. Therapist B was coded with normative C1-2 strategy of attachment. Tyler was coded with a more extreme C5 strategy of attachment in the pre-therapy assessment. In the follow-up assessment Tyler was again coded with a C5 attachment, which indicates that Tyler's strategy of attachment remained constant across the course of therapy. Individuals with a Type C strategy show a bias towards 'sympathetic affects' such as panic, terror, rage and pain and sympathetic states of high arousal (Schore, 2012) as evident in Tyler's play and the malicious joy expressed in inflicting pretend pain. Using CARE-Index descriptors for the initial session, the therapist's behaviour was described as sensitive and the child's as co-operative with some moments of difficulty. In session 11 the therapist's behaviour was again coded as primarily sensitive and the child's as both co-operative and difficult. In session 17 the therapist's behaviour was coded as controlling and the child's as difficult. As the hostility directed towards the therapist increased across the course of therapy, the therapist was observed to becoming increasingly controlling and the dyad became increasingly involved in a power struggle. Therapy sessions were dominated by discussions around safety and frequent limit setting by the therapist.

First Phase (Session 1)

Heart Rate

Distribution of HR. Tyler's HR ranged from 87.5 to 177.2 with a mean HR of 113 (SD 19.05). Therapist B's HR ranged from 77 to 126 with a mean HR of 89.15 (SD 8.59) (Figure 61).

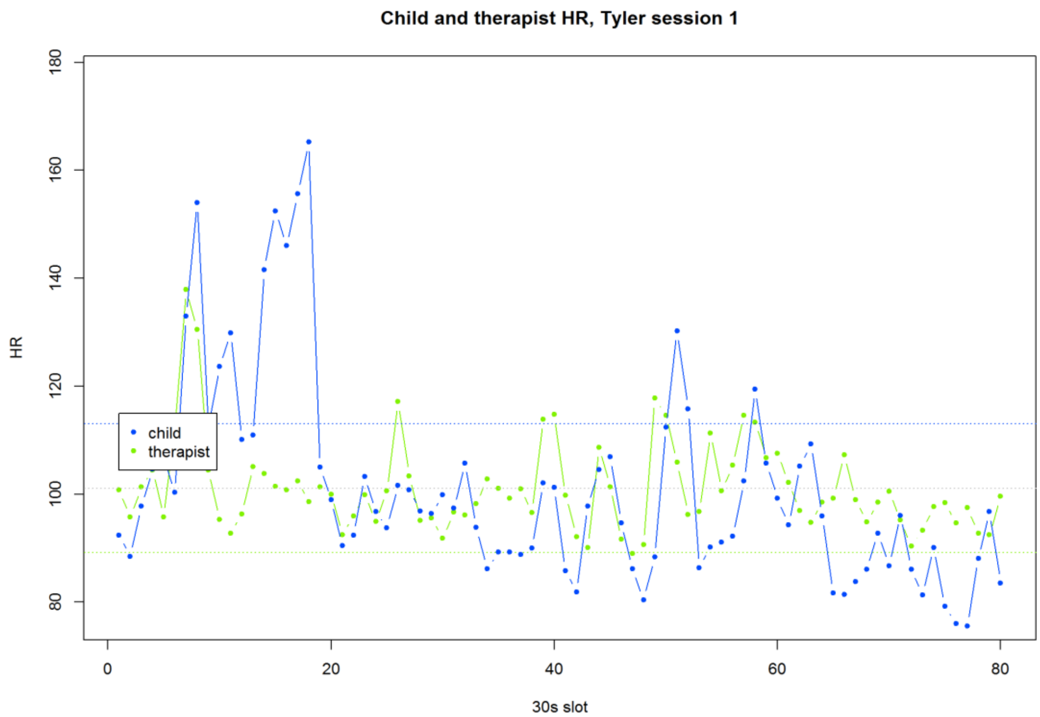

Figure 61. HR for Tyler and Therapist B for session 1. The child's HR is in blue and the therapist's HR is in green. The high peaks show sequences of joint active play for therapist and child.

Pearson's Correlation Coefficients. Table 19 displays the Pearson's correlation coefficients for HR for session 1. The therapist (r=0.51; 95% CI (0.27, 0.73)) and the child (r=0.74; 95% CI (0.57, 0.86)) both show a significant positive autocorrelation for HR. The degree of autocorrelation is higher for the child than the therapist, which suggests that the child's HR changes more slowly across time than the therapist's. The concurrent correlation is also significant (r=0.35; 95% CI (0.14, 0.59)) indicating a potentially synchronous relationship between the HR of the therapist and child. In addition the lagged correlations show a significant positive therapist-led lag (r=0.42; 0.24, 0.65)) and a non-significant child-led lag (r=0.11; 95% CI (-0.05, 0.33)) which indicates that the therapist is driving the interaction more than the child for this session.

P-technique SEM. The path diagram (Figure 62) confirms that the child's autoregressive pathway (0.68; 95% CI (0.4, 1.0)) is higher than the therapist's pathway (0.54; 95% CI (0.3, 0.8)). Both autoregressive pathways are significant. Similarly to the correlations the within-lag covariance is also significant (57.43; 95% CI (7.9, 107.5)). However, both the child-led lag (-0.04; 95% CI (-0.1, 0.0)) and the therapist-led lag (0.41; 95% CI (0.41; 95% CI (-0.1, 0.9)) are non-significant according to the p-technique. The p-technique confirms significant autoregressive pathways and the presence of a significant simultaneous linkage between the HR of the therapist and child for session 1.

LOESS Plots. The LOESS smoother plots confirm a weak linear relationship for the simultaneous correlation (Appendix E. Figure 63) and the child-led and therapist-led HR data (Appendix E. Figure 64 and 65).

PACF Plots. The PACF plots (Appendix E. Figure 66) show a lag=1 effect for the therapist and child's autocorrelation and the therapist-led lag. The child-led lag shows no significant lag effects.

Table 19

Pearson correlation coefficients for HR and lagged HR for the therapist and child session 1

	thHR	thLagHR	chHR	chLagHR
thHR	1.00	0.51	0.35	0.11
thLagHR	0.51	1.00	0.42	0.35
chHR	0.35	0.42	1.00	0.74
chLagHR	0.11	0.35	0.74	1.00

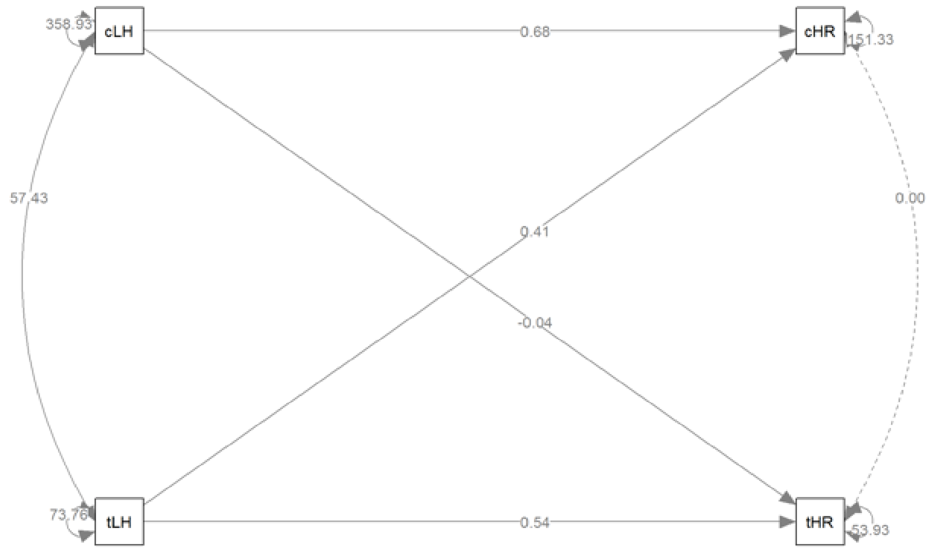

Figure 62. Path diagram for dynamic p-technique SEM for therapist and child's HR for a single lagged analysis session 1. Significant effects are evident for the autoregressive pathways (top and bottom horizontal paths) and the within-lag covariance (left arc).

RSA First Phase

Distribution of RSA. Tyler's RSA ranged from 1.6 to 7.6 with a mean RSA of 5.24 (SD 1.47). Therapist B's RSA ranged from 1.9 to 6.0 with a mean RSA of 4.38 (SD 0.79) (Figure 67).

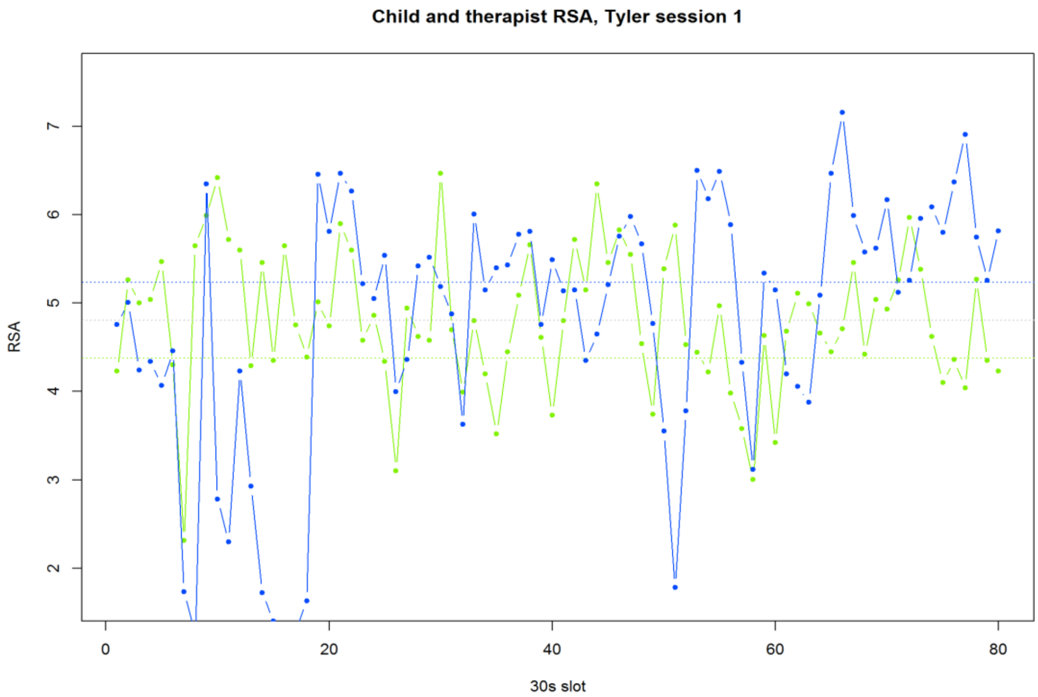

Figure 67. RSA for Tyler and Therapist B session 1. The child's RSA is in blue and the therapist's RSA is in green.

Pearson's Correlation Coefficients. Table 20 displays the Pearson's correlation coefficients for RSA for session 1. The correlations show that the therapist's RSA is significantly correlated with her RSA in the previous 30-seconds (r=0.27; 95% CI (0.05,0.43)). The child's RSA is also significantly correlated with his RSA is the previous 30-seconds (r=0.61; 95% CI (0.32, 0.78)). The degree of autocorrelation is higher for the child than the therapist, which indicates that the child's RSA changes more slowly than the therapist's. All other correlations for RSA are non-significant including the intercorrelation (r=0.00; 95% CI (-0.24, 0.29)), the child-led correlation (r=-0.13; 95% CI (-0.33, 0.06)) and the therapist-led correlation (r=0.00; 95% CI (-0.24, 0.30)).

P-technique SEM. The path diagram (Figure 68) confirms that the child's autoregressive pathway (0.61; 95% CI (0.3, 0.9)) is higher than the therapist's autoregressive pathway (0.27; 95% CI (0.0, 0.5)). Both autoregressive pathways are significant. All other pathways are non-significant including the within-lag covariance (0.01; 95% CI (-0.3, 0.3)), the child-led lag (-0.07; 95% CI (-0.2, 0.0)) and the therapist-led lag (0.00; 95% CI (-0.4, 0.4)).

LOESS Plots. The LOESS smoother plots confirm a weak linear relationship for the child-led lag (Appendix E. Figure 71) with a possible curvilinear rather than linear relationship for the therapist-led lag (Appendix E. Figure 70) and the simultaneous correlation (Appendix E. Figure 69).

PACF Plots. The PACF plots (Appendix E. Figure 72) show a strong lag=1 effect for the therapist and child autocorrelations and the therapist-led lag. No lag effects are evident for the child-led lag.

Table 20

Pearson correlation coefficients between RSA and lagged RSA for the therapist and child session 1

	thRSA	thLagRSA	chRSA	chLagRSA
thRSA	1.00	0.27	0.00	-0.13
thLagRSA	0.27	1.00	0.00	0.01
chRSA	0.00	0.00	1.00	0.61
chLagRSA	-0.13	0.01	0.61	1.00

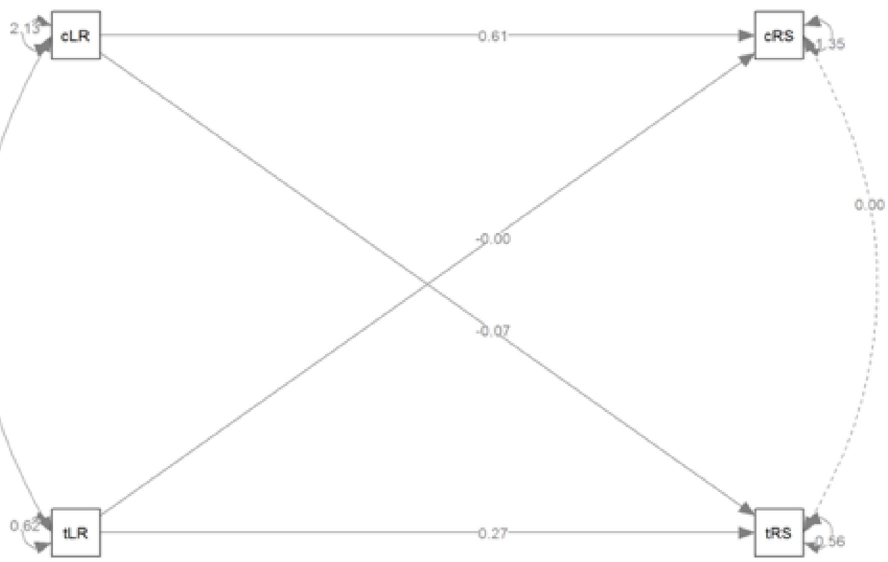

Figure 68. Path diagram for dynamic p-technique SEM for therapist and child's RSA for a single lagged analysis session 1. Significant effects are evident for the child and therapist's autoregressive pathways (top and bottom horizontal path).

Early Phase (Session 11)

Heart Rate

Distribution of HR. Tyler's HR ranged from 82.6 to 123.9 with a mean HR of 96.44 (SD 7.7). Therapist B's HR ranged from 80.9 to 97.1 with a mean HR of 87.61 (SD 3.18) (Figure 73).

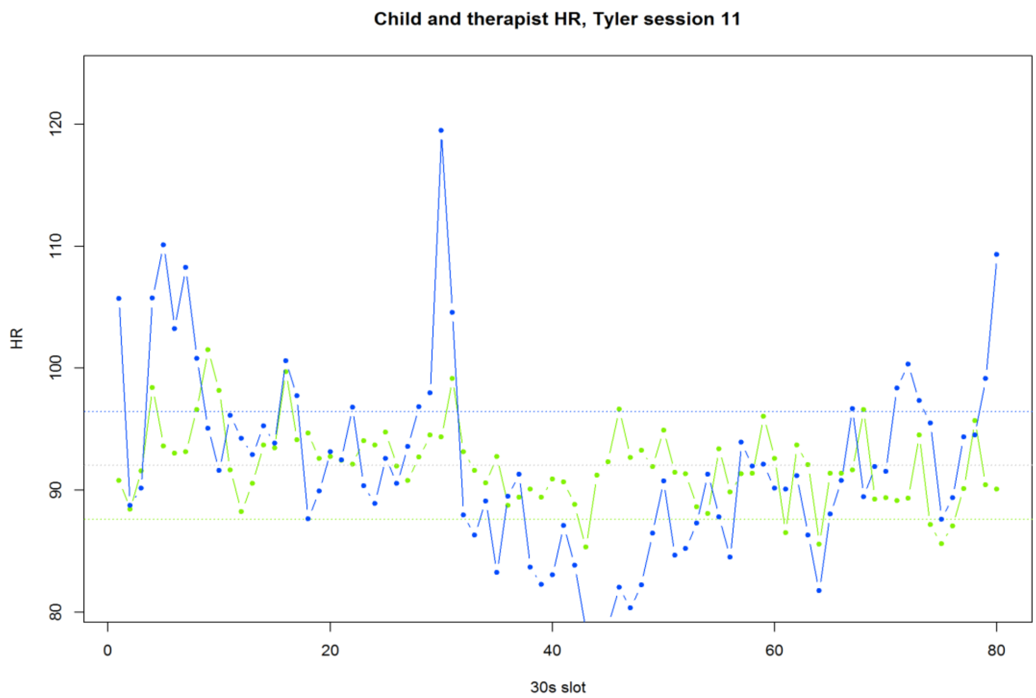

Figure 73. HR for Tyler and Therapist B session 11. The child's HR is in blue and the therapist's HR is in green.

Pearson's Correlation Coefficients. Table 21 displays the Pearson's correlation coefficients for HR for session 11. The therapist (r=0.39; 95% CI (0.22, 0.55)) and the child (r=0.68; 95% CI (0.51, 0.78)) both show a significant positive autocorrelation for HR. The degree of autocorrelation is higher for the child than the therapist, which suggests that the child's HR changes more slowly across time. The intercorrelation is significant (r=0.33; 95% CI (0.14, 0.50)) indicating a potentially synchronous relationship between the HR of therapist and child. In addition the lagged correlations show a significant positive therapist-led lag (r=0.23; 95% CI (0.04, 0.42)) and a significant positive child-led lag (r=0.33; 95% CI (0.11, 0.53)). The child-led lag is slightly higher than the therapist-led lag, which indicates that the child is driving the therapist's HR more than the therapist is driving the child's HR.

P-technique SEM. The path diagram (Figure 74) confirms that the child's autoregressive pathway (0.68; 95% CI (0.5, 0.9) is higher than the therapist's autoregressive pathway (0.31; 95% CI (0.1, 0.5)). Both positive pathways are significant. The within-lag covariance is positive and significant (8.20; 95% CI (3.1, 13.5)). The child-led lag is positive and significant (0.10; 95% CI (0.0, 0.2)) although the therapist-led lag is non-significant (-0.01; 95% CI (-0.4, 0.4)). The p-technique confirms a positively synchronous and child-driven linkage between the HR of the therapist and child.

LOESS Plots. The LOESS smoother plots confirm a linear relationship for the simultaneous correlations (Appendix E. Figure 75) and the therapist-led and child-led lags (Appendix E. Figure 76 and Figure 77).

PACF Plots. The PACF plots (Appendix E. Figure 78) show a strong lag=1 effect for the therapist and child autocorrelations. No lag effects are evident for the child-led or therapist-led lag.

Table 21

Pearson correlation coefficients for HR and lagged HR for the therapist and child session 11

	thHR	thLagHR	chHR	chLagHR
thHR	1.00	0.39	0.33	0.33
thLagHR	0.39	1.00	0.23	0.35
chHR	0.33	0.23	1.00	0.68
chLagHR	0.33	0.35	0.68	1.00

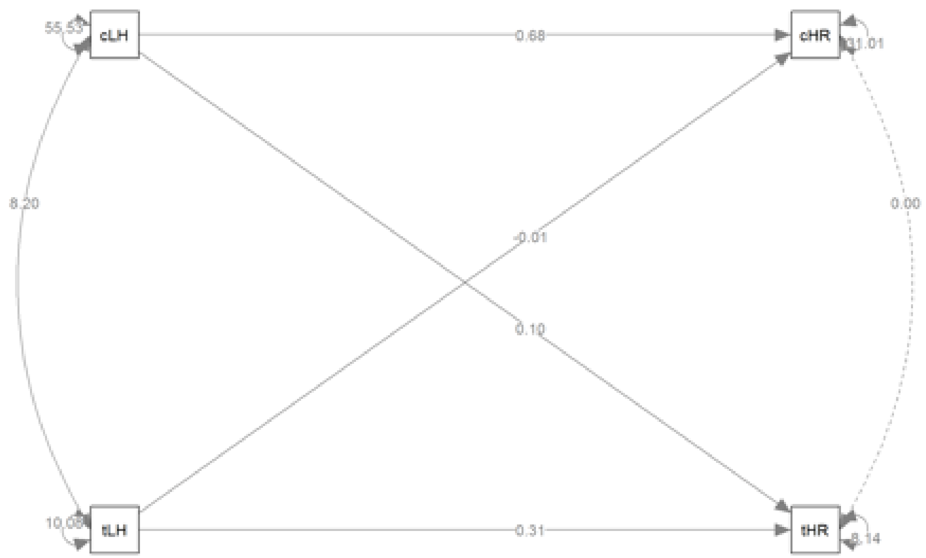

Figure 74. Path diagram for dynamic p-technique SEM for therapist and child's HR for a single lagged analysis session 11. Significant effects are evident for the autoregressive pathways (top and bottom horizontal paths) and the within-lag covariance (left arc) and the child-led lag (cLH to tHR diagonal path).

RSA Early Phase

Distribution RSA. Tyler's RSA ranged from 3.4 to 6.8 with a mean RSA of 5.59 (SD 0.67). Therapist B's RSA ranged from 2.8 to 5.8 with a mean RSA of 4.36 (SD 0.66) (Figure 79).

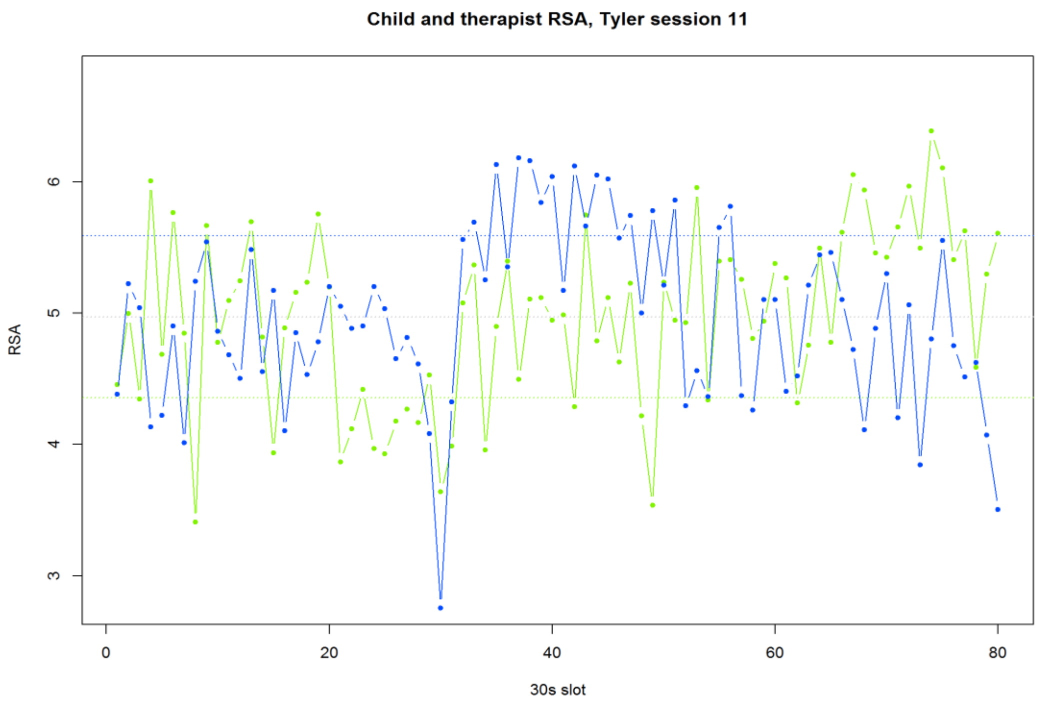

Figure 79. RSA for Tyler and Therapist B session 11. The child's RSA is in blue and the therapist's RSA is in green.

Pearson's Correlation Coefficients. Table 22 displays the Pearson's correlation coefficients for RSA for session 11. The correlations show that the therapist's RSA is significantly correlated with her RSA in the previous 30-seconds (r=0.30; 95% CI (0.08, 0.48)). The child's RSA is also significantly correlated with his RSA in the previous 30-seconds(r=0.45; 95% CI (0.27, 0.58)). The degree of correlation is higher for the child than the therapist, which indicates as for prior sessions, that the child's RSA changes more slowly than the therapist's RSA. All other correlations for RSA are non-significant including the intercorrelation (r=0.00; 95% CI (-0.20, 0.28)), the child-led correlation (r=0.05; 95% CI (-0.18, 0.29)) and the therapist-led correlation (-0.12; 95% CI (-0.33, 0.10)).

P-technique SEM. The path diagram (Figure 80) confirms that the only significant effects are the autoregressive pathways. As for the correlations the child's autoregressive pathway (0.47; 95% CI (0.3, 0.7)) is higher than the therapist's autoregressive pathway (0.30; 95% CI (0.1, 0.5)). All other pathways are non-significant including the lagged covariance (0.01; 95% CI (-0.1, 0.1)), the child-led lag (0.04; 95% CI (-0.2, 0.3)) and the therapist-led lag (-0.14; 95% CI (-0.3, 0.1

LOESS Plots. The LOESS smoother plots confirm a linear relationship for the simultaneous correlation (Appendix E. Figure 81) and the therapist-led and child-led lags (Appendix E. Figure 82 and Figure 83).

PACF Plots. The PACF plots (Appendix E. Figure 84) show a strong lag=1 effect for the therapist and child autocorrelations. No lag effects are evident for the child-led or therapist-led lags.

Table 22

Pearson correlation coefficients between RSA and lagged RSA for the therapist and child session 11

	thRSA	thLagRSA	chRSA	chLagRSA
thRSA	1.00	0.30	0.00	0.05
thLagRSA	0.30	1.00	-0.12	0.03
chRSA	0.00	-0.12	1.00	0.45
chLagRSA	0.05	0.03	0.45	1.00

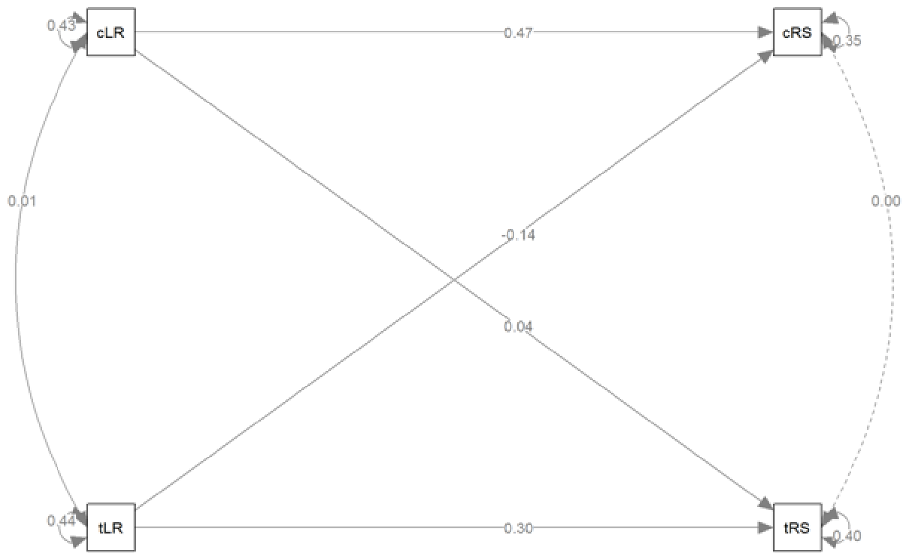

Figure 80. Path diagram for dynamic p-technique SEM for therapist and child's RSA for a single lagged analysis session 11. A significant effect is evident for the child and therapist's autoregressive pathways (top and bottom horizontal path).

Late Session (Session 17)

Heart Rate

Distribution of HR. Tyler's HR ranged from 80.3 to 126.8 with a mean HR of 93.72 (SD 7.51). Therapist B's HR ranged from 75.5 to 109.7 with a mean HR of 82.58 (SD 5.17) (Figure 85).

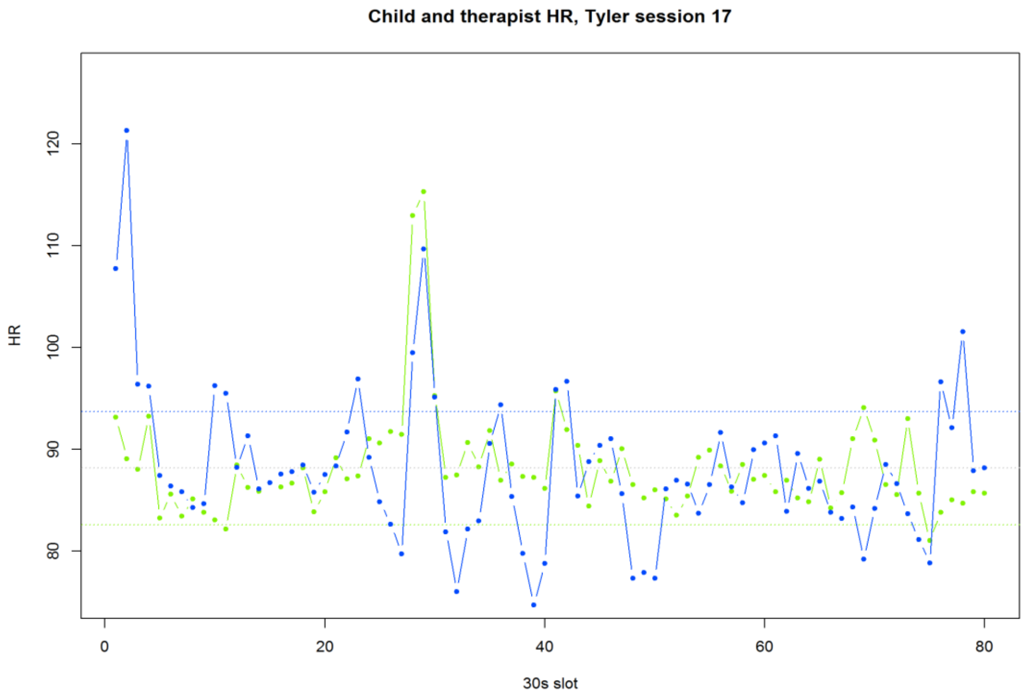

Figure 85. HR for Tyler and Therapist B for session 17. The child's HR is in blue and the therapist's HR is in green.

Pearson's Correlation Coefficients. Table 23 displays the Pearson's correlation coefficients for HR for session 17. The therapist (r=0.58; 95% CI (0.32, 0.86)) and the child (r=0.54; 95% CI (0.31, 0.69)) both show a similar, significant and positive autocorrelation for HR. The intercorrelation is also significant and positive (0.35; 95% CI (0.05, 0.66)) indicating a potentially synchronous relationship between the HR of therapist and child. The child-led lagged correlation (0.10; 95% CI (-0.18, 0.36)) and the therapist-led lagged correlation (0.28; 95% CI (-0.01, 0.59)) both fail to reach significance.

P-technique SEM. The path diagram (Figure 86) confirms that the autoregressive pathway for the child (0.48; 95% CI (0.2, 0.8) and therapist (0.63; 95% CI (0.3, 1.9) are positive and significant. The degree of autoregression is higher for the therapist. All other relationships are non-significant for the p-technique including the within-lag covariance (14.03; 95% CI (-1.7, 30.2)), the child-led lag (-0.09; 95% CI (-0.2, 0.1)) and the therapist-led lag (0.14; 95% CI (-0.2, 0.6)). Thus the p-technique fails to confirm the presence of a synchronous linkage between the HR of the therapist and child.

LOESS Plots. The LOESS smoother plots show a linear relationship for the simultaneous correlation (Appendix E. Figure 87) and therapist-led data (Appendix E. Figure 88) with a possible curvilinear relationship for the child-led lag (Appendix E. Figure 89).

PACF Plots. The PACF plots (Appendix E. Figure 90) show a strong lag=1 effect for the therapist and child autocorrelations. No significant lags are found for the therapist-led or child-led lag.

Table 23

Pearson correlation coefficients for HR and lagged HR for the therapist and child session 17

	thHR	thLagHR	chHR	chLagHR
thHR	1.00	0.58	0.35	0.10
thLagHR	0.58	1.00	0.28	0.36
chHR	0.35	0.28	1.00	0.54
chLagHR	0.10	0.36	0.54	1.00

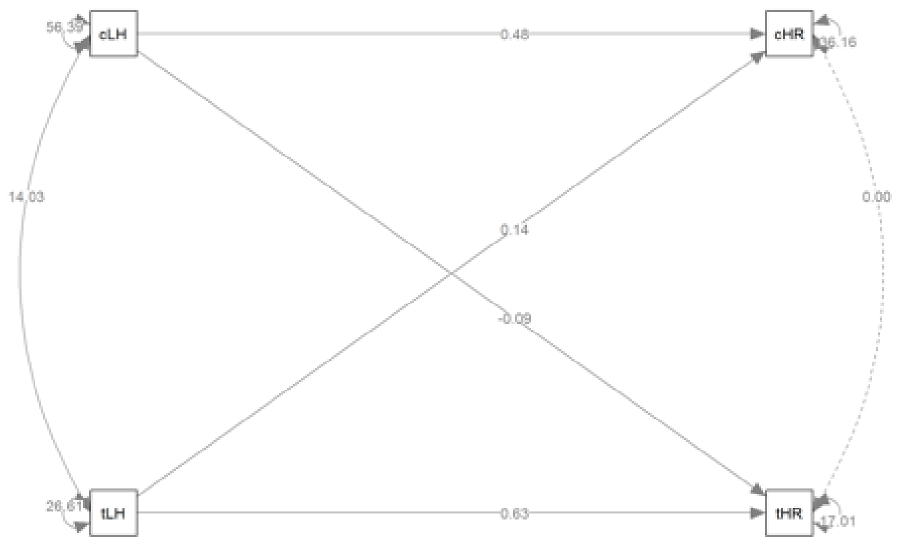

Figure 86. Path diagram for dynamic p-technique SEM for therapist and child's HR for a single lagged analysis session 17. A significant effect is evident for the child and therapist's autoregressive pathway (top and bottom horizontal path).

RSA Late Phase

Distribution of RSA. Tyler's RSA ranged from 3.2 to 7.3 with a mean RSA of 5.75 (SD 0.64). The therapist B's RSA ranged from 1.8 to 6.5 with a mean RSA of 4.26 (SD 0.23) (Figure 91).

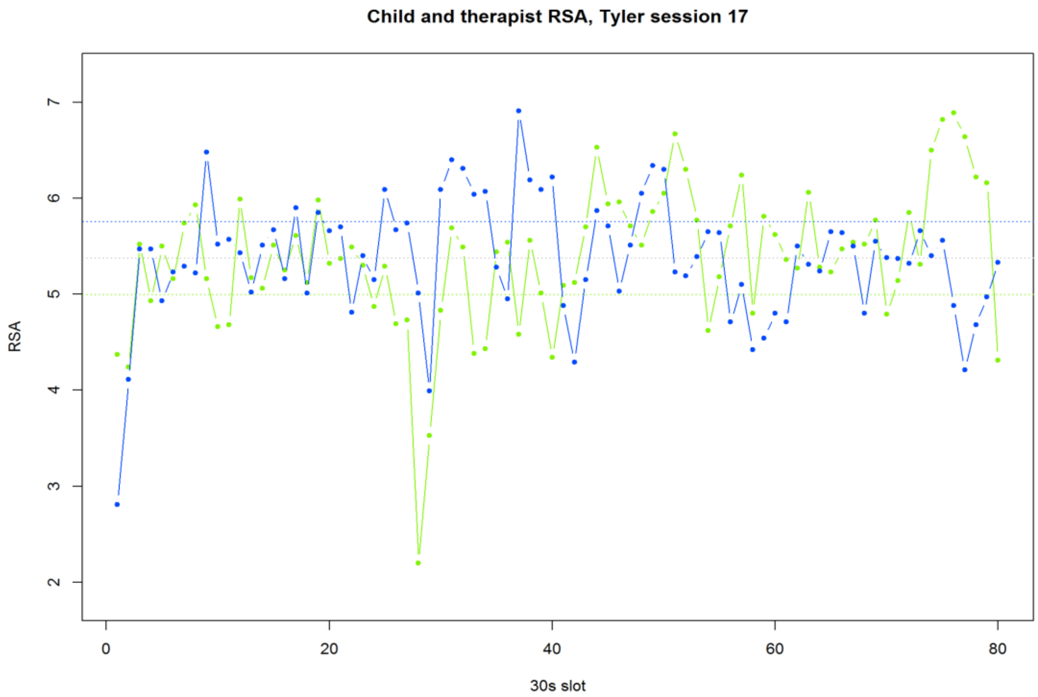

Figure 91. RSA for Tyler and Therapist B session 17. The child's RSA is in blue and the therapist's RSA is in green.

Pearson's Correlation Coefficients. Table 24 displays the Pearson's correlation coefficients for RSA for session 17. The correlations show that the therapist's RSA is significantly correlated with her RSA in the previous 30-seconds (r=0.51; 95% CI (0.31, 0.69)). The child's RSA is also significantly correlated with his RSA in the previous 30-seconds (r=0.42; 95% CI (0.16, 0.61)). The therapist's autocorrelation is higher than the child's, which indicates that the therapist's RSA changes more slowly than the child's for this session. All other correlations are non-significant including the intercorrelation (r=-0.02; 95% CI (-0.29, 0.27)), the child-led lagged correlation (r=-0.02; 95% CI (-0.24, 0.25)) and the therapist-led lagged correlation (r=0.00; 95% CI (-0.30, 0.38)).

P-technique SEM. The path diagram (Figure 92) confirms that the child (0.37; 95% CI (0.2, 0.6)) and the therapist's autoregressive pathways are significant (0.51; 95% CI

(0.3. 0.7)) with the therapist displaying a higher autoregression, unlike previous sessions in which the child's displayed a higher degree of autoregression. All other pathways are non-significant for RSA including the lagged covariance (0.02; 95% CI (-0.1, 0.1)), the child-led lag (-0.06; 95% CI (-0.3, 0.2)) and the therapist-led lag (-0.02; 95% CI (-0.3, 0.2)). Thus the p-technique confirms no linkages for RSA for session 17.

LOESS Plots. The LOESS smoother plots confirm a linear relationship for the simultaneous correlation (Appendix E. Figure 93) and child-led lag (Appendix E. Figure 95) and a possible curvilinear rather than linear relationship for the therapist-led lag (Appendix E. Figure 94).

PACF Plots. The PACF plots (Appendix E. Figure 96) show a strong lag=1 effect for the therapist and child autocorrelations. No significant lags are found for the child-led or therapist-led data.

Table 24

Pearson correlation coefficients between RSA and lagged RSA for the therapist and child session 17

	thRSA	thLagRSA	chRSA	chLagRSA
thRSA	1.00	0.51	-0.02	-0.02
thLagRSA	0.51	1.00	0.00	0.05
chRSA	-0.02	0.00	1.00	0.42
chLagRSA	-0.02	0.05	0.42	1.00

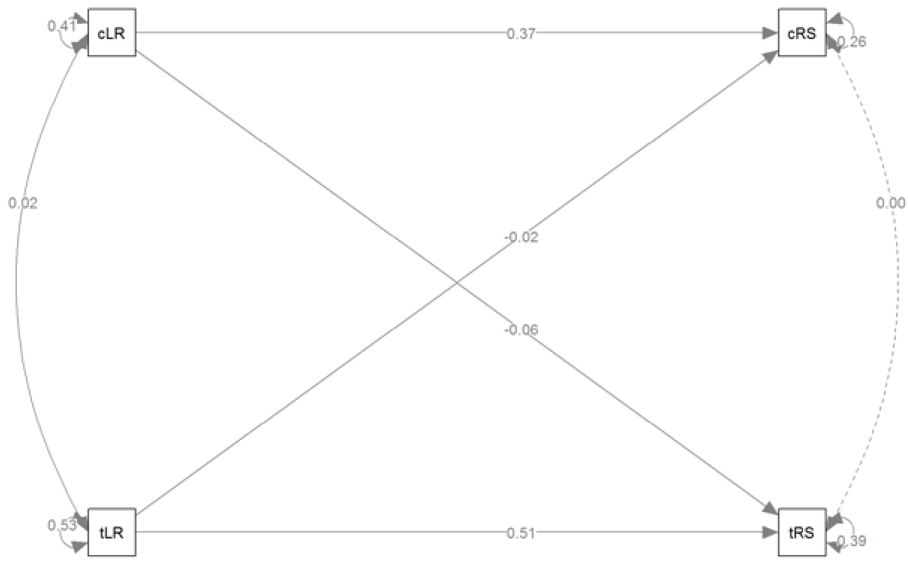

Figure 92. Path diagram for dynamic p-technique SEM for therapist and child's RSA for a single lagged analysis session 17. A significant effect is evident for the child and therapist's autoregressive pathway (top and bottom horizontal path).

Case Study 3 Summary and Interpretation

Tyler and Therapist B showed examples of cardiac linkage in the initial and early session. Session 1 evidenced a significant simultaneous linkage for HR and session 11 a simultaneous and child-driven linkage for HR. This indicates that in the initial session the child and therapist showed dynamic simultaneous changes in HR. In session 11 a similar pattern is observed although there is evidence that the child drives the interaction and the therapist responds to changes in the child's HR. Session 17 was the least synchronous of the 3 sessions with no cardiac linkages observed. No evidence of RSA linkage was found for any session outside of the autocorrelations or autoregressions. In the initial and early session Tyler enjoyed his interactions with the therapist and appeared interpersonal and playful. In session 1 and session 11 Therapist B's behaviour was described as sensitive and Tyler's behaviour as co-operative. As therapy progressed Tyler was observed to project increasing hostility toward the therapist and by the latter session, session 17, the therapist's behaviour was coded as controlling and the child's as difficult. The increased child difficulty and the loss of therapist sensitivity appear to be reflected in a lack of cardiac linkage for this session. Contrary to the previous sessions, the therapist's autocorrelation or autoregression for HR and RSA in session 17 is lower than the child's. Thus the therapist's cardiac physiology appears less flexible and less reactive in this session. The therapist is potentially less physiologically responsive and less socially engaged for this session, which has resulted in a loss of cardiac linkage.

Case Study 4: Josh and Therapist B

"You need to kill them before they kill you."- Josh

Sessions Analysed. Play therapy session 1 (first phase), session 6 (early phase) and session 15 (late phase) were chosen for analysis for Josh and Therapist B. 68 matched epochs were available for analysis for session 1 and 72 matched epochs for session 6 and 15.

Child History and School Observations. Josh was a round-faced, coy, 8-year old boy of white British descent. Josh was new to the school following several permanent exclusions due to aggression in previous schools. In the initial weeks Josh appeared nervous and kept a small teddy bear with him at all times. He constantly sought attention and reassurance from the class teachers and presented as timid and clingy and requested help with everything from tying his shoelaces to completing his schoolwork. In his interaction with adult staff he was observed to seek out close physical proximity and frequent eye contact. He sat directly in front of the class teacher during lessons and would assist the teacher in handing out pencils and packing away items at the end of each class. Josh was vigilant to his surroundings and would orientate to noise and notice if anyone raised their voice, moved suddenly, or entered the room. As the weeks progressed Josh was observed to become more vocal and would roam the school hall shouting, barking and making high-pitched screeching noises. When he joined in active play he quickly become sweaty and red-faced although insisted on wearing his jumper at all times. On several occasions he refused to participate in class and climbed onto a ledge in the classroom. Several outbursts of racist language were also observed. On several occasions Josh was physically restrained by teaching staff due to violent behaviour. Josh was reportedly exposed to domestic violence in his early years perpetrated by his father, with reports of subsequent family violence perpetrated by other partners of his mother. Josh's older siblings also experienced extreme behavioural disturbances and engaged in violence in the home. One older sibling had spent time a secure unit due to juvenile convictions. Josh's father was in prison for assaulting a child. Josh also had exposure to community violence, with a neighbour reportedly stabbed during a robbery. Following this incident Josh was reported to fear the dark and insisted on sleeping in the same room as his mother.

Therapy Overview. In therapy Josh presented as a flush-faced giggly boy. Josh was controlling in his play and tirelessly issued commands to the therapist. During therapy Josh's arousal appeared high and he shifted between over-the-top displays of positive affect such as exaggerated giggling, to strong displays of negative affect and displeasure. Session 1 was dominated by a long sequence of floor play in which Josh hid treasures in the sand and cooked and prepared pretend food. The session was punctuated by points of tension between the therapist and child, for example when the therapist set a limit on eating sand, Josh replied, "It's not your job to keep me safe. You can go now!" Session 6 consisted of long periods of setting-up or pre-play activity that did not develop into symbolic play, which was commonly observed across the first 10 sessions of therapy. Within therapy Josh was primarily concerned with disarming the therapist and issuing instructions rather than creating play narratives. Sessions 11 to 13 were distinct as Josh spent each of these sessions setting traps, emptying the contents of the playroom and stacking each item in the room against the door as a barricade, in a seemingly paranoid play sequence. There were also secretive and deceptive elements to his play where Josh instructed the therapist to look away, for example in session 16 Josh announced that he was going to do something "special" and hid the baby doll under the covers and insisted, "You're not allowed to see it!" Josh directed hostility and aggression toward the therapist that was both passive and overt. The trainee therapist utilised basic play therapy techniques such as tracking the child's play behaviour and verbalising his feelings, although she passively resisted Josh's commands, following them slowly or ignoring his requests.

Attachment Measures. Therapist B and Josh both exhibit a similar Type C strategy of attachment. Therapist B was coded by the AAI with a normative C1-2 strategy of attachment. Josh was coded by the CAPA with a more extreme C+ strategy of attachment (i.e. C5-6), which falls outside of a normative C1-2 pattern. This indicates that both Therapist B and Josh may have a tendency toward hyper-activating sympathetically dominant states of high arousal and a tendency to exaggerate negative affect and seek control in relationship. In the follow-up assessment Josh was coded with a C7-8 strategy of attachment, which indicates that his strategy of attachment deteriorated across the course of the intervention. The relationship between the therapist and Josh was coded using CARE-Index descriptors. For session 1 the therapist's behaviour was coded as sensitive and Josh's behaviour as difficult (co-operative). For session 6 the therapist's behaviour was coded as primarily controlling and Josh's behaviour as difficult (co-operative). For session 15 the therapist's behaviour was coded as unresponsive and the child's behaviour as difficult (oppositional). Thus as the child's difficulty increased the therapist was observed to become less sensitive and more controlling and eventually unresponsive across the course of therapy.

First Phase (Session 1)

Heart Rate

Distribution of HR. Josh's HR ranged from 96.3 to 120.1 with a mean HR of 104. 96 (SD 4.9). Therapist B's HR ranged from 75.0 to 97.5 with a mean HR of 84.1 (SD 5.52) (Figure 97).

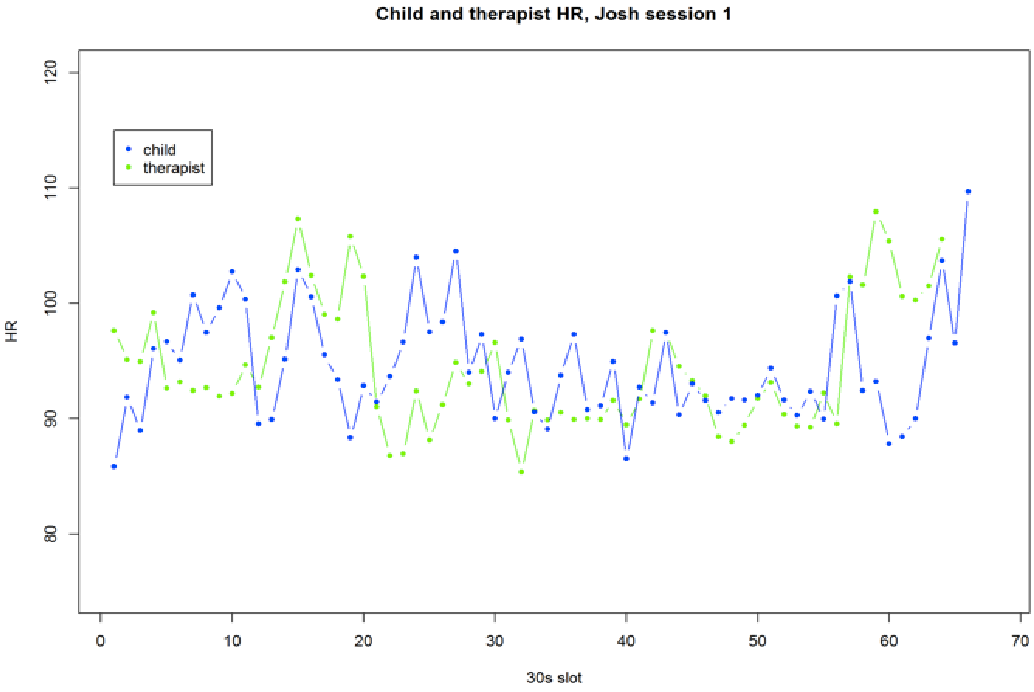

Figure 97. HR for Josh and Therapist B for session 1. The child's HR is in blue and the therapist's HR is in green.

Pearson's Correlation Coefficients. Table 25 displays the Pearson's correlation coefficients for HR for session 1. The therapist (r=0.72; 95% CI (0.56, 0.84)) and the child (r=0.40; 95% CI (0.19, 0.56)) both show a significant autocorrelation for HR. The degree of autocorrelation is higher for the therapist than child, which suggests that the therapist's HR changes more slowly across the session than the child's HR. No other correlations were significant including the intercorrelation (r=0.10; 95% CI (-0.17, 0.38)), the child-led lagged correlation (r=0.05; 95% CI (-0.17, 0.28)) or the therapist-led lagged correlation (r=-0.06; 95% CI (-0.32, 0.23)).

P-technique SEM. The path diagram (Figure 98) confirms that the therapist's autoregressive pathway (0.77; 95% CI (0.6, 1.0)) is higher than the child's autoregressive pathway (0.40; 95% CI (0.2, 0.6)). Both positive pathways are significant. All other effects are non-significant including the lagged covariance (0.42; 95% CI (-5.7, 6.6)), the child-led lag (0.04; 95% CI (-0.2, 0.2)) and the therapist-led lag (-0.05; 95% CI (-0.3, 0.1)). The only significant effects for the p-technique SEM for session 1 are the autoregressive pathways. No significant effects were found for the relationship between therapist and child's HR data.

LOESS Plots. The LOESS smoother plots show a weak linear relationship for the simultaneous correlation (Appendix E. Figure 99) and therapist and child-led lags (Appendix E. Figure 100 and 101).

PACF Plots. The PACF plots (Appendix E. Figure 102) show a strong lag=1 effect for the therapist and child autocorrelations. No significant lags are found for the child-led or therapist-led lags.

Table 25

Pearson correlation coefficients for HR and lagged HR for the therapist and child session 1

	thHR	thLagHR	chHR	chLagHR
thHR	1.00	0.75	0.10	0.05
thLagHR	0.75	1.00	-0.06	0.02
chHR	0.10	-0.06	1.00	0.40
chLagHR	0.05	0.02	0.40	1.00

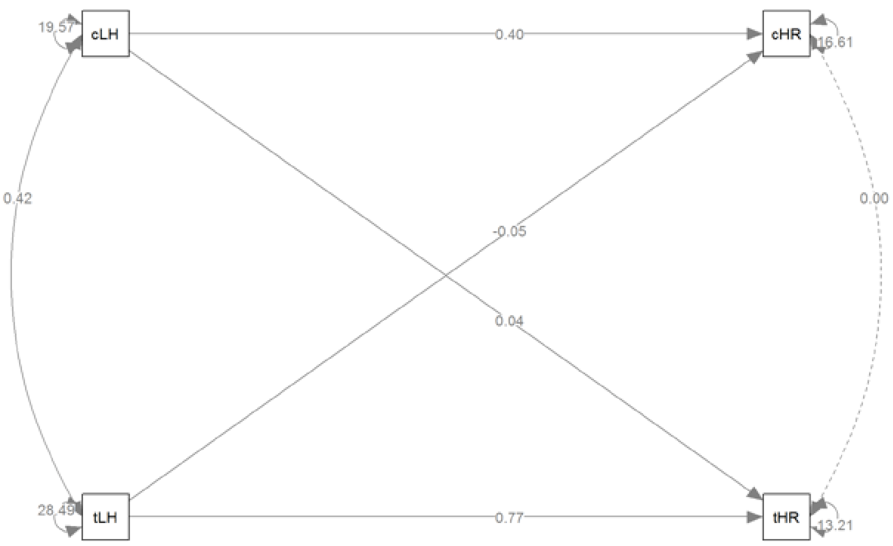

Figure 98. Path diagram for dynamic p-technique SEM for therapist and child's HR for a single lagged analysis session 1. A significant effect is evident for the child and therapist's autoregressive pathways (top and bottom horizontal path).

RSA First Phase

Distribution of RSA. Josh's RSA ranged from 5 to 7.6 with a mean RSA of 6.34 (SD 0.64). The therapist's RSA ranged from 3 to 5.6 with a mean RSA during the session of 4.49 (SD 0.61).

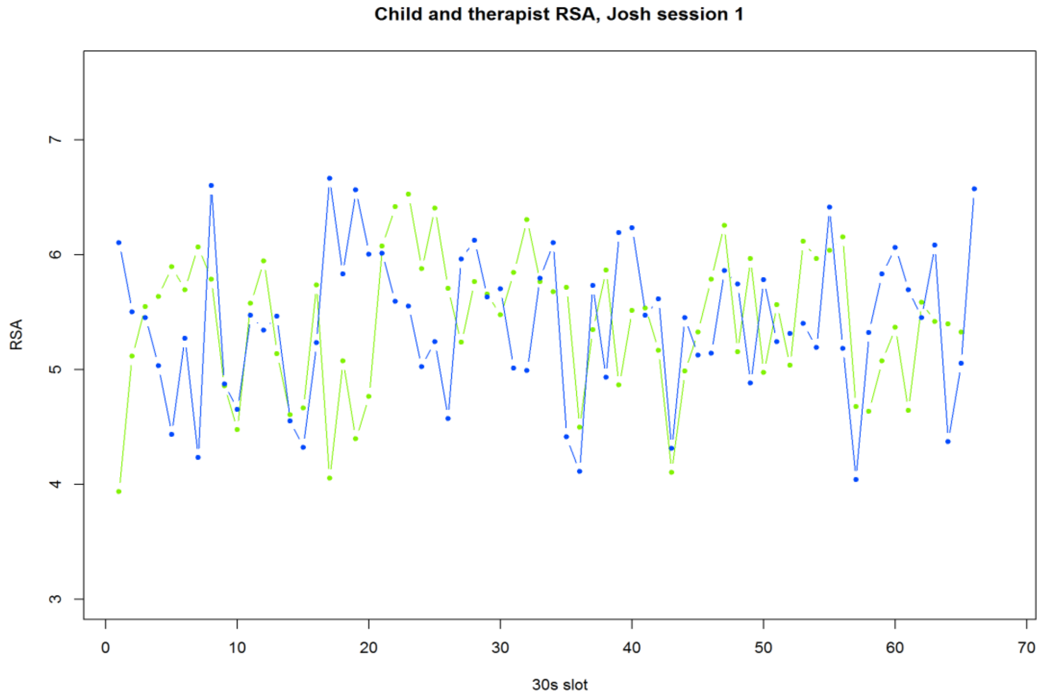

Figure 103. RSA for Josh and Therapist B for session 1. The child's RSA is in blue and the therapist's RSA is in green.

Pearson's Correlation Coefficients. Table 26 displays the Pearson's correlation coefficients for RSA for session 1. The correlations show that the therapist's correlation is significantly correlated with her RSA in the previous 30-seconds (r=0.33; 95% CI (0.12, 0.51)). The child's correlation is also significantly correlated with his RSA in the previous 30-seconds (r=0.10; 95% CI (-0.16, 0.32)). The therapist's autocorrelation is higher than the child's, which indicates that the therapist's RSA changes more slowly than the child's across time. All other correlations for RSA are non-significant including the intercorrelation (r=0.03; 95% CI (-0.30, 0.33)), the child-led cross-correlation (r=0.09; 95% CI (-0.13, 0.32)), and the therapist-led cross-correlation (r=-0.07; 95% CI (-0.27, 0.15)).

P-technique SEM. The path diagram (Figure 104) confirms that the child's autoregressive pathway (0.08; 95% CI (-0.2, 0.3) and the therapist's autoregressive pathways are significant (0.31; 95% CI (0.1, 0.5)). The degree of autoregression is higher for the therapist than the child. All other pathways are non-significant for RSA including the lagged covariance (0.00; 95% CI (-0.1, 0.1)), the child-led lag (0.08; 95% CI (-0.1, 0.3)) and the therapist-led lag (-0.07; 95% CI (-0.3, 0.1)).

LOESS Plots. The LOESS smoother plots show a weak linear relationship for the simultaneous correlation (Appendix E. Figure 105) and therapist and child-led lags (Appendix E. Figure 106 and Figure 107).

PACF Plots. The PACF plots (Appendix E. Figure 108) show a strong lag=1 effect for the therapist and child autocorrelations. No other significant lag effects are evident.

Table 26

Pearson correlation coefficients between RSA and lagged RSA for the therapist and child session 1

	thRSA	thLagRSA	chRSA	chLagRSA
thRSA	1.00	0.33	0.03	0.09
thLagRSA	0.33	1.00	-0.07	-0.01
chRSA	0.03	-0.07	1.00	0.10
chLagRSA	0.09	-0.10	0.10	1.00

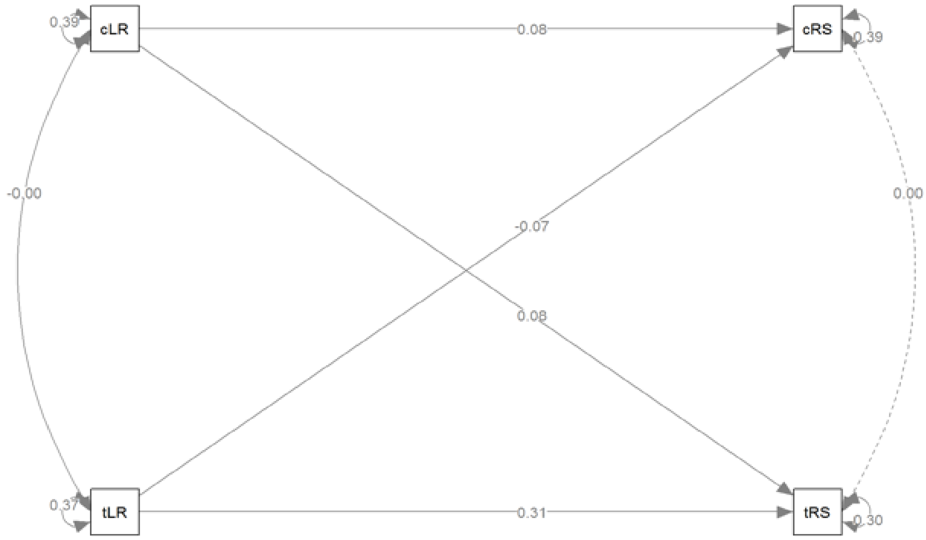

Figure 104. Path diagram for dynamic p-technique SEM for therapist and child's RSA for a single lagged analysis session 1. A significant effect is evident for the child and therapist's autoregressive pathways (top and bottom horizontal path).

Early Phase (Session 6)

Heart Rate

Distribution of HR. Josh's HR ranged from 96.6 to 135.8 with a mean HR of 113.85 (SD 8.08). The therapist's HR ranged from 71.3 to 108.0 with a mean HR of 79.3 (SD 5.49) (Figure 109).

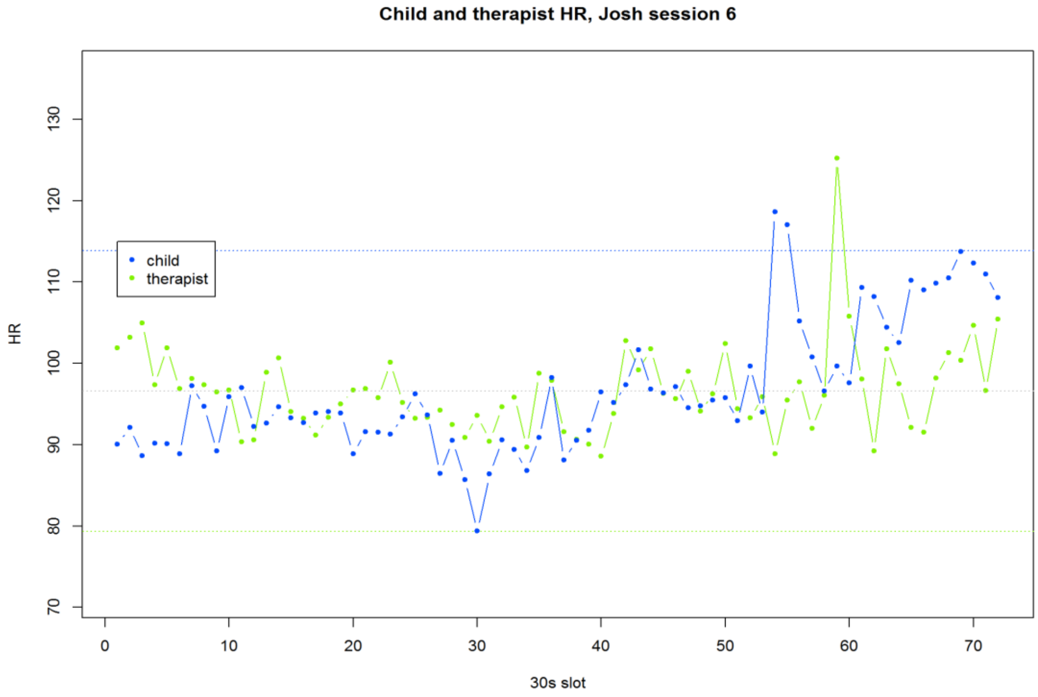

Figure 109. HR for Josh and Therapist B for session 6. The child's HR is in blue and the therapist's HR is in green.

Pearson's Correlation Coefficients. Table 27 displays the Pearson's correlation coefficients for HR for session 6. The therapist (r=-.33; 95% CI (0.12, 0.54)) and child (r=0.80; 95% CI (0.59, 0.89)) both show a significant autocorrelation for HR. The degree of autocorrelation is higher for the child than the therapist, which suggests that the child's HR changes more slowly than the therapist's from epoch to epoch. No other correlations are significant including the intercorrelation (r=0.15; 95% CI (-0.11, 0.35)), the child-led cross-correlation (r=0.19; 95% CI (-0.01, 0.41)) and the therapist-led cross-correlation (r=0.14; 95% CI (-0.11, 0.35)).

P-technique SEM. The path diagram (Figure 110) shows that the child's autoregressive pathway (0.80; 95% CI (0.7, 0.9)) is higher that the therapist's autoregressive pathway (0.32; 95% CI (0.2, 0.5)). Both positive pathways are significant. The lagged covariance is not significant (4.8; 95% CI (-4.2, 13.8)) nor is the therapist-led lag (0.11; 95% CI (-0.2, 0.3)) or the child-led lag (0.07; 95% CI (0.0, 0.2)). Thus no linkage for HR for session 6 is evident for the correlations or the p-technique.

LOESS Plots. The LOESS smoother plots confirm a weak linear relationship for the simultaneous correlation (Appendix E. Figure 111) and therapist and child-led lags (Appendix E. Figure 112 and Figure 113).

PACF Plots. The PACF plots (Appendix E. Figure 114) show a strong lag=1 effect for the therapist and child autocorrelations. No significant lags are evident for the child or therapist-led data.

Table 27

Pearson correlation coefficients for HR and lagged HR for the therapist and child session 1

	thHR	thLagHR	chHR	chLagHR
thHR	1.00	0.33	0.15	0.19
thLagHR	0.33	1.00	0.14	0.11
chHR	0.15	0.14	1.00	0.80
chLagHR	0.19	0.11	0.80	1.00

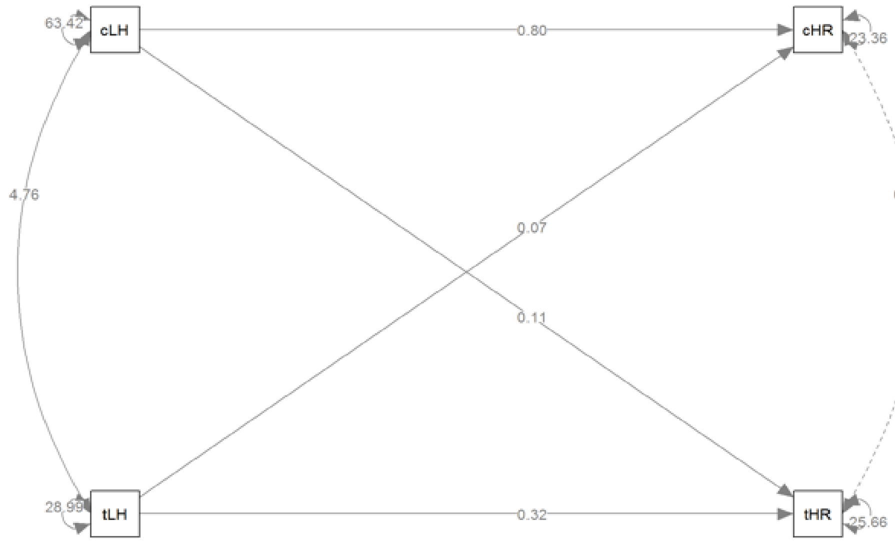

Figure 110. Path diagram for dynamic p-technique SEM for therapist and child's HR for a single lagged analysis session 6. A significant effect is evident for the child and therapist's autoregressive pathways (top and bottom horizontal path).

RSA Early Phase

Distribution of RSA. Josh's RSA ranged from 4 to 7.3 with a mean RSA for session 6 of 5.82 (SD 0.78). The therapist's RSA ranged from 2.8 to 6.7 with a mean RSA of 5.29 (SD 0.65) (Figure 115).

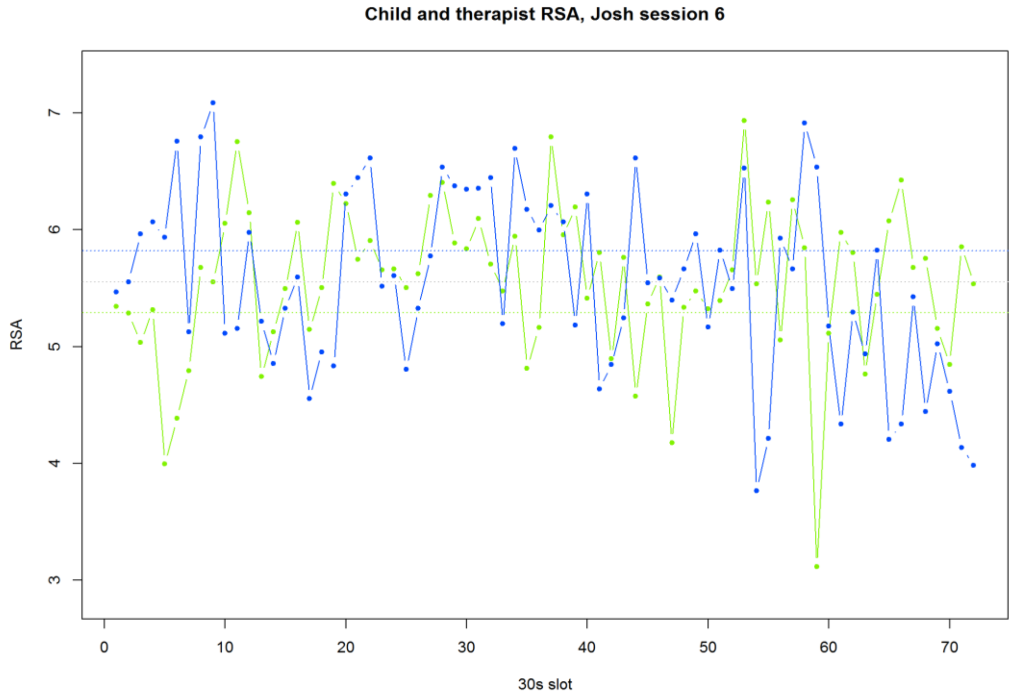

Figure 115. RSA for Josh and Therapist B for session 6. The child's RSA is in blue and the therapist's RSA is in green.

Pearson's Correlation Coefficients. Table 28 displays the Pearson's correlation coefficients for RSA for session 6. The correlations show that the therapist's correlation is significantly correlated with her RSA in the previous 30-seconds (r=0.22; 95% CI (0.04, 0.42)). The child's correlation is also significantly correlated with his RSA in the previous 30-seconds (r=0.35; 95% CI (0.09, 0.55)). Both autocorrelations are significant. The therapist's autocorrelation is higher than the child's, which indicates that the therapist's RSA changes to a lesser degree across time than the child's for this session. All other correlations for RSA are non-significant including the intercorrelation (r=-0.06; 95% CI (-0.28, 0.18)), the child-led lagged correlation (r=-0.18; 95% CI (-0.40, 0.04)) and the therapist-led lagged correlation (r=0.07; 95% CI (-0.23, 0.28)).

P-technique SEM. The path diagram (Figure 116) confirms that both the child's autoregressive pathway (0.36; 95% CI (0.1, 0.6)) and the therapist's autoregressive pathway is significant (0.22; 95% CI (0.0, 0.4)). The degree of autoregression is higher for the therapist. All other pathways are non-significant for RSA including the within-lag covariance (-0.03; 95% CI (-0.1, 0.1)), the child-led lag (-0.14; 95% CI (-0.4, 0.1)), and the therapist-led lag (0.11; 95% CI (-0.2, 0.4)). Thus there are no statistically significant linkages for RSA for session 6.

LOESS Plots. The LOESS smoother plots confirm a weak linear relationship for the simultaneous correlations (Appendix E. Figure 117) and therapist and child-led lags (Appendix E. Figure 118 and Figure 119).

PACF Plots. The PACF plots (Appendix E. Figure 120) show a strong lag=1 effect for the child's autocorrelation. No significant lags are found for the therapist's autocorrelation or the child or therapist-led data.

Table 28

Pearson correlation coefficients between RSA and lagged RSA for the therapist and child session 6

	thRSA	thLagRSA	chRSA	chLagRSA
thRSA	1.00	0.22	-0.06	-0.18

thLagRSA	0.22	1.00	0.07	-0.06
chRSA	-0.06	0.07	1.00	0.35
chLagRSA	-0.18	-0.06	0.35	1.00

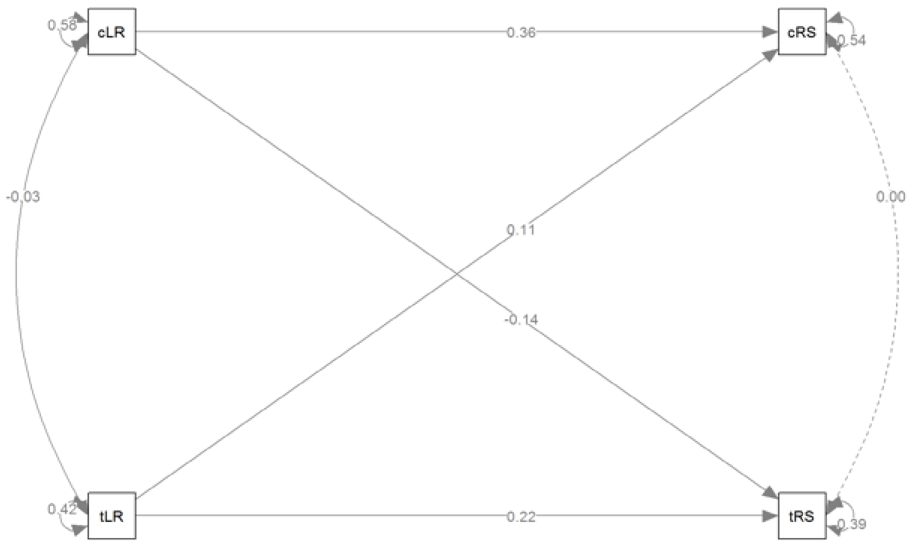

Figure 116. Path diagram for dynamic p-technique SEM for therapist and child's RSA for a single lagged analysis session 6. A significant effect is evident for the child and therapist's autoregressive pathways (top and bottom horizontal path).

Late Phase (Session 15)

Heart Rate

Distribution of HR. Josh's HR ranged from 87.9 to 124.1 with a mean HR of 101.42 (SD 7.09). The therapist's HR ranged from 79.2 to 103.6 with a mean HR of 88.0 (SD 6.14) (Figure 121).

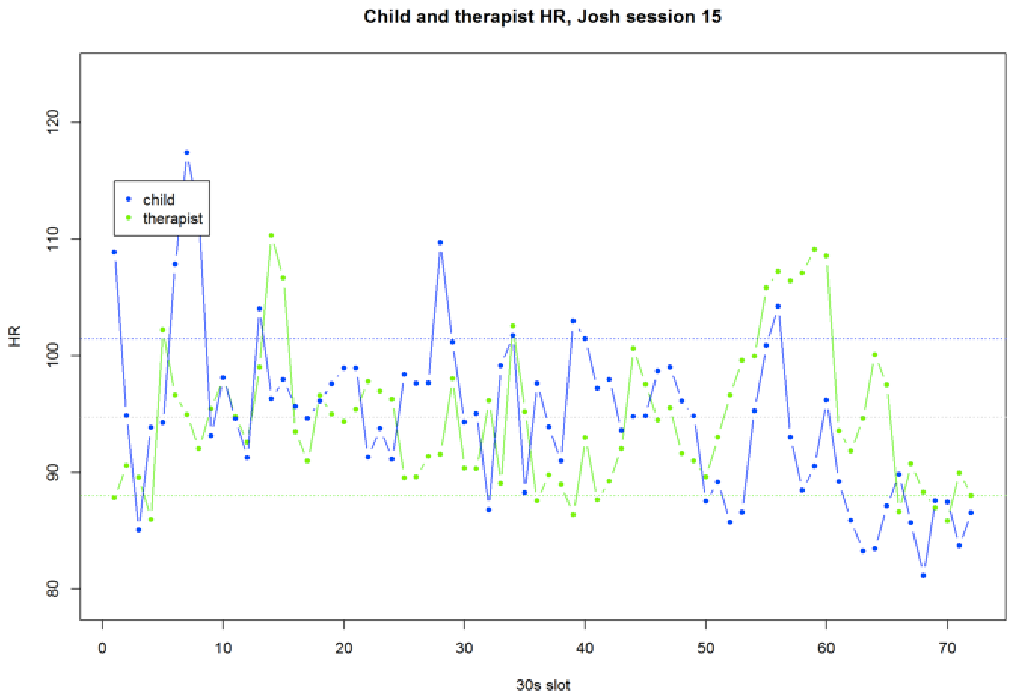

Figure 121. HR for Josh and Therapist B for session 15. The child's HR is in blue and the therapist's HR is in green.

Pearson's Correlation Coefficients. Table 29 displays the Pearson's correlation coefficients for HR for session 15. The therapist (r=0.62; 95% CI (0.39, 0.77)) and child (r=0.56; 95% CI (0.36, 0.72)) both show a significant autocorrelation for HR. The degree of autocorrelation is higher for the therapist than the child, which suggests that the therapist's HR changes more slowly than the child's. No other correlations are significant including the intercorrelation (r=0.12; 95% CI (-0.08, 0.31)), the child-led cross-correlation (r=0.15; 95% CI (-0.07. 0.36)) and the therapist-led cross-correlation (r=0.12; 95% CI (-0.08, 0.31)).

P-technique SEM. The path diagram (Figure 122) confirms that both the therapist (0.61; 95% CI (0.4, 0.8)) and the child's autoregressive pathways (0.55; 95% CI (0.3, 0.8)) are significant. The degree of autoreggression is higher for the therapist. All other effects are non-significant including the within-lag covariance (2.98; 95% CI (-5.2, 11.3)), the child-led lag (0.09; 95% CI (-0.1, 0.2)) and the therapist-led lag (0.09; 95% CI (-0.1, 0.3)). Thus there is no significant linkage for HR for session 15.

LOESS Plots. The LOESS smoother plots confirm a weak linear relationship for the simultaneous correlations (Appendix E. Figure 123) and therapist and child-led lags (Appendix E. Figure 124 and Figure 125).

PACF Plots. The PACF plots (Appendix E. Figure 126) show a strong lag=1 effect for the child and therapist's autocorrelations. No other significant lags are found with the exception of an atypical negative lag=3 effect for the therapist-led lag.

Table 29

Pearson correlation coefficients for HR and lagged HR for the therapist and child session 15

	thHR	thLagHR	chHR	chLagHR
thHR	1.00	0.62	0.12	0.15
thLagHR	0.62	1.00	0.12	0.07
chHR	0.12	0.12	1.00	0.56
chLagHR	0.15	0.07	0.56	1.00

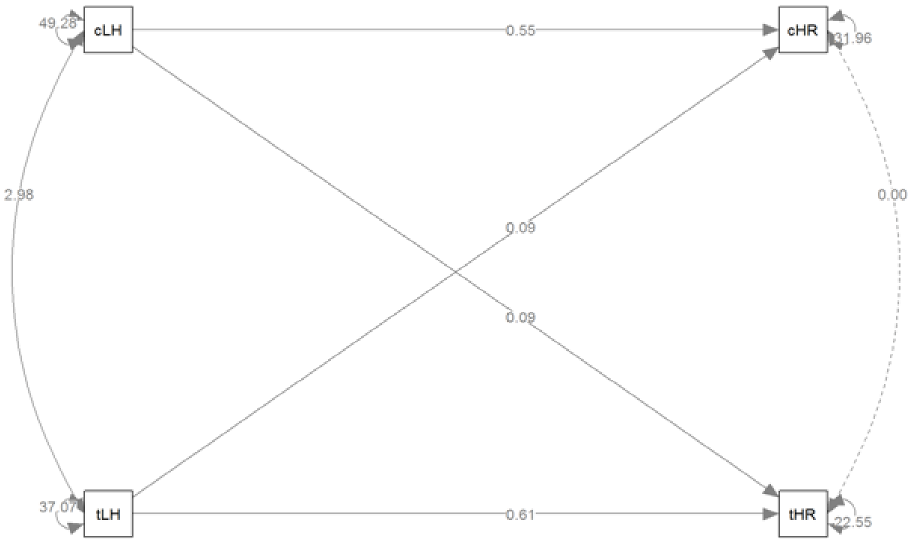

Figure 122. Path diagram for dynamic p-technique SEM for therapist and child's HR for a single lagged analysis session 15. A significant effect is evident for the child and therapist's autoregressive pathways (top and bottom horizontal path).

RSA Late Phase

Distribution of RSA. Josh's RSA ranged from 4 to 8.3 with a mean RSA of 6.52 (SD 0.96). The therapist's RSA ranged from 1.4 to 5.0 with a mean RSA of 3.73 (SD 0.7) (Figure 127).

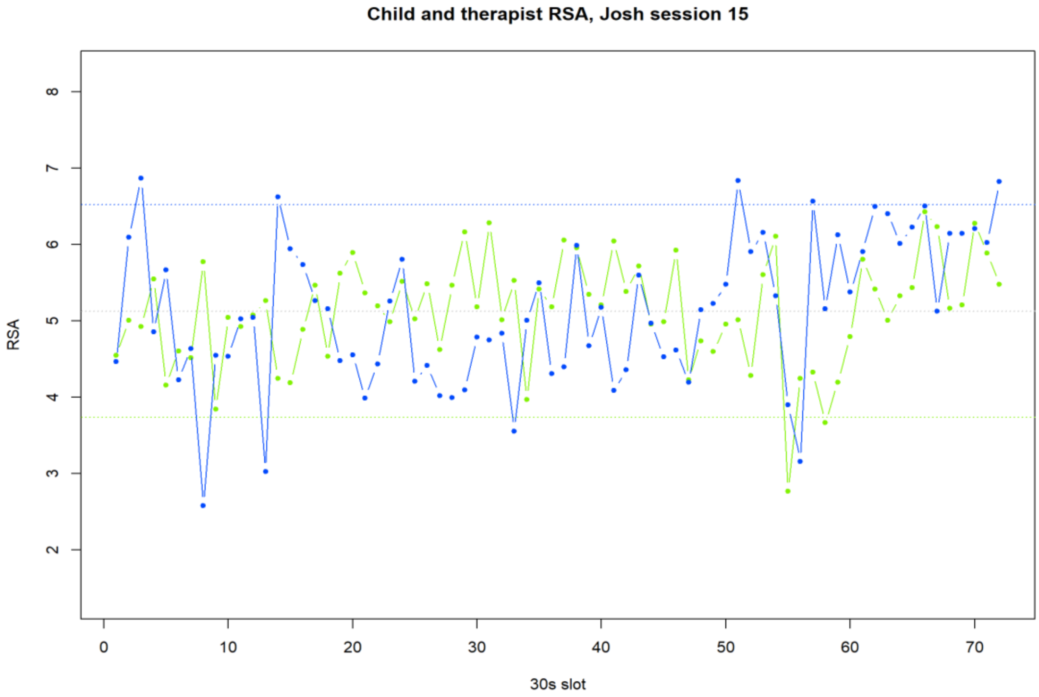

Figure 127. RSA for Josh and Therapist B for session 15. The child's RSA is in blue and the therapist's RSA is in green.

Pearson's Correlation Coefficients. Table 30 displays the Pearson's correlation coefficients for RSA for session 15. The only significant correlation for session 15 is the child's autocorrelation (r=0.36; 95% CI (0.08, 0.54)). All other correlations fail to reach significant including the therapist's autocorrelation (r=0.21, -0.08, 0.43)), the intercorrelation (r=0.02; 95% CI (-0.21, 0.27)), the child-led lagged correlation (0.17; 95% CI (-0.11, 0.43)), and the therapist-led lagged correlation (r=0.05; 95% CI (-0.19, 0.33)).

Table 30

Pearson correlation coefficients between RSA and lagged RSA for the therapist and child session 15

	thRSA	thLagRSA	chRSA	chLagRSA

thRSA	1.00	0.21	0.02	0.17
thLagRSA	0.21	1.00	0.05	0.02
chRSA	0.02	0.05	1.00	0.36
chLagRSA	0.17	0.02	0.36	1.00

P-technique SEM. The path diagram (Figure 128) confirms that the only significant effect is the child's autoregressive pathway (0.37; 95% CI (0.1, 0.6)). All other effects: the therapist's autoregressive pathway (0.20; 95% CI (0.0, 0.4)), the lagged covariance (0.01; 95% CI (-0.1, 0.2)), the child-led lag (0.12; 95% CI (-0.1, 0.3)) and the therapist-led lag (0.05; 95% CI (-0.3, 0.4)) are non-significant for RSA for session 15. There are no significant linkages for RSA for session 15.

LOESS Plots. The LOESS smoother plots confirm a weak linear relationship for the simultaneous correlation (Appendix E. Figure 129) and the therapist-led lag (Appendix E. Figure 130) and a tendency toward a curvilinear rather than linear relationship for the child-led lag (Appendix E. Figure 131).

PACF Plots. The PACF plots (Appendix E. Figure 132) show a strong lag=1 effect for the child's autocorrelation. No other lag effects are evident.

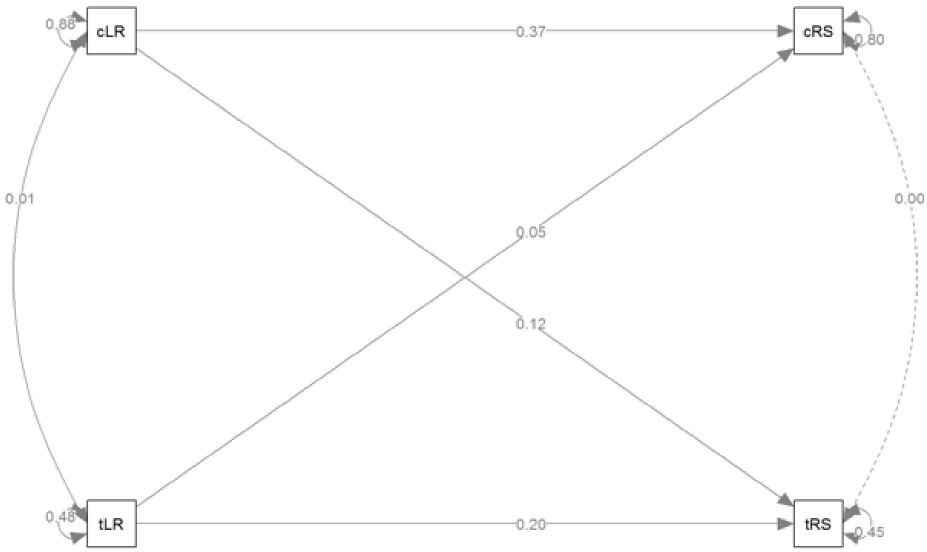

Figure 128. Path diagram for dynamic p-technique SEM for therapist and child's RSA for a single lagged analysis session 15. A significant effect is only evident for the child autoregressive pathway (top horizontal path).

Case Study 4 Summary & Interpretation

As for the previous dyads, case study 4 shows significant positive autocorrelation/autoregression effects for HR and RSA for the therapist and child across all 3 sessions analysed, with the exception of the therapist's autocorrelation/ autoregression for RSA for session 15, which inexplicable fails to show a significant effect. However unlike the previous case studies, the autocorrelation/ autoregression is typically higher for the therapist, which suggests that the therapist's HR and RSA is less flexible and changes more slowly, from epoch to epoch in comparison to the child. This may indicate that the therapist is less physiologically engaged, or that the child has an over-reactive physiological profile in comparison. Unlike the other case studies there are no examples of cardiac linkage for HR or RSA confirmed by both the correlations and the p-technique SEM. The therapist and child's cardiac physiology appears to respond independently of each other and there is no evidence of a co-regulation of overall arousal as indicated by HR linkage, or a co-regulation of parasympathetic processes as indicated by RSA linkage. The absence of linkages suggests that this dyad is the least synchronous of the therapy dyads examined. Of the four dyads Josh experienced the most disturbed strategy of attachment that worsened across the course of therapy.

In CARE-Index terms Josh's behaviour was also observed to be difficult for all three sessions. In response, the therapist was observed to be initially sensitive, but as therapy progressed her behaviour became increasingly controlling and eventually unresponsive. The child's extremely disturbed pattern of attachment may indicate that Josh has an atypically functioning vagal brake and a disturbed social engagement biology that has compromised the formation of cardiac linkages. In response to this attachment strategy the trainee therapist has struggled to maintain a sensitive and empathetic stance and appears to be both psychologically and physiological distant from the child. One of the difficulties of working therapeutically with a child with C+ strategy is that they may give the appearance of positive social engagement, although this may be accompanied by veiled threat or deception, which may make true empathy especially challenging for a novice therapist.

Discussion

This exploratory study provides a unique contribution to the field of play therapy research as it examined the novel application of HR and RSA to naturalistic play therapy research and captures the play therapy process as it is actually practiced by trainee therapists in the real world with real-time physiological data. The study utilised within-dyad analysis to examine dynamic cardiac synchrony on a moment-by-moment basis within several complex case studies. It is the first known study to examine physiological linkage within play therapy dyads. Linear-based measures including correlations and a structural equation modeling of the dynamic p-technique were used to measure the dynamic linkage between a child and therapist's cardiac data for each session analysed. The findings indicate that it is possible to measure physiological linkage within child-centered play therapy dyads at the level of the heart, although the observed effects must be interpreted with caution due to a number of limitations including a lack of a control group, low statistical power and several threats to internal validity. The primary research question was to establish whether play therapists and children do exhibit a moment-by-moment linkage or synchrony in dynamic changes in HR and RSA within therapy. It was initially hypothesised that:

A. Play therapy dyads would show evidence of positive linkage for HR and RSA.

B. A co-occurring linkage for HR and RSA would be the most desirable linkage signifying a dynamic play state.

C. RSA linkage would increase across the course of play therapy indicating an increasingly positive social connection between a therapist and child.

D. The presence of a negative synchrony or an absence of synchrony would suggest a less attuned pattern of interaction between a therapist and child.

The results are the first to show that play therapists and children do exhibit a synchrony in dynamic changes in HR and RSA within therapy sessions - although this was not consistently observed for all sessions or for all dyads. Of the 11 sessions analysed a positive cardiac linkage was observed in 5 sessions. A greater number of linkages were observed for HR than RSA. Three of the 4 dyads showed examples of HR synchrony and one of the 4 dyads (Billy & Therapist A) showed evidence of HR and RSA synchrony. Therapist A and Billy had the highest number of linkages of the 4 case studies and were therefore the most synchronous dyad. The late session for Billy and Therapist A showed a co-occurring linkage for HR and RSA, which it was hypothesised would be the most positive and adaptive linkage as this would indicate that the dyad was adaptively co-regulating arousal via parasympathetic or vagal processes, which would allow the dyad to maintain a social engaged state and may exemplify a dyadic state of dynamic social play. This session was observed to be a mutually joyful and playful session and the dyad was coded with a sensitive therapist and a co-operative child, an ideal pattern of interaction, which provides support to the hypothesis that a combined HR and RSA linkage is associated with a greater connectedness, more adaptive interactions and dynamic social play.

The least synchronous dyad (Josh & Therapist B) showed no evidence of any linkage for HR or RSA. It was hypothesised that an absence of synchrony would suggest a less attuned pattern of interaction between a therapist and child. Of the 4 case studies Josh also showed the most extreme pattern of insecure attachment, which suggests that Josh may have a greater disturbance in his autonomic functioning which may have compromised the formation of cardiac linkages. The autocorrelation/autoregression effects for HR and RSA were higher for Therapist B than Josh, whereas in the other therapy dyads the child typically displayed slower changes in HR and RSA over time.

This may indicate a lack of physiological responsiveness and a lack of engagement on the part of the therapist, or that Josh had an overly labile cardiac reactivity.

The statistical and mathematical methods utilised in this study allowed for the identification of three possible linkages: a simultaneous linkage, a child-driven linkage or a therapist-driven linkage for HR and RSA. The most commonly observed linkage was a positive simultaneous linkage for HR, which occurred on 5 occasions. A positive child-driven linkage for HR was also observed for 2 sessions. Thus the HR of the therapist and child were equally influenced by each other, with some instances of a child-to-therapist direction of influence where the therapist's HR mirrored the child's HR at a lag of 30-seconds, which theoretically may be associated with therapist empathy. No examples of a positive therapist-driven regulatory linkage were observed. It was initially conjectured that a therapist-driven linkage might indicate that a therapist was leading an interaction in a bid to regulate a child, although this pattern was not observed. It is possible that therapist-driven regulation may be an advanced clinical skill not yet mastered by the trainee therapists in the present study.

Only one session showed a linkage for RSA. It was originally hypothesised that RSA linkage would be integral to play therapy practice and would increase across the course of therapy, indicating an increasing positive social connection between a therapist and child, although no evidence was found to support these hypothesises. The lack of linkage for RSA indicates that there was little co-regulation of parasympathetic processes for the observed dyads, which may be attributed to potential disruptions in the functioning of the vagal system in this at-risk sample. With highly traumatised children it may not be possible to co-regulate parasympathetic processes. With these children the initial goal of therapy may not be to obtain RSA synchrony, but rather for the therapist to increase or maintain her own parasympathetic tone to ensure that she is operating from her parasympathetically driven social engagement biology, irrespective of the autonomic state of the child client.

Children who've experienced adverse childhood experiences especially exposure to domestic violence, have been shown to have an atypical response to stress and a poorly functioning vagal brake (Katz, 2007). A higher degree of externalising difficulties has also been associated with poor vagal functioning and atypical parasympathetic responses (Calkins et al., 2007; Hastings et al., 2008; Hinnant & El-Sheikh, 2009). Linkages were more commonly observed for HR, indicating that there was some synchrony or co-regulation of overall arousal between a therapist and child. It is possible that the sympathetic fight, flight system was more active than the parasympathetic social engagement system within these dyads. Typically sympathetic mobilisation will reduce access to the parasympathetically driven social engagement system (Ogden et al., 2006). Helm and colleagues (2014) propose that higher quality dyads may show a synchrony in parasympathetic measures such as RSA, while low quality, or stressed dyads, may show a synchrony in sympathetic measures. It is possible that the dyads in the present study are less parasympathetically driven, less socially engaged, more stressed and more sympathetically driven. However, since HR reflects overall arousal and is influenced by both the PNS and the SNS it is not possible to determine if the simultaneous changes in HR within the studied dyads are due to sympathetic or other processes. SNS specific measures would need to be incorporated into future studies to examine these speculations.

It is also likely that individual differences in the quality of each therapist-child relationship played an important part in the frequency of cardiac synchrony observed. Both therapists were observed to be inconsistently sensitive towards their child clients and tended towards unresponsiveness (Therapist A) or over-control (Therapist B). Therapist sensitivity may have been constrained by a number of factors including the therapist's inexperience, the stress of being monitored, and the therapist's own attachment security. Neither trainee therapist displayed a secure strategy of attachment as assessed by the AAI. The study highlights how a therapist's own attachment security may be a significant determinant of therapist sensitivity and a therapist's ability to manage her own arousal and autonomic responsiveness, especially if a therapist and client display similar attachment insecurities and a propensity for either autonomic over-arousal (Type C) or under-arousal (Type A). The dyads in the present study showed complementary strategies of attachment with a Type A therapist paired with Type A children, and a Type C therapist paired with Type C children. A match in a therapist and child's strategy of attachment may weaken co-regulation or cardiac synchrony, given that the therapist and child have a similar predisposition for immobilisation defences (Type A) or sympathetically driven mobilisation defences (Type C).

In this study the avoidant Type A dyads were less emotionally engaged and the ambivalent Type C dyads showed a greater degree of conflict and tension. The children using a Type C strategy also displayed more violent and aggressive play themes and directed more overt hostility toward the therapist. Overall, the conflicted Type C dyads displayed fewer linkages than the avoidant Type A dyads. One example of a negative therapist-driven linkage was observed during Therapist A's initial encounter with Eli, a silent child. A negative synchrony for HR was proposed to reflect a disrupted connection, given that negative synchrony in mother-child dyads is typically associated with relationship ruptures and a disrupted co-regulation. In addition almost half of the sessions analysed showed no linkage for HR or RSA, which suggests that for these sessions the therapist and child were unable to obtain a consistent co-regulation of cardiac arousal for HR or RSA. Overall the dyads in the present study were inconsistent in their ability to form cardiac linkages. Less experienced and insecurely attached therapists are more likely to be drawn into a client's hyper-activating or deactivating behaviours and autonomic responses. It is anticipated that more experienced therapists may be more sensitive and better able to separate their own reactions from a child's and therefore better able to engage a child at the level of the heart.

Clinical Implications

The application of autonomic measures to future play therapy research and practice holds promise as it allows access to implicit processes beyond the conscious control of therapists and clients, that may help identify what play therapy techniques and relationship features best facilitate psychological and physiological engagement, and provide new ways of assessing progress in therapy. It is anticipated that physiological linkage within therapy dyads may prove an important biomarker of the quality of a therapy relationship and therapy outcomes. The application of the Polyvagal theory and physiological monitoring to live play therapy practice highlights the clinical importance of autonomic nervous system regulation for therapists and children. A therapist's ability to be 'present' and optimally engaged at an autonomic level is a concept that is gaining esteem in the therapy literature. A play therapist must regulate her own arousal as well as a child's arousal within therapy and notice when either she or a client becomes 'tuned-up' or 'tuned-out.' In Polyvagal terms a therapist must remain within her social engagement biology and encourage clients into a similar socially engaged state by down regulating a client's involuntary defences (Porges, 2011, 2012). Thus 'feeling safe' at a biological level is essential for effective therapy (Porges, 2017). Activation of the social engagement or vagal system slows a client's heart rate and supports calm, meaningful engagement. A play therapist is only able to truly display Rogers' core relationship conditions of empathy, congruence and unconditional positive regard when they too are operating from their social engagement biology (i.e. they maintain high parasympathetic vagal tone). Thus a therapist needs to sustain a vagally mediated state of social engagement if they are to foster a client's social engagement and regulatory abilities (Ogden et al., 2006).

The benefit of incorporating play into therapy is that play uniquely functions to allow children to experience states of higher or lower autonomic arousal while socially engaged. The Polyvagal definition of play supports what play therapists have identified as dynamic post-traumatic play, which is a type of play that allows children to process traumatic experiences through play, without activation of a defensive fight, flight or freeze response. This type of play requires activation of the ventral vagus (social engagement system) and sympathetic mobilisation to create a state that allows mobilised play without fear (Porges, 2011). Or activation of the ventral vagus and dorsal vagus to create a dynamic state of immobilised play without fear (Kestly, 2016). Although to achieve this type of play a child must unconsciously and continuously detect a neuroception of safety in the environment and the therapist. A neuroception of safety contains the ANS within a homeostatic range that is also referred to as the window of tolerance (Ogden et al., Siegel, 1999) that can be expanded through neural exercises, such a play, embedded in therapy (Porges, 2017).

Traditional child-centred play therapy techniques are designed to communicate safety, for example the modality emphasises the consistency of the playroom and play equipment, and the careful consideration of a therapist's verbal and nonverbal responses, including the use of vocal tone, positioning, distance from the child, eye-contact and facial expressions to communicate a sense of safety. The Polyvagal theory contends that the parasympathetic system can only be regulated via face-to-face engagement, and it is the vagus nerve that connects the face, voice and heart. It is this 'face-heart connection' that makes it possible for a therapist's nonverbal and verbal communications to sooth a child's autonomic arousal (Porges, 2011). As Meares (2005, p.124) observes:

> Not only is the therapist being unconsciously influenced by a series of slight and subliminal signals, so also is the client. Details of the therapist's posture, gaze, tone of voice, even respiration, are recorded and processed. A sophisticated therapist may use this processing in a beneficial way, potentiating a change in the patient's state without, or in addition to, the use of words.

The study highlights the importance of training therapists in how to operate out of their social engagement biology. Traditionally play therapy training does not instruct therapists to recognise changes in their own autonomic arousal, nor changes in the autonomic arousal of their child clients. Given the importance of parasympathetic vagal tone in sustaining positive social encounters and dynamic play, this may prove an important and necessary component of future play therapy training and supervision. A therapist's ability to modulate her own arousal in response to a client's distress is also considered a crucial component of empathy (Coutinho, Silva & Decety, 2104). The findings suggest that trainee therapists need to assess states of over or under-arousal in themselves and the clients they work with. If a therapist observes that they, or a client, are in a state of dorsal vagal shutdown, the therapist must up-regulate her own and/or the client's arousal. If a therapist observes that they, or a client, are in a state of mobilisation or hyper-arousal, a therapist must down-regulate arousal her own and/or the client's arousal (Wagner, 2015). This will be more difficult with at-risk children who've not had an early experience of co-regulation within a secure attachment relationship, and experience a distorted neuroception of safety and a poorly functioning vagal brake. These children will be less able to co-regulate autonomic arousal within therapy and may be at risk of reacting to the stress of therapy with sympathetic activation or parasympathetic shutdown.

Psychophysiological data is not typically available to therapists and physiological monitoring may be used in the future as a form of biofeedback to enhance therapist awareness of the physiological aspects of the therapist-child relationship. A single case study observation by Marci and Riess (2005) found that providing a therapist with information on a client's physiological arousal (i.e. skin conductance) increased the therapist's awareness of the client's hidden anxiety and enhanced within session therapist empathy. In a similar way measures of synchrony may also be used to increase a therapist's awareness of the strength of a therapy alliance. Additionally, trainee play therapists are not routinely assessed for their strategy of attachment, nor trained in how their attachment history may influence their ability to empathies and regulate their own and a child's arousal in therapy, especially when working with clients who show a similar pattern of insecure attachment. The findings in this study suggest that therapist's should be made aware of their own strategy of attachment. Similarly, Marmarosh and colleagues (2014) and Siegel (2010) advocate that therapists be made aware of their own attachment-based beliefs and expectations. Educating therapists in their own strategy of attachment and the associated pattern of defense may be another means through which trainee therapists can be made aware of how their own autonomic defenses may function within therapy. An understanding of the Polyvagal theory may also help play therapists better attune to shifts in their own neuroception of safety and autonomic arousal within therapy (Porges, 2017). An understating of the Polyvagal theory may help play therapists better attune to the physiological state of their child clients and identify the links between a child's physiological state, play and behaviours.

Limitations and Recommendations for Future Research

The HRV literature is difficult to navigate due to a wide variation in how HRV is measured, reported and interpreted and there are few studies that apply HRV analysis to child therapy research. A recent paper has begun to address this need and provides specific recommendations for therapy research utilising physiological monitoring, which will assist future researchers (see Laborde, Mosley & Thayer, 2017). A number of limitations are inherent to real-world research. This exploratory study was unable to control for a number of threats to internal validity due to the naturalistic nature of the study. Furthermore, the autonomic nervous system is highly complex and there are a number of technical and statistical challenges involved in measuring its activity, especially within dyads. This study is at risk of Type I error (the possibility that chance findings were accepted as true) and Type II error (the possibility that important findings were missed due to limited statistical power). Some of the key limitations and considerations for future research include:

- The children in this study represent an at-risk sample that is potentially more complex and distressed than typically found in the literature. It is possible that the dyads observed were less attuned at the level of HR and RSA due to the combination of trainee therapists and complex children. Atypical RSA responding during social interaction has been observed in children exposed to domestic violence (Katz, 2007) and children with dysregulated, externalizing behaviours (Calkins, Graziano & Keane, 2007; Hastings et al., 2008; Hinnant & El-Sheikh, 2009; Lunkenheimer et al., 2015). The children in the present sample may have such extreme disruptions in autonomic functioning during social interaction that the formation of cardiac linkages during therapeutic encounters is compromised. This study also relied on novice clinicians who were still engaged in training; in addition both therapists displayed insecure strategies of attachment that may have impacted on therapist sensitivity and the formation of cardiac linkages. Experienced play therapists may be better able to physiologically attune to their child clients and where necessary counteract the influence of their own insecure attachment. Future studies would benefit from incorporating a more typically developing comparison control group and more experienced play therapists. Larger and better-powered studies are needed to extend the tentative findings of this present study and establish norms for physiological linkage between therapists and children.

- There are external events and variables not controlled for in this study. In particular the ambulatory nature of the data which confounds the interpretation of the results. In comparison to laboratory settings, naturalistic settings are characterised by more frequent variation in activity, posture, speech patterns, temperature, emotional state and mental load. Studies have shown that RSA is especially sensitive to changes physical activity and posture (Grossman et al., 2004). In this study therapy sessions were chosen for analysis where the child was engaged predominantly in sequences of seated play, although this may have also created a selection bias. Given that movement is integral to a child's play (Pankseep & Biven, 2012) future studies could better control for movement by utilizing additional measures such as accelerometry to compare segments of therapy that contain similar levels of movement. It is also possible that a higher frequency of RSA linkage may be evident once movement is better controlled for. Thus, for the present study it was not possible to determine if the observed instances of cardiac synchrony are due to a social-emotion connection between the therapist and child, or similarities in physical activity due to the uncontrolled ambulatory nature of the study.

- This study focused solely on cardiac measures of HR and RSA. HR provides an overall measure of autonomic arousal while RSA provides an indirect measure of the functioning of the parasympathetic nervous system. Given the links between social interaction and the PNS it was initially hypothesized that RSA linkage would be a key physiological mechanism underlying play therapy. The low occurrence of RSA linkage suggests that other process such as sympathetic arousal may be more influential, especially for the complex dyads examined in this study. Future research incorporating an independent measure of sympathetic activity such as cardiac preejection period (PEP) or skin conductance (SC) may help obtain a more complete picture of the functioning of the autonomic nervous system for both the therapist and child. The inclusion of behavioural measures of synchrony may also provide further insight into the relationship between behavioural and physiological synchrony within therapy dyads. A microanalysis of episodes of gaze, prosody, facial expression or other features of social communication may also yield meaningful results given the theoretical links between face-to-face interaction and the vagus nerve (Geller & Porges, 2014), and would generate larger and more robust data sets for more powerful statistical analysis (Kleinbub, 2017).

- The small number of linkages for RSA may also be due to the size of the units analysed. RSA is not as temporarily discrete as measures such as skin conductance as it is typically averaged in 60 to 120-second intervals due to the number of IBI intervals required for calculating RSA by spectral methods (Task Force, 1996). However there is evidence to suggest that recordings of less than one minute are also reliable (Heathers, 2014) and epochs of 30-seconds have been utilised in a number of studies examining within-dyad synchrony (Bernston et al., 1997; Fortunato et al., 2013; Fracasso et al., 1994; Lunkenhimer et al., 2015; Helm et al., 2014; Fisher & Woodward, 2014; Woody et al., 2016). Thirty-second epochs were chosen for this study as this provided a larger number of data points for statistical analysis. Although even with smaller 30-

second epochs it was not possible to obtain a 100 data points for each therapy session as recommended for p-technique analysis. Jones and Nesselroade (1990) conjecture that results from studies with less than 100 time points for the p-technique are thought provoking but not necessarily robust.

Future studies may consider averaging RSA in smaller epochs to increase the number of observations and the statistical power of the analysis, which may prove possible given that several recent studies have utilised a new second-by-second method for analysing simultaneous and lagged relationships for RSA within dyadic interactions (see Fisher, Reeves & Chi, 2106; Gates et al., 2015). This method provides a higher temporal resolution and allows researchers to examine RSA linkage on a time-scale that is closer to the frequency at which parasympathetic control is proposed to act on social engagement behaviours (Gates et al., 2015). The present study also examined lagged effects of 30-seconds or greater and it is possible that lagged effects occur in epochs smaller than 30-seconds.

- The advantage of utilising correlations and the p-technique is that they are data-driven approaches that can assess the presence of simultaneous or lagged linkages between paired data points. However these techniques only measure linear associations (Kleinbub, 2017). While these techniques proved a good fit for a large portion of the data in the present study, there was also evidence to suggest that there may be more complex curvilinear relationships between the child and therapist's cardiac data, not represented by the correlations or the p-technique SEM. Other studies have also observed nonlinear patterns of RSA reactivity in mother-child dyads (Miller et al., 2013; Oppenheimer et al., 2013). Thus future research may consider the application of more complex nonlinear mathematical models such as system dynamics to examine the complex interaction between physiological signals within therapy dyads (Kleinbub, 2017). Furthermore the current study examined the overall pattern of cardiac linkage for the entire time-series for each therapy session analysed. It is likely that there are more nuanced fluctuations in linkage and a series of ruptures and repair that occur across a single therapy session that have not been captured by the p-technique SEM.

- The present study assumed that the presence of a positive linkage or synchrony between a dyad was positive, given mother-infant research to date. This assumption is common to studies examining physiological linkage within clinical settings (Kleinbub, 2017). However the degree of positive synchrony may also be relevant as an overly synchronous linkage may not be therapeutic and may actually reflect entrenched patterns of stress. While a positive linkage is typically associated with positive interactions within dyads, a distinction is made between linkages that are arousal matching, where a dyad up and down-regulate (or co-regulate) around an optimal set point; and linkage that is arousal escalating, where a dyad's arousal increases away from an optimal set point so that they become increasingly over-aroused and dysregulated (Helm et al., 2014). Theoretically a dyad may also have a linkage that is arousal deescalating, where the dyad simultaneously move away from an optimal range of functioning and become increasingly under-aroused. The statistical measures in the current study did not allow for an assessment of the type of linkage and whether it was truly co-regulating. Further research is needed to ascertain the degree of positive cardiac linkage within therapy dyads that is associated with a stronger therapy alliance and better therapy outcomes. Furthermore, while synchrony is widely thought to reflect co-regulation and physiological attunement between a dyad, this phenomenon may also be due to both members of the dyad similarly responding to external events and not the internal world of the other person, a variable not examined in the present study.

- Physiological monitoring is resource intensive given the cost of equipment and laboratory analysis and the time to code and analyse video footage. For the present study the video footage was manually time stamped and matched to the physiological data, a protracted method that is likely to have a degree of measurement error. Future research would benefit from using a system that can simultaneously record video and physiology.

- To date all published studies examining cardiac linkage in therapy dyads are small case-based studies that use an experimental methodology to examine physiological synchrony (see review by Kleinbub, 2017), as is the case for the present study. The benefit of a case-based within-dyad analysis is that it allows a more detailed examination of cardiac reactivity that can be used inform larger powered studies, although the present findings are limited as they cannot be generalized due to the small sample size. The present exploratory study also included a qualitative description of the therapy relationship resulting in a mixed methods approach. The addition of a quantitative measure of the quality of the therapy relationship would have provided a more robust and clearly quantitative study.

- Finally the present study raises a number of conceptually interesting areas for future enquiry. While there were few linkages for HR or RSA for the play therapy dyads in this study, future studies may examine the relationship between a therapist's RSA and a child's HR. For example, if an increase in the therapist's RSA reduces a child's overall arousal as indicated by a decrease in HR. Another line of enquiry may be to examine whether there is an increase in a child's resting RSA (resting vagal tone) across the course of play therapy. Interventions that increase vagal tone or improve parasympathetic functioning are proposed to have a positive influence on stress sensitivity due to the links between higher RSA and social, emotional and physiological health (Mclaughlin et al., 2015).

Effective therapeutic interventions should reprogram autonomic stress reactivity and shift an individual's pattern of physiological reactivity in a more adaptive direction (McCraty et al., 1998).

Conclusion

Study 2 examined cardiac synchrony for HR and RSA within 4 play therapy dyads. The research questions were driven by a combined application of the Polyvagal theory and attachment theory to the treatment of developmental trauma with humanistic play therapy. The study is unique as it brings a contemporary understanding of dyadic nervous system regulation as outlined by the Polyvagal theory to clinical play therapy practice and was driven by a desire to see if there is an observable cardiac synchrony between therapists and children within play therapy. Play is proposed to be a 'neural exercise' that enhances the synchrony or co-regulation of physiological state and it was therefore reasoned that cardiac synchrony must play an important role in play therapy intervention given the focus on play as a primary mechanism of change within this therapy modality.

The study highlights the complexities involved in applying physiological monitoring to live play therapy and puts forth a number of considerations for future research, including the addition of accelerometers to better control for movement variables, and sympathetic measures to obtain a more complete picture of autonomic nervous system functioning within therapy dyads. However, despite the challenge of applying physiological monitoring to live play therapy research, this area is worth pursuing as there is a need for empirical based play therapy research that evidences the effectiveness of play therapy within the mental health field. Physiological monitoring also has the potential to provide new insights into the features of therapy and the therapy relationship that best help soothe and regulate the stress physiology of child clients, especially for those who have experienced developmental trauma.

The present study found that play therapists and children inconsistently synchronise real-time cardiac interactions within therapy, as cardiac synchrony was only evident in a portion of the therapy sessions analysed. It was hypothesised that an absence of synchrony would suggest a less attuned pattern of interaction between a therapist and child. The absence of attuned cardiac synchrony within the present sample is likely due to a number of factors including the complex sample and therapist inexperience. The most frequently observed linkage was a positive linkage for HR, which occurred in 5 of the 11 sessions analysed which indicates that play therapy dyads show a synchrony in overall cardiac arousal within some therapy sessions. However, it was initially hypothesised that RSA synchrony would be more important than HR synchrony in play therapy, given the links between RSA and social play as outlined by the Polyvagal theory, and the view that RSA linkage is a characteristic of high quality relationships. Of the 11 sessions examined there was only one example of RSA synchrony. However this one session was observed to be the most positive, playful attuned session observed, with a sensitive therapist and a co-operative child. Thus the presence of RSA linkage for this session provides support to the hypothesis that RSA linkage may be associated with a greater connectedness, more adaptive interactions and dynamic social play. However the remaining sessions failed to show a synchrony for RSA so there is limited evidence to suggest that play therapists and children co-regulate parasympathetic processes within play therapy within the current study. Future studies incorporating experienced therapists and a more normative sample may help determine whether parasympathetic processes are co-regulated within more normative play therapy dyads. Conversely, it is possible that RSA synchrony may not be as vital to therapy relationships as originally hypothesised. It may be more important for a therapist to maintain a high level of vagal tone (RSA) irrespective of a child's level of vagal tone, especially when working with traumatised children. The study findings are also limited by the methods used to analyse the HR data collected and future studies may need to incorporate more sophisticated mathematical models to test the presence and degree of cardiac synchrony within therapy dyads, and whether a sympathetic or a parasympathetic physiological linkage is associated with higher quality interactions and improved therapy outcomes for child clients.

This is the first known study to examine cardiac synchrony within child therapy dyads. The study makes a unique contribution to knowledge as it makes the technical area of HR and HRV analysis more accessible to play therapy researchers and provides a number of guidelines and recommendations for future research in an area in which few guidelines exist. This exploratory study lays the groundwork for future studies and points to the need for studies that examine both sympathetic and parasympathetic measures of physiological synchrony in less complex therapy dyads. The study also points to the potential role of a therapist's experience and strategy of attachment in the development of cardiac synchrony as a therapist's attachment security may impact on her sensitivity and ability to manager her own arousal and responsiveness within therapy.

Chapter 5

Conclusion

The field of child psychotherapy is on the cusp of advancement, fuelled by the growing influence of neuroscientific principles on therapy theory and practice. It is anticipated that non-invasive physiological monitoring will become increasingly accessible and pertinent to child therapy research and practice. Physiological monitoring is advantageous as it can access implicit processes beyond the awareness of therapists and clients, and may prove useful in the identification of therapy techniques and relationship features that best facilitate psychological and physiological growth. This thesis examined two exploratory studies applying the physiological construct of vagal reactivity to play therapy research. The first study examined the individual cardiac reactivity of five children who'd experienced early adversity during the construction of play narratives, as part of the Child Attachment and Play Assessment. The second study examined the interpersonal physiology of four play therapy dyads and the presence of cardiac linkage or synchrony within these dyads, during a child-centred play therapy intervention. Cardiac measures of heart rate (HR) and respiratory sinus arrhythmia

(RSA) were measured in both studies. RSA was analysed due to its use as an index of social-emotional regulation during interpersonal interactions. Both studies were exploratory in nature due to the small sample size, insufficient control for a number of variables, and limitations to the degree of statistical analysis possible. However, few studies have applied autonomic measures to play therapy research and the present studies were designed to gain an initial insight into the physiological mechanisms that may underlie play therapy, by interpreting cardiac activity through the lens of the Polyvagal Theory. The Polyvagal theory is applicable to play therapy given its emphasis on the role of relationships and social play in regulating autonomic arousal via the vagus nerve, the activity of which is indexed RSA.

There is renewed emphasis on the importance of nervous system regulation in child therapy and the need for neurodevelopmentally-informed interventions that improve the regulation of the lower stress regulatory parts of the brain. In light of this play therapy is receiving growing theoretical support from the field of neuroscience, with indications that lower-brain activating interventions such as play therapy are fundamental to the treatment of childhood trauma. Play is now recognised as a ‘neural exercise’ that promotes psychological health and enhances the co-regulation of physiological state (Porges, 2017). Social play widens a child’s autonomic window of tolerance and allows a child to play with states of heightened or lowered arousal that may approximate physiological states associated with trauma, but within the safety of a therapy relationship and without triggering a defensive fight, flight or freeze response. Thus social play allows a child to move without fear between the states of social engagement, mobilisation and immobilisation (Porges, 2017). This unique function makes play a powerful tool in nervous system regulation, and makes possible the dynamic reworking and integration of traumatic or troubling experiences within play therapy. It is reasoned that the most therapeutic play occurs in the zones of increased or decreased arousal that occur at the regulatory edges of a child's window of tolerance, where the social engagement system co-opts the stress response system for a type of play, known conceptually to play therapists as dynamic post-traumatic play. Dynamic post-traumatic play that occurs at the upper edge of the window of tolerance requires activation of the ventral vagus (i.e. the social engagement system) and sympathetic mobilisation, to create a state that allows mobilised play without fear. Dynamic play that occurs at the lower edge of the window of tolerance requires activation of the ventral vagus and the dorsal vagus, to create a state of immobilised play without fear. If a child moves outside of the lower edges of his play-expanded window of tolerance he will activate his immobilisation defences. If a child moves outside the upper edges of his play-expanded window of tolerance he will activate his mobilisation defences. Outside of his window of tolerance a child is no longer in his social engagement system or a state of dynamic or Polyvagal play, but rather in a defensive play state, described in the play therapy literature as stuck post-traumatic play. Thus the Polyvagal theory provides play therapists with a biological mechanism for understanding concepts such as post-traumatic play, and a biological theory of how play assists children to process trauma.

However, despite a growing science-based theoretical argument for play therapy as a treatment for adverse childhood experiences, play therapy needs to evidence these arguments and re-examine and expand on traditional play therapy practices to capitalise on the neurobiological benefits of play. Physiological monitoring may prove useful in further investigating the differences between defensive and dynamic post-traumatic play and in developing techniques that enable children to maintain a state of dynamic social play within therapy. Play therapists are not typically trained in the physiology of the stress response system and the present studies indicate that play therapists need to enhance their understanding and appreciation of autonomic nervous system regulation within play therapy. Historically research into the stress response system has focused on the role of the sympathetic nervous system and the fight, flight response, although recent theory and research highlights the importance of the parasympathetic nervous system in managing stress in relationships. The Polyvagal theory specifically links parasympathetic activity to social interaction and argues that an unconscious feeling of biological safety detected by the vagal system (neuroception) is vital to effective therapy (Porges, 2017). Indeed many tried and true humanistic play therapy techniques rely on a therapist's nonverbal behaviours such as vocal tone, eye contact, facial express, and proximity, to communicate safety. These techniques are effective precisely because they are detected by the vagal system and can facilitate a neuroception of safety. An effective play therapist must emit a steady stream of 'play signals' to her child clients, through the use of her voice, eyes, face, and body position, if she is to keep a child within the safety of his autonomic window of tolerance.

The Polyvagal theory provides a biological basis for a number of previously intuitive processes central to play therapy. The ability to observe these processes at a biological level, through the analysis of RSA, may lead to an improved understanding of how play therapy works and may lead to better therapy techniques and therapy outcomes. Yet despite the potential benefits of physiological monitoring, the present thesis also highlights the complexities in the application of heart rate variability to play therapy research. The HRV literature is complex and difficult for a novice to navigate due to the wide variation in how HRV is measured, reported and interpreted; and there are few guiding studies that apply HRV analysis to child therapy research. A further difficulty is the number of variables that must be controlled for in HRV analysis, especially the influence of movement and respiration if RSA is to be a true index of social-emotional regulation. Since movement is integral to children's play, future research needs to robustly account for movement variables only crudely accounted for in the present studies. This is perhaps most practically achieved through the addition of a continuous measure of movement, such as accelerometry. The present studies also focused on RSA as an index of parasympathetic functioning and HR as a measure of overall autonomic arousal. A further measure specific to sympathetic functioning (e.g. cardiac pre-ejection period or skin conductance) would provide a more complete picture of the activity of the autonomic nervous system within therapy and aid in the interpretation of results. Future studies would also benefit from a larger sample and the addition of a more normative comparison control group.

Despite a number of limitations, the present exploratory findings indicate that psychophysiological measures such as RSA may provide unique insights into autonomic regulation at an individual and dyadic level within play therapy. The first study in this thesis examined several children's play narratives during a pre and post-play therapy intervention assessment, the Child Attachment and Play Assessment. Early attachment relationships play a key role in shaping the ANS. A secure attachment indicates that an individual has learnt to utilise relationships to modulate fear and arousal. An insecure attachment implies that an individual has had insufficient experience of having his arousal regulated in an attuned attachment relationship, which is reflected in a less resilient nervous system. An insecure attachment indicates difficulty turning off defensive strategies so that social engagement can occur, with individuals with Type A+ strategies struggling to turn off parasympathetic shutdown defences, and individuals with Type C+ strategies struggling to turn off sympathetic mobilisation defences. Individuals with an insecure Type A avoidant attachment strategy tend to use cognition, psychological inhibition and the suppression of negative affect as a way of dealing with challenging situations and difficult feelings. Type A strategies are characterised by self-reliance and an over-regulation of the autonomic nervous system and a bias towards parasympathetic dominance in an attempt to shutdown activation (Schore, 2003). Individuals with a Type C strategy of attachment tend to hyper-activate their attachment system and exaggerate their experience of negative affect, especially fear and anger, to cope with stress (Crittenden, 1995), and tend towards under-regulation of the autonomic nervous system and sympathetic dominance (Schore, 2003).

The findings support the hypothesis that there are differences in the cardiac reactivity of children with highly insecure Type A+ and Type C+ strategies of attachment during the construction of play narratives in response to the CAPA. In the pre-intervention assessment the children with a Type A+ strategy of attachment predominantly showed an atypical pattern of vagal augmentation (i.e. an increase in RSA from baseline) during the construction of play narratives, which suggested a failure of the vagal brake and increased parasympathetic inhibition. In the initial assessment a heightened degree of cardiac inhibition was also observed for A+ play narratives coded for intrusions of negative affect such as anger or rage, which indicated a greater inhibition of negative arousal-escalating affects. Thus it appears that children with a Type A+ strategy struggle to experience negative emotions, without withdrawing psychologically and physiologically. In the pre-intervention CAPA, A+ and C+ play narratives coded for unresolved loss or trauma also showed a heightened degree of vagal augmentation, which suggests that high levels of physiological inhibition may be a marker for unresolved trauma, irrespective of the pattern of attachment. Future research needs to further examine whether a pattern of heightened vagal augmentation (i.e. parasympathetic inhibition of the heart) during the construction of play narratives during the CAPA is indeed a marker for unresolved trauma. With the exception of the trauma narratives, those children with a Type C+ strategy of attachment typically showed a pattern of vagal withdrawal (i.e. a decrease in RSA from baseline) in the pre-intervention assessment. A moderate degree of vagal withdrawal facilitates sustained attention and active coping (Porges, 1996), although vagal withdrawal is also associated with the expression of negative affect and sympathetic excitation in instances of over or under-withdrawal. Thus while vagal withdrawal is an expected and adaptive response to a stress task, it is suspected that the children with highly insecure Type C+ strategies in the present study did not show adaptive levels of withdrawal, and further research with a comparison control group is needed.

A different autonomic reactivity profile for children with an A+ or C+ strategy of attachment suggests that these children also have different therapeutic needs. It is ventured that children with a Type A+ strategy, who tend to inhibit increased arousal, need help to turn off parasympathetic defences and experience socially engaged states of mobilisation without fear. Children with a Type C+ strategy, who escalate arousal in an attempt to avoid uncomfortable states of low arousal may need help to turn off sympathetic defences and experience socially engaged states of immobilisation without fear. Within study one, several shifts were noted in physiological reactivity between the pre and post-intervention assessment, most notably for Eli who shifted from an atypical pattern of vagal augmentation, to a pattern of vagal withdrawal during the construction of play narratives, a potentially adaptive shift in vagal reactivity. However, research with a larger sample and a control group is needed to further ascertain what constitutes an adaptive level of vagal reactivity and whether it is possible to retune the vagal brake through play therapy intervention.

The second study focused on the bidirectional communication that exists between the nervous systems of interacting individuals and examined cardiac linkage or synchrony within several play therapy dyads. A psychobiological co-regulation, where two individuals reciprocally influence each other’s physiological state, is foundational to secure attachment and therapy relationships. The presence of physiological linkage within a dyad indicates a coordinated moment-by-moment match in physiology that reflects a dynamic co-regulation of arousal (Feldman, 2012). This study was the first known study to incorporate cardiac measures into live play therapy research and examine the real-time physiological linkage between a play therapist and child. The results indicate that play therapists and children do exhibit a positive synchrony in dynamic changes in HR and RSA within therapy sessions, although this was not consistently observed for all sessions or all dyads. The most commonly observed linkage was a positive simultaneous linkage for HR, which occurred for 5 of the 12 sessions analysed. Billy and Therapist A were the most synchronous dyad with evidence of linkage for HR and RSA for the later session. A co-occurrence of HR and RSA linkage was hypothesised to be the most adaptive linkage as this would indicate that a dyad were adaptively co-regulating arousal via parasympathetic or vagal processes (i.e. they were both operating from their social engagement biology) rather than sympathetic processes, and would be the physiological basis for a playfully-attuned, socially engaged dyad. The later session for Billy and Therapist A depicted a long sequence of jack-in-the box play and was the most mutually joyful and playful session observed, with a sensitive therapist and a co-operative child, an ideal pattern of interaction, which indicates that combined HR and RSA linkage may be associated with a greater connectedness, more adaptive interactions and dynamic social play. Josh and Therapist B were the least synchronous dyad with no linkages evident for HR or RSA for the three sessions observed. Josh displayed the most disturbed strategy of attachment and it is possible that Josh also had the greatest disturbance in autonomic functioning that may have compromised the formation of cardiac linkages within therapy.

In addition to the presence of simultaneous linkages for HR, several examples were found for a child-to-therapist direction of influence, where the therapist's HR mirrored the child's HR at a lag of 30-seconds. This indicated a physiological responsiveness on the part of the therapist who mirrored changes in the child's cardiac physiology, which may be associated with higher levels of therapist empathy. No examples of a therapist-leg lag were observed. It was initially conjectured that a therapist-driven linkage would indicate that a therapist was leading an interaction in a bid to regulate a child, although it is possible that therapist-driven regulation may be an advanced clinical skill not yet mastered by the trainee therapists in the present study. It was originally hypothesised that RSA linkage would be integral to play therapy practice and would increase across the course of therapy, indicating an increasingly positive social connection between a therapist and child, although no evidence was found to support this hypothesis. The lack of linkage for RSA indicates that there was little co-regulation of parasympathetic processes for the observed dyads, which may be attributed to potential disruptions in the functioning of the vagal system in this at-risk sample. Children who've experienced adverse childhood experiences, especially exposure to domestic violence, have been shown to have an atypical response to stress, a poorly functioning vagal brake and atypical parasympathetic responses. Linkages were most frequently observed for HR, indicating a synchrony or co-regulation of overall arousal between a therapist and child. It is possible that the sympathetic fight, flight system was more active than the ventral vagal social engagement system within these dyads. Linkages for parasympathetic measures such as RSA may be associated with high quality relationships, with low quality or stressed dyads demonstrating a synchrony in sympathetic measures. The combination of trainee therapists and complex children may have resulted in a sample of stressed, sympathetically linked dyads, although additional SNS measures are needed to test these speculations.

In the present study both trainee therapists were observed to be inconsistently sensitive towards their child clients and tended towards unresponsiveness (Therapist A) or over-control (Therapist B), which may in part be due to the therapist's inexperience and their own insecure strategies of attachment. A therapist's own attachment security may impact on her sensitivity and ability to manage her own arousal and autonomic responsiveness. Furthermore, the dyads in the present study showed complementary strategies of attachment, with a Type A therapist paired with Type A children, and a Type C therapist paired with Type C children. A match in a therapist and child's strategy of attachment may weaken co-regulation or cardiac synchrony, given that the therapist and child have a similar bias for immobilisation defences (Type A) or sympathetically driven mobilisation defences (Type C). In this study the avoidant Type A dyads were less emotionally engaged and the ambivalent Type C dyads showed a greater degree of conflict. The children with a Type C+ strategy also engaged in more violent and aggressive play themes and directed more overt hostility toward the therapist. Overall, the conflicted Type C dyads displayed fewer linkages than the avoidant Type A dyads. Thus a therapist's attachment insecurity and the associated pattern of autonomic reactivity may impact on a therapist's ability to consistently operate from her social engagement biology, especially for trainee therapists, resulting in less regulated and less connected therapy dyads.

Almost half of the sessions analysed showed no linkage for either HR or RSA, which suggests that for these sessions the therapist and child were unable to obtain a consistent co-regulation of cardiac arousal. However it is possible that within these sessions there may have been moments of linkage. An analysis of linkages and ruptures within individual play therapy sessions would provide a more fine-grained focus on within-session dynamics, although this would require more complex mathematical modelling than used in the present study. Within the present study the dyads were inconsistent in their ability to form cardiac linkages and it is anticipated that more experienced play therapists may be better able to engage a child at the level of the heart, irrespective of their own strategy of attachment. The lack of evidence for RSA or parasympathetic linkage in the present study indicates that there is more to learn as to whether parasympathetic processes are co-regulated within less complex play therapy dyads.

The application of the Polyvagal theory to live play therapy practice highlights the clinical importance of the regulation of autonomic state by ventral vagal pathways (i.e. the social engagement system), rather than sympathetic or dorsal vagal pathways, for both therapists and children. If a therapist is not operating from her social engagement biology she will be unable to foster a neuroception of safety in a child client, and the child will activate self-protective rather than social engagement behaviours. When a play therapist operates from her social engagement biology (i.e. maintains high parasympathetic vagal tone) she is able to truly display Rogers' core relationship conditions of empathy, congruence and unconditional positive regard. Her voice and facial expression will cue safety in a child's vagal system and down-regulate a child's involuntary defences (Porges, 2012, 2017). Traditional play therapy training does not instruct therapists in how to operate out of their social engagement biology, or how to recognise shifts in their own autonomic arousal, or that of their child clients. Given the importance of parasympathetic vagal tone in sustaining positive social encounters, this may prove an important and necessary component of future play therapy training and supervision.

The two studies in this thesis bring together two influential theories in play therapy: the Polyvagal theory and attachment theory. Both theories describe a quest for safety in relationship. Attachment theory identifies the behaviours and the Polyvagal theory identifies the biology that accompanies this quest. The contribution to knowledge in the field of play therapy is that this thesis expands on the conceptual links between the Polyvagal theory, attachment theory and the concept of post-traumatic play and it is the first study to examine these concepts at a physiological level through the application of HRV analysis to live play therapy research. This thesis makes the complex area of HRV analysis more accessible to play therapy researchers and provides recommendations to guide future research in an area where few guidelines exist. While the studies are small and exploratory they have unearthed several avenues worthy of ongoing investigation including the presence of different autonomic defence biases for children with insecure Type A+ and Type C+ strategies of attachment, and the presence of increased vagal inhibition for play narratives that are unresolved or post-traumatic in nature, especially for children operating from an insecure Type A+ strategy of attachment. The second study also found several examples of HR and RSA synchrony within play therapy dyads and points to the need to examine both sympathetic and parasympathetic synchrony in future studies of cardiac linkage. While currently embryonic, physiological monitoring has the potential to be a useful tool in future play therapy training and research as it may bring us closer to understanding the biological mechanisms that underlie the healing power of heartfelt play.

Glossary of Terms

Attachment. Attachment refers to the relationship between an infant and his primary caregiver, usually his mother, which forms a template for relationship patterns throughout life. Attachment theory describes the ways in which children behaviourally adapt to the degree of sensitivity demonstrated by their adult caregiver and identifies different types of self-protective strategies. Attachment strategies are categorised as secure (Type B), insecure anxious avoidant (Type A) or insecure ambivalent or preoccupied (Type C). A regulation theory of attachment further highlights the role of the early caregiving relationships in shaping the stress response. A secure attachment indicates that an individual has learnt to utilise relationships to modulate fear and arousal. An insecure attachment implies that an individual has had insufficient experience of having his arousal regulated in an attuned attachment relationship, which is reflected in a less resilient nervous system.

Autonomic Nervous System (ANS). The ANS is the part of the nervous system that 'automatically' regulates the internal organs of the body without conscious awareness. It is responsible for functions such as respiration, digestion, heart rate and blood pressure. Traditionally the ANS is divided into two subsystems: the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS). The Polyvagal Theory divides the ANS into three subsystems and presents a hierarchy of the ANS. The Polyvagal theory proposes that the social engagement system (governed by the myelinated component of the vagus nerve, the ventral vagus) is active in physiological states of safety to promote health, growth, restoration and social interaction. In the face of challenge or stress the vagus withdraws its inhibition to the heart to allow a mobilisation of metabolic resources to deal with the task at hand, without activation of the sympathetic nervous system. If there is a neuroception of danger (see neuroception) defensive states of mobilisation and fight, flight behaviours result from activation of the SNS. States of immobilisation occur as a final line of defence and are governed by the unmyelinated component of the vagus nerve, the dorsal vagus.

Child Attachment and Play Assessment (CAPA). The CAPA is a doll-play story stem procedure and manualised coding system that assesses attachment, play and mentalising in children between 3 and 11 years of age. The CAPA is the only narrative story stem assessment to use Crittenden's Dynamic Maturational Model of Attachment and Adaptation in the analysis of children's story stems. The DMM is a developmental model that classifies self-protective attachment patterns learnt in infancy through interaction with adult caregivers. Within this model self-protective attachment strategies are categorised as secure (Type B), insecure anxious avoidant (Type A) or insecure ambivalent or preoccupied (Type C). Type A strategies are classified A1 through A8 and Type C strategies, C1 through C8

Child-Centred Play Therapy (CCPT). CCPT is a humanistic approach to play therapy also referred to a non-directive play therapy (NDPT). CCPT was founded on Carl Rogers' core relationship conditions of genuineness, authenticity, non-possessive warmth and empathy; and the understanding that a child's play is inherently healing and a child's natural means of self-expression.

Heart Rate Variability (HRV). HRV is the variation in time between heartbeats. The heart does not beat at a constant rate but varies in response to internal and external environmental demands. A large portion of the variation in heart rate is determined by vagal influences, especially the ventral vagus, which is measured by respiratory sinus arrhythmia (RSA), also referred to as the high frequency component of heart rate variability (HF-HRV). HRV is an indicator of the flexibility and adaptability of the

ANS. A high resting HRV is typically associated with greater psychological and physical health and a greater capacity for social engagement.

Mentalising. Mentalising is the capacity for reflective self-functioning. It is the awareness that our own internal experiences are different from the internal experience of others. Mentalising makes it possible to process difficult experiences and is a key component of healing from trauma.

Neuroception. Neuroception is a term specific to the Polyvagal theory that is used to describe the neural process through which the nervous system unconsciously evaluates cues of safety, danger or life threat. A neuroception of safety promotes a physiological state that supports social engagement behaviours. A neuroception of danger or life threat promotes physiological states that support defensive mobilisation or immobilisation behaviours. Individuals who've experienced chronic trauma may have a faulty neuroception and detect risk when they are safe, or identify cues of safety when they are at risk.

Non-Directive Play Therapy (NDPT). See Child-Centred Play Therapy.

Parasympathetic Nervous System (PNS). The PNS is one of the two main divisions of the autonomic nervous system (ANS). The primary neural pathway of the PNS supports health, growth and restoration.

Polyvagal Theory. The Polyvagal theory explains the importance of physiological state in influencing behaviour and our capacity to interact with others. The theory provides an explanation of how the nervous system unconsciously detects risk and shifts physiological states to support defensive behaviours. The theory also explains how feeling safe is not dependent on the removal of threat but on unique cues in the environment and our relationships that inhibit defence circuits and promote health and feelings of love and trust. In essence the Polyvagal theory is a theory of how relationships regulate the fear response.

Post-traumatic Play. Children have an innate tendency to play-out troubling experiences. Two types of post-traumatic play have been observed: dynamic post-traumatic play and stuck or stagnant post-traumatic play. Dynamic post-traumatic play is recognised as healthy, while stuck play is considered unhealthy and is characterised by an absence of play signals and defensive fight, flight or freeze behaviours.

Respiratory Sinus Arrhythmia (RSA). RSA is the rhythmic increase or decrease in HR that occurs at the high frequency band of spontaneous breathing. The amplitude of RSA is used to index the influence of the myelinated ventral vagus nerve on the heart. RSA is an estimate of parasympathetically mediated HRV and an index of vagal tone. Resting levels of RSA reflect the activity of the PNS at rest and the ability of an individual to sustain attention, regulate emotion and engage in social communication. RSA reactivity examines the change in RSA from a baseline to a task condition. An increase in RSA is described as a pattern of vagal augmentation and a decrease in RSA is described as a pattern of vagal withdrawal. A pattern of augmentation indicates increased parasympathetic or vagal influence and a pattern of vagal withdrawal indicates decreased parasympathetic influence on the heart.

Social Engagement System. The social engagement system is a term used by the Polyvagal theory to refer to the neural pathways that connect the face to the heart, and enable an individual to convey their own physiological state to others through social behaviours such as vocal tone, prosody and facial expression; as well as enabling the social behaviours of others to influence physiological state in return. The social engagement system describes the vagal pathways on which attachment processes occur.

Sympathetic Nervous System (SNS). The SNS is one of the two main divisions of the autonomic nervous system (see ANS). The sympathetic system functions to increase blood flow throughout the body to support mobilisation, including fight, flight behaviours.

Vagal Tone (VT). The amplitude of RSA indexes cardiac vagal tone. It refers to the degree of influence of the vagus nerve on the pacemaker of the heart. Given that the vagus nerve is a key component of the parasympathetic nervous system, vagal tone may also be referred to as parasympathetic tone.

Vagus Nerve. The vagus nerve is the 10^{th} cranial nerve. The vagus is the primary nerve of the parasympathetic division of the ANS. The vagus nerve consists of a myelinated component called the ventral vagus and an unmyelinated component called the dorsal vagus. The ventral vagus is responsible for social engagement, while the dorsal vagus is responsible for the immobilisation or freeze response according to the Polyvagal theory.

Appendix A

Ethics and Consent Forms

PARENT/ CAREGIVER PARTICIPANT CONSENT FORM

Title of Research Project: A psychological and physiological investigation into play therapy process: A naturalistic case-based exploration into the interplay between play therapy intervention and the stress physiology of children referred for play therapy.

Brief Description of Research Project: This project aims to investigate how play therapy helps children with stress. 6-12 case studies will be conducted with children between the ages of 5 and 11 years who are attending a block of play therapy, either at school or in a clinic at the university. Each child will attend 2 assessment sessions, 15 sessions of play therapy and 2 follow-up sessions, which will be conducted during term time over a 3-4 month period. Within the research your child will be required to wear sensors that measure his/her heart rate, breathing, movement and skin conductance (sweating). This equipment will consist of several sensors applied to the skin and a belt worn over clothing. The sensors used within the study are designed for children, comfortable and easy to apply. Within the pre and post assessment sessions the child will complete a Narrative Story Stem Assessment where the therapist and child will make-up stories together with a dollhouse and toys. This can elicit mild stress, for example the child might be asked to tell the story of what happens to a lost pig.

A parent/caregiver will also be asked to attend 1-2 assessment sessions to provide a history of his/her child and to complete several parent/caregiver questionnaires. Caregivers will also be asked to assist in a day of cortisol sampling for the child before and after the play therapy intervention. Cortisol is a stress hormone that is easily measured in our saliva. This will require a parent taking 4 saliva samples from the child over a day with the use of cotton saliva swabs. Training will be provided on how to do this. The parent will also be required to record the child's food intake for the day of saliva sampling as this can influence cortisol readings.[2]

It is anticipated that your child will enjoy being a participant in this study as children often find play therapy to be an intrinsically enjoyable experience where they can communicate through play things that they are happy, sad, excited, angry or worried about. All of the assessment and play therapy sessions will be video recorded for later analysis by the lead investigator. All of the data collected will be securely stored and kept confidential. In some instances confidentiality may be broken, for example if there is concern that the child or another person is at risk of harm.

Investigator Contact Details:

Natalie Prichard
Psychology Department
Roehampton University
Whitelands College
Holybourne Avenue SW15 4JD

Consent Statement:

I agree to take part in this research, and am aware that I am free to withdraw at any point. I understand that the information I provide will be treated in confidence by the investigator and that my identity will be protected in the publication of any findings. I understand that there may be some instances where the investigator is required to break confidentially; such as if there is concern that the child or another is a risk of serious harm.

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[2] Note. Cortisol and skin conductance recording was removed from the final implementation of the study.

Name ………………………………….

Signature ………………………………

Date ……………………………………

I agree for my chid to take part in this research. I am aware that my child is free to withdraw at any point. I understand that the information provided by my child will be treated in confidence by the investigator and his/her identity will be protected in the publication of any findings. I understand that there may be some instances where the investigator is required to break confidentiality; such as if there is concern that the child or another is at risk of serious harm.

Name ………………………………….

Signature ………………………………

Date ……………………………………

Please note: if you have a concern about any aspect of your participation or any other queries please raise this with the investigator. However, if you would like to contact an independent party please contact the Head of Department (or if the researcher is a student you can also contact the Director of Studies).

Director of Studies Contact Details:

Dr Steve Farnfield
Psychology Department

Head of Department Contact Details:

Dr Diane Bray
Psychology Department

Roehampton University
Whitelands College
Holybourne Avenue SW15 4JD

Roehampton University
Whitelands College
Holybourne Avenue SW15 4JD

Video Recording

Throughout this research it will be necessary to video record all of your child's assessment and play therapy sessions for later analysis. In the first instance the recordings will be used by the investigator to explore how your child's heart rate as he/she engages in play therapy. Recordings will be stored on a PC that is password protected. Any hardcopies of the recordings will be kept in a locked cabinet. The recordings will be reviewed by the lead investigator, the director of studies and other research assistants involved in the analysis of the data. No recordings will be made available online. In any written session transcripts/ published material the child will be given a pseudonym to maintain confidentiality.

In some instances recordings may be used for teaching or training purposes within the university or at conferences for the training of other therapists and professionals. Segments of recordings will be carefully chosen to illustrate teaching points. In the recordings the child will be referred to by a pseudonym or their first name only.

Video Recording Consent Statement:

I agree to the use of video recordings of my child for teaching and training purposes. I'm aware that I'm free to withdraw at any point in this study.

Name ………………………………….

Signature ………………………………

Date ……………………………………

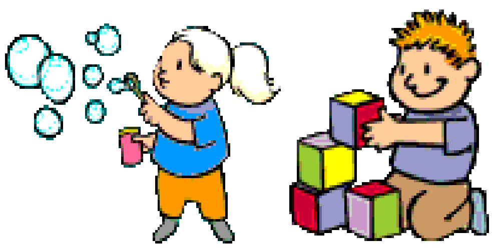
Child Participant Form

Hi! My name is Natalie. I'm a play therapist and a researcher. I want to find out more about how play therapy helps kids with stress.

I'm doing a special study and I'm looking for children who would like to play with a play therapist once a week for about 15 times. That's this many times:

☺☺☺☺☺☺☺☺☺☺
☺☺☺☺☺

A play therapist is an adult who knows how to play with kids to help them feel better on the inside. A play therapist has a playroom and toys that you can play with, in most of the ways you would like.



As part of the study I will also see you 2 times ☺☺ before you start play therapy, to find out more about you and the things that make you stressed, and 2 times ☺☺ after you finish all of your play therapy times to find out if it helped you with stress.

☺☺☺☺☺☺☺☺☺☺☺
☺☺☺☺☺☺☺☺☺

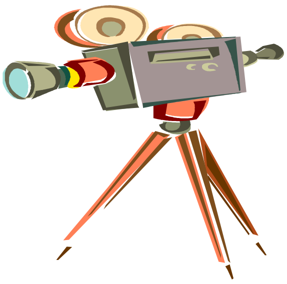
In the study I will measure your stress by looking at your heart rate. Two special sensors placed on the skin on your chest will measure your heart rate.

HEART RATE 

The sensors that measure your heart rate look a bit like stickers. Sometimes people wear sensors like this when they are in in hospital or if they are a sportsperson or an Olympian training for an event.

The play therapist will also wear stickers too.

A teacher or teacher aid will help you put on the stickers before each playtime.

VIDEO 

As part of the study I will also video record each of your play times. This is so I can learn more about how children play. The videos will be locked in a safe place and will be looked at by my teacher (supervisor) and I. Sometimes I might show parts of the videos to other people who are learning how to help children with stress.

At the end of all of your playtimes I will write a story about your time in play therapy. In the story I will give you a pretend name so that no one knows that the story is about you. It will be anonymous.

CONSENT

It is important that you know that you don't have to do anything in this study that makes you feel upset. If at any time you decide that you don't want to put on the stickers you can say NO and you won't have to. You won't get into trouble for saying NO.

If you feel okay about being part of this study you can write your name below to show this. But remember, you can change your mind at any time.

Your Name_________________________

My Name__________________________

DATE_____________________________

Appendix B

Narrative Story Stem Assessment Procedure

1. Setup. The child assists the interviewer in selecting a doll family and setting up the dollhouse furniture. The interviewer asks the child to choose a family. “Will you choose a family from the dolls here in this box?” Prompt “As many or as few as you would like.” The interview assists the child in setting up the dollhouse furniture and arranging the doll family in the house. The interviewer prompts the child to choose a name for each child in the doll family. “ Do you want to give him/her a name?”

2. The interviewer explains the assessment procedure. “Now I’m going to tell you the beginning of a story. What I would like you to do is tell me or show me how the story ends.”

3. The interviewer works through a series of 6-8 story stems with the child. For each story the interviewer askes the child to choose a key child for each story. “Now let’s tell a story about one of the children. Can you choose one of the children for the story?” Throughout the story the interviewer may summarise what has happened in the story, ask the child the elaborate “Does anything else happen in this story?” The interviewer prompts the child to provide information on how the characters feel in the story. “So how does (doll’s name) feel?”

Birthday Cake (Bretherton and the MacArthur Battery)

The interviewer sets the doll family around the table. "Now look what's happening here. Mum has just come in with a lovely birthday cake. Show me and tell me what happens next...so how does (child) feel?"

Spilt Juice (Bretherton and the MacArthur Battery)

The interviewer sets the doll family around the table. "The family are having a meal together and X (child) reaches out and spills his/her juice. Mum says (reproachful tone) "Oh X you spilt your juice. It's gone into the carpet." (Agitate mother doll just a little). Okay, now tell me and show me what happens next." "How does (child) feel?"

Hurt Knee (Bretherton and the MacArthur Battery)

"Now, in this story, all the family go out to the park (SET UP DOLLS). Here they see (points to doll) X (child) she/he is climbing up this rock (SHOW CHILD CLIMBING) and s/he goes quiet high and she turns round and says, 'Look, Mum. Dad. Look at me' but, Oh dear! She slips (MAKE CHILD FALL) and 'boo hooo my knee, I've hurt my knee (CRYING VOICE).' Now tell me and show me what happens next…how does (child) feel?"

The Noise in the Night (Bretherton and the MacArthur Battery - adaptation of the 'Burglar in the Dark' story stem)

Set up the family for the child's bedtime. "Now, in this story, X (child) is in bed one night. Everyone else is in bed and X (child) hears a loud noise downstairs (BANG TABLE). Tell me or show me what happens next…how does (child) feel?"

Parent Departure Story (Bretherton and the MacArthur Battery)

Now in this one mum and dad are going away on a trip (SHOW MUM AND DAD BY THE CAR AND THE CHILDREN STANDING WITH GRANDMA). Well now. Mum says, "We're going now children on our trip. Grandma will look after you. We will see you tomorrow. (MOVE MOTHER SLIGHTLY TOWARDS THE CHILDREN AS SHE SPEAKS). Now tell me and show me what happens next…how does (child) feel?"

Parent Reunion Story (Bretherton and the MacArthur Battery)

Now look. Mum and dad are back from their trip (SHOW WITH DOLLS) and here are the children with Grandma. And Grandma looks out the window and she says, 'Here are mum and dad' (BRING PARENTS AND THE CAR UP TO THE HOUSE). Tell me and show me what happens next…how does (child) feel?"

The Lost Pig (The McArthur Battery and Hodges)

SET OUT THE PLACE WHERE THE BIG AND LITTLE PIGS LIVE TOGETHER. DESCRIBE IT AS YOU DO SO. "Now here is the farmyard. See all the animals. And little piggy s/he is going for a walk (ENACT THIS). S/he walks and s/he walks and, Oh dear (SLIGHT DRAMA) s/her gest lost and does not know how to get back. Tell me and show me what happens next…how does (child) feel?"

Picture Home (The McArthur Battery and Hodges)

Now, this child X has does a really nice picture at school, one of the best s/he has ever done and s/her goes home and knocks at the door. Tell me and show me what happens next…how does (child) feel?"

Lost Keys (The McArthur Battery and Hodges)

Now mum and dad come home and they are standing outside the front door with their faces like this (SHOW ANGRY FACE).

Mum: ‘You lost my keys’

Dad: ‘No I didn’t’

Mum: ‘Yes you did!’

Dad: ‘No I didn’t!’

Mum: ‘You always lose my keys.’

Dad: ‘Well I didn’t lose them this time!’

“Tell me and show me what happens next…how does (child) feel?”

Crying Outside (The McArthur Battery and Hodges)

“Now let’s tell this story about one of the children...The family are inside watching television. This child goes out the back of the house. The family inside can’t see him/her, but they can hear her going (MAKES CRYING NOISE)…Tell me and show me what happens next...how does (child) feel?”

Stamping Elephant (The McArthur Battery and Hodges)

“Now here is a big elephant and he is in a really bad mood. He goes stamp, stamp, stamp (SHOW) all over the farmyard and the other animals (SLIGHT TONE OF DRAMA) are scared. Tell me and show me what happens next…how does (child) feel?”

Appendix C

Published Chapter

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Appendix D

Play Narrative Transcripts Study 1

1. Parent Departure Narrative (Eli)

Eli: Yes, and the Sat Nav got them to where they were, and then, they um, sat down and looked at the sun, and then, they um, was doing camping, and then they burned the sausages on the wood (*looks to camera*), and they sleep in the tent, and then, when it was morning, um-dad, um-mum, drove the car. No mum drove the car to, then, when mum was driving - um - she looked and dad was still - she wasn't noticing that dad was still in the tent, then she drove back home and she asked, " Where's dad?"

She said, "Oh no, I left him, we need to. I need to go back for him."

But this time the kids got to come (*loads the children into the car)*.

Um, and then granny and grandpa, both of them didn't want to go, both of them wanted to watch their favourite show, and um, put the baby at the front, and then they drove back. They left the baby (*removes baby from the car*) then they drove back and when they was there, they looked in the tent and dad won't there. So they looked everywhere, then they were there for about two weeks (*rubs eyes*), and they drove everywhere around to look for dad.

But dad was um, um, in an airplane, because the, um, the airplane took all their old stuff, and all the big stuff they had to shift off somewhere, and they told them, and they collected dad - then they drive back, then, the-they, "We've been gone for two weeks with nothing to eat" they said. Then they all lived happily every after (*looks to interviewer*).

2. Noise in the Night (Eli)

Eli: So she (*mum)* goes downstairs and sees robbers, and then she arrests them and brings them to the police station, and then they smashed the television. The policemen brought them a new telly (*slight yawn*) and then the robbers got arrested, and Troy (*boy*) was scared, and then, while that was happening, dad was asleep. And then in the morning, they was like, dad says, "Where's my jewellery?" And mum says, "I tooken it because you weren't awake and the people could have hurt me, us, really badly, and you're the man of the house."

IV: Oh

Eli: And Troy says, "I was the man of the house yesterday." And then dad was ashamed of himself

IV: Dad was ashamed of himself. He slept through the whole thing

Eli: Yeah

IV: And yesterday Troy was the man of the house

Eli: Yep (*leans back in chair and looks at IV)*

IV: Mum's quiet upset. So how do the sisters feel?

Eli: They - um - mum gives them all a treat. But dad don't get one

IV: Dad didn't get one (*Eli shakes his head*). He didn't help out. No - he just slept. How does dad feel about all of this?

Eli: He feels - um - pretty ashamed of it

3. Hot Gravy (Billy)

The interviewer enacted a story of a child touching the stove. The child in the story cries, "Ow! Ow! I've burnt my hand!"

IV: What happens next? Can you show and tell me?

Billy: "You're bad!" He goes to his room

IV: Who says that?

Billy: Mum

IV: Mum says "Your bad!" and he goes to his room

Billy: Yep…He says sorry, then, he can now sit down on his chair…

IV: So how did Billy feel when he burnt his hand?

Billy: *Billy turns over his hand and beats it while smiling.* (*Cheery tone*) Sad!

IV: And how did mummy feel?

Billy: (*Upward inflection, cheery tone with a big smile*) Upset!

IV: Did anyone do anything about his burnt hand?

Sad: (*Brother, cheery*) "You better not do it again next time!"

4. Noise in the Night (Billy)

Billy: (*Billy doll*) Waaaaah! Waah! Ah! (*Billy waves doll, screaming)* Dave! Dave!

(*Dave*) Yes!

Billy: (*Garbles)* Bl-bl-gla!

IV: What did he say to Dave?

Billy: (*Bill doll frantically)* There was a car!

IV: There was a car?

Billy: Yeah (*Billy gestures movement of a car backwards)*

IV: And it backed into?

Billy: The neighbours

IV: And is that what the loud noise was?

Billy: Yeah!

IV: So what do they do next?

Billy: They fall asleep again (*puts dolls to bed)*

IV: How did Billy feel when he heard the noise?

Billy: A little bit scared

5. Hurt Knee (Billy)

Billy: Then, he (*dad*) walked up to there. Then, he said, “Boys don’t walk on rocks that will hurt you. You have to go round it.” *(Billy walks the dad doll around the rocks, demonstrating)*

IV: Ah, dad shows him how to go around rocks. But does dad do something about the knee?

Billy: Err. He puts a plaster on (*Billy gestures putting on a plaster*). Then, then, this one (*another child*) goes to fall down and says, “Ow!” and he hurts his knee, a little bit, and then he goes to the rock and jumps (*Billy jumps the doll over the rock)*

IV: And jumps over it

Billy: Yeah, and takes a piece of rock. This one - then - he found out this was, he put it somewhere, a big one, a boulder. He put this right here, right here. (*Billy puts the rock in front of the dad doll and makes the dad fall over the rock)*

(*Dad*) “Ow! Help! Somebody call a doctor or something!

IV: Oh-no! Did dad hurt himself?

Billy: No. This isn’t blood. Hurt himself?

Then he managed to jump it (*Billy jumps dad doll over the rock and then takes another doll and smashes it into the rock)*

Billy: He made it!

IV: He made it!

Billy: But he broken his knee

IV: He broke his knee

Billy: Yeah

C: Then the little one (*baby*) he tries to jump (*Billy jumps the baby over the rock*) and he hurts his foot, and he's ok…then. He jumps on dad!

Billy continues to jumps the dolls over the rock and bangs them onto the dad doll, dangling the father doll from the edge of the table with lots of vocalisations as the dolls cry out.

6. Picture Home (Billy)

IV: Can you show and tell me what happens next?

Billy: Well, mum and dad said, 'It's beautiful!" (*Billy puts his hands under his chin and rocks back in his chair)*. Then mum thinks about it, "It's a little bit bad and a little bit good"

IV: Mum feels a little bit bad and a little bit good

Billy: Then he (*boy Fin*) plays monopoly, and then he wins! He goes and have a bath, wash his hair

IV: But how does Fin feel?

Billy: Ha - a little bit happy and a little bit sad

IV: Oh, I wonder why he feels sad?

Billy: Mum didn't like it too much

IV: Oh, mum didn't like the picture too much. That makes Fin feel sad

Billy: A little bit

IV: A little bit sad and a little bit happy

Billy: Weeeeee! *Billy waves the doll up in the air between his face and the interviewer and then places doll on the table and shifts his gaze to the doll*

IV: (*Echoes*) Weeeee!

IV: Does something else happen or is this the end?

Billy: No. Okay. Then he goes to the table, playing monopoly with him. Then he wins. And he got upset and go to bed. And it was a sad, sad, sad, sad, sad (*looks to interviewer*) sad, sad, sad, sad day!

IV: It was a sad, sad, terribly sad day for Fin!

Billy: Then, the next day. Woop! (*Billy scoops up the doll raising it high)* He feels happy!

7. Parent Reunion (Lizzie)

IV: Can you show me what happens? (*Lizzie immediately leans forward, takes the baby doll and places it behind the toy couch)*

*Lizzie: (Baby doll)"*Argh! I'm going to hide."

(*Girl)* "Argh! Tell them, I– I'm dead" *(Lizzie puts girl the doll behind the couch and looks to the interviewer)*

IV: So they're hiding and Alice has told Grandma to tell mummy and daddy that she is dead

Lizzie rocks, finger in mouth

IV: So what happens when mummy and daddy come in?

Lizzie: (*Mother*) "Where's my little girl?"

(*Granny*) "I'm sorry we've lost your little girl"

IV: Who's saying that? I'm sorry?

Lizzie: "We lost her!" Granny

IV: Granny. What do mummy and daddy say?

Lizzie: (*Parents*) "We've lost the baby and we've lost - and we've lost Rosie."

Lizzie rocks in chair...

IV: What do mummy and daddy do?

Lizzie picks up the mother and daddy doll in one hand and waves them in the air

Lizzie: (*Parents, frantically)* "Errr my children!" (*Lizzie stamps the dolls around in a circle and then holds them to her ear and looks to IV)*

Lizzie: (*Mother*) "Ambulance! 999999!" (*Lizzie bangs parent dolls frantically on the table)*

Lizzie: (Granny) "I hope she's going to be all right."

IV: Who did they call?

Lizzie: (*Rosie jumps out from the couch in a sing-song voice*) "Here I am!"

IV: Oh, she's come out. Was she hiding?

Lizzie: (*Baby*) "And here I am! Here I am!"

IV: Were Rosie and Alice hiding?

Lizzie: (*Baby, firmly*) Here I am!

Lizzie puts the baby doll into the car

Lizzie: And they go hide. And they driiiiiiveeeee! *Lizzie* r*uns the car into the mother with a scowl*. Run the mum over!

IV: Who's run mum over?

Lizzie: Mum! Now dad!

Lizzie pushes the car into the daddy doll and knocks him from the table

IV: Baby Rosie has run them over?

Lizzie: And then! Grandma gets run over. *Lizzie pushes grandma off the table with the car and looks to the IV, mouth open*

8. Hot Gravy (Lizzie)

IV: Can you show and tell me what happens next?

Lizzie leans forward, grabs mother doll and stamps her on the table. And then mum said. "You shouldn't have touched it then! I'll put a plaster on it. Bloody hell" (*looks to IV*)

IV: Is that what mummy says? (*Lizzie nods*)

So, she said she shouldn't touch it, and then she's going to put a plaster on it

Lizzie: (*Mother*) And now I have to cook the dinner. Get back there and it will be finished in 5 minutes

IV: How does Alice feel?

Lizzie: (*Alice*) Mummy, it really hurts!

(*Mother*) Well, sit down! I'll give you something, a milkshake after - if you be quiet

IV: She's told mum it really hurts, mum has told her to sit down and be quiet, then she can have a milkshake

Lizzie: (*Mother*) And then the food. Here you are, I told you!

IV: How does Alice feel now?

Lizzie: Dad said, "Mm, dinners ready. But I'm sorry I have to go to work."

IV: Dad's going to work

Lizzie: And then she (*mother*) said, "I have to go to the shops. Alice look after baby. If there's any, no - if somebody comes and tries to take you, ring the police, and ring me. I'll give you my phone"

IV: So mum's left Alice in charge of Rosie

Lizzie: And then they hide from mum and dad (*smiles and hides the baby doll in the oven*)

9. Hurt Knee (Lizzie)

IV: Can you tell me and show me what happens next?

Lizzie: They all go like this (*puts hands to ears*), "Ambulance, ambulance, emergency!" (*The mother dolls rushes over panting, panicked*). "Get up, get up!"

IV: (*Urgently)* Get up, get up, the mum says

Lizzie: And she's like this, Err, Dead! *Lizzie closes her eyes and rolls her head back, making a dead face*

IV: Oh, she died

Lizzie: And then after that, someone goes like that. *Lizzie takes the stone wall and cuts the doll in a saw like fashion across the neck, grimaces and cuts again*

IV: And cuts her!

Lizzie: Head off!

IV: Head off!

Lizzie: Chops her head off! (*Lizzie looks to IV, long stare*)

IV: Chops her head off, someone does that, I wonder who

Lizzie saws hard at the head with a grimace, drops the doll to the ground

Lizzie: Dead!

IV: And she has no head, and she's dead! She fell off the wall and she's dead

Lizzie: And now that's what the dad gets

Lizzie saws the dad's neck and throws the dad doll to the ground

IV: Cut the head off the dad as well

Lizzie: *Cuts head off girl doll and throws doll.* Cut!

IV: Argh! Cut the sister!

Lizzie: *Cuts baby doll's head.* Cut!

IV: Cut the baby

Lizzie: No actually *(puts down baby)*

IV: Not cutting the baby

Picks up baby, makes a cutting noise, cuts the baby's neck and throws the doll to the ground

IV: Oh, we are cutting the baby

Lizzie makes a cutting noise and saws the mother doll's neck

IV: And cut the mum. So they're all dead

10. Picture Home (Lizzie)

Lizzie: (*Sisters*) They walk off. They say (*urgently whispers*), "Come on, they can't know that we're leaving, they can't know, come on!" *Lizzie stamps dolls hurriedly along the table*

IV: They all leave. Does the baby take the picture with her?

Lizzie nods and hides the dolls behind her on the chair

Lizzie: And the mum goes, "Come on it's time for tea!" Then they go *(moves mother and father doll hurriedly along table looking for the children*)

IV: And they're not there!

Lizzie: (*Mother & father doll call out*) "Come on! Where are you?"

Then they, the dad, someone goes behind him and breaks his legs so he didn't had no leg (*bends doll legs backwards)*

IV: Daddy has no leg. Someone broke daddy's leg

Lizzie: And he has to have a fake leg

IV: Oh, he has to have a fake leg. And the girls have gone missing. They just went away, with the baby and the picture

Lizzie: After that, Dad! Went like that to the mum (*Lizzie slices the dad's foot across the mother doll's face with a grimace*) and goes like that *(bends mother's leg backwards*) and goes like that (*bends other leg*)

IV: Oh, mum loses both her legs and dad has just kicked her in the face

Lizzie continues to make the father doll kick the mother doll repeatedly in the face. Lizzie's face contorted, tongue protruding

IV: And kicks her again. It looks like dad is really hitting mum.

IV: Now what happened to mum and dad?

Lizzie: Dad gets his legs back. But he still got his feet chopped off (*bends feet on father doll*)

IV: Gets his feet chopped off. He's got legs but not feet (*Lizzie looks sad*). And the girls are still lost

Lizzie: And after than the mum comes back, and they say, "Sorry, sorry, Mm, Mm (*rubs face of mother and father doll together, kissing*)

11. Hot Gravy (Lizzie)

Lizzie hurriedly picks up the mother doll, stamps mother doll with an angry face

Lizzie: He hasn't touched that! And she's like… Come and get him to the doctors. *The mother doll picks up the baby doll and places him on the kitchen table*

IV: Get the baby to the doctors. *Lizzie moves the baby doll to the bed*

Lizzie: And he lays in bed and he stops crying. Then the mum gets the food and goes takes it, and everyone goes to the table

IV: And everyone goes to the table. The baby has been put to bed to stop the crying

Lizzie: And then, this - this, and then (*pause*) - actually, they all go to the cinema (*looks to IV, happy voice)*

IV: Oh, they just all go to the cinema…Does the baby go with them to the cinema?

Lizzie nods, looks withdrawn, sad

Lizzie: No! *Points to baby.* The baby stays there (*suddenly re-reengages in story, urgency in voice*)

IV: The baby stays there

Lizzie: Then they all go, leave the baby, they watch the film, they sit there watching, they're all eating sweeties and candy

IV: Oh, and the baby's just left there

Lizzie: (*Eating noises*) "Um, yum, yum, yum"

IV: How does the baby feel?

Lizzie: The film finishes (*taps dolls along table*) they all go back…

And they all go back and the baby is dead - in the bed

IV: The baby is dead in the bed!

Lizzie: Bleeding. Because someone hu-hurt it

12. Spilt Juice (Tyler)

Tyler looks to IV, giggles and continues to hit the mother and father dolls together making raspberry noises with his lips

IV: How did she feel when she spilt the juice?

Tyler: Um, he (*father*) feels scared that she was going to smack him

IV: She felt scared that she was going to get smacked

Tyler: No he!

IV: She spilt the juice though

Tyler: No-o! He did!

IV: But this one spilt the juice

Tyler: No this one! This one (*pouts, exhales, looks to camera*)

IV: So he was scared that he was going to get smacked?

Tyler: Yeah, but she already did

IV: Who cleaned up the juice?

Tyler: Ah (*pause, looks and speaks to camera*). Hello! Of course you can!

Tyler looks to IV and then to the camera with a grin

IV: What happened to the juice?

Tyler: Ah (*long pause*) ah-di-di-

IV: Did they all clean it up?

Tyler: No. Yea, yeah, yes!

13. Parent Reunion (Tyler)

IV: Grandma was looking out the window and she sees the car coming and she goes, "Children, mummy and daddy are home!"

Tyler: (*Stutters)* Yeah-yeah-yeah-and-and-um-no-no-no-an-um, when she come back, um, she, she was going to get, she was going to go to the doctors, to fix her face, and her face look good, and then they like her. Come! (*Tyler grabs all of the dolls and pushes them together making aggressive kissing noises).* The kids like her now

IV: They like their grandma now. Okay

Tyler drives the car across the table

Tyler: And see, (*Grandmother*) "Mummy and daddy are here!"

Tyler: (*Children)* "Wooohoo! We had'ed a great time, did we?"

IV: What do the children say? Did they have a good time?

Tyler: (*Children*) "No thanks to you!" *(Looks to IV and holds grandmother and child doll together in a hug)*

IV: How do the children feel now that mummy and daddy are back?

No response

IV: How do the children feel?

Tyler: Hmm. They're hugging…

Tyler: (*Grandma, silly voice*) "Bye-bye I had a good time"

IV: Where is she going to go?

Tyler: (*Grandmother*) "I'm going to go down to the beach"

IV: Nice

Tyler: (*Mockingly, softly)* Nice, nice, yeah, nice, nice, nice. "Bye-Bye!"

14. Stamping Elephant (Tyler)

Tyler: *Moves the animals across the table*. Weee! Weee! Weee! Weee! Weee!

IV: What are they doing?

Tyler: They're moving. Weee!

IV: Are they running away?

Tyler: Yeah

IV: Why?

Tyler: And he scared them up. *Tyler moves the elephant behind the animals and sweeps the animals across the table*

IV: He's scaring them. They're running away

Tyler: Yeah

IV: And what's the elephant going to do? *Tyler has the elephant in one hand and a turkey in the other; he holds them face-to-face on the table. Tyler picks up the elephant and crashes it down on the turkey*

Tyler: (*Turkey*) "Owwwoooo!"

IV: What has he done to the turkey?

Tyler: (*Turkey*) "No, you hurt me!" *Again the elephant crashes down on the Turkey. Tyler looks to the interviewer and moves the turkey off the table and onto his lap*. Look it's gone. He killed it

IV: And how do the animals feel?

Tyler: He killed the animals. See, loo-look-look they're all dead

IV: All of them?

Tyler turns away from the interviewer and examines the tusks on the elephant

Tyler: Look he's going to kill himself

(Elephant) "Moo!" *Tyler crashes the elephant upside down on the table*

IV: So everyone dies?

Tyler: We've got no animals

IV: No more animals

Tyler: Yeah, but they teleported again. *Tyler retrieves the elephant and turkey*

(*Elephant, deep voice*) *"*Moo! I'm going to suck you're blood. I'm a mosquito."

Tyler puts the elephant's trunk onto the turkey and makes glugging noises

IV: So he's sucking the turkey's blood. *Tyler continues to make glugging noises, abruptly bangs the turkey on the table and looks to the interviewer*

IV: Is that the end of that story?

Tyler: No! (*Drawls*) He can still kill a few more!

….

C: (*Goat*): "Meeeh!" *Tyler raises the doll and the air and slowly brings it to rest on the table, abruptly bangs the doll onto the table, looks at the doll and falls silent*

IV: What has happened to the Princess?

Tyler: She's dead

Tyler fiddles with the skirt on the doll, looks up skirt

Tyler: Look-look he's going to butt her

Tyler puts the goat's horns up the doll's skirt

Tyler: Look, he's going to go inside

Tyler: (*Princess*) "Argh!"

Tyler: Look, she's dead there's blood

Tyler continues to put the goat horns up the doll's skirt

IV: So the goat was killing people?

C: Yeah, look, and it was smelling their bums (*looks to IV, direct eye contact*)

C: Yuck (*looks again to IV*). That's disgusting

15. Birthday Cake (Tyler)

Tyler: Yay, let's cut the cake. Let's eat the cake. (*Child*) "Can we eat it?"

Tyler: (*Mother*) "Of course you can."

IV: Of course they can

Tyler: (*Children*) “Yay, let’s all eat the cake. Yay! Num, num, num, num. Mm. Tasty!”

IV: And how does Kim feel?

Tyler: (*Sighs*) Um, um, um, um - really, really impressed

IV: He’s impressed

Tyler: And surprising

IV: And it was surprising

Tyler: Yeah, she, she, feels really surprised

IV: She feels really surprised, Kim does

Tyler: Yes, she’s lucky

16. Picture Home (Tyler)

Tyler: (*Father*) Wow! Pretty.”

(*Mother*) “Wow! Pretty.”

(*Child Kim*) “Wow! Pretty. Brilliant. Yay!”

IV: Everyone likes the picture. And what does Kim do?

Tyler: Ah, she, and she, she, sticked it to her wall

IV: Oh, she stuck it to her wall. And how does she feel?

Tyler: (*Pause*) Happy

IV: She feels happy

Tyler: And, um, um, and she put it, she put it in her pillow, and she, she, she went in, she went in the bed, and she had a dream.

17. Crying Outside (Tyler)

Tyler: What’s this? *Points to doll legs*

IV: The thighs

Tyler: The legs

IV: The legs

Tyler: What's this? *Points in-between doll legs*

IV: The bum

Tyler: *Looks to IV and smiles*. Yeah

IV: Yeah. So she's showing her bum

Tyler: Yes. She puts the bum in the peoples face

IV: She puts the bum in peoples' face

Tyler: Yes. And she poo on it…

IV: Did she poo on the people's face?

Tyler: (*Smiles*) Yes

IV: Yes, she did, Kim poo'ed on the peoples face. And how did she feel?

Tyler: (*Quietly*) Ah, she feels, ah, a little bit good

IV: She felt a little bit good

Tyler: Yes

IV: She was able to poo on the peoples face (*Tyler smiles*) and that made her feel a little bit good

18. Hot Gravy (Tyler)

Tyler: (*Mother*) "Cinderella, why's it on the floor? Argh! You! YOU ate it! You poured it, and you ate it.

Tyler makes a screeching noise

IV: It sounds like mum is really angry (*Tyler smiles*)

Tyler: (*Mother*) "I'm really upset with you. Go to your room!"

IV: Go to your room

Tyler: (*Mother, sad*) "Go to your room now, you ruined my cake (*cries*). Go, go away!"

Cinderella flies through space, Tyler makes a screeching noise and lands her on the table with a bump

IV: And she kicked her into her room. She has a burnt hand

Tyler: Yes. She can't actually feel anything

IV: Oh, right, she can't feel anything

Tyler: Yes. And tomorrow - and tomorrow, um, um (*stutter*) she got it a plaster

19. Noise in the Night (Josh)

Josh: (*Mothe*r) "Heeelloo!" (*Jonny*) "Hello!"

Josh: Roll his sleeves up! *Josh rolls up the sleeves on Jonny doll*

IV: What's mum going to say to Jonny?

Josh: (*Mother high pitched voice)* "You're naughty!"

Josh looks to the interviewer

Josh: Guess what he done?

IV: What?

Josh: Later. Guess what he done? (*Fighting noises*) Yah! Yah!

Josh hits the Jonny doll against the mother. The mother groans. Josh puts the mother doll back into the car with the policeman leaving the baby behind.

Josh: (*Mother*) "Take me away!" (*Siren noise*) Ewoo!

Josh: (*Jonny, evil tone*) "Ah-ha! I've still got the baby (*looks to IV*) I can punch the baby up now!"

Josh: Ah-ah! Hump!

Josh looks to IV, grimaces and grunts as the Jonny doll hits the baby

20. Hot Gravy (Josh)

IV: And what does mum do?

Josh: Nothing

IV: Does she say anything?

Josh: Nope

IV: And how does she feel after she put it under the tap?

Josh: Then she has a bag of crisps to eat

IV: Is her hand better now?

Josh: Yeah

IV: How did it get better?

Josh: Rub the special rubber (*looks to IV and blinks*)

IV: Ah, ok. So she put it under the tap, she blew on it and rubbed it?

Josh: Yep (*pulls up skirt of doll*)

IV: And then she got better and got a bag of crisp

Josh: Yep

IV: Is that the end of that story?

Josh: No. *(Pause*) Um

IV: What happens next then?

Josh: She gets the bag of crisps, to eat now

IV: Cause she's so hungry

Josh: And she took all of them

IV: All the crisps!

Josh: Mum didn't know. And she said, "Are you hungry?"

Josh: (*Child, eating noises*) Num, num, numm, num num

IV: So mum's saying, "Are you hungry?" And what is Jackie doing. Eating all the crisps?

Josh: (*Mother looks in cupboard for the crisps*) "What are you eating!?"

Josh: (*Child*) "All of the bags of crisps! Ha-ha-ha-ha!"

Josh: (*Grunting*) "Err! Err! Err!" *Josh has the mother doll repeatedly hit the child doll with an angry scowl on his face*

Josh: She broke the house

IV: Mum did?

Josh knocks over the furniture with the mother doll

IV: Why did mum break the house?

Josh: She got mad

21. Lost Pig (Josh)

Josh: (*Mother*) "So they went this way. This way still. Cows - did she go this way?"

IV: What do the cows say?

Josh: Yes, she went right over here, in the woods

Josh: (*Mother)* "Yes, I got him. That's why you should never run away"

IV: So mummy is saying, "That's why you should never run away"

Josh: No daddy

IV: Daddy is saying you should never run away. So has mummy and daddy taken the little pig home?

Josh: Yes

IV: So how did little pig feel when he was lost?

Josh: Humph! *Josh looks to the interviewer and then to the camera shouting and gesturing thumbs down.* Sad! Sad! Okay! Sad!

IV: And how does he feel now?

Josh: Happy!

IV: What did mummy and daddy say? Daddy said he should never run away

Josh: And he told daddy something. *The little pig whispers into daddy pig's ear*. "If you jump on mummy's back and then jump on my back, I'll take you to water."

IV: Okay. Is that why he went for a walk? He was looking for water? Does anything else happen in the story?

Josh: Yes! The goats comed and saw a yummy tasty cow (*repeats rhythmic tone*) a yummy tasty cow

Josh: Then mummy goes, yeah, went to get something to eat

Josh: (*Cow*): Moo! Then something happens, bad (*softly, sad look, furrows brow and purses lips*)

IV: What happened?

Josh: (*Goat*) "Mm. Mm. That looks yummy." *Josh licks his lips*

IV: Is that the mummy goat saying that looks yummy?

Josh: The daddy

IV: The daddy goat is saying that looks yummy

Josh: (*Daddy goat whispers and sneaks up on the mummy cow*) "Let me go eat meat"

The daddy goat knocks the mummy cow over and begins to eat its belly. Josh makes eating and crying noises. The cow wails

IV: So daddy goat is eating the cow

Josh: (*Dad*) "Num, num!"

Josh: And the other cows say, "Where is mummy cow? Where is mummy cow? Let me go look for her."

22. Hurt Knee (Josh)

Josh: Wait! Let me twist it. *Josh firmly twists leg of doll three times round*

IV: "Ow! I twisted my knee!"

Josh: Twisted his ankle

IV: "Ow! I twisted my ankle!" Can you show me and tell me what happens next?

Josh: (*Jack doll*) “Oh I hurt my knee!” Then the baby goes - and you say, “No baby!”

IV: The mum says, “No baby!”

Josh: Yeah, cause the baby was going into the woods

IV: Right

Josh: (*Jack*) “No, don’t go into the woods!”

IV: Oh, Jack shouts at the baby, “Don’t go into the woods!”

Josh: (*Josh picks up Jack doll)* Now he’s better

IV: He’s better now. Did anyone come and put a plaster on?

Josh: No, nothing, just, God gave him a ma-massage (*looks to IV)*

IV: God gave him a massage

Josh: Yeah now (*puts baby under shirt of mother doll)*

IV: The baby goes under the shirt (*looks at IV and laughs*)

Josh: So it means that, Agrh! *Pulls baby out from shirt.* Pretend this story hasn’t started yet

IV: Oh, the story hasn’t started. You’re going to start it again

Josh: Yeah. So, the mummy - I’m going to put this in her belly (*puts baby doll up the dress of the mother doll)*. So I’ll pretend. What way does the babies come out? That way? With their head?

IV: Their head

Josh: Their head. I put them in here (*long look to camera and then to IV)*...

IV: So the mummy has the baby in her belly

Josh: And somebody (*nods head in direction of doll*) the um, Jack, punched it

IV: Jack punched mummy’s belly

Josh: Yeah. Look, in here, it looks like a big fat belly (*shows IV mother doll with baby under dress)*

IV: It does. It looks like she's pregnant (*Josh makes groaning noise*) and Jake punched her belly

Josh: Yeah

IV: Did he punch it hard?

Josh: Yeah

IV: Oh, he punched it hard. And what happened?

Josh: The baby come out and she's bleeding (*sniffs)*

23. Lost Keys (Josh)

IV: Can you show and tell me what happens next?

Josh: Then he touches his bum

IV: Who touches his bum?

Josh: The mum

IV: The mum touches his bum

Josh: And kills him

IV: And kills him. Mum touches his bum and kills him (*Josh sneezes loudly and dramatically).* And what happens next?

Josh: Wait, wait, wait. *Josh hits the doll across the room*

IV: Mum has killed him. And how does Jake feel in all this?

Josh: Then the baby goes. *Josh puts baby doll's head in his mouth*

IV: Ah! You eat the baby

Josh: Then he goes. *Josh hits the baby doll across the room*

Josh: Uh-oh! There's a lady on the floor (*IV retrieves doll)*

IV: Are mum and dad still arguing?

Josh: *Takes doll from IV.* That's his girlfriend

IV: That's dad's girlfriend

Josh puts the father doll on top of the girlfriend and makes kissing noises. Mm. Mm

IV: And they kiss

Josh: And you say, "What!"

IV: "What!" says mum

Josh frantically bangs the mother doll up and down, stamping the doll on top of the father doll and his girlfriend. The mother doll screams in a shrill voice, "What!"

IV: (*Mirrors*) What!

Josh continues banging the mother doll up and down… (*Mum)* "That's my friend. Police officer, that's my friend."

IV: Mum's really angry

Josh: That's a friend. That's a friend. Now you're going to get your booty kicked

Josh hits the girlfriend doll across the room

IV: And mum kicks her away

Josh: Then Jack (*son*) kicks her bum. *Josh puts the mother doll into his mouth and grits his teeth*

Appendix E

Tests of Statistical Assumptions Study 2 (LOESS and PACF PLOTS)

Case Study 1: Eli & Therapist A

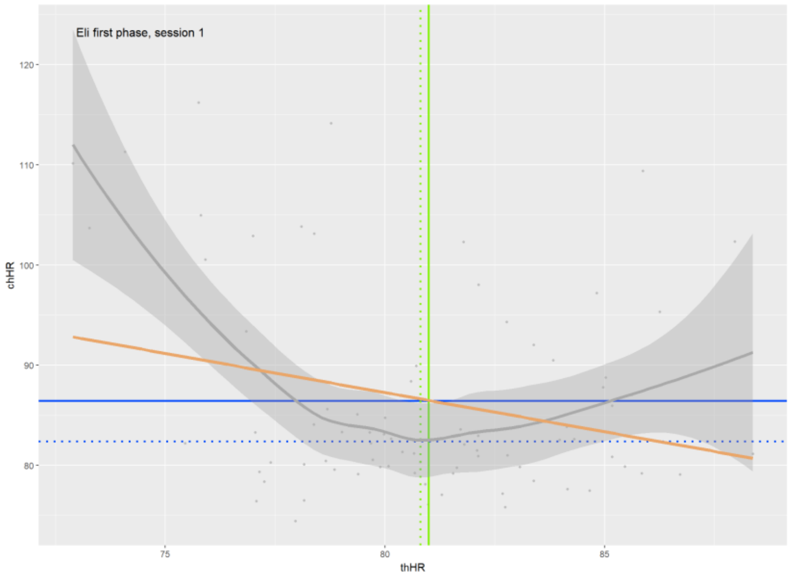

Figure 3. LOESS smoother plot for the simultaneous correlation session 1 Eli (HR). The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values. The graph indicates a potential curvilinear rather than linear relationship for the simultaneous linkage.

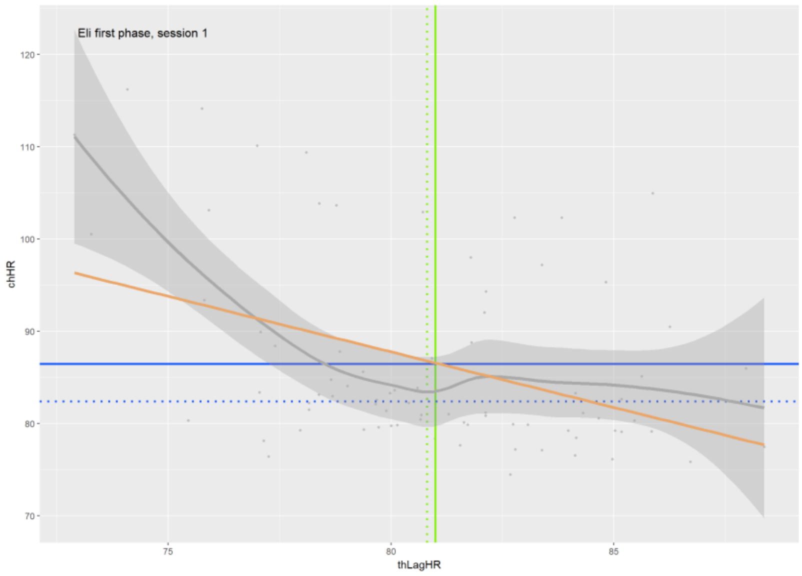

Figure 4. LOESS smoother plot for the significant therapist-led lag session 1 Eli (HR). The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values. The graph confirms a linear relationship for the therapist-led lag.

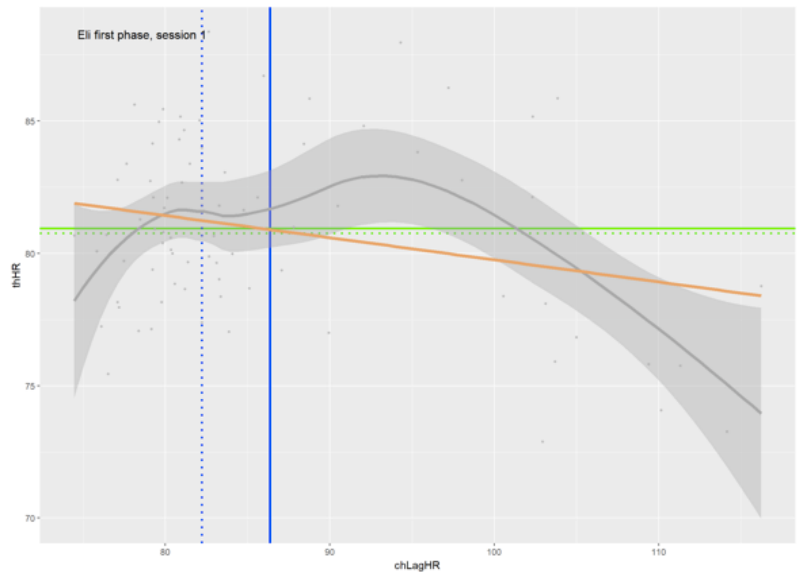

Figure 5. LOESS smoother plot for the non-significant child-led lag session 1 Eli (HR). The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values. The plot suggests a curvilinear rather than linear relationship for the child-led lag.

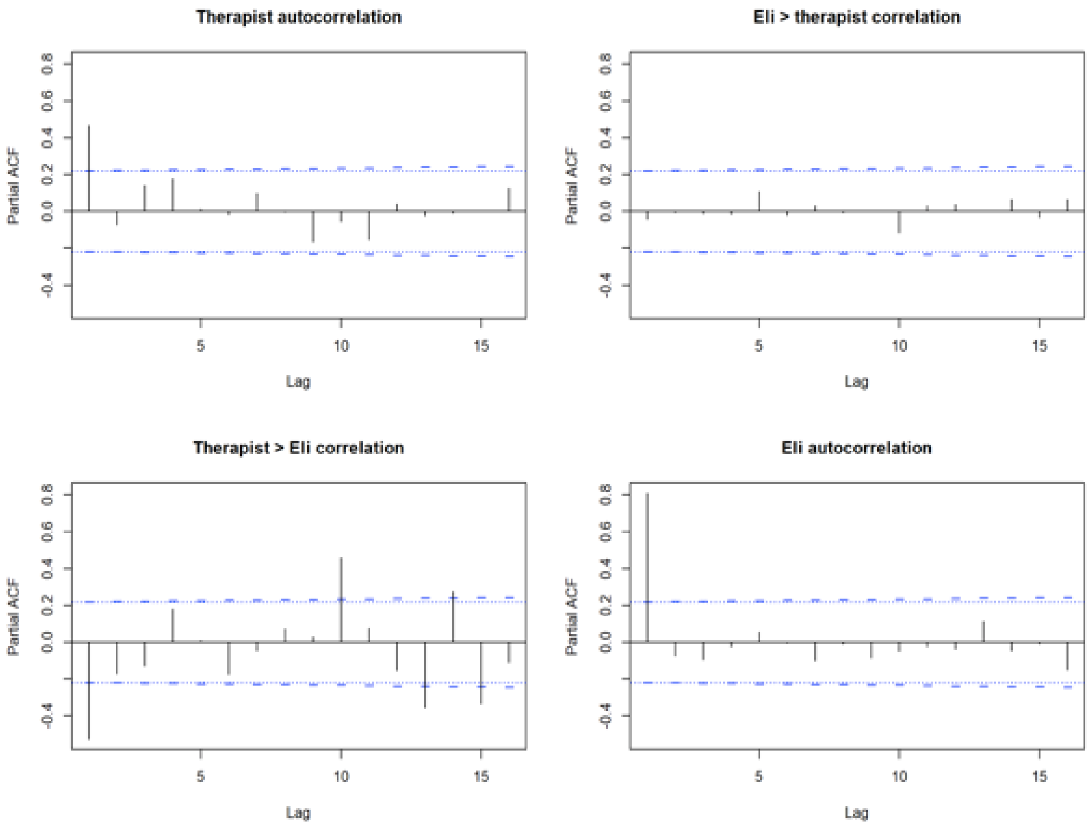

Figure 6. PACF plots for therapist and child, session 1 Eli (HR). The blue lines are the "significance bounds." The plots confirm that a lag of one 30-second epoch is the most meaningful lag with a strong negative lag=1 effect evident from the therapist to the child (bottom left plot).

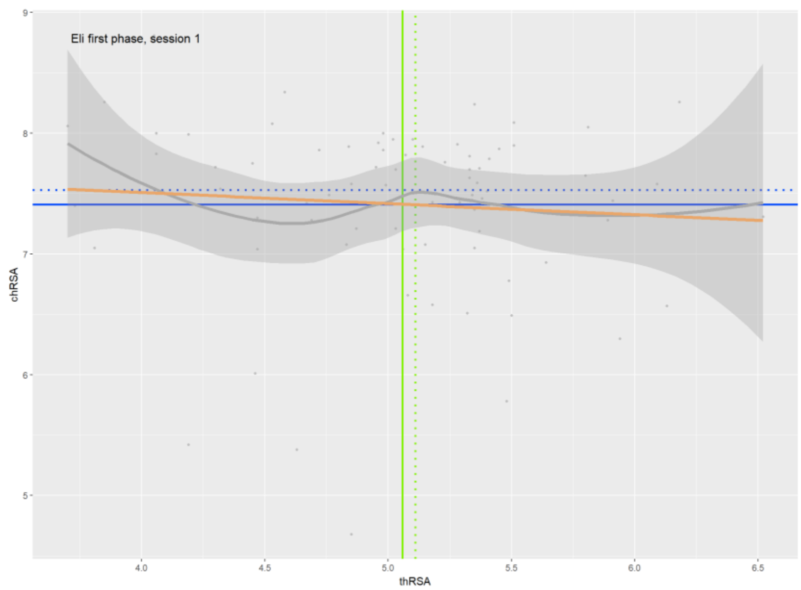

Figure 9. LOESS smoother plot for the simultaneous correlations session 1 Eli (RSA) The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values. The graph confirms a linear relationship.

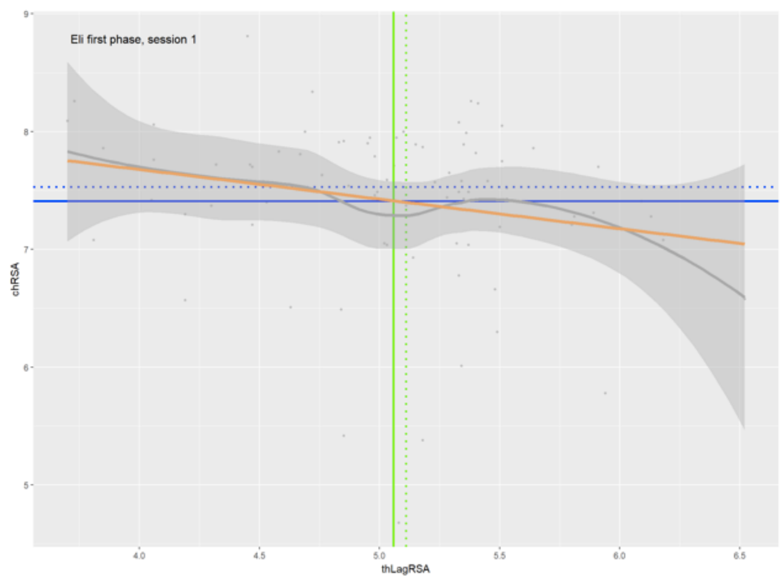

Figure 10. LOESS smoother plot for the non-significant therapist-led lag session 1 Eli (RSA) The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values. The graph confirms a linear relationship for the therapist-led lag.

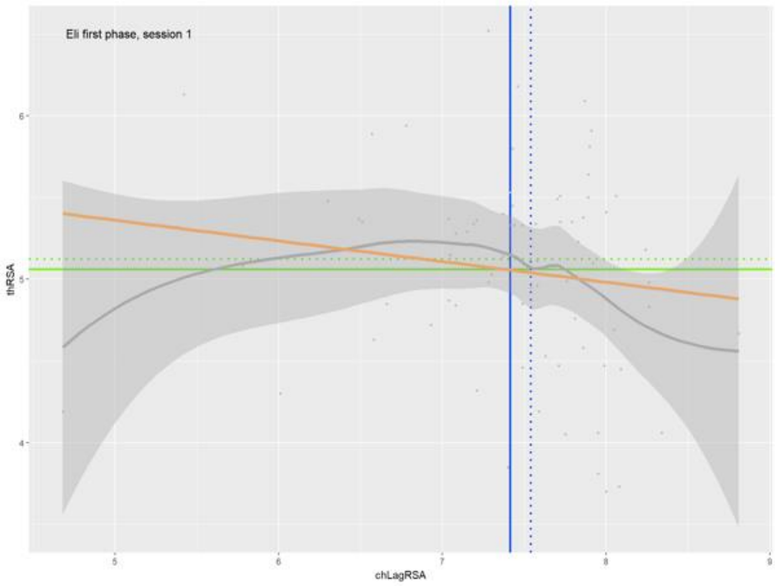

Figure 11. LOESS smoother plot for the non-significant child-led lag session 1 Eli (RSA). The plot confirms a linear relationship for the child-led lag. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values).

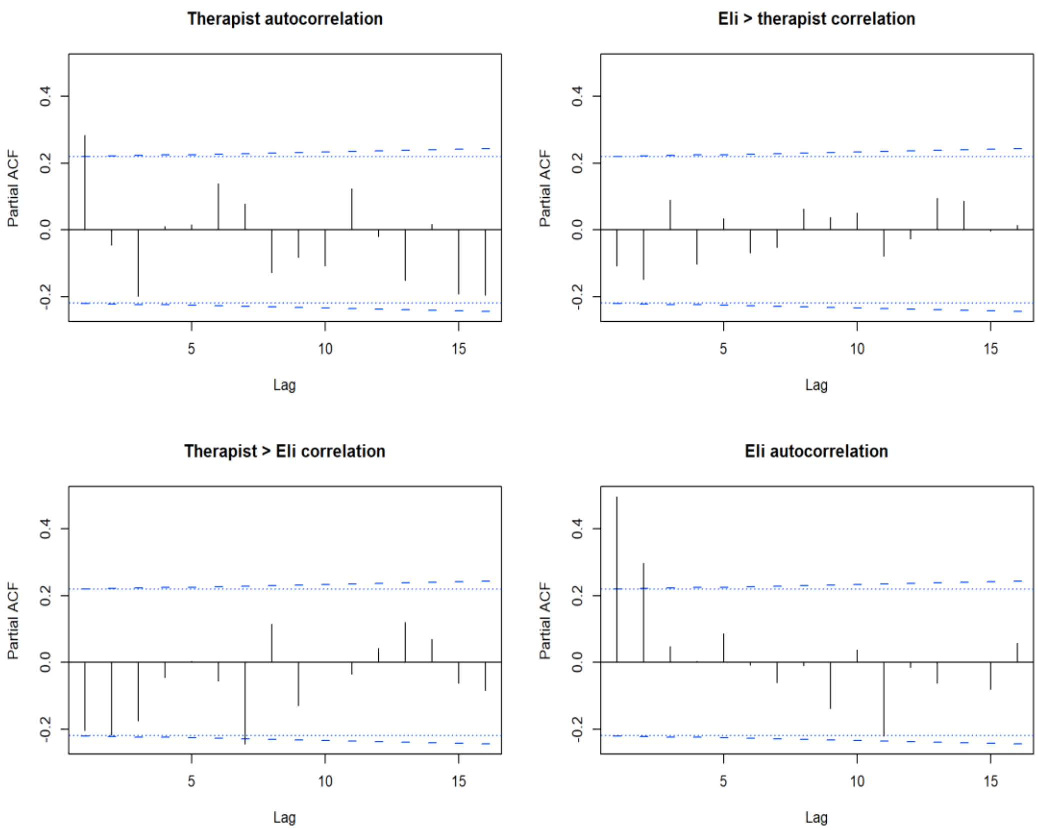

Figure 12. PACF plots for therapist and child for RSA session 1 (RSA). The blue lines are “significance bounds.” A lag=1 is the most significant lag for the therapist (top left) and child (bottom right) autocorrelations. No other significant lag effects are evident

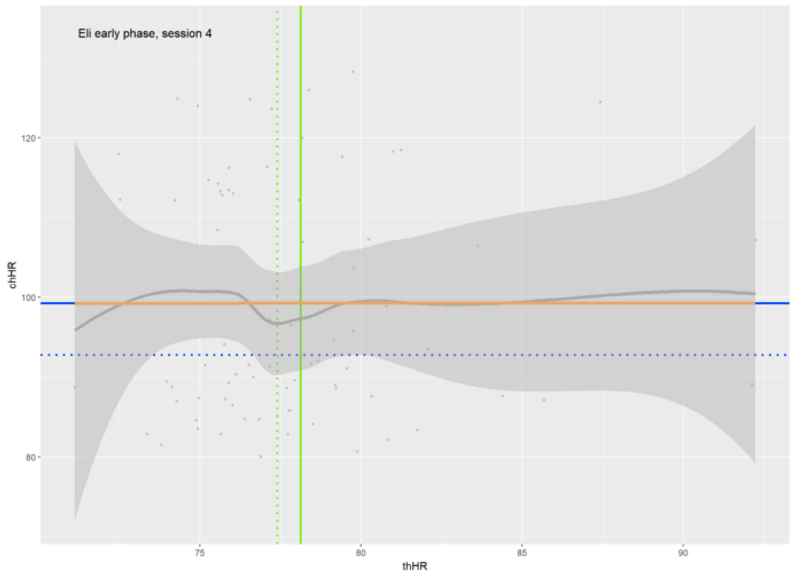

Figure 15. LOESS smoother plot for the simultaneous correlation session 4 Eli (HR). The graph confirms a linear relationship. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values.

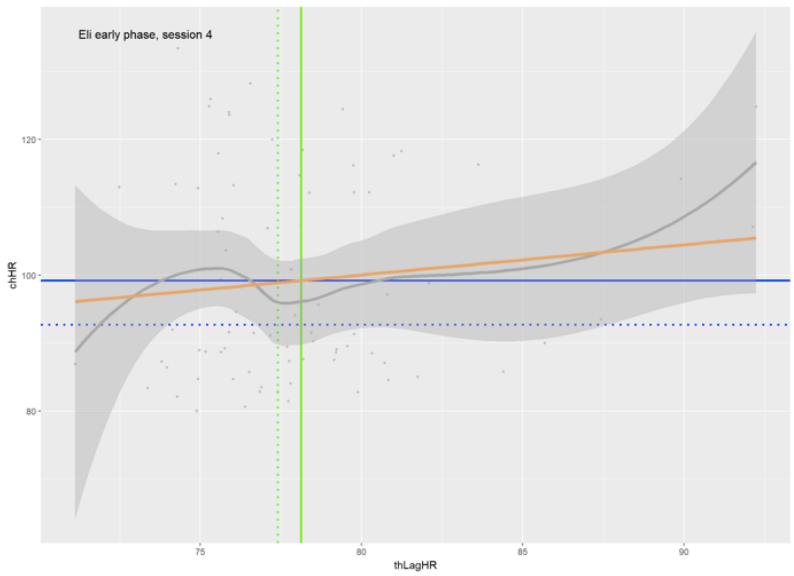

Figure 16. LOESS smoother plot for the non-significant therapist-led lag session 4 Eli (HR). The graph confirms a linear relationship. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values.

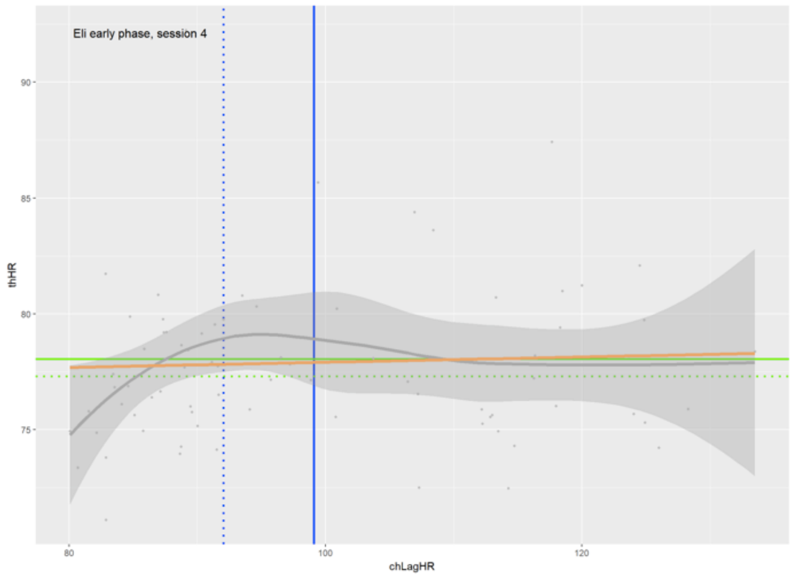

Figure 17. LOESS smoother plot for the non-significant child-led lag session 4 Eli (RSA). The plot confirms a linear relationship. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values.

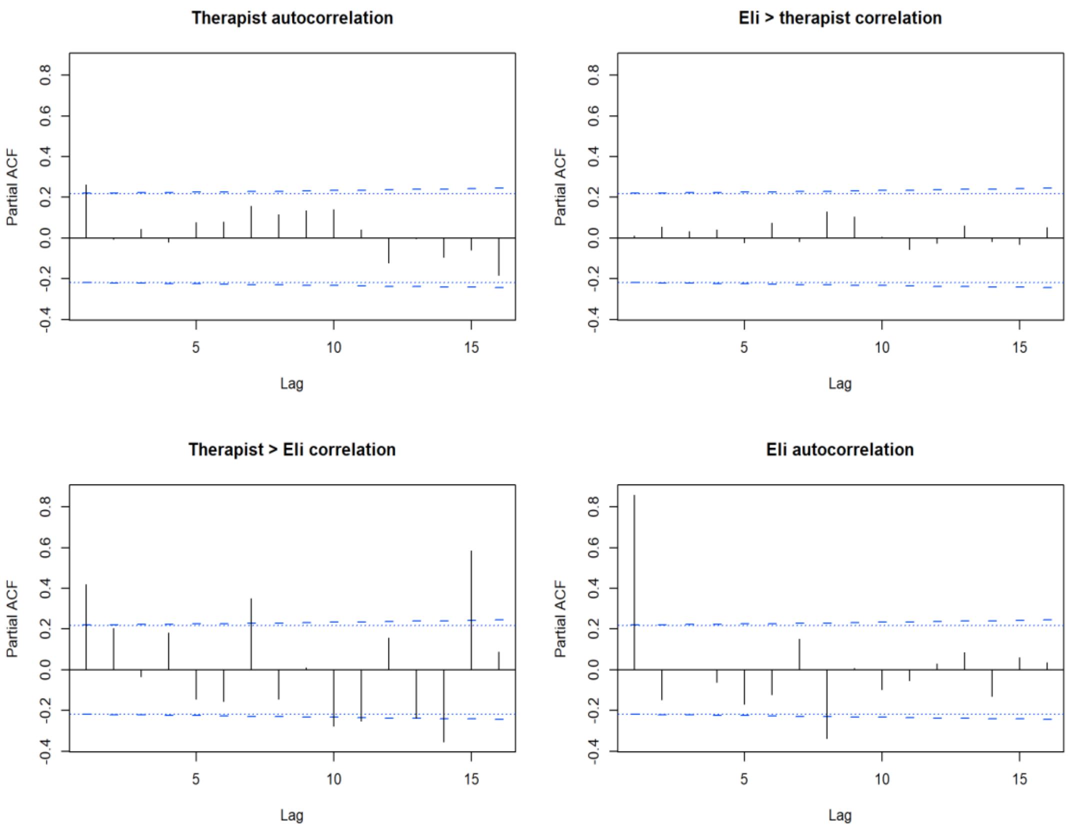

Figure 18. PACF plots for therapist and child session 4 Eli . The blue lines are the “significance bounds.” The plots confirm a meaningful positive lag=1 effect for the autocorrelations (top left and bottom right plot) and for the lagged relationship from the therapist to child (bottom left plot).

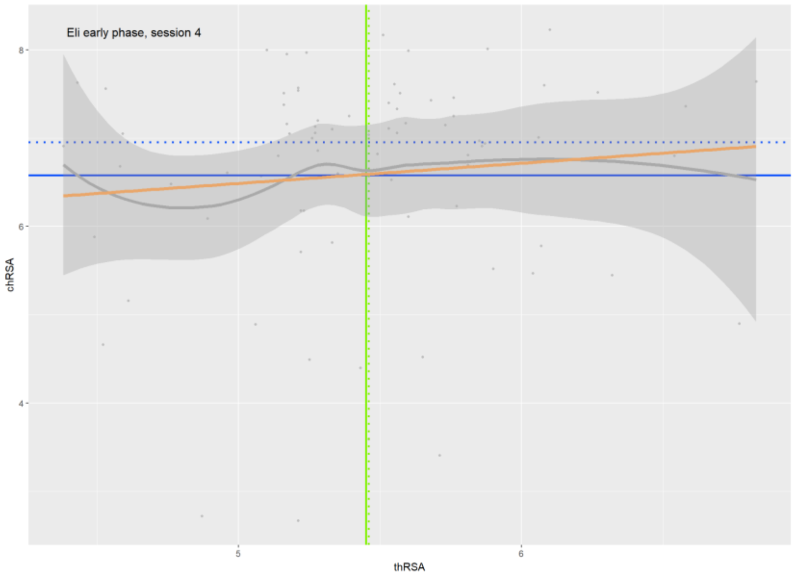

Figure 21. LOESS smoother plot for simultaneous correlation. The graph confirms a linear relationship. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values.

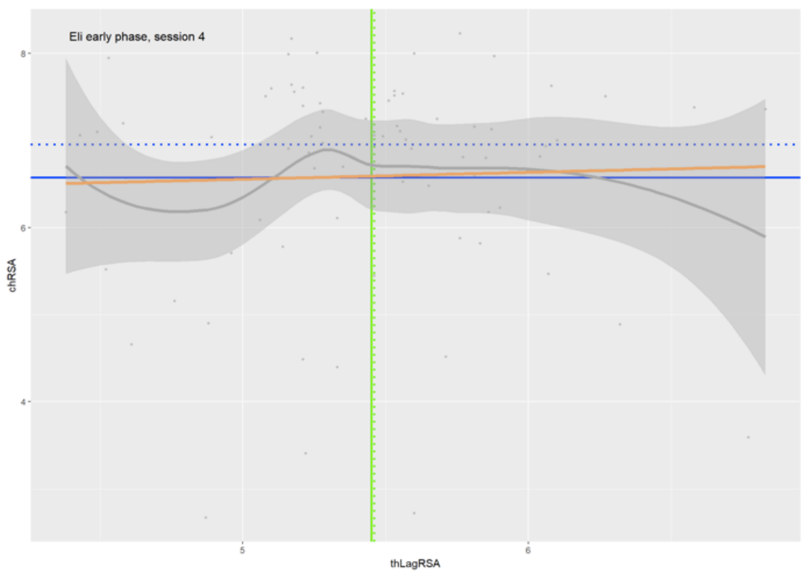

Figure 22. LOESS smoother plot for the non-significant therapist-led lag. The graph confirms a linear relationship. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values.

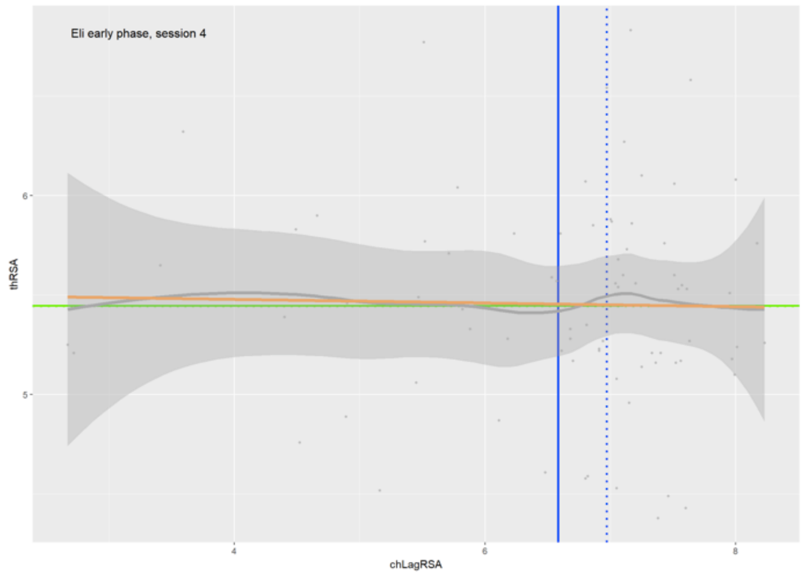

Figure 23. LOESS smoother plot for the non-significant child-led lag. The graph confirms a linear relationship. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values.

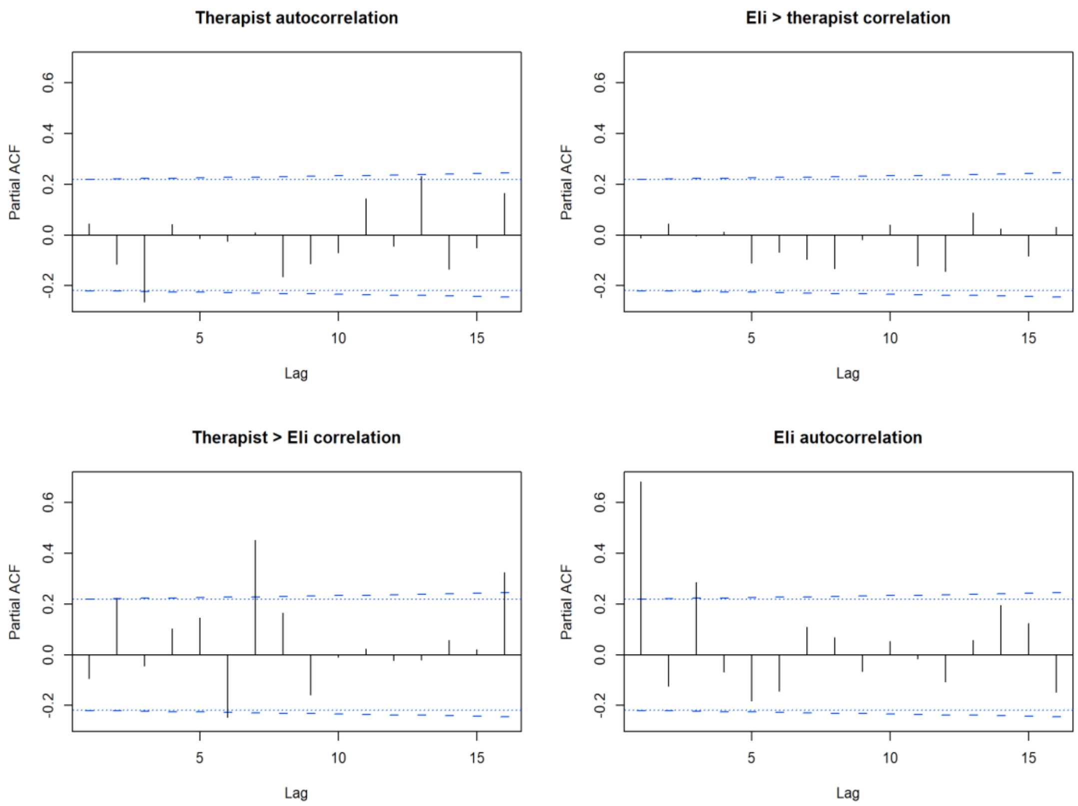

Figure 24. PACF plots for therapist and Eli, session 4. The blue lines are the “significance bounds.” The plots show a lack of meaningful lags with the exception of a strong lag=1 effect for the child’s autocorrelation (bottom right).

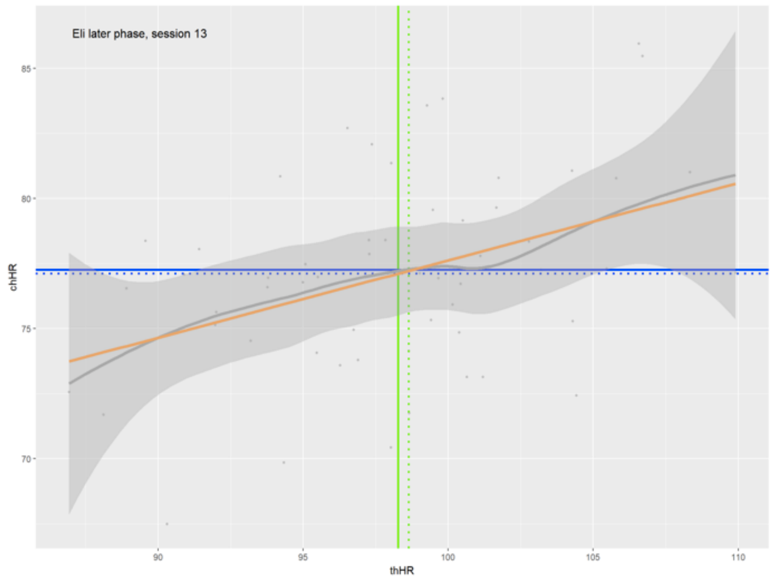

Figure 27. LOESS smoother plot for the simultaneous correlation for Eli session 13. The graph confirms a linear relationship. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values.

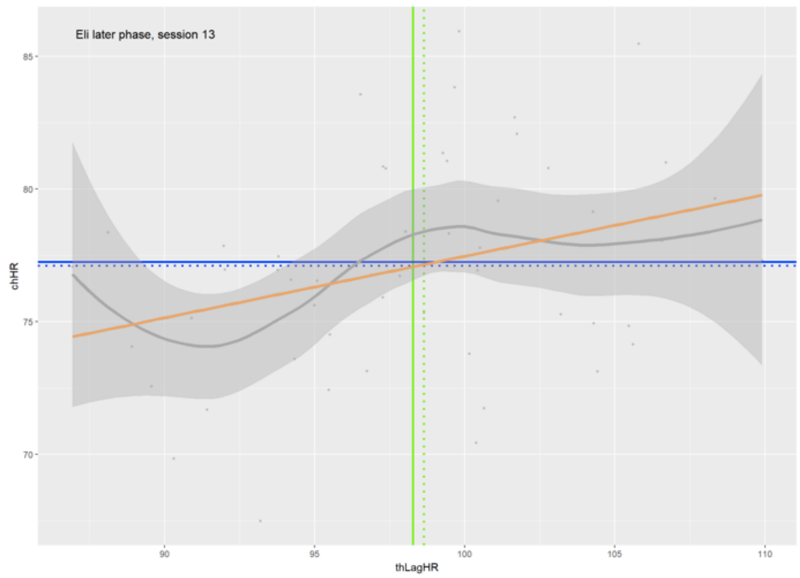

Figure 28. LOESS smoother plot for the therapist-led lag for Eli session 13. The graph confirms a linear relationship for the therapist-led lag. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values.

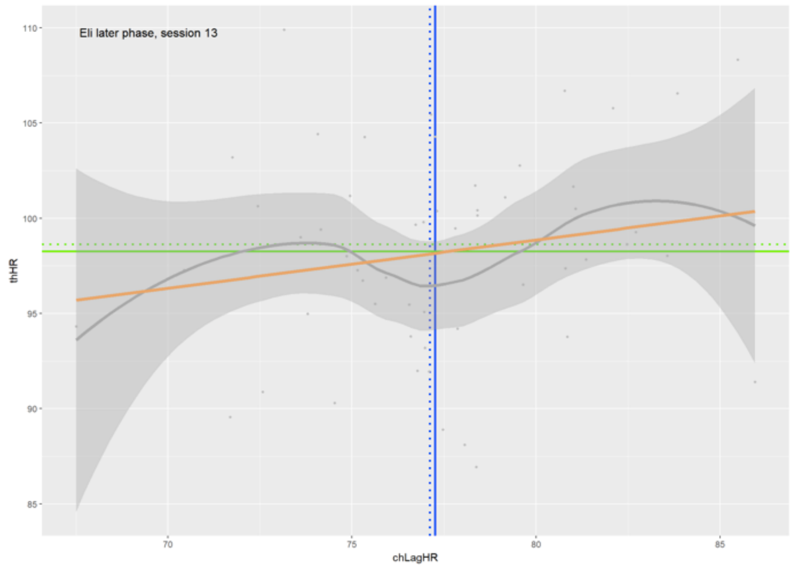

Figure 29. LOESS smoother plot for the child-led lag for Eli session 13. The graph confirms a linear relationship for the child-led lag. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values.

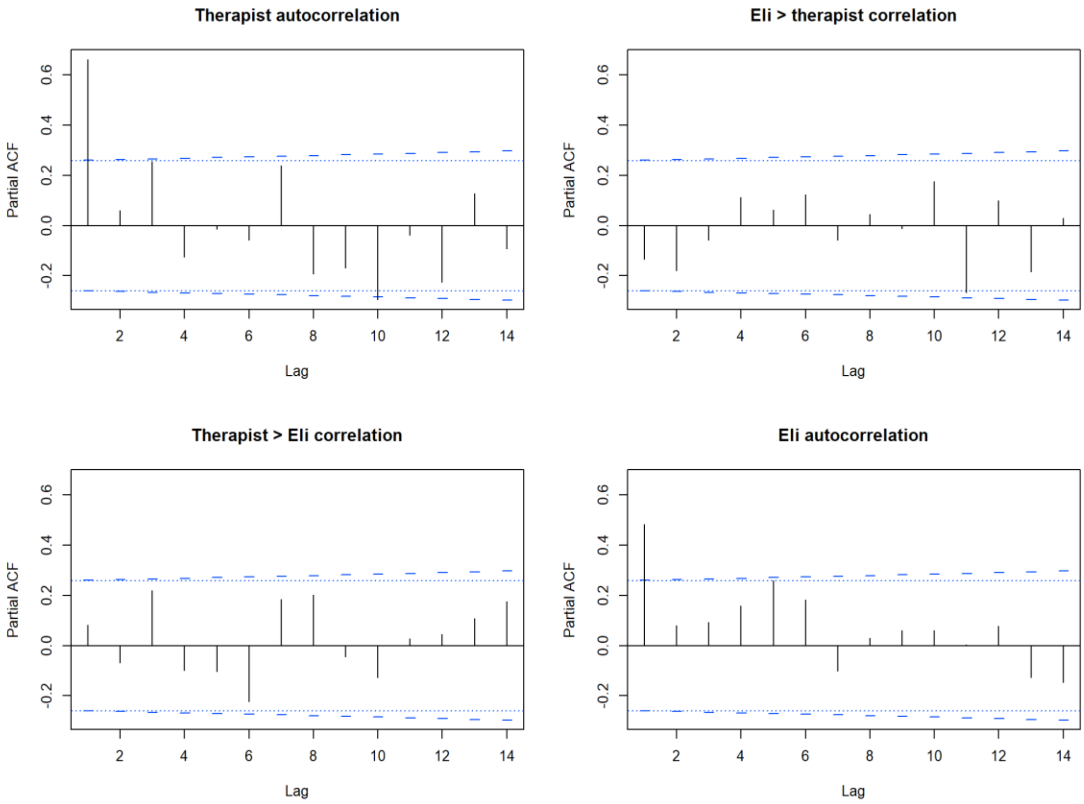

Figure 30. PACF plots for the therapist and Eli, session 13. The blue lines are the "significance bounds." A strong lag=1 effect is evident for the child and therapist's autocorrelations (top left and bottom right plot).

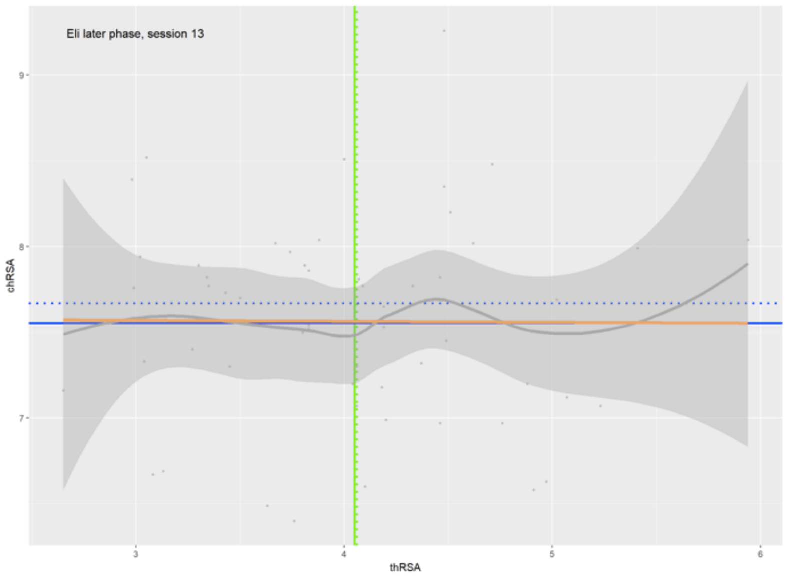

Figure 33. LOESS smoother plot for the simultaneous correlation for Eli session13. The graph confirms a linear relationship. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values.

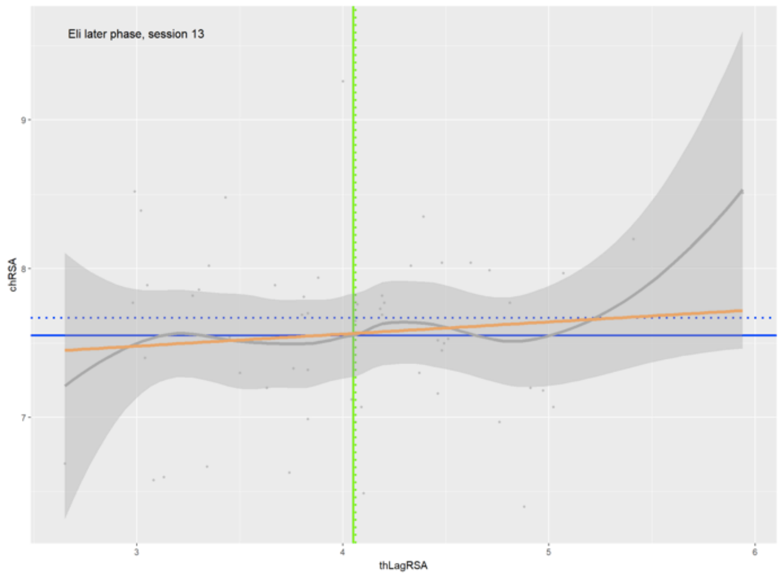

Figure 34. LOESS smoother plot for the non-significant therapist-led lag for Eli session 13. The graph confirms a linear relationship. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values.

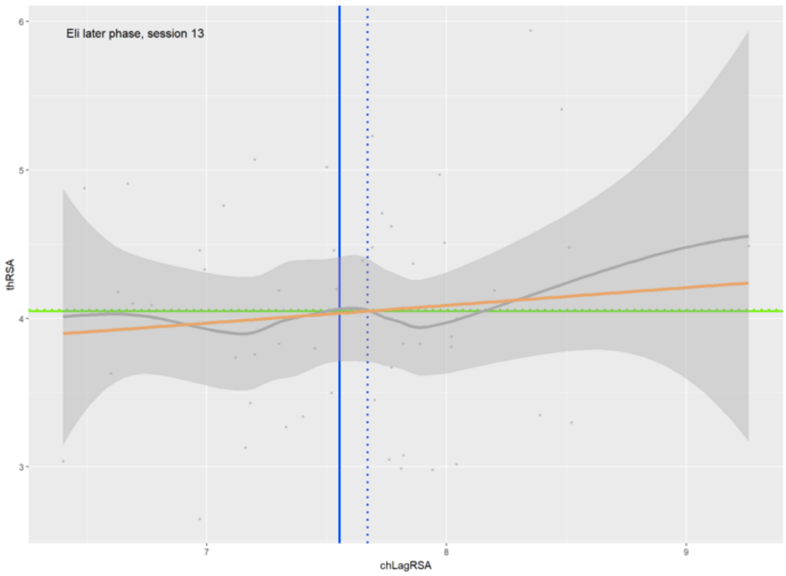

Figure 35. LOESS smoother plot for the non-significant child-led lag for Eli session 13. The graph confirms a linear relationship. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values.

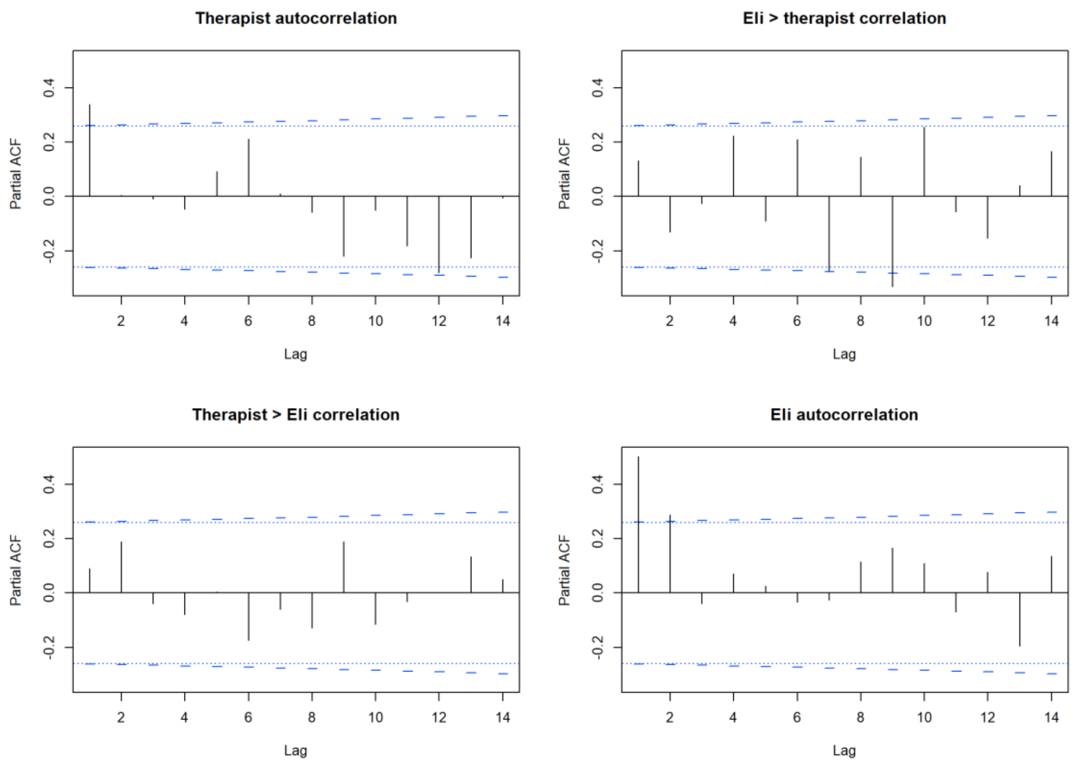

Figure 36. PACF plots for the therapist and Eli for session 13. The blue lines are the “significance bounds.” A strong lag=1 effect is evident for the child and therapist’s autocorrelations for RSA (top left and bottom right plot).

Case Study 2: Billy & Therapist A

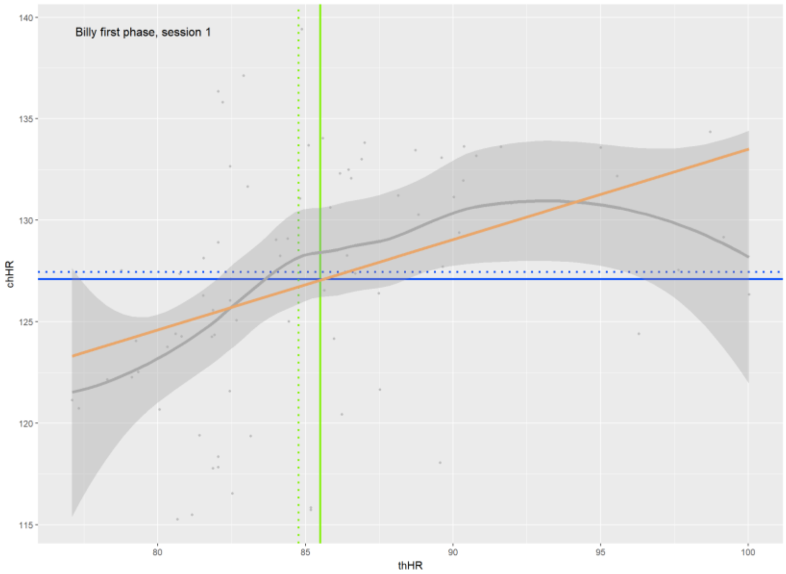

Figure 39. LOESS smoother plot for the simultaneous correlation for Billy session 1. The graph confirms a linear relationship. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median RSA values.

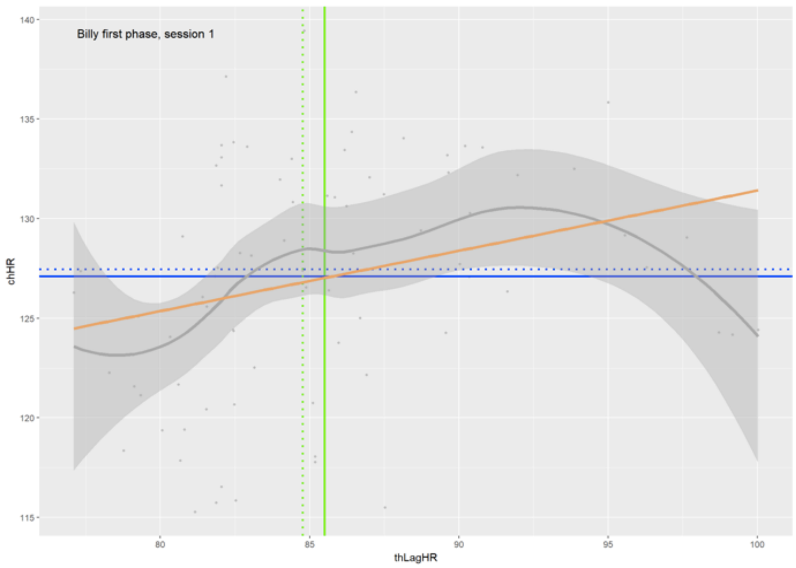

Figure 40. LOESS smoother plot for the non-significant therapist-led lag Billy Session 1. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values. The graph indicates a potential curvilinear relationship for the therapist-led lag.

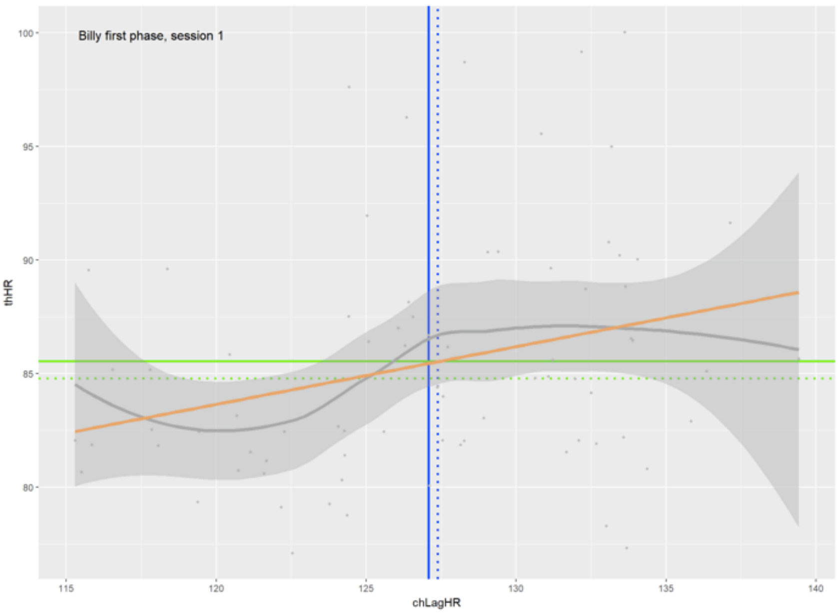

Figure 41. LOESS smoother plot for the non-significant child-led lag Billy session1. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values. The graph confirms a linear relationship for the child-led lag.

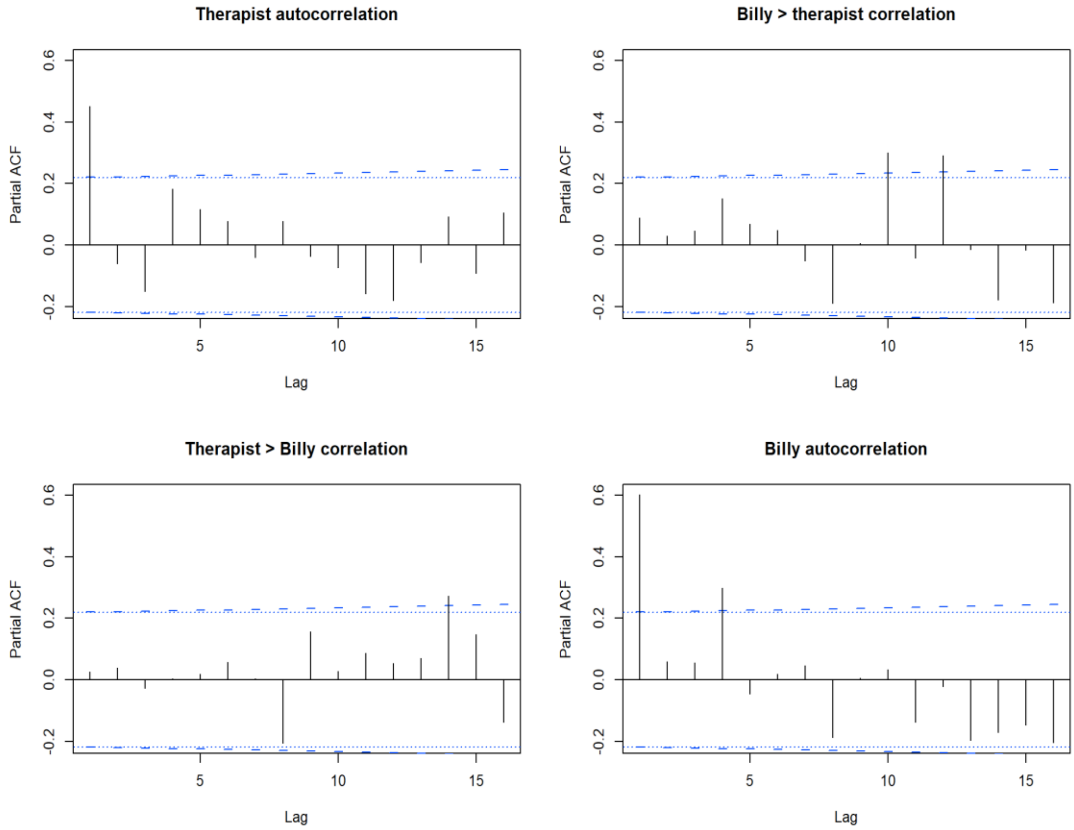

Figure 42. PACF plots for therapist and child, Billy session 1. The blue lines are the "significance bounds." The top left and bottom right plot show the autocorrelation for the therapist and child. The plots confirm that a lag of one 30-second epoch is the most meaningful lag for the autocorrelations. No significant lag effects are evident for the child or therapist-led data.

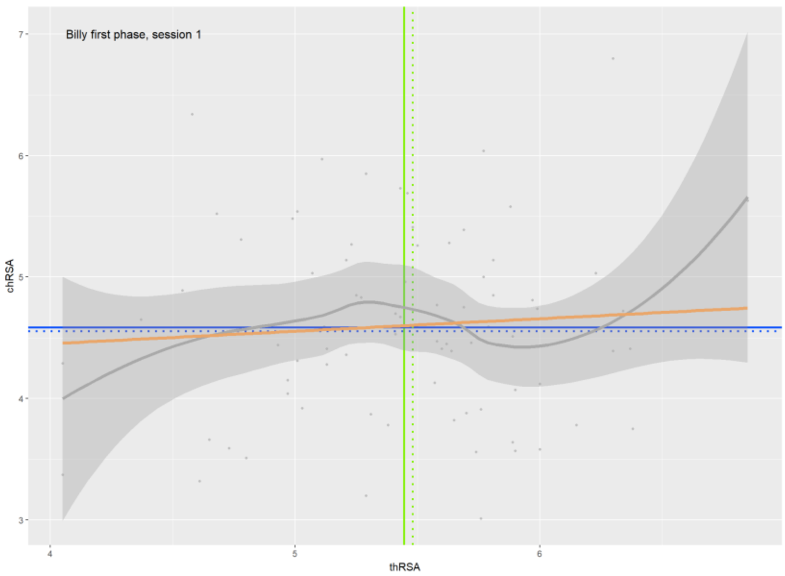

Figure 45. LOESS smoother plot for the simultaneous correlation for Billy session 1 (RSA). The graph confirms a linear relationship. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values.

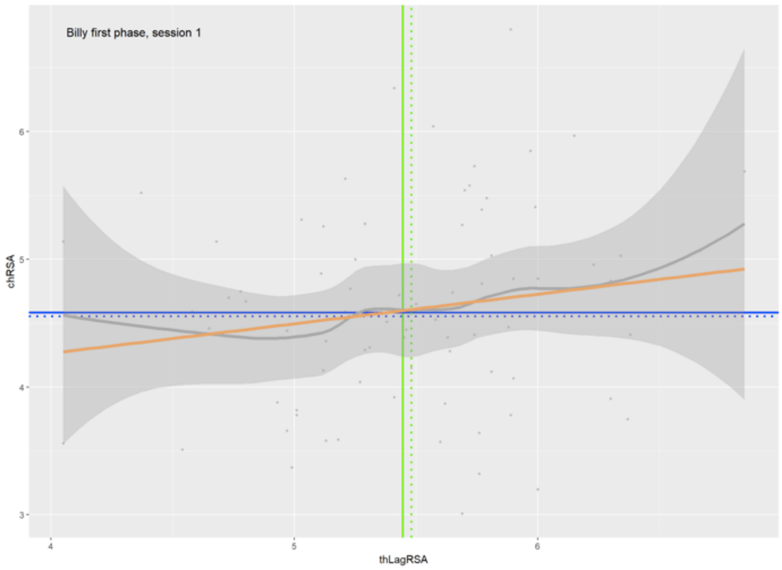

Figure 46. LOESS smoother plot for the non-significant therapist-led lag Billy session 1 (RSA). The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values. The graph confirms a linear relationship for the therapist-driven lag.

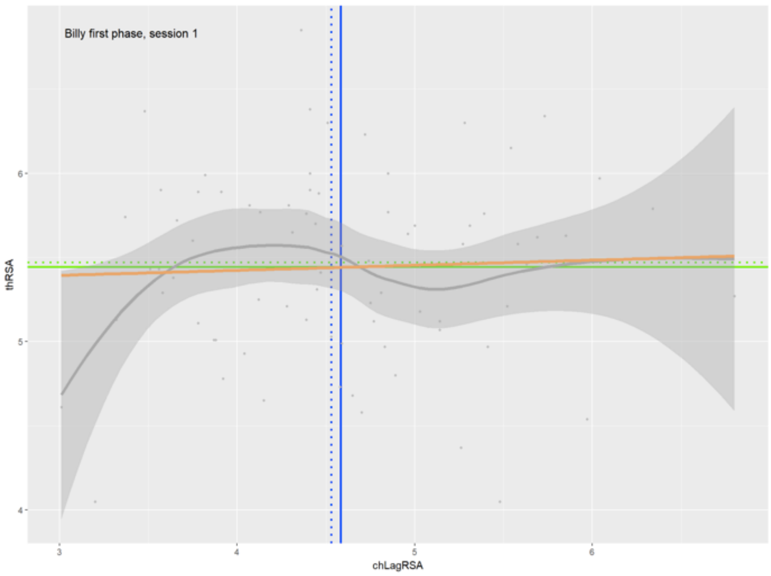

Figure 47. LOESS smoother plot for the non-significant child-led lag Billy session 1 (RSA). The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values. The graph shows a linear relationship for the child-driven lag.

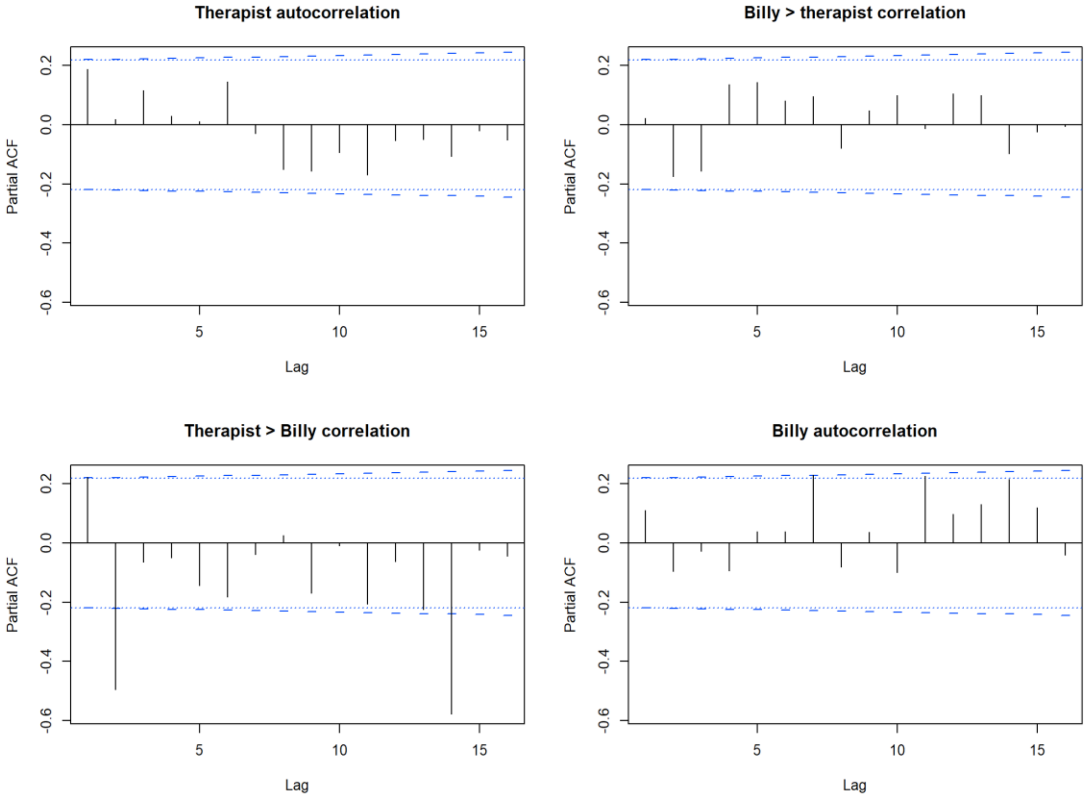

Figure 48. PACF plots for the child and therapist, Billy session 1 (RSA). The blue lines are the "significance bounds." The plots show no meaningful lags with the exception of a possible lag=2 effect for the therapist-led lag.

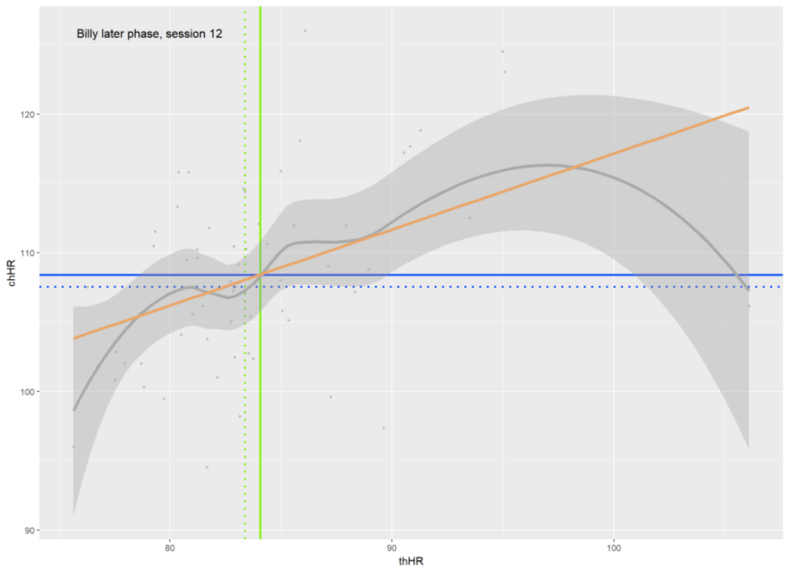

Figure 51. LOESS smoother plot for the simultaneous correlation for session 12. The graph indicates a possible curvilinear relationship. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median RSA values.

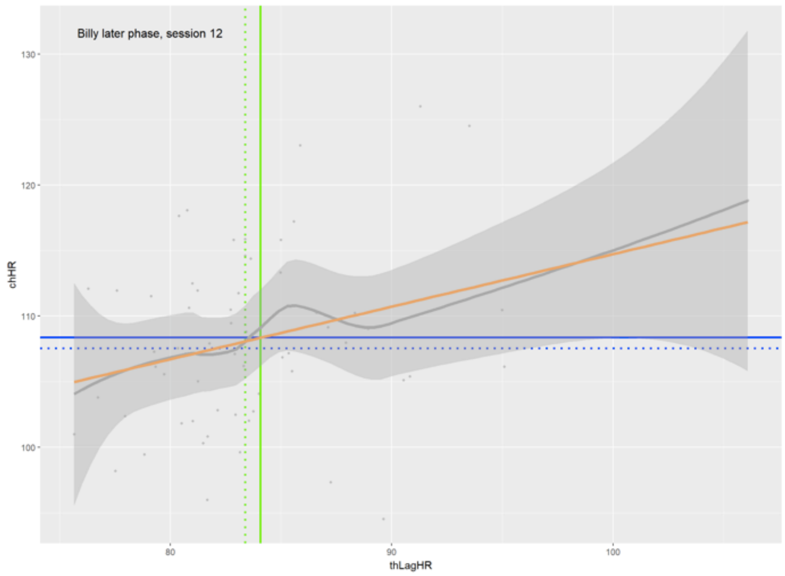

Figure 52. LOESS smoother plot for the non-significant therapist-led lag Billy session 12 (HR). The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values. The graph confirms a linear relationship for the therapist-led lag.

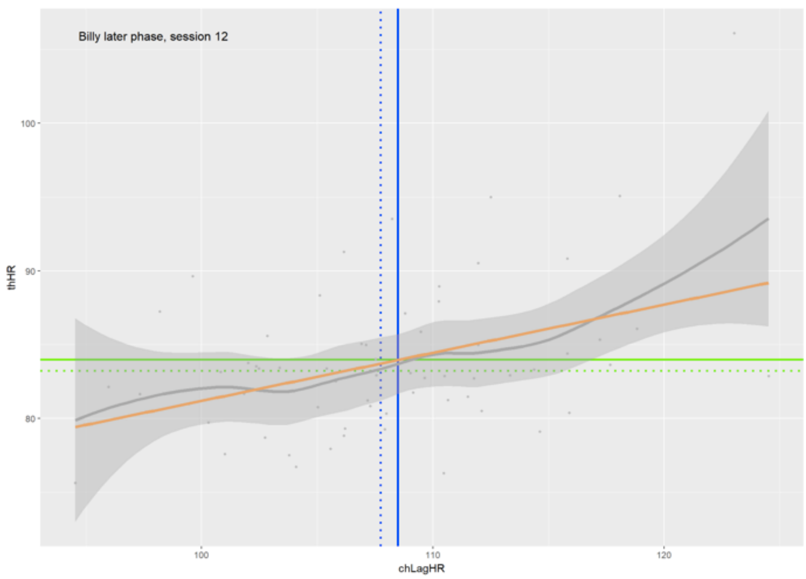

Figure 53. LOESS smoother plot for the significant child-led lag Billy session 12. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values. The graph confirms linear relationship for the child-led lag

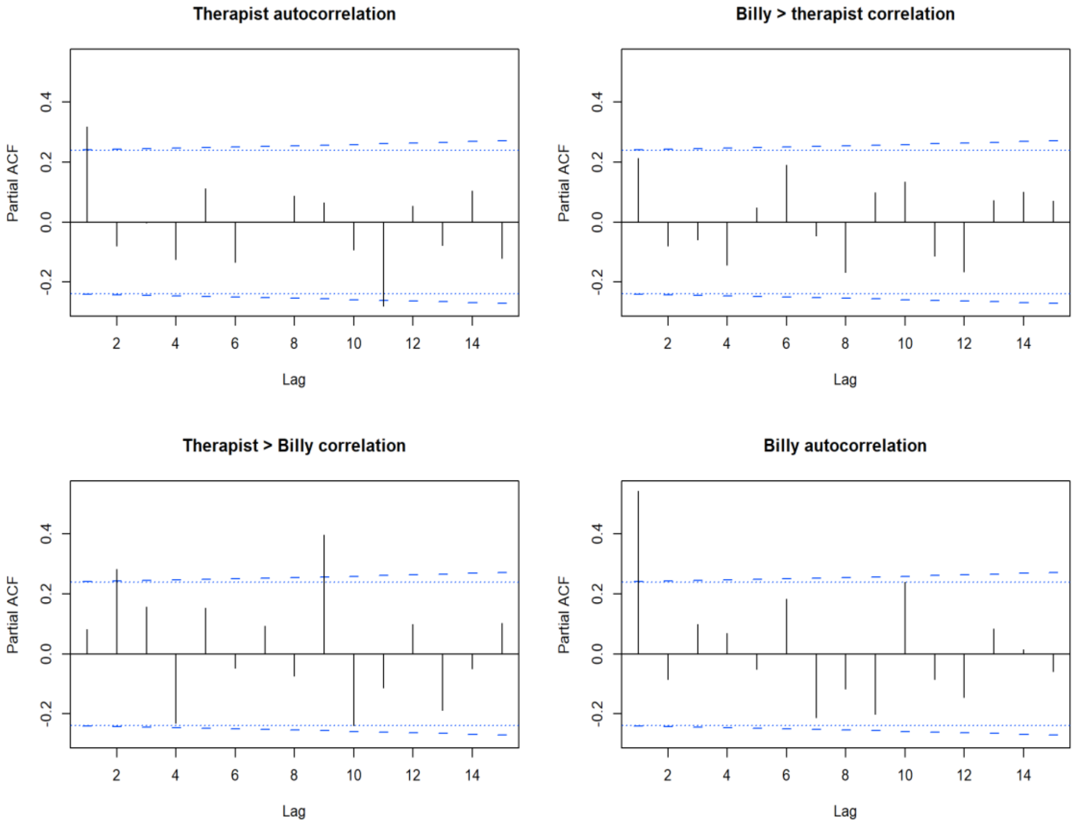

Figure 54. PACF plots for therapist and child, session 12. The blue lines are the “significance bounds.” A strong lag=1 is significant for the autocorrelations for the therapist and child. A lag=2 effect is evident for the therapist-led data (bottom left).

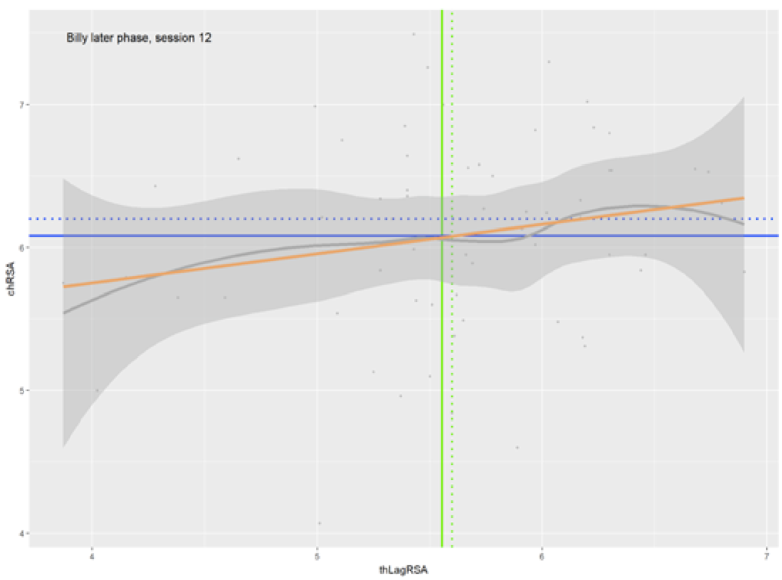

Figure 57. LOESS smoother plot for the simultaneous correlation for session 12. The graph confirms a linear relationship. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values.

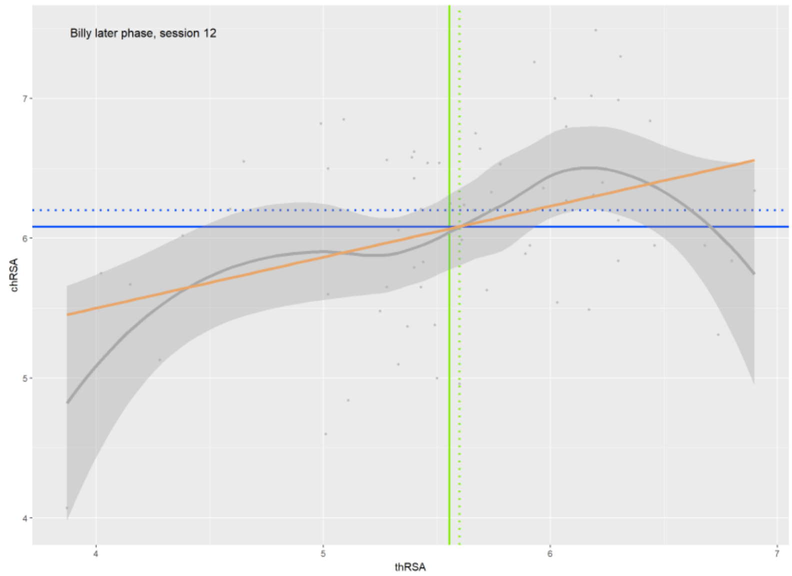

Figure 58. LOESS smoother plot for the non-significant therapist-led lag. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values. The graph confirms a linear relationship for the therapist-led lag.

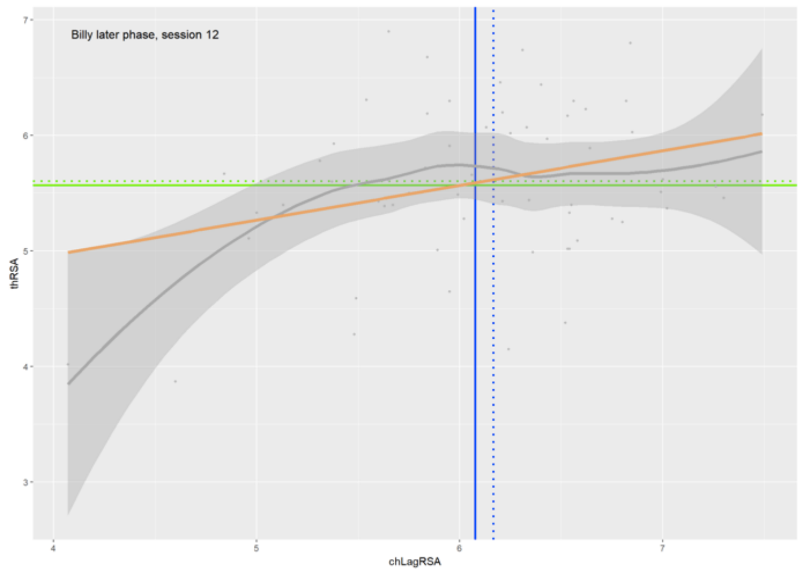

Figure 59. LOESS smoother plot for the significant child-led lag. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values. The graph confirms a linear relationship.

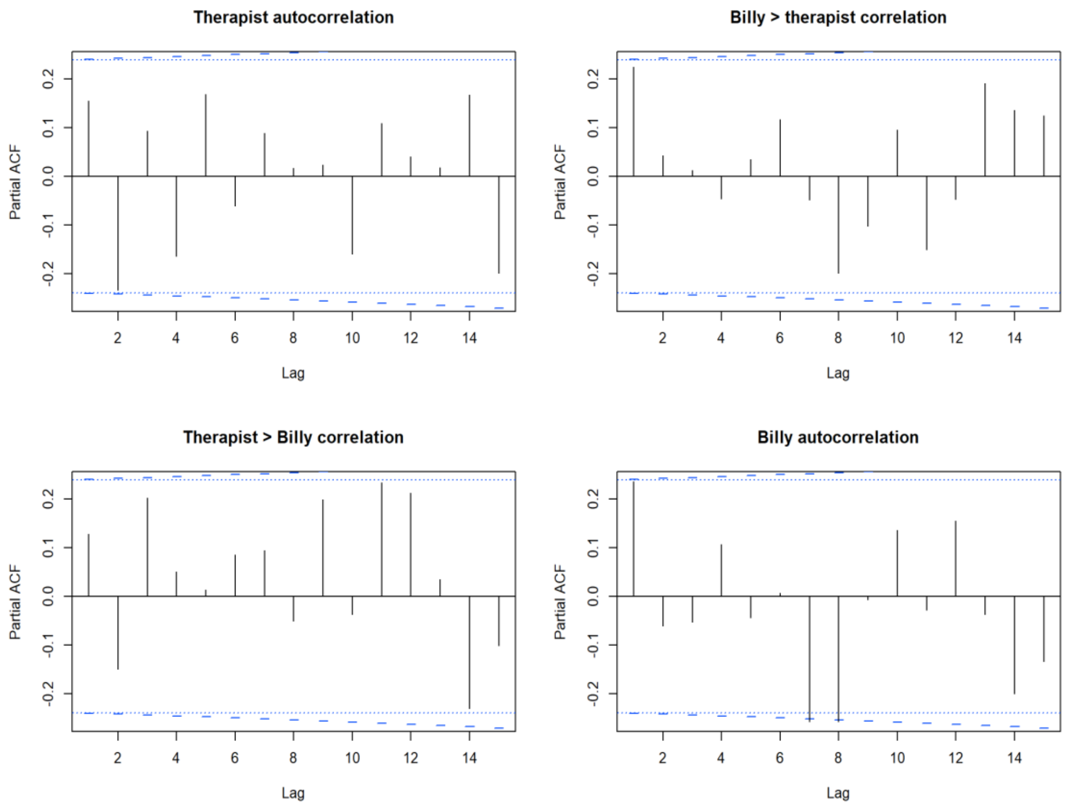

Figure 60. PACF plots for the therapist and child, session 12. The blue lines are the "significance bounds." The plots atypically show an absence of lag effects for lag=1 or any other lag.

Case Study 3: Tyler & Therapist B

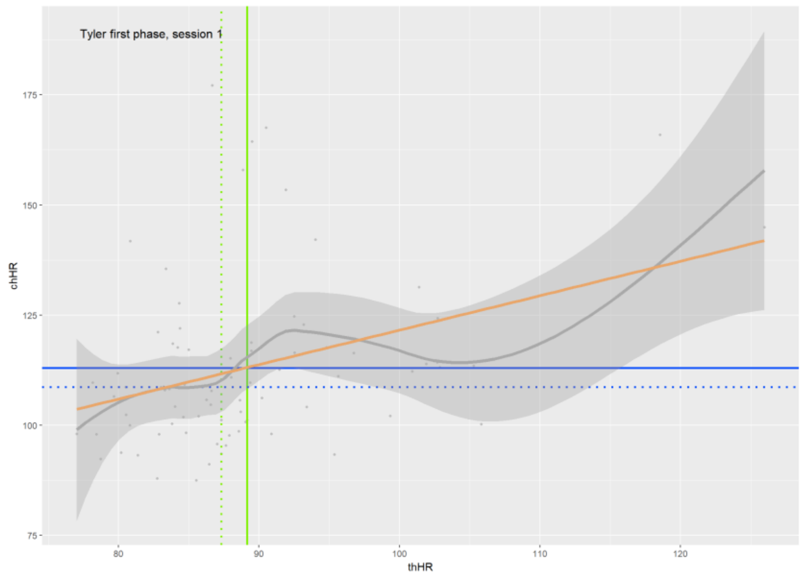

Figure 63. LOESS smoother plot for the simultaneous correlation for session 1. The graph confirms a linear relationship. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values.

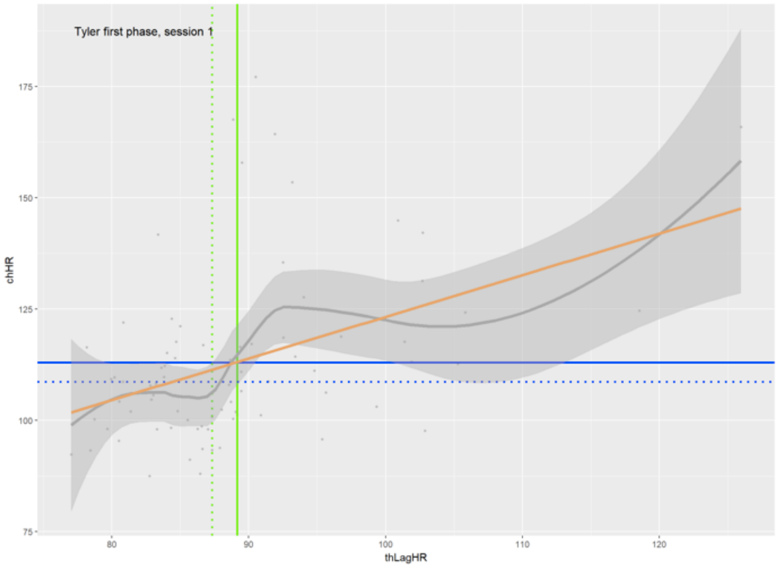

Figure 64. LOESS smoother plot for the non-significant therapist-led lag. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values. The graph confirms a linear relationship.

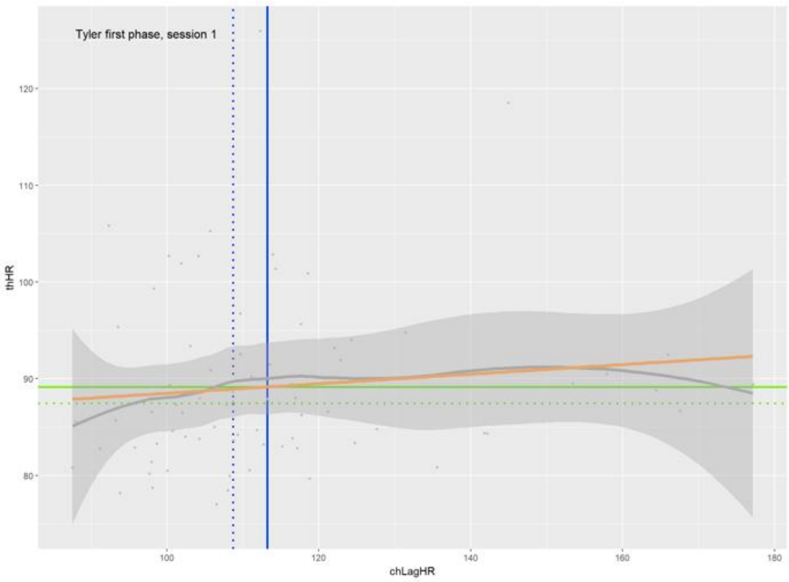

Figure 65. LOESS smoother plot for the non-significant child-led lag. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values. The graph confirms a linear relationship for the child-led lag.

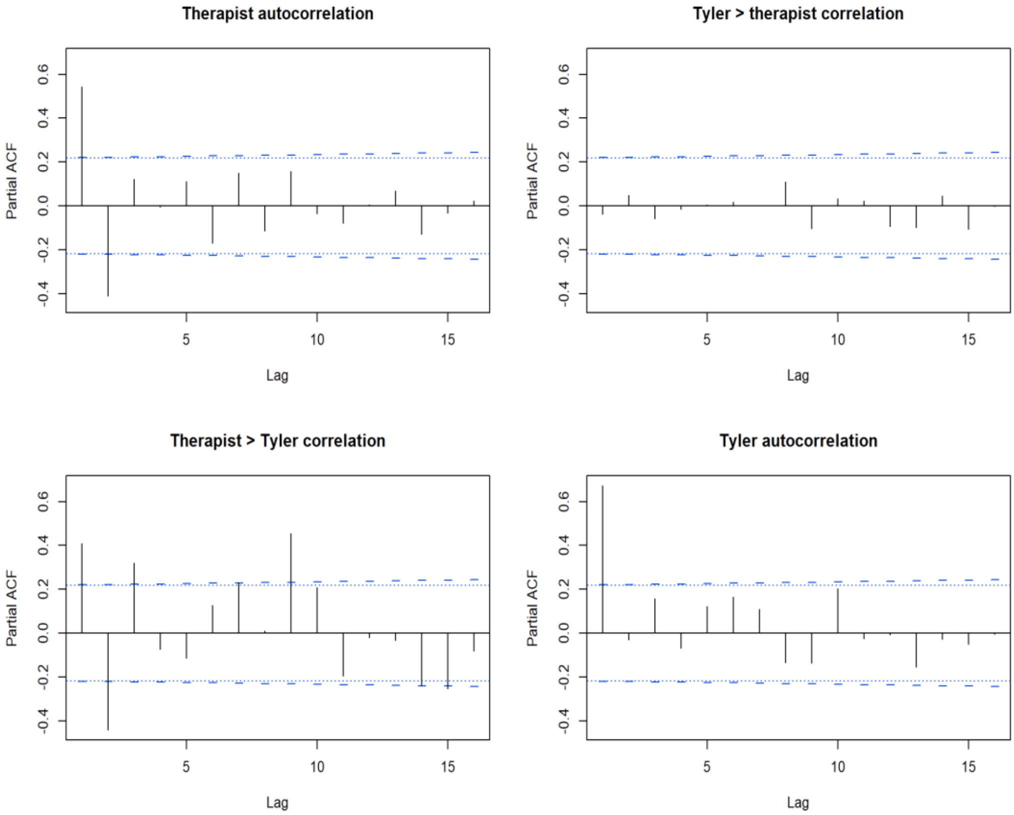

Figure 66. PACF plots for therapist and child, session 1. The blue lines are "significance bounds." There is a significant lag=1 effect for the child's autocorrelation (bottom right), therapist's autocorrelation (top left) and the therapist-led lag (bottom left plot).

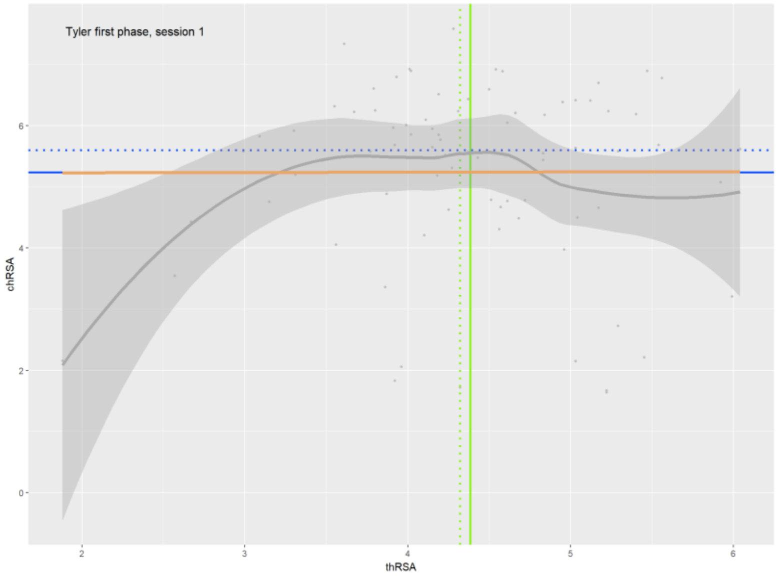

Figure 69. LOESS smoother plot for the simultaneous correlation for session 1. The graph suggests a potential curvilinear linear relationship. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values.

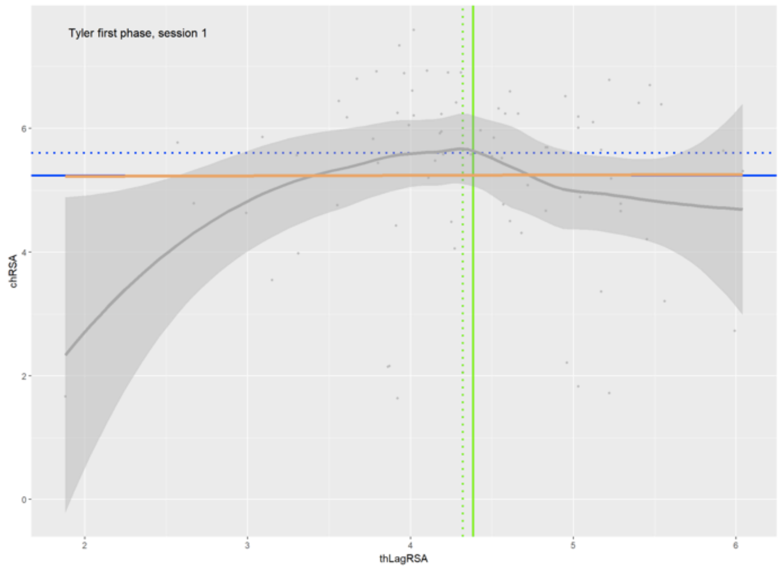

Figure 70. LOESS smoother plot for the non-significant therapist-led lag. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values. The graph indicates a possible curvilinear rather than linear relationship for the therapist-led lag.

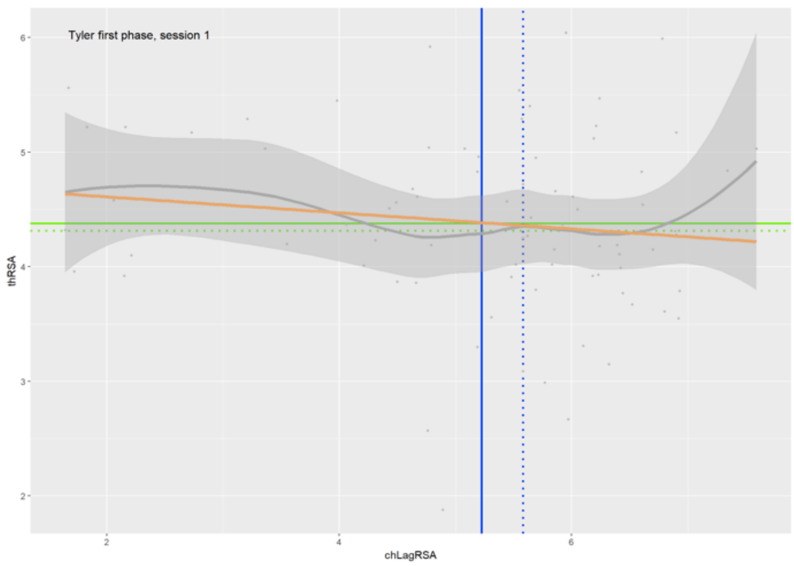

Figure 71. LOESS smoother plot for the non-significant child-led lag. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values. The graph confirms a linear relationship for the child-led lag.

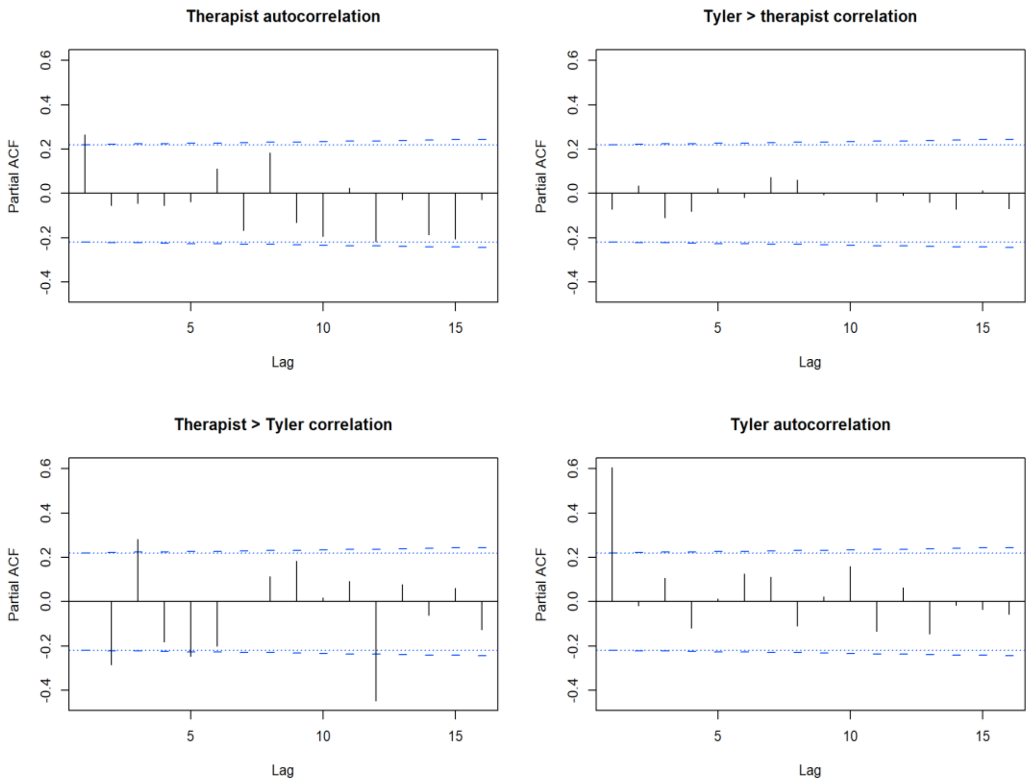

Figure 72. PACF plots for therapist and child, session 1. The blue lines are the "significance bounds." The plots show a strong lag=1 effect for the therapist and child's autocorrelations and the therapist-led lag (bottom left).

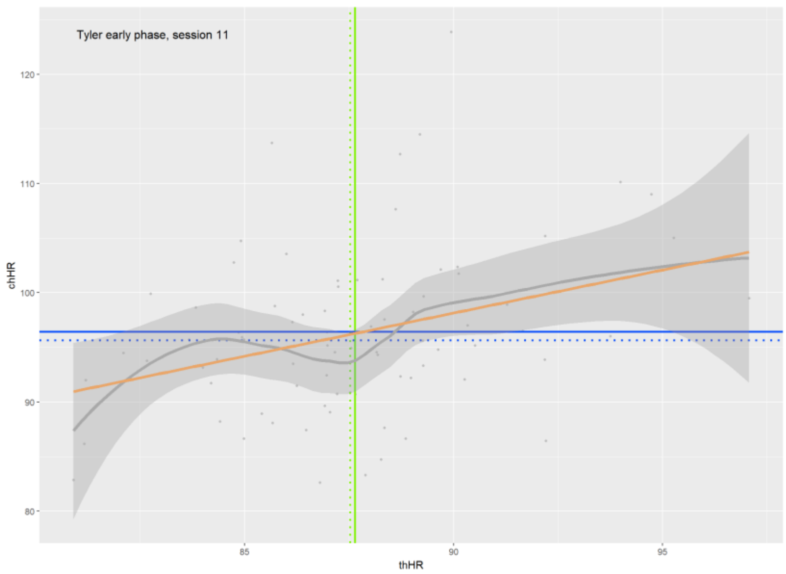

Figure 75. LOESS smoother plot for the simultaneous correlation for session 11. The graph confirms a linear relationship. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values.

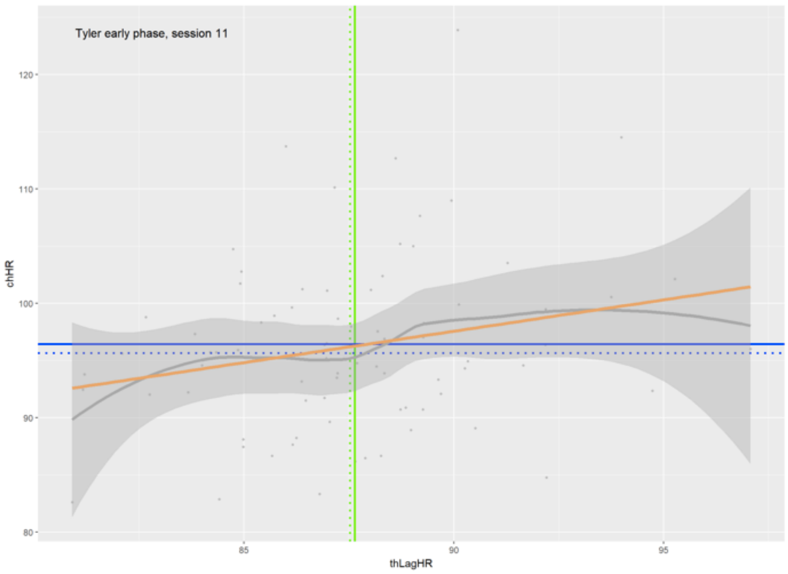

Figure 76. LOESS smoother plot for the non-significant therapist-led lag. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values. The graph confirms a linear relationship for the therapist-led lag.

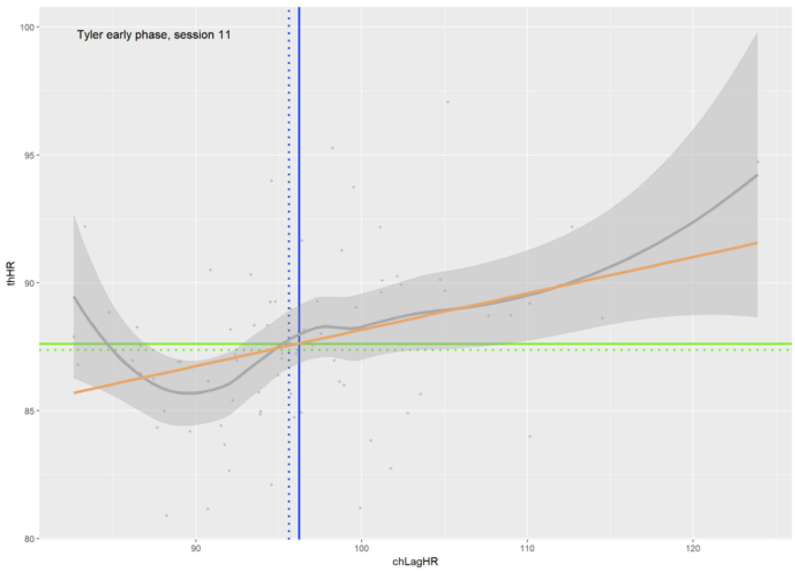

Figure 77. LOESS smoother plot for the significant child-led lag. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values. The graph confirms a linear relationship.

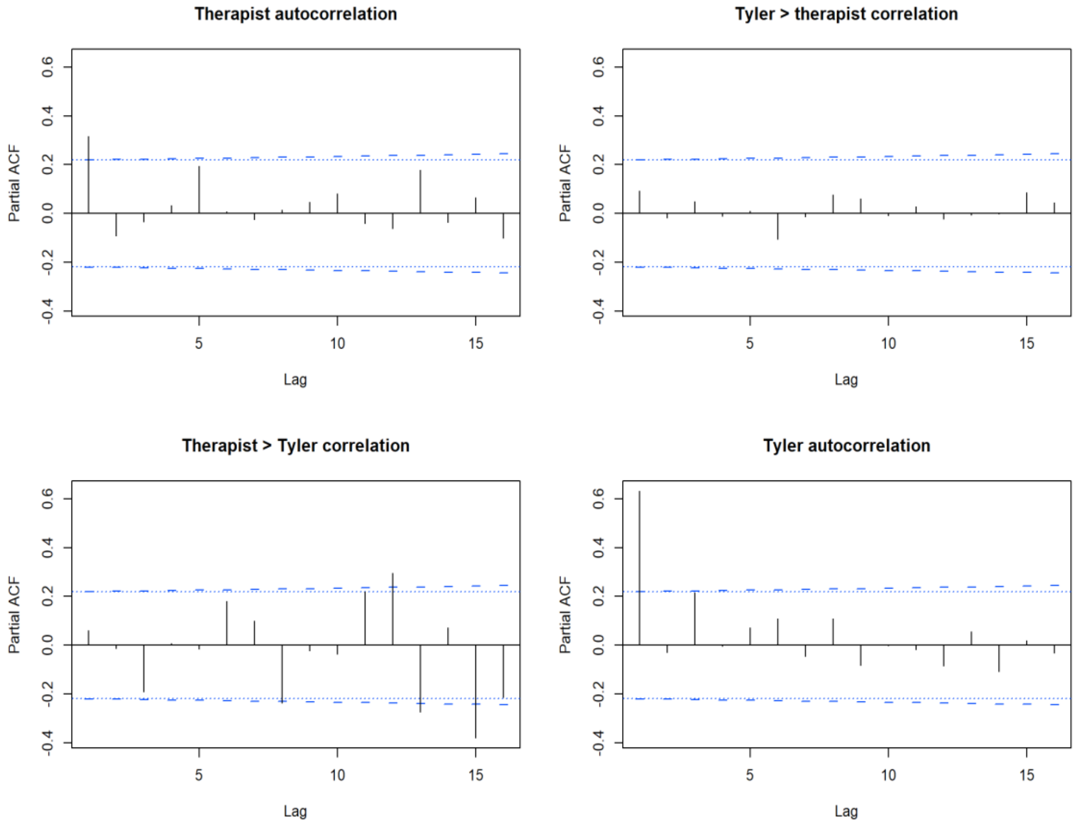

Figure 78. PACF plots for therapist and child, session 11. The blue lines are the "significance bounds." There is a significant lag=1 effect for the child and therapist's autocorrelation (top left and bottom right). No lag effects are evident for the child-led or therapist led-lag.

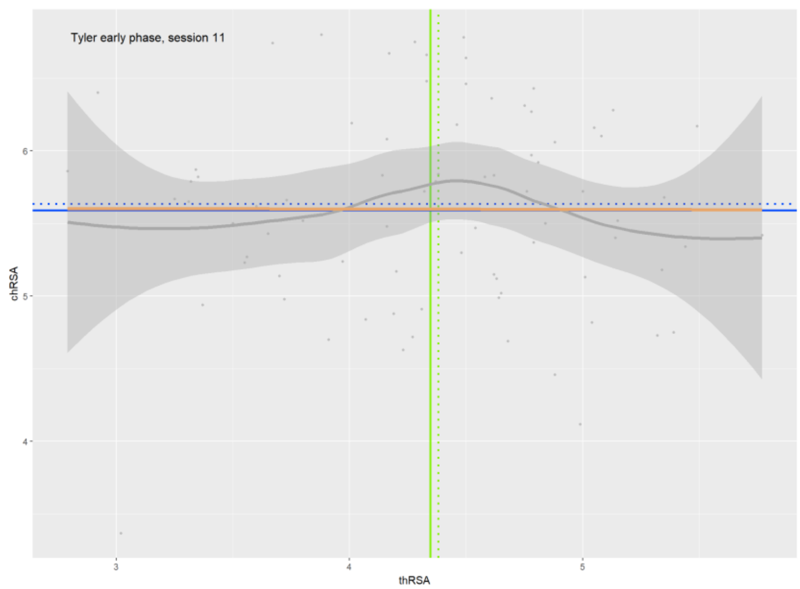

Figure 81. LOESS smoother plot for the simultaneous correlation for session 11. The graph confirms a linear relationship. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values.

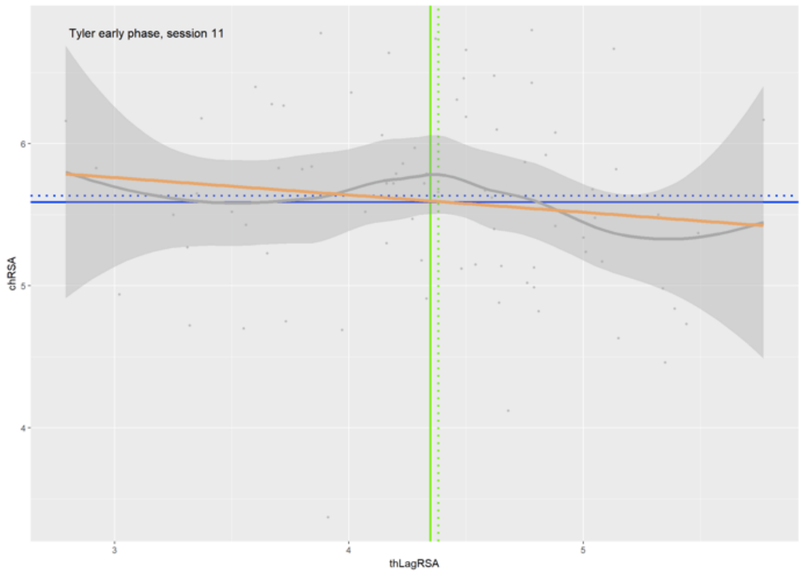

Figure 82. LOESS smoother plot for the non-significant therapist-led lag. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values. The graph confirms a linear relationship for the therapist-led lag.

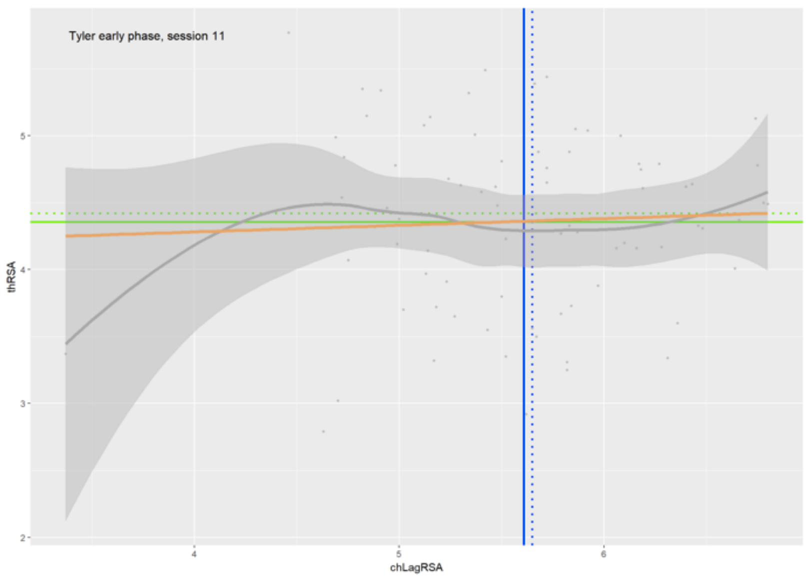

Figure 83. LOESS smoother plot for the non-significant child-led lag. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values. The graph confirms a linear relationship for the child-led lag.

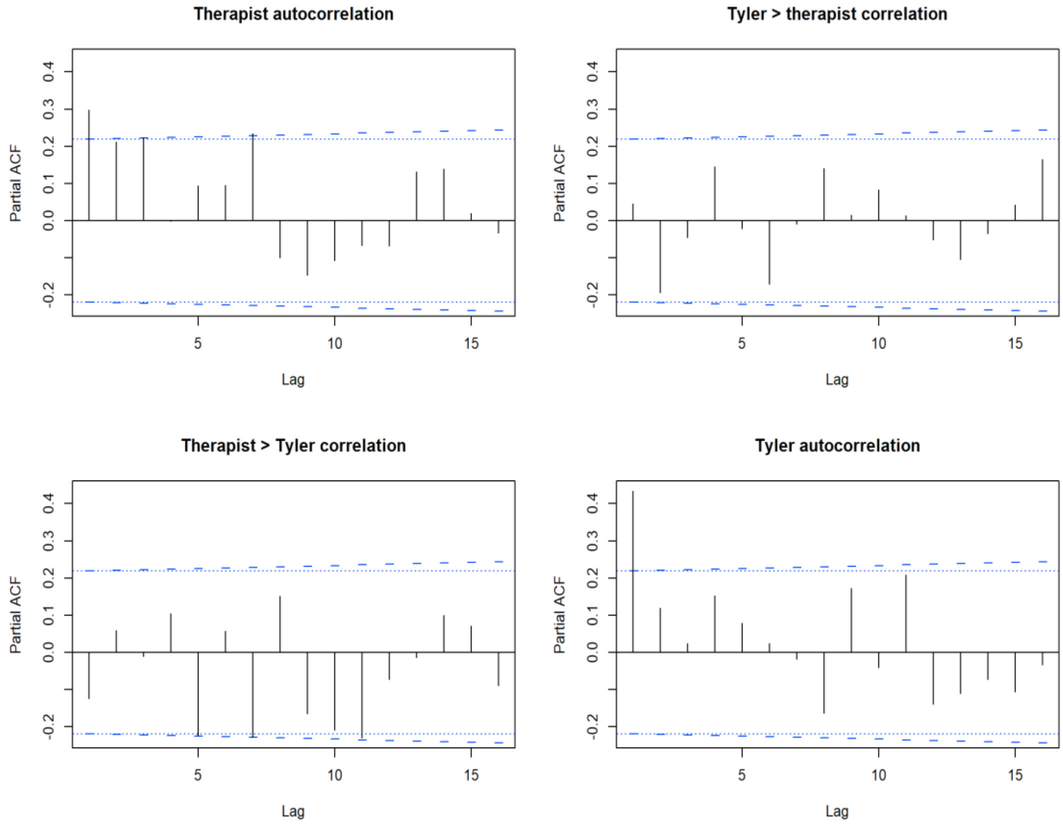

Figure 84. PACF plots for therapist and child, session 11. The blue lines are "significance bounds." There is a significant lag=1 effect for the child and therapist's autocorrelation (to left and bottom right). No lag effects are evident for the child-led or therapist led-lag.

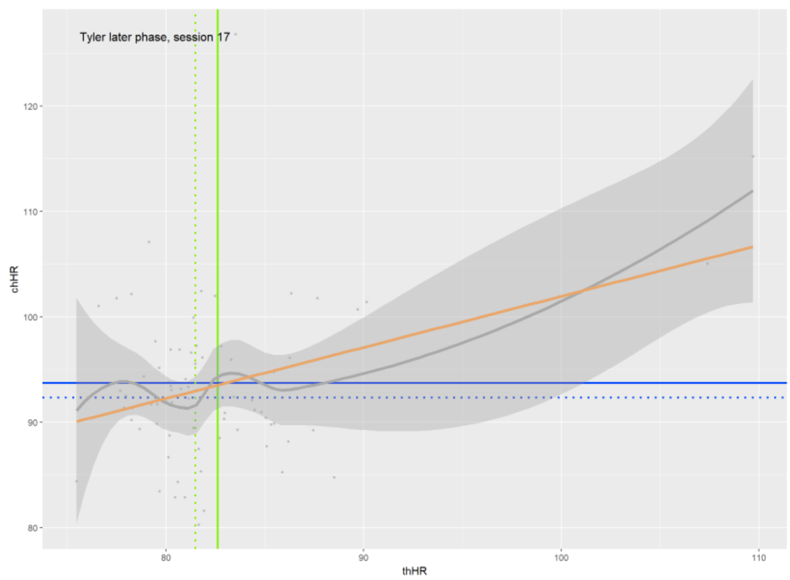

Figure 87. LOESS smoother plot for the simultaneous correlation for session 11. The graph confirms a linear relationship. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values.

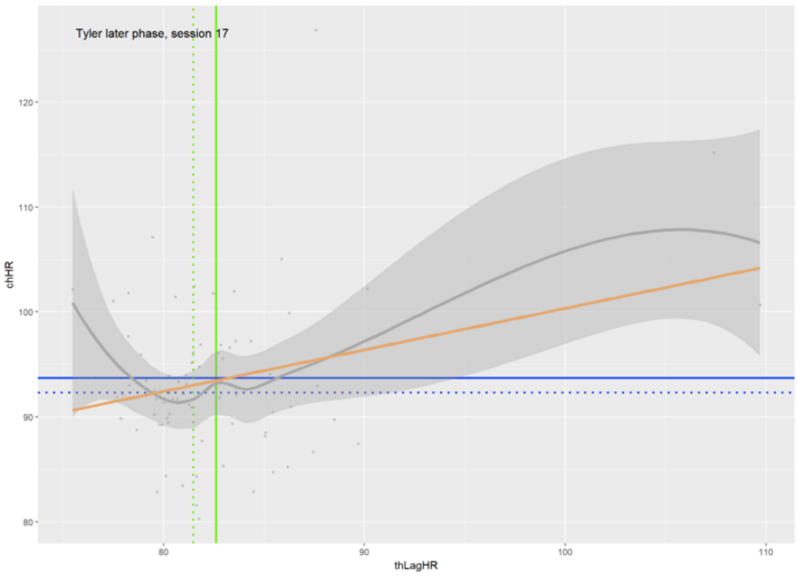

Figure 88. LOESS smoother plot for the non-significant therapist-led lag. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values. The plot confirms a linear relationship for the therapist-led lag.

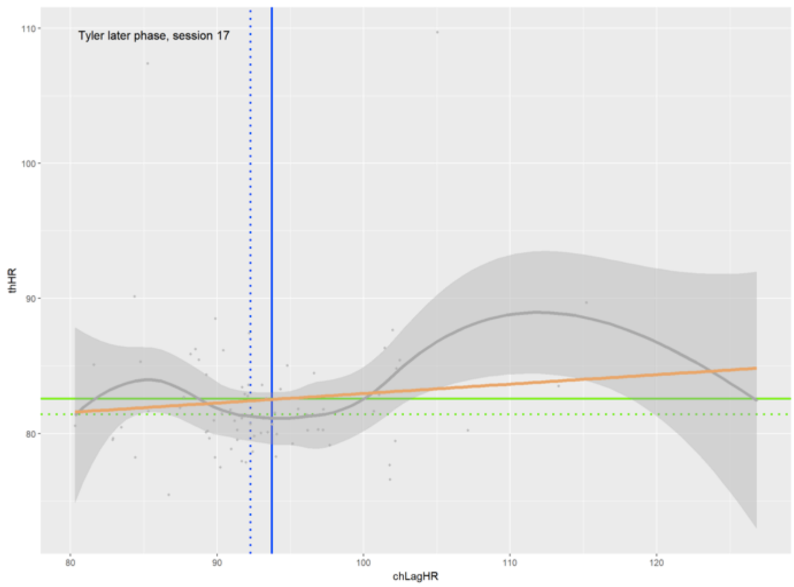

Figure 89. LOESS smoother plot for the non-significant child-led lag. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values. The graph indicates a potential curvilinear rather than linear relationship for the child-led lag.

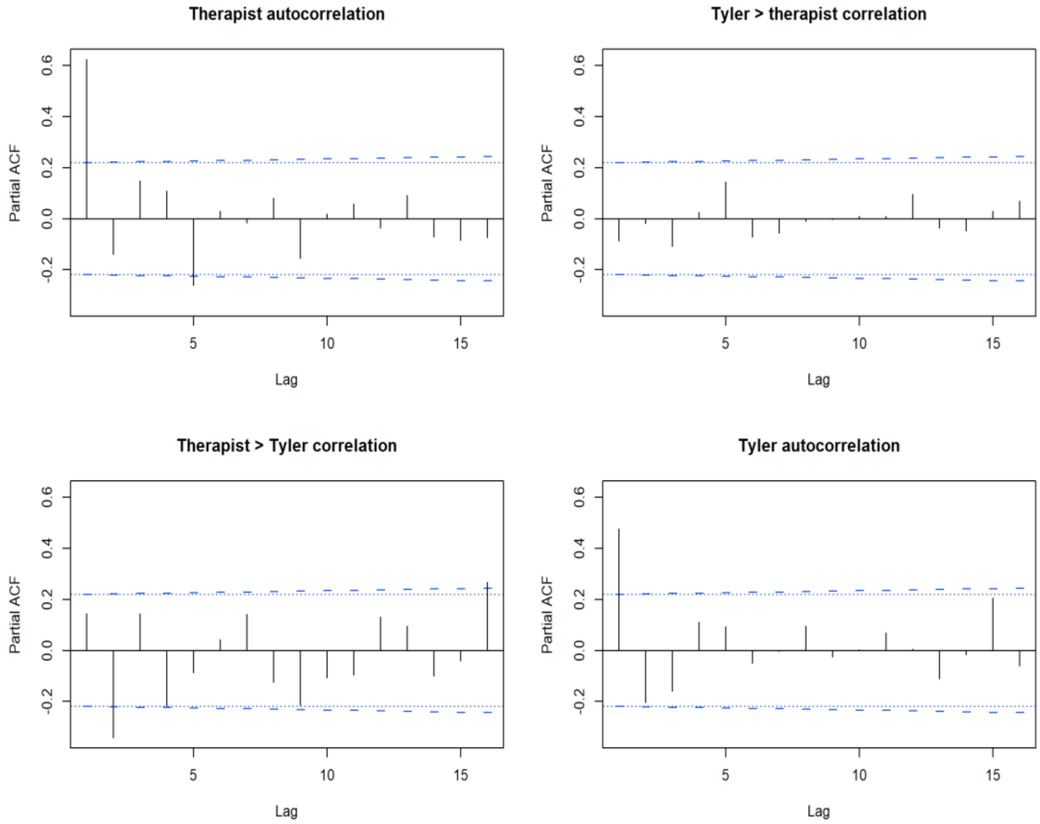

Figure 90. PACF plots for therapist and child, session 17. The blue lines are the “significance bounds.” There is a significant lag=1 effect for the child and therapist’s autocorrelation (to left and bottom right

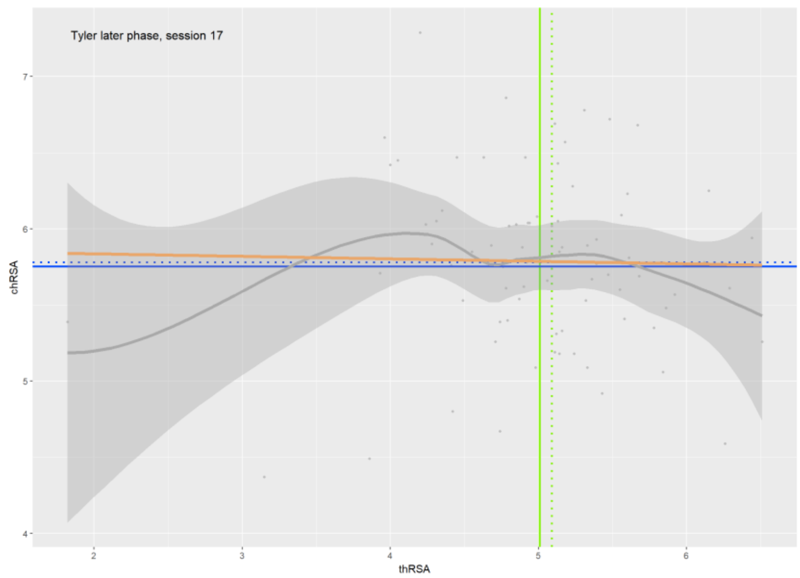

Figure 93. LOESS smoother plot for the simultaneous correlation for session 17. The graph confirms a linear relationship. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values.

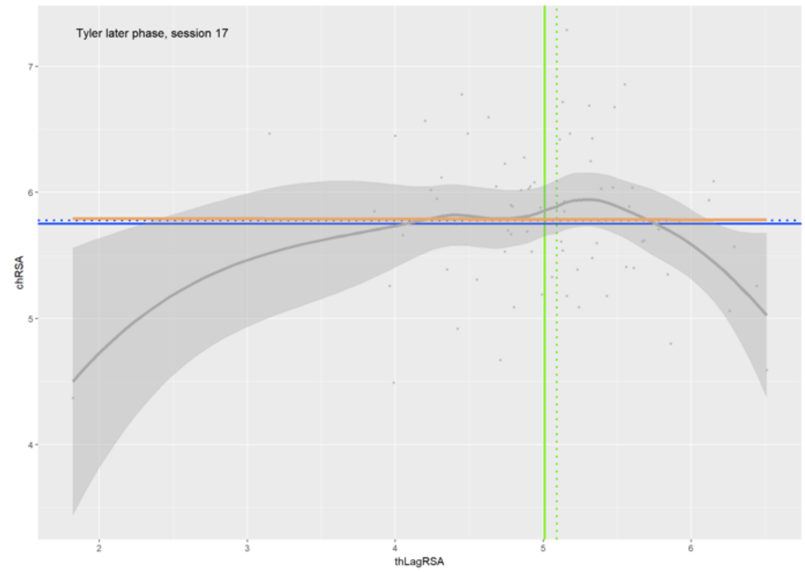

Figure 94. LOESS smoother plot for the non-significant therapist-led lag. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values. The graph indicates a potential curvilinear rather than linear relationship for the therapist-led lag.

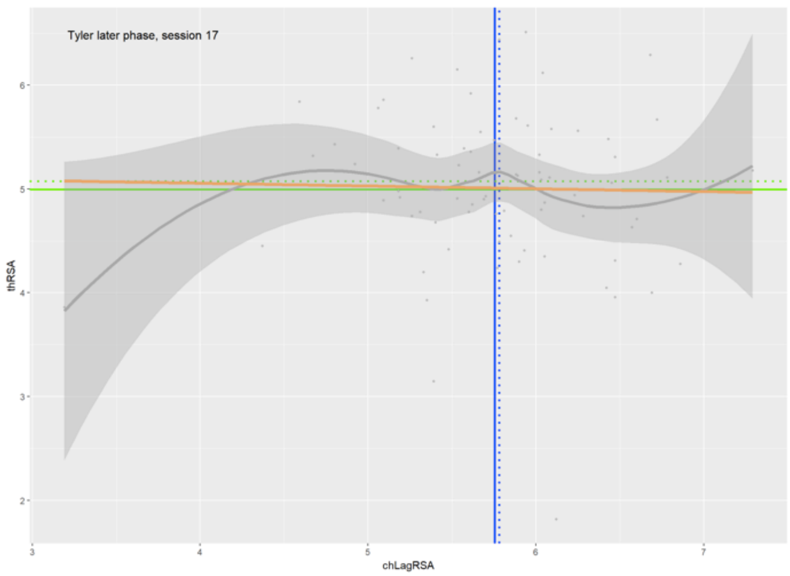

Figure 95. LOESS smoother plot for the non-significant child-led lag. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values. The graph confirms a linear relationship for the child-led lag.

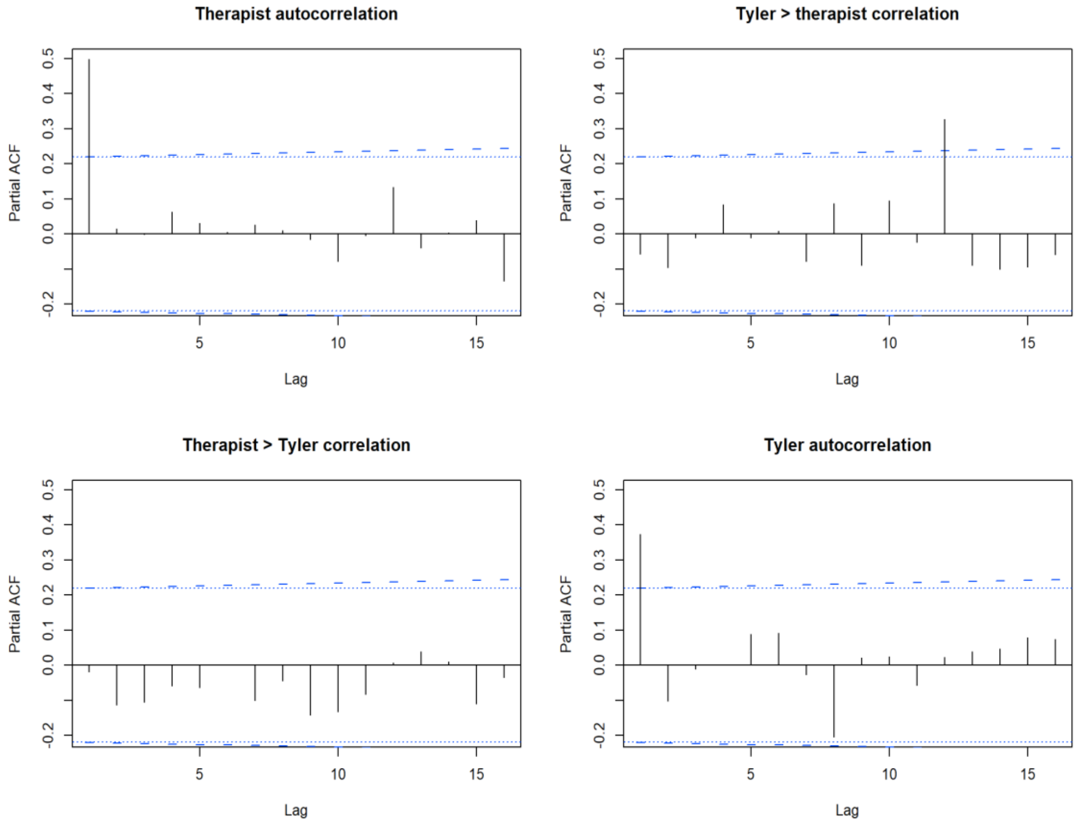

Figure 96. PACF plots for therapist and child, session 17. The blue lines are the “significance bounds.” There is a significant lag=1 effect for the child and therapist’s autocorrelation (to left and bottom right). No other lag effects are evident.

Case Study 4: Josh & Therapist B

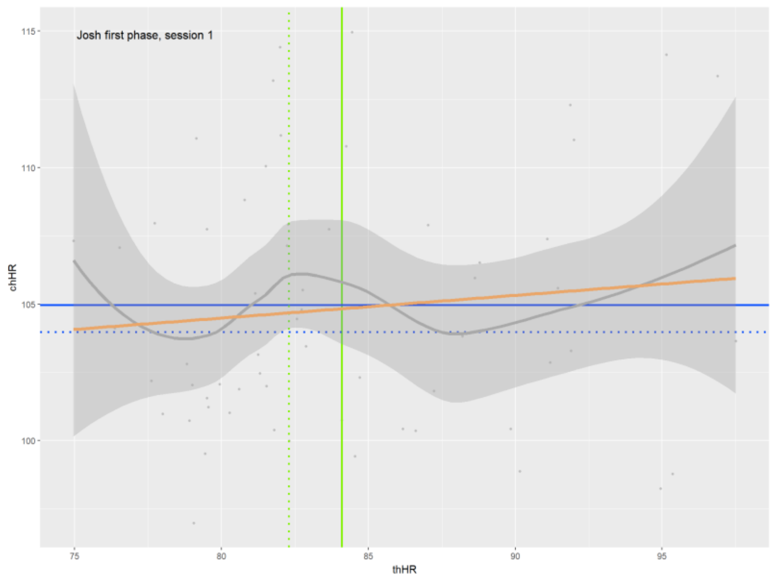

Figure 99. LOESS smoother plot for the simultaneous correlation for session 17. The graph confirms a linear relationship. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values.

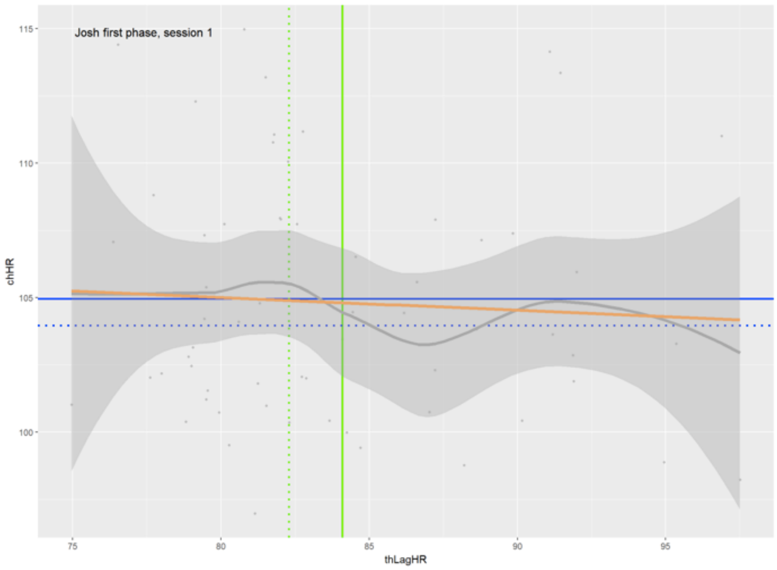

Figure 100. LOESS smoother plot for the non-significant therapist-led lag. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values. The graph confirms a linear relationship for the therapist-led lag.

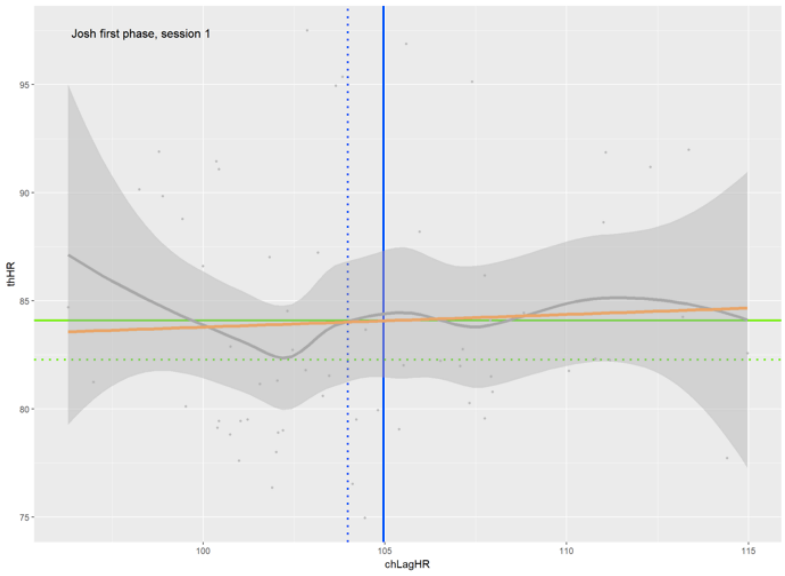

Figure 101. LOESS smoother plot for the non-significant child-led lag. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values. The graph confirms a linear relationship for the child-led lag.

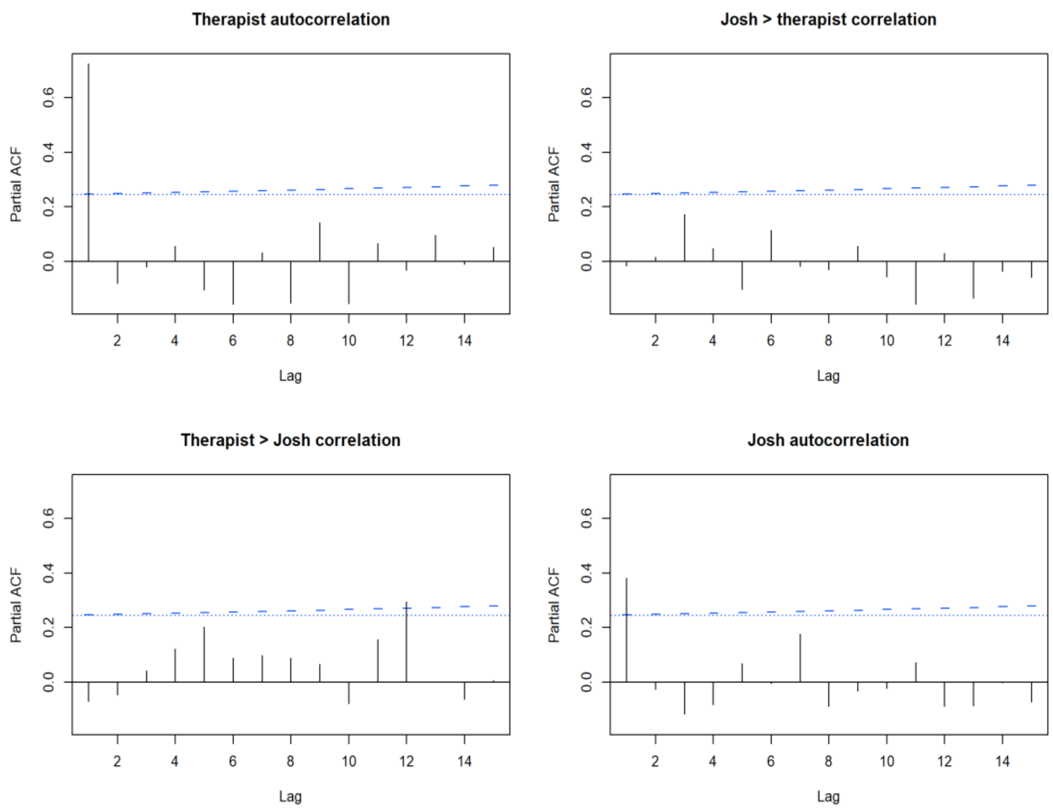

Figure 102. PACF plots for therapist and child, session 1. The blue lines are the "significance bounds." There is a strong lag=1 effect for the child and therapist's autocorrelation (to left and bottom right). No other lag effects are evident.

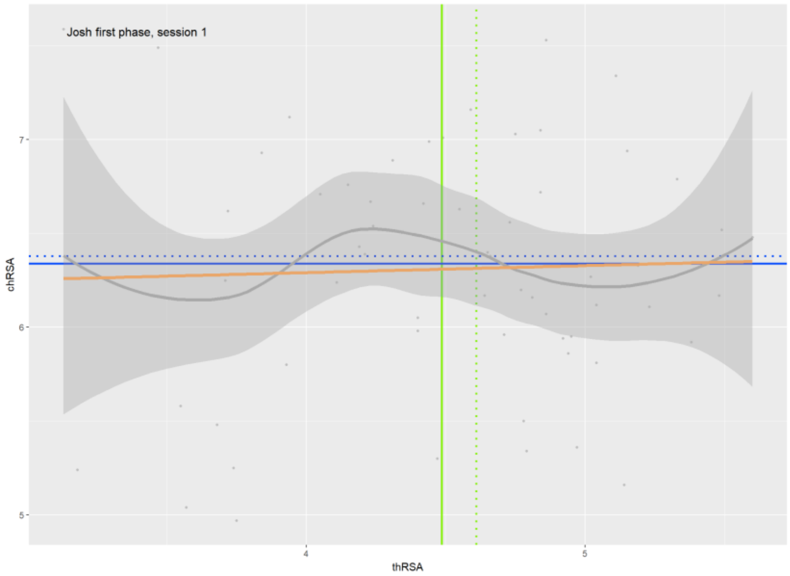

Figure 105. LOESS smoother plot for the simultaneous correlation for session 17. The graph confirms a linear relationship. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values.

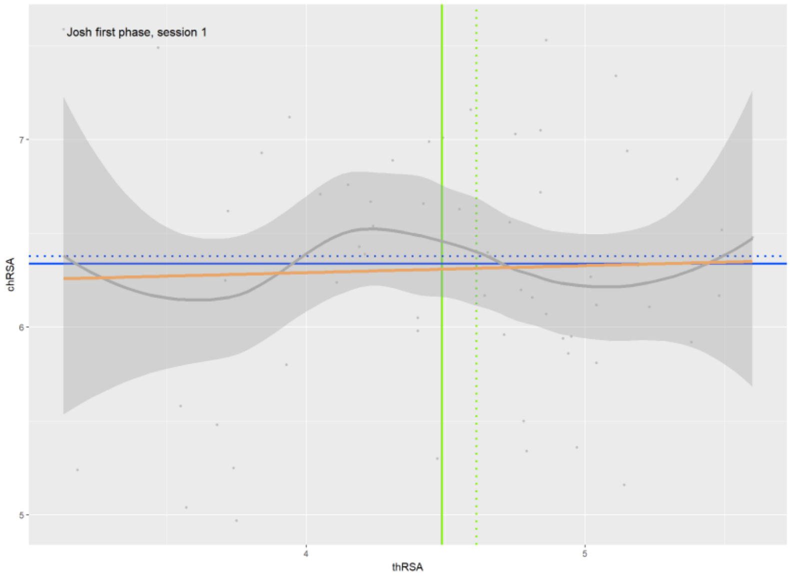

Figure 106. LOESS smoother plot for the non-significant therapist-led lag. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values. The graph confirms a linear relationship for the therapist-led lag.

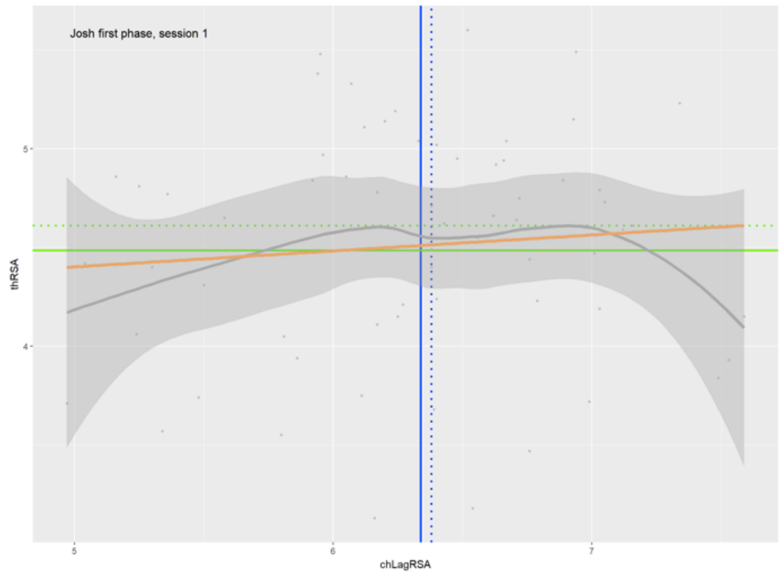

Figure 107. LOESS smoother plot for the non-significant child-led lag. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values. The graph shows a weak linear relationship for the child-led lag.

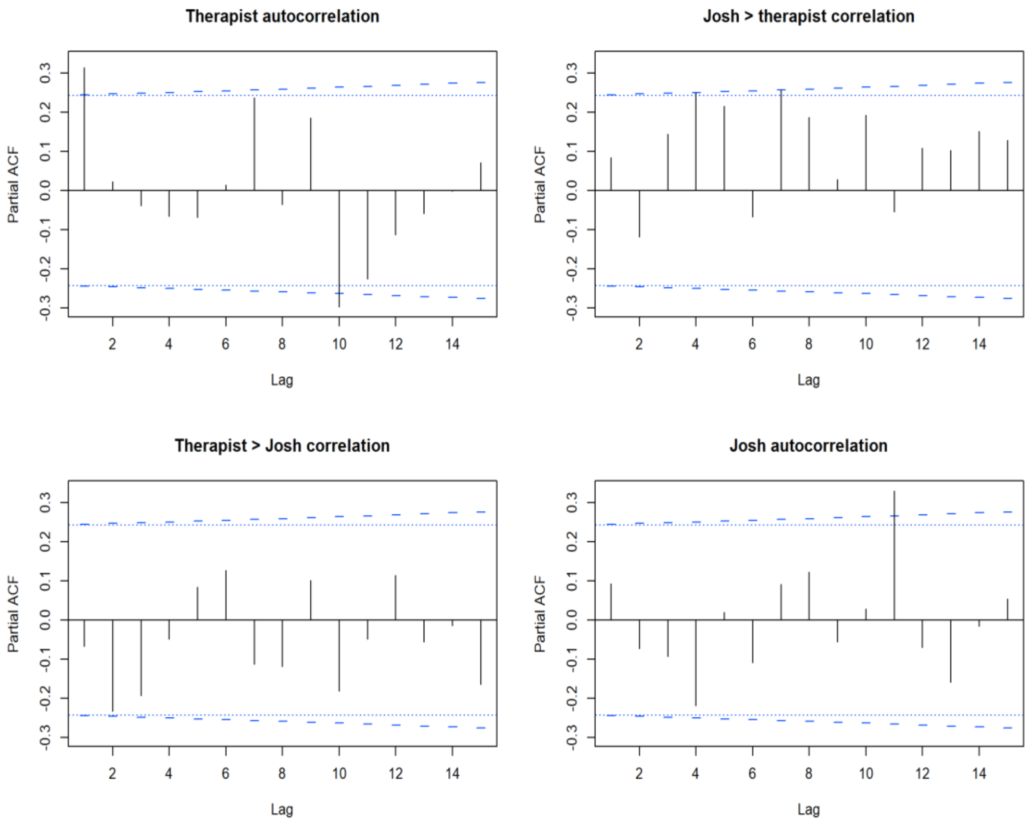

Figure 108. PACF plots for therapist and child, session 1. The blue lines are the “significance bounds.” There is a significant lag=1 effect for the therapist’s autocorrelation (top left). No other significant lag effects are evident.

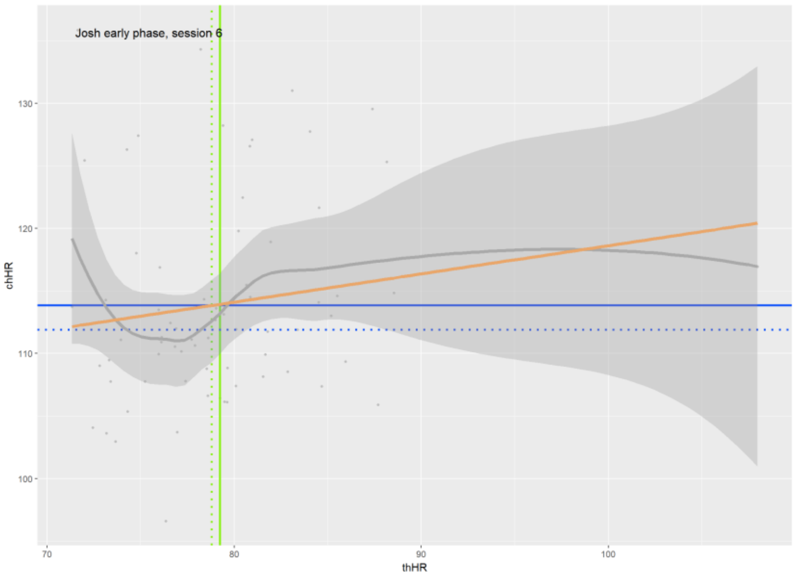

Figure 111. LOESS smoother plot for the simultaneous correlation for session 6. The graph confirms a linear relationship. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median values.

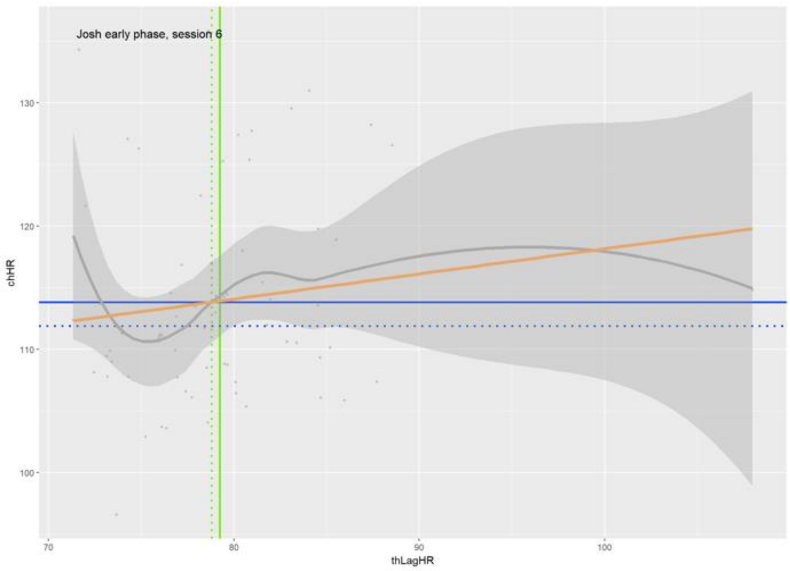

Figure 112. LOESS smoother plot for the non-significant therapist-led lag. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values. The graph confirms a linear relationship for the therapist-led lag.

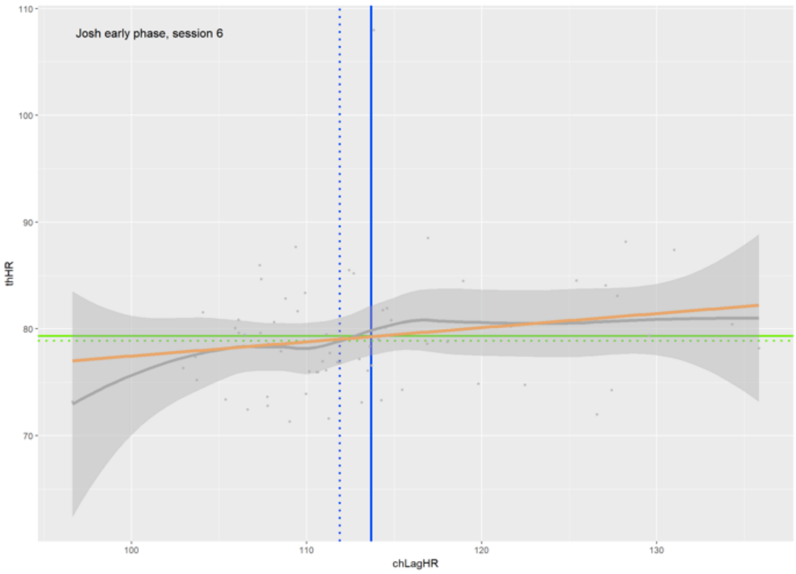

Figure 113. LOESS smoother plot for the non-significant child-led lag. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values. The graph confirms a linear relationship for the child-led lag.

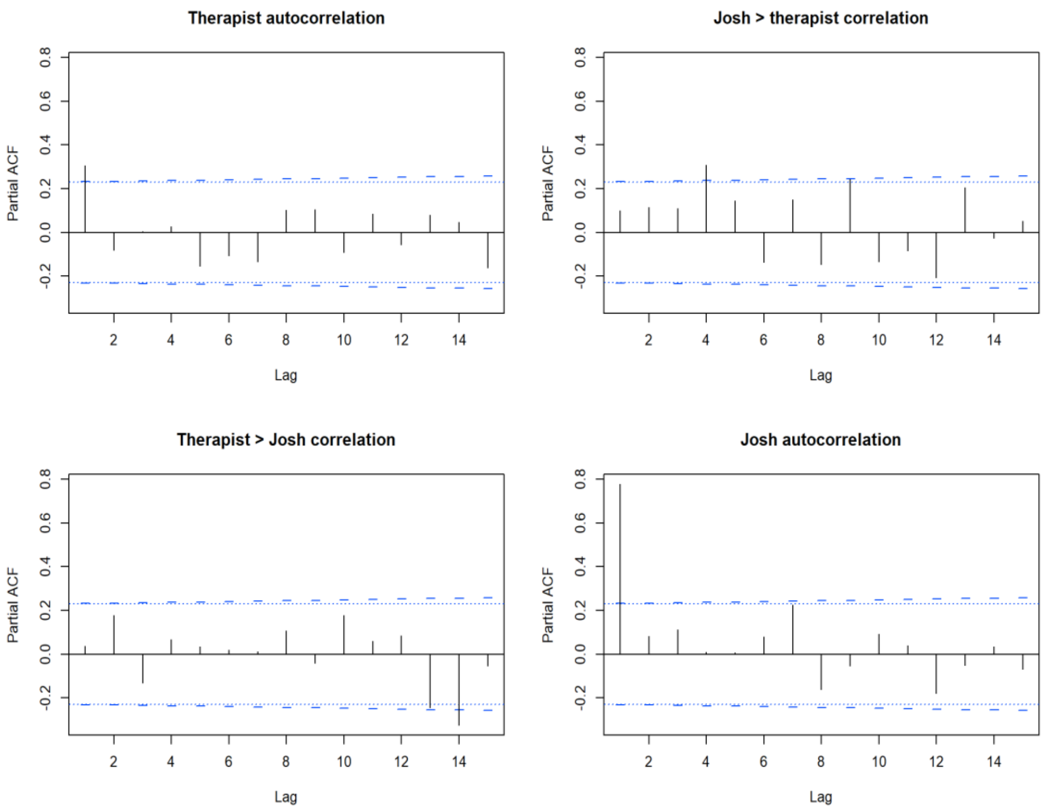

Figure 114. PACF plots for therapist and child, session 6. The blue lines are the "significance bounds." There is a significant lag=1 effect for the therapist's and child's autocorrelation (top left and bottom right). No other significant lag effects are evident.

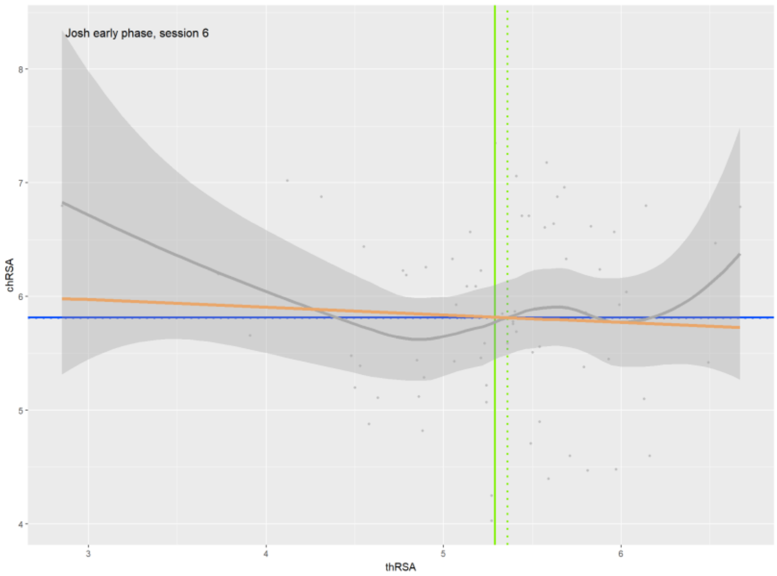

Figure 117. LOESS smoother plot for the simultaneous correlation for session 6. The graph confirms a linear relationship. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median values.

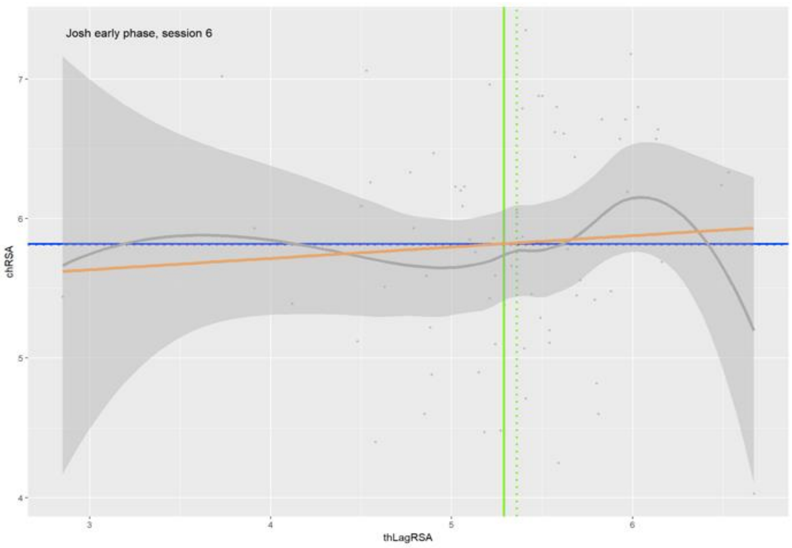

Figure 118. LOESS smoother plot for the non-significant therapist-led lag. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values. The graph confirms a weak linear relationship for the therapist-led lag.

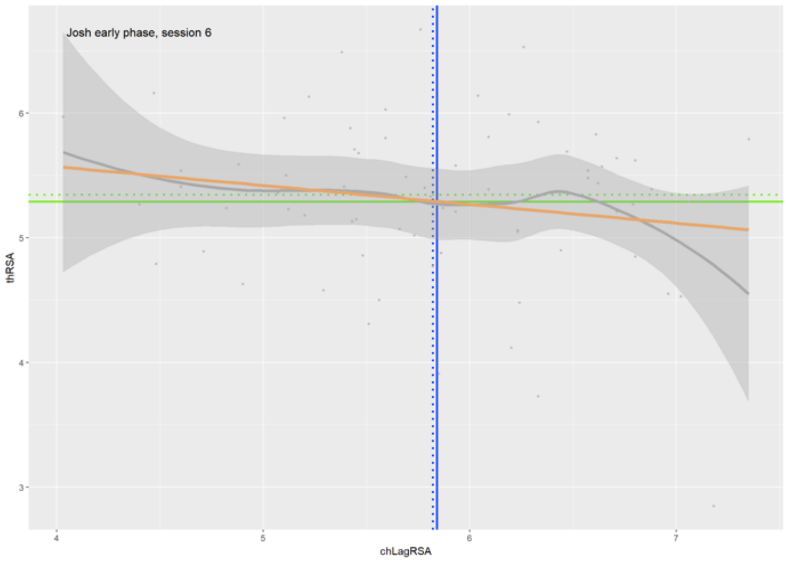

Figure 119. LOESS smoother plot for the non-significant child-led lag. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values. The graph confirms a linear relationship for the child-led lag.

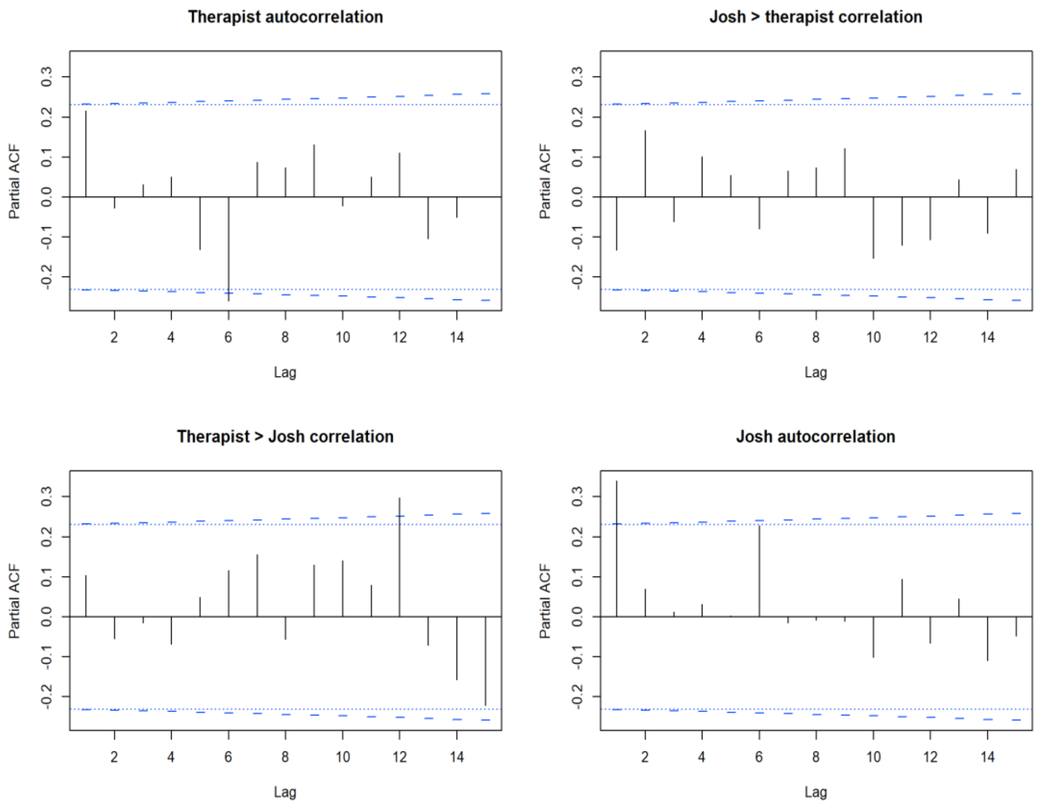

Figure 120. PACF plots for therapist and child, session 6. The blue lines are the "significance bounds." There is a significant lag=1 effect for the child's autocorrelation (bottom right). No other significant lag effects are eviden

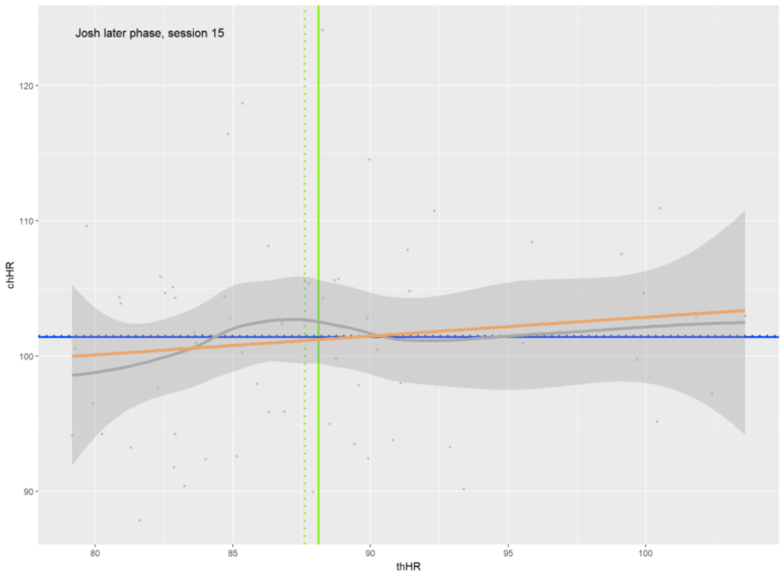

Figure 123. LOESS smoother plot for the simultaneous correlation for session 15. The graph confirms a linear relationship. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median values.

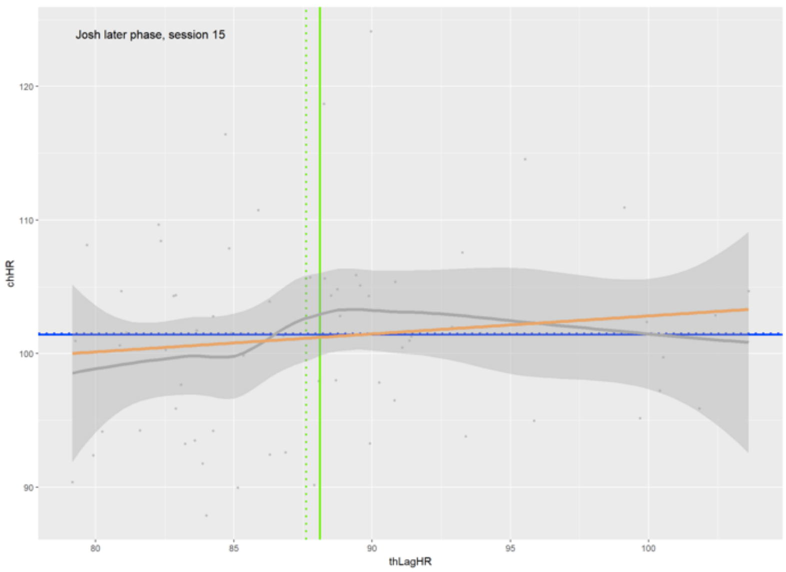

Figure 124. LOESS smoother plot for the non-significant therapist-led lag. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values. The graph confirms a linear relationship for the therapist-led lag.

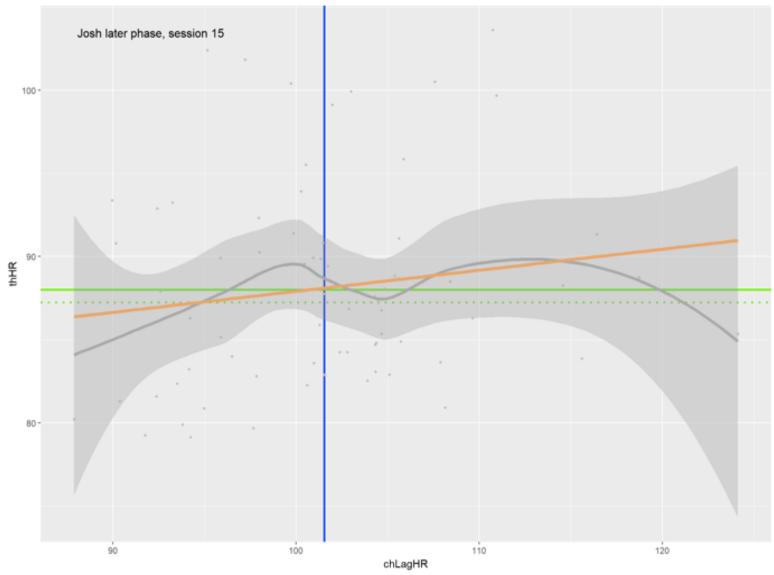

Figure 125. LOESS smoother plot for the non-significant child-led lag. The solid reference lines illustrate the mean HR values (blue for the child and green for the therapist) and the dotted lines the median HR values. The graph confirms a weak linear relationship for the child-led lag.

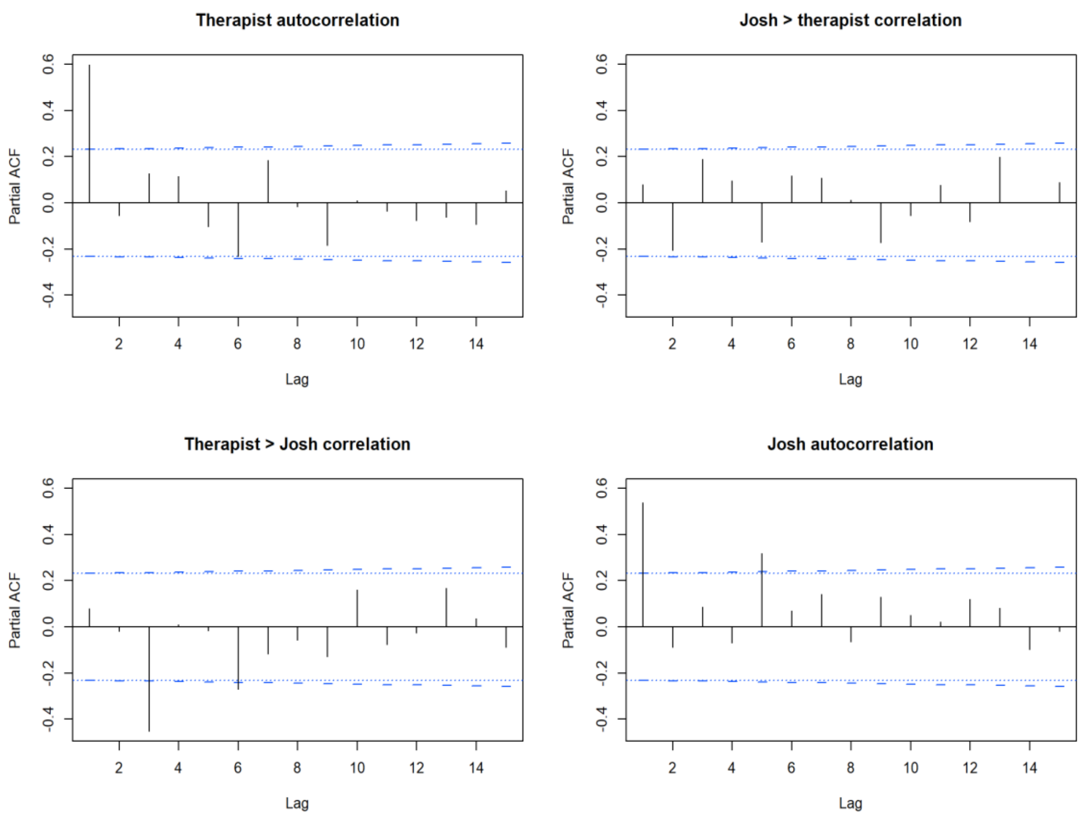

Figure 126. PACF plots for therapist and child, session 15. The blue lines are the “significance bounds.” There is a significant lag=1 effect for the child’s and therapist’s autocorrelation (top left and bottom right).

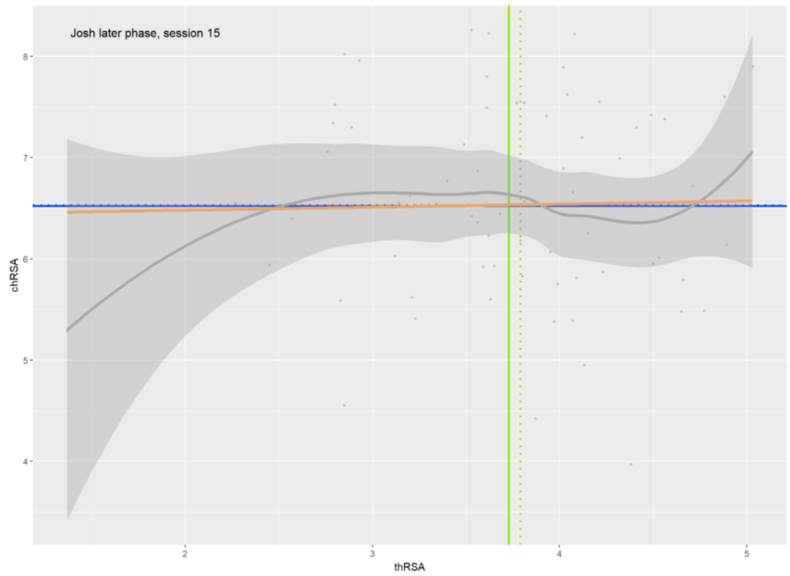

Figure 129. LOESS smoother plot for the simultaneous correlation for session 15. The graph confirms a linear relationship. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median values.

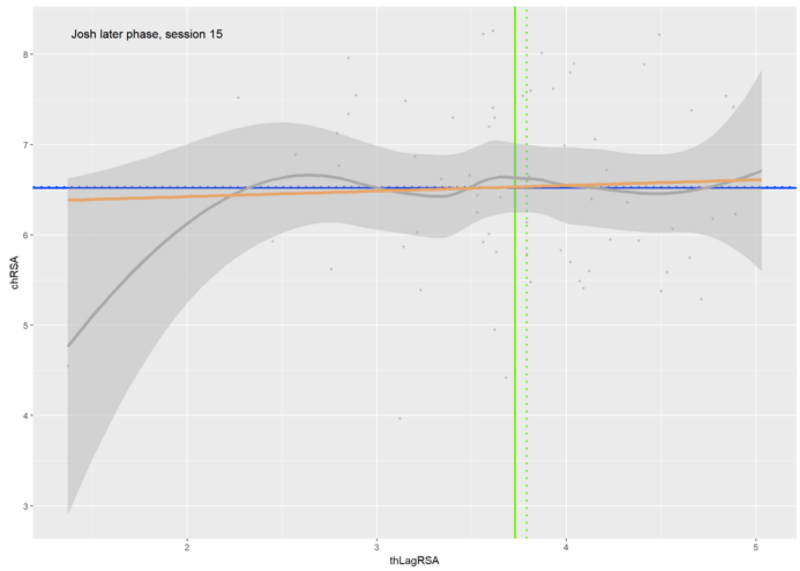

Figure 130. LOESS smoother plot for the non-significant therapist-led lag. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values. The graph confirms a weak linear relationship for the therapist-led lag.

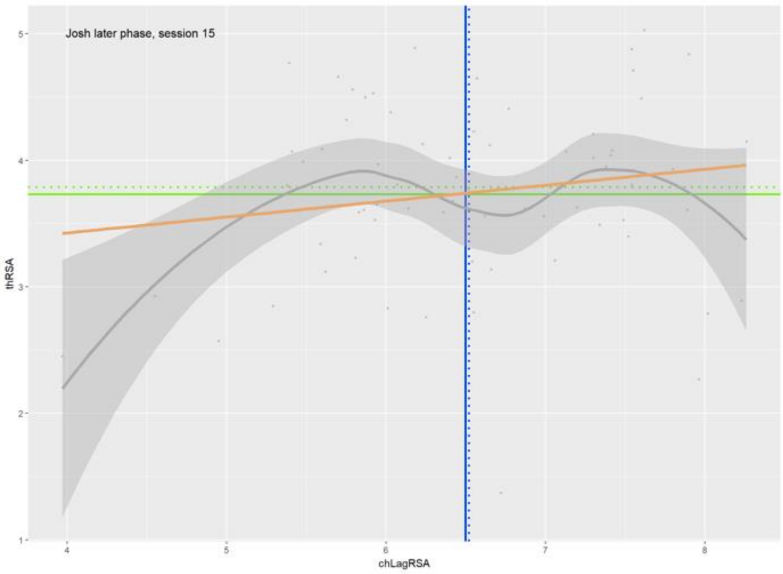

Figure 131. LOESS smoother plot for the non-significant child-led lag. The solid reference lines illustrate the mean RSA values (blue for the child and green for the therapist) and the dotted lines the median RSA values. The graph shows a potential curvilinear rather than linear relationship for the child-led lag.

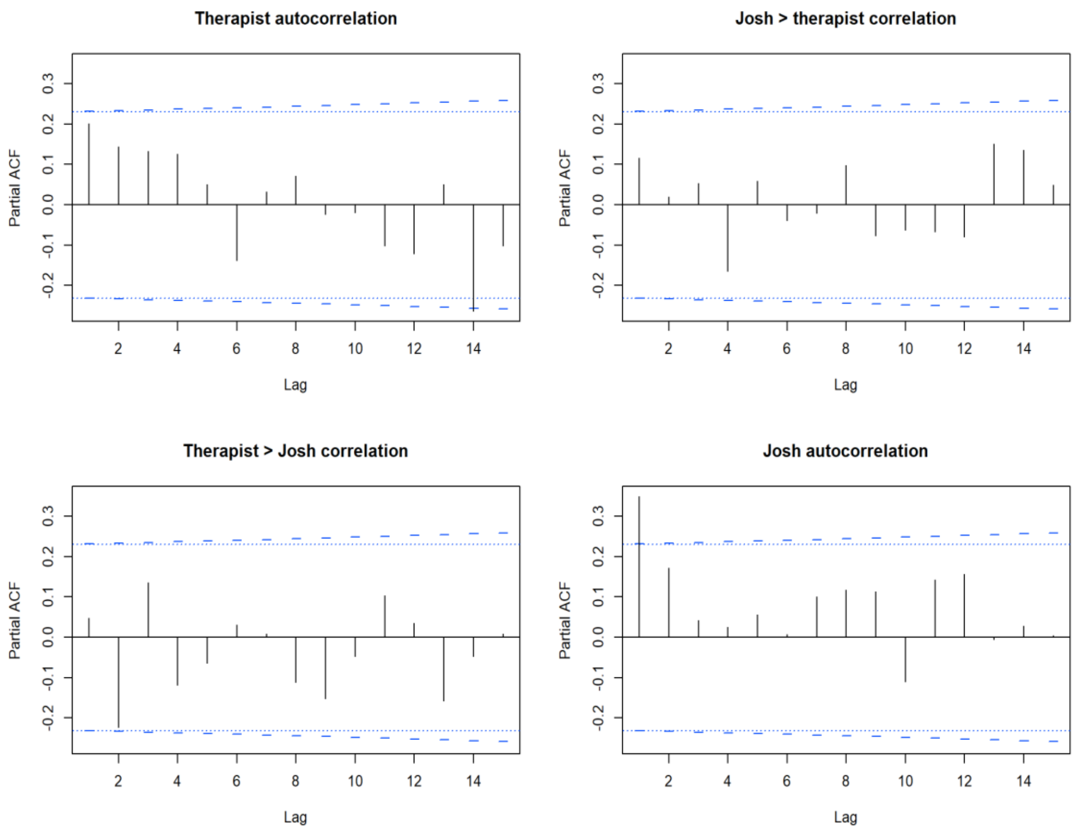

Figure 132. PACF plots for therapist and child, session 15. The blue lines are the “significance bounds.” There is a significant lag=1 effect for the child’s autocorrelation (bottom right). No other significant lag effects are evident

References

Abtahi, M. M., & Kerns, K. A. (2017). Attachment and emotion regulation in middle childhood: Changes in affect and vagal tone during a social stress task. *Attachment and Human Development, 19*(3), 221-242.

Ainsworth, M., Belhar, M., Waters, E., & Wells, S. (1978). *Patterns of attachment: A psychological study of the strange situation.* Hillsdale, NJ: Erlbaum.

Allen, J. (2001). *Traumatic relationships and serious mental disorders*. England: John Wiley & Sons.

Allen, J., Chambers, A. S., & Towers, D. N. (2007). The many metrics of cardiac chronotrophy: A pragmatic primer and a brief comparison of metrics. *Biological Psychology*, *74*(2), 243-262.

Allen, M. T., Matthews, K. A., & Kenyon, K. L. (2000). The relationships of resting baroreflex sensitivity, heart rate variability and measures of impulse control in children and adolescents. *International Journal of Psychophysiology, 37*(2), 185-194.

Appelhans, B. M., & Luecken, L. J. (2006). Heart rate variability as an index of regulated emotional responding. *Review of General Psychology*, *10*(3), 229-240.

Ax, A. F. (1964). Goals and methods of psychophysiology. *Psychophysiology, 1*(1), 8-25.

Axline, V. (1947). Nondirective play therapy for poor readers. *Journal of Consulting*

Psychology, 11(2), 61-69.

Axline, V. (1964). *Dibs: In Search of Self*. New York, NY: Ballantine.

Axline, V. (1969). *Play Therapy*. New York, NY: Ballantine.

Bacon, S. L., Watkins, L. L., Babyak, M., Sherwood, A., Hayano, J., Dinderliter, A. L., Waugh, R., & Blumenthal, J. A. (2004). The effects of daily stress on autonomic cardiac control in coronary artery disease patients. *American Journal of Cardiology, 93*, 1292-1294.

Badenoch, B. (2008). *Being a brain-wise therapist: A practical guide to interpersonal neurobiology*. New York, NY: W. W. Norton & Company.

Baer, J. C., & Martinez, C. D. (2006). Child maltreatment and insecure attachment: a meta-analysis. *Journal of Reproductive and Infant Psychology, 24*(3), 187-197.

Bagner, D. M., Pettit, J. W., Lewinsohn, P. M., & Seeley, J. R. (2010). Effect of maternal depression on child behaviour: a sensitive period? *Journal of the American Academy of Child and Adolescent Psychiatry, 49*(7), 699-707.

Bar-Haim, Y., Marshall, P. J., & Fox, N. A. (2000). Developmental changes in heart period and high-frequency heart period variability from 4 months to 4 years of age. *Developmental Psychobiology, 37*(1), 44-56.

Bar-Haim, Y., Fox, N. A., VanMeenen, K. M., & Marshall, P. J. (2004). Children's narratives and patterns of cardiac reactivity. *Developmental Psychobiology, 44*, 238-

249.

Beauchaine, T. P. (2001). Vagal tone, development, and Gray's motivation theory: Toward an integrated model of autonomic nervous system functioning in psychopathology. *Development and Psychopathology, 13*, 183-214.

Beauchaine, T. P., Gartner, J., & Hagan, B. (2000). Comorbid depression and heart rate variability as predictors of aggressive and hyperactive symptom responsiveness during impatient treatment of conduct-disordered ADHD boys. *Aggressive Behaviour, 26*, 425-441.

Beauchaine, T. P., Katkin, E. S., Strassberg, Z., & Snarr, J. (2001). Disinhibitory psychopathology in male adolescents: Discriminating conduct disorder from attention-deficit/ hyperactivity disorder through concurrent assessment of multiple autonomic states. *Journal of Abnormal Psychology, 110*(4), 610-624.

Beitchman, J. H., Zucker, K. J., Hood, J. E., daCosta, G. A., Akman, D., & Cassavia, E. (1992). A review of the long-term effects of child sexual abuse. *Child Abuse and Neglect, 16*(1), 101-118.

Bell, M. A., & Calkins, S. D. (2012). Attentional control and emotion regulation in early development. In M. I. Posner (Ed.), *Cognitive neuroscience of attention* (2nd ed., pp. 322-330). New York, NY: Guilford.

Bellis, M.A., Hughes, K., Lackenby, N., Perkins, C., Lowey, H. (2014). National household survey of adverse childhood experiences and their relationship with resilience to health-harming behaviours in England. *BMC Medicine, 12*, 72.

Belsky, J. (2005). Differential susceptibility to rearing influence: An evolutionary hypothesis and some evidence. In B. Ellis, & D. F. Bjorklund (Eds.), *Origins of the Social Mind: Evolutionary Psychology and Child Development* (pp. 139-189). New York, NY: The Guildford Press.

Bernier, A., & Dozier, M. (2002). The client-counsellor match and the corrective emotional experience: Evidence from interpersonal and attachment research. *Psychotherapy: Theory, Research and Practice, 39*, 32-43.

Berntson, C. G., Cacioppo, J. T., & Quigley, K. S. (1991). Autonomic determinism: The modes of autonomic control, the doctrine of autonomic space, and the laws of autonomic constraint. *Psychological Review, 98*, 459-487.

Berntson, C. G., Cacioppo, J. T., Quigley, K. S. & Fabro, V. T. (1994). Autonomic space and psychophysiological response. *Psychophysiology, 31*(1), 44-61.

Bernston, G. A., Bigger, J. T., Eckberg, D. L., Grossman, P., Kaugmann, P. G., Malik, M.,…van der Molen, M. L. (1997). Heart rate variability: origins, methods, and interpretive caveats. *Psychophysiology, 34*, 623-648.

Berntson, G. G., Cacioppo, J. T., & Grossman, P. (2007). Whither vagal tone. *Biological Psychology*, *74*(2), 295–300.

Bettelheim, B. (1987). The importance of play. *Atlantic Monthly, 3*, 35-46.

Bion, W. (1962). *Learning from experience*. London: Karnac.

Blair, C., & Peters, R. (2003). Physiological and neurocognitive correlates of adaptive behaviour in preschool among children in Head Start. *Developmental Neurophysiology*, *24*, 479-302.

Blandon, A. Y., Calkins, S. D., Keane, S. P. & O'Brien, M. (2010). Contributions of child's physiology and maternal behaviour to children's trajectories of temperamental reactivity. *Developmental Psychology*, *46*(5), 1089-1102.

Borckardt, J. J., Nash, M. R., Murphy, M. D., Moore, M., Shaw, D., & O'Neil, P. (2008). Clinical practice as natural laboratory for psychotherapy research. A guild to case-based time-series analysis. *American Psychologist, 63*(2), 77-95.

Bornstein, M. H., & Suess, P. E. (2000). Child and mother cardiac vagal tone: Continuity, stability, and concordance across the first five years. *Developmental Psychology*, *36*(1), 54-65.

Bowlby, J. (1969). *Attachment and Loss. Volume 1*. New York, NY: Basic Books.

Bowlby, J. (1980). *Attachment and Loss*. *Volume 2*. New York, NY. Basic Books.

Bowlby, J. (1988). *A secure base: Clinical applications of attachment theory*. London: Routledge.

Boyce, W. T., Quas, J., Alkon, A., Smider, N. A., Essex, M. J., Kupfer, D. J., & Worki, M. A. B. (2001). Autonomic reactivity and psychopathology in middle childhood. *British Journal of Psychiatry, 179,* 144-150.

Boyce, W. T., & Ellis, B. J. (2005). Biological sensitivity to context I: An evolutionary developmental theory of the origins and functions of stress reactivity. *Development and Psychopathology, 17*(2), 271-301.

Bradley, S. J. (2000). *Affect Regulation and the Development of Psychopathology*. London: Gilford Press.

Bradshaw, A. R., Cook, A., & McDonald, M. J. (2011). Observed and experiential integration (OEI): Discovery and development of a new set of trauma therapy techniques. *Journal of Psychotherapy Integration*, *21*(2), 104-171.

Bratton, S. C., & Ray, D. (2000). What the research shows about play therapy. *International Journal of Play Therapy, 9*, 47-88.

Bratton, S. C., Ray, B., Rhine, T., & Jones, L. (2005). The efficacy of play therapy with children: A meta-analytic review of treatment outcomes. *Professional Psychology: Research and Practice*, *36*, 376-390.

Bratton, S. C., Ceballos, P. L., Sheely-Moore, A. I., Meany-Walen,K., Pronchenko,Y., & Jones, L.D. (2013). Heart start to early mental health intervention: Effects of Child-Centred Play Therapy on disruptive behaviours. *International Journal of Play Therapy*, *22* (1), 28-42.

Brenning, K. M., & Braet, C. (2013). The emotion regulation model of attachment: An emotion specific approach. *Personal Relationships*, *20*(1), 107-123.

Bretherton, I., Oppenheim, D., Buchsbaum, H., & Emde, R. (2003). The McArthur Story Stem Battery. In R. Emde, D. Wolf and D. Oppenheim (Eds). *Revealing the inner worlds of young children: The MacArthur Story Stem Battery and Parent-Child*

Narratives (pp. 381-396). New York, NY: Oxford University Press.

Bromberg, P.M. (2006). *Awakening the dreamer: Clinical journey*. Mahwah, NJ: Analytic Press.

Burgdorf, J., Kroes, R. A., Beinfeld, M. C., Panksepp, J., & Moskal, J. R. (2010). Uncovering the molecular basis of positive affect using rough-and-tumble play in rats: a role for insulin-like growth factor I. *Neuroscience*, *168*(3), 769-777.

Burgess, K. B., Marshall, P. J., Rubin, K. H., & Fox, N. A. (2003). Infant attachment and temperament as predictors of subsequent externalising problems and cardiac physiology. *Journal of Child Psychology and Psychiatry, 44*(6), 819-831.

Burt, K. B., & Obradovic, J. (2012). The construct of psychophysiological reactivity: Statistical and psychometric issues. *Developmental Review, 33*(1), 29-57.

Butler, E. A. (2011). Temporal interpersonal emotional systems: The “TIES” that form relationships. *Personality and Social Psychology Review, 15*(4), 367-393.

Butler, E. A., & Randall, A. K. (2013). Emotional coregulation in close relationships. *Emotion Review, 5*(2), 202-210.

Butler, E. A., Wilhelm, F. H., & Gross, J. J. (2006). Respiratory sinus arrhythmia and emotion regulation during social interaction. *Psychophysiology, 43*(6), 612-622.

Cacioppo, J. T. (1994). Social neuroscience: autonomic, neuroendocrine, and immune responses to stress. *Psychophysiology*, *31*(2), 113-128.

Cacioppo, J. T., & Sandman, C. A. (1978). Physiological differentiation of sensory and cognitive tasks as a function of warning, processing demands, and reported unpleasantness. *Biological Psychology, 6*(3), 181-192.

Calkins, S. D. (1997). Cardiac vagal tone indices of temperamental reactivity and behavioural regulation in young children. *Developmental Psychobiology*, *31*, 125-135.

Calkins, S. D., Smith, C. L., Gill, K. L., & Johnson, M. C. (1998). Maternal interactive style across contexts: Relations to emotional, behavioural, and physiological regulation during toddlerhood. *Social Development*, *7,* 350-369.

Calkins, S. D., & Dedmon, S. E. (2000). Physiological and behavioural regulation in two-year-old children with aggressive/destructive behaviour problems. *Journal of Abnormal Child Psychology*, *28*, 103-118.

Calkins, S., & Keane S. P. (2004). Cardiac vagal regulation across the preschool period: Stability, continuity, and implications for childhood adjustment. *Developmental Psychobiology*, *45*(3), 101-112.

Calkins, S. D., Graziano, P. A., & Keane, S. P. (2007). Cardiac vagal regulation difficulties among children at risk for behaviour problems. *Biological Psychology*, *74*, 144-153.

Calkins, S., Graziano, P. A., Berdan, L. E., Keane, S. P., & Degan, K. A. (2008). Predicting cardiac vagal regulation in early childhood from maternal-child relationship quality during toddlerhood. *Developmental Psychobiology*, *50*(8), 751-766.

Carroll, J. (2000). Evaluation of therapeutic play: A challenge for research. *Child and Family Social Work*, *5*, 11-22.

Carroll, J. (2002). Play Therapy: The children's views. *Child and Family Social Work*, *7*, 177-187.

Cattell, R. B. (1963). The structuring of change by P- and incremental R-technique. In C. W. Harris (Ed.), *Problems in measuring change*. Madison: University of Wisconsin Press.

Chambers, A. S., & Allen, J. B. (2007). Cardiac vagal control, emotion, psychopathology and health. *Biological Psychology*, *74*(2), 113-115.

Champagne, F. A. (2008). Epigenetic mechanisms and the transgenerational effects of maternal care. *Frontiers in neuroendocrinology, 29*(3), 386-397.

Chazan, S. E. (2002). *Profiles of Play. Assessing and observing structure and process in play therapy.* London: Jessica Kingsley Publishers.

Coan, J. A., Schaefer, H. S., & Davidson, R. J. (2006). Lending a hand: Social regulation of the neural response to threat. *Psychological Science*, *19*(12), 1032-1039.

Coleman, R., Greenblatt, M., Solomon, H. C. (1956). Physiological evidence of rapport during psychotherapeutic interviews. *Diseases of the Nervous System, 17*(3), 71-77.

Conradt, E., & Ablow, J. (2010). Infant physiological response to the still-face paradigm: contributions of maternal sensitivity and infants' early regulatory behaviour. *Infant Behaviour Development, 33*(3), 251-265.

Coutinho, J. F., Silva, P. O., & Decety, J. (2014). Neurosciences, empathy, and healthy interpersonal relationships: Recent findings and implications for couseling psychology. *Journal of Counseling Psychology, 61*(4), 541-548.

Cozolino, L. (2002). *The neuroscience of psychotherapy: Building and rebuilding the human brain*. New York, NY: W.W. Norton & Company.

Cozolino, L. (2006). *The neuroscience of human relationships: Attachment and the developing social brain.* New York, NY: W.W. Norton & Company.

Cozolino, L. (2010). *The neuroscience of psychotherapy: Healing the social brain* (2nd ed.). New York, NY: W.W. Norton & Company.

Creaven, A., Skowron, E. A., Hughes, B. M., & Loken, E. (2014). Dyadic concordance in mother and pre-schooler resting cardiovascular function varies by risk status. *Developmental Psychobiology*, *56*(1), 142-152.

Crenshaw, D. A., & Mordock, J. B. (2005). *Handbook of play therapy with aggressive children*. Landham, MD: Jason Aronson/Rowman & Littlefield Publishers.

Crenshaw, D. A. (2007). An interpersonal neurobiological-informed treatment model for childhood traumatic grief. *Journal of Death and Dying*, *54*(4), 319-335.

Crenshaw, D. A., & Hardy, K. V. (2007). The crucial role of empathy in breaking the silence of traumatised children in play therapy. *International Journal of Play Therapy, 16*(2), 160-175.

Crenshaw, D. A., & Kenny-Noziska, S. (2014). Therapeutic presence in play therapy. *International Journal of Play Therapy, 23*(1), 31-43.

Crick, N. R., & Dodge, K. A. (1994). A review and reformulation of social information-processing mechanisms in children's social adjustment. *Psychological Bulletin, 115*(1), 74-101.

Crittenden, P. M. (1995). Attachment and psychopathology. In S. Golberg, R. Muir, & J. Kerr (Eds.), *John Bowlby's attachment theory: Historical, clinical and social significance* (pp.367-406). New York, NY: The Analytic Press.

Crittenden, P. M. (2006). A Dynamic-Maturational Model of Attachment. *Australia and New Zealand Journal of Family Therapy, 27*, 105-115.

Crittenden, P. M. (2008). *Raising parents: Attachment, parenting and child safety*. Oregon: Willan Publishing.

Cronbach, L. J., & Fuby, L. (1970). How we should measure "change" – or should we? *Psychological Bulletin, 74*(1), 68-80.

Dale, L. P., O'Hara, E. A., Keen, J., & Porges, S. W. (2011). Infant regulatory disorders: Temperamental, physiological and behavioural features. *Journal of Developmental Behavioural Paediatrics, 32*(3), 216-224.

D'Andre, W. & Pole, N. (2012). A naturalistic study of the relation of psychotherapy process to changes in symptoms, information processing, and physiological activity in complex trauma. *Psychological Trauma, 4*(4), 438-446.

Daniel, S. I. F. (2006). Adult attachment patterns in individual psychotherapy: A review. *Clinical Psychology Review*, *26,* 968-984.

Davenport, B., & Bourgeois, N. M. (2008). Play, aggression, the preschool child, and the family: A review of literature to guide empirically informed play therapy with aggressive preschool children. *International Journal of Play Therapy, 17*, 2-23.

Danvers, A. F., & Shiota, M. N. (2017). Going off script: Effects of awe on memories for script – typical and irrelevant narrative detail. *Emotion*, *17*(6), 938-952.

Davis, E. L., Quinones-Camacho, L. E., & Buss, K. A. (2016). The effects of distraction and reappraisal on children's parasympathetic regulation of sadness and fear. *Journal of Experimental Child Psychology, 142*, 344-358.

De Bellis, M. D., Spratt, E. G., & Hooper, S. R. (2011). Neurodevelopmental biology associated with childhood sexual abuse. *Journal of Child Sexual Abuse*, *20,* 548-587.

DeGangi, G. A., DiPietro, J. A., Greenspan, S. I., & Porges, S. W. (1991). Psychophysiological characteristics of the regulatory disordered infant. *Infant Behaviour and Development*, *14,* 37-50.

Dellinger, J. A., Taylor, H. L., & Porges, S. W. (1987). Atropine sulfate effects on aviator performance and on respiratory-heart period interactions. *Aviation, Space and Environmental Medicine, 58*(4), 333-338.

Denver, J. W., Reed, S. F., & Porges, S. W. (2007). Methodological issues in the quantification of respiratory sinus arrhythmia. *Biological Psychology, 74*(2), 286-294.

De Vries-Bouw, M., Popma, A., Vermeiren, R., Doreleijers, T., van de ven, P., & Jansen, L. (2011). The predictive value of low heart rate and heart rate variability during stress for reoffending in delinquent male adolescents. *Psychophysiology, 48*, 1596-1603.

Diamond, L. M. (2001). Contribution of psychophysiology to research on adult attachment: Review and recommendations. *Journal of Social and Personal Relationships*, *5*(4), 276-295.

Diamond, L. M., & Hicks, A. M. (2005). Attachment style, current relationship security, and negative emotions: The mediating role of physiological regulation. *Journal of Social and Personal Relationships, 22*(4), 499-518.

Diamond, L. M., Hicks, A. M., & Otter-Henderson, K. D. (2011). Individual differences in vagal regulation moderate associations between daily affect and daily couple interactions. *Personality and Social Psychology Bulletin, 37*(6), 731-744.

Diamond, L. M. & Cribbet, M. R. (2013). Links between adolescent sympathetic and parasympathetic nervous system functioning and interpersonal behaviours over time. *International Journal of Psychophysiology, 88*(3), 339-349.

Di Mascio, A., Boyd, R. W., Greenblatt, M., Solomon, H. C. (1955). The psychiatric interview: A sociophysiologic study. *Diseases of the Nervous System, 16*(1), 4-9.

Dinger, U., Strack, M., Sachsse, T., & Schauenburg, H. (2009). Therapists' attachment, patients' interpersonal problems and alliance development over time in inpatient psychotherapy. *Psychotherapy Theory, Research, Practice, Training, 46*(3), 277-290.

Dinger, U., Strack, M., & Monroe, J. M. (2011). The relationship between adult attachment styles and therapeutic alliance in individual psychotherapy: A meta-analytic review. *Psychotherapy, 48*, 237-248.

Dion, L., & Gray, K. (2014). Impact of therapist authentic expression on emotional tolerance in synergetic play therapy. *International Journal of Play Therapy*, *23*(1), 55-67.

Disseth, T. H. (2005). Dissociation in children and adolescents as reaction to trauma. An overview of conceptual issues and neurobiological factors. *Nordic Journal of Psychiatry, 59*, 79-91.

Doussard-Roosevelt, J.A., Montgomery, L. A. & Porges, S. W. (2003). Short-term stability of physiological measures in kindergarten children: Respiratory sinus arrhythmia, heart period and cortisol. *Developmental Psychobiology*, *43*(3), 230-242.

Dozier, M., Cue, K. L., & Barnett, L. (1994). Clinicians as caregivers: Role of attachment organisation in treatment. *Journal of Consulting and Clinical Psychology*, *62*, 793-800.

Eisenber, N., Fabes, R. A., Murphy, B., Maszk, P., Smith, M., & Karbon, M. (1995). The role of emotionality and regulation in children's social functioning: A longitudinal study. *Child Development, 66*, 1239-1261.

Ellis, B. J., Essex, M. J., & Boyce, W. T. (2005). Biological sensitivity to context II: Empirical exploration of an evolutionary-developmental theory. *Development and Psychopathology*, *17*(2), 303-328.

Ellis, B. J., & Boyce, W. T. (2008). Biological sensitivity to context. *Current Directions in Psychological Science*, *17*(3), 183-187.

Erickson, E. H. (Ed.). (1963). *Youth: Change and Challenge*. London: Basic Books.

Fabes, R. A., Eisenberg, N., & Eisenbud, L. (1993). Behavioural and physiological correlates of children's reactions to others in distress. *Developmental Psychology*, *29*(4), 655-663.

Fabes, R. A., Eisenberg, N., Karbon, M., Bernzweig, J., Speer, A. L., & Carlo, G. (1994). Socialisation of children's vicarious emotional responding and prosocial behaviour: Relations with mothers' perceptions of children's emotional reactivity. *Developmental Psychology, 30,* 44-55.

Fabes, R. A., & Eisenberg, N. (1997). Regulatory control and adults' stress-related responses to daily life events. *Journal of Personality and Social Psychology, 73*, 1107-1117.

Farnfield, S. (2015a). *The child attachment and play assessment CAPA coding manual: Using narrative stems to assess attachment, play and mentalising in children aged 3-11 years* (version 3). London: Attachment Courses Direct.

Farnfield, S. (2014b). From preschool to school age: Narrative story stems. In S. Farnfield & P. Holmes (Eds.) *The Routledge Handbook of Attachment Assessment* (pp. 81-101). East Sussex: Routledge.

Farnfield, S. (2015c). The Child Attachment and Play Assessment (CAPA): Validation of a new approach to coding narrative stems with children ages 3–11 years. *International Journal of Play Therapy, 25*(4), 217-229.

Fatisson, J., Oswald, V., & Lalonde, F. (2016). Influence diagram of physiological and environmental factors affecting heart rate variability: An extended literature overview. *Heart International, 11* (1), 32-40.

Fein, G. (1987). Pretend Play: Creativity and Consciousness. In D. Gorlits & J. F. Wohlwill, (Eds.). *Curiosity, Imagination and Play*. (pp.300). Hillsdale, N.J: Erblaum.

Feldman, R. (2012). Oxytocin and social affiliations in humans. *Hormones and Behaviour, 61*(3), 380-391.

Feldman, R., & Eidelman, A. I. (2004). Parent-infant synchrony and the social-emotional development of triplets. *Developmental Psychology, 40,* 1133-1147.

Feldman, R., Singer, M., & Zagoory, O. (2010). Touch attenuates infants' physiological reactivity to stress. *Developmental Science, 13*(2), 271-278.

Feldman, R., Magori-Cohen, R., Galili, G., Singer, M., & Louzoun, Y. (2011). Mother and infant coordinate heart rhythms through episodes of interaction synchrony. *Infant Behaviour and Development*, *34*, 569-577.

Felitti, V.J., Anda, R.F., Nordenberg, D., Williamson, D.F., Spitz, A.M., Edwards, V., Koss, M. P. & Marks, J. S. (1998). Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults: The Adverse Childhood Experiences (ACE) Study. *American Journal of Preventative Medicine*, *14*(4), 245-258.

Field, T. (1981). Infant gaze aversion and heart rate during face-to-face interactions. *Infant behaviour and Development, 4,* 307-315.

Field, T. (1985). Attachment as psychobiological attunement: Being on the same wavelength. In M. Reite & T. Field (Eds.). *The psychobiology of attachment and separation* (pp. 415-454). Orlando, FL: Academic.

Field, T. (1994). The effects of mother's physical and emotional unavailability on emotion regulation. *Monographs of the Society for Research in Child Dvelopment, 59*, 208-277.

Field, T. M. (2002). Early interactions between infants and their postpartum depressed mothers. *Infant Behaviour and Development*, *7*(1), 19-25.

Field, T. M. (2007). *The Amazing Infant*. London: Blackwell.

Field, T. M. (2012). Relationships as regulators. *Psychology, 3*(6), 467-479.

Field, T., Healy, B., & LeBlanc, W. G. (1989). Sharing and synchrony of behaviour states and heart rate in nondepressed verse depressed mother-infant interactions. *Infant Behaviour Development, 12*(3), 357-376.

Field, T., & Reite, M. (1984). Children's responses to separation from mother during the birth of another child. *Child Development, 55*, 1308-1316.

Findling, J. H., Bratton, C. B., & Henson, R. K. (2006). Development of the Trauma Play Scale: An observation-based assessment of the impact of trauma on play therapy behaviours of young children. *International Journal of Play Therapy, 15*(1), 7-36.

Finley, J. P., Nugent, S. T., Hellenbrand, W., Craig, M., & Gillis, D. A. (1989). Sinus arrhythmia in children with atrial septal defect: an analysis of heart rate variability before and after surgical repair. *British Heart Journal, 61*(3), 280-284.

Fisher, A. J., Reeves, J. W., & Chi, R. C. (2016). Dynamic RSA: Examining parasympathetic regulatory dynamics via vector-autoregressive modelling of time-varying RSA and heart period. *Psychophysiology, 53*(7), 1093-1099.

Fonagy, P., Gergely, G., Jurist, E. L. & Target, M. (2004). *Affect Regulation, Mentalization, and the Development of Self.* London: Karnac Books.

Fonagy, P., Steele, M., Steele, H., Leigh, T., Kennedy, R., Mattoon, G., & Target, M. (1995). Attachment, the reflective self, and borderline states: The predictive specificity of the Adult Attachment Interview and pathological emotional development. In S. Goldberg, R. Muir, & J. Kerr, *Attachment Theory: Social,* *Developmental and Clinical Perspectives* (pp.233-279). Hillsdale, NJ: The Analytic Press.

Fortunato, C. K., Gatzke-Koop, L. M., & Ram, N. (2013). Associations between respiratory sinus arrhythmia reactivity and internalising and externalising symptoms are emotion specific. *Cognitive, Affective & Behavioural Neuroscience, 13*(2), 238-251.

Fox, N. A., Kirwan, M., & Reeb-Sutherland, B. (2012). Physiological measures of emotion from a developmental perspective: State of the science: Measuring the physiology of emotion regulation – Timing is everything. *Monographs of the Society for Research in Child Development, 77*(2), 98-108.

Fracasso, M. P., Porges, S. W., Lamb, M. E., & Rosenberg, A. A. (1994). Cardiac activity in infancy: Reliability and stability of individual differences. *Infant Behaviour and Development, 17*(3), 277-284.

Fredrickson, B. I., & Levenson, R. W. (1998). Positive emotions speed recovery from the cardiovascular sequelae of negative emotions. *Cognitions and Emotion*, *12*,191-220.

Frick-Helms, S. B., & Drewes, A. A. (2010). Introduction to play therapy research theme issue. *International Journal of Play Therapy*, *19*(1), 1-3.

Friedman, B. H. (2007). An autonomic flexibility-neurovisceral integration model of anxiety and cardiac vagal tone. *Biological Psychology*, *10*, 527-540.

Galeev, A. P., Igishera, L. N., & Kazin, E. M. (2002). Heart rate variability in healthy six to sixteen-year-old children. *Human Physiology, 28*(4), 428-432.

Gallese, V., Eagel, M. N., & Migone, P. (2007). Intentional attunement: mirror neurons and the neural underpinnings of interpersonal relations. *Journal of the American Psychoanalytic Association, 55*(1), 131-176.

Garland, E. L., Fredrickson, B., Kring, A. M. Johnson, D. P., Meyer, P. S. & Penn, D. L. (2010). Upward spirals of positive emotions counter downward spirals of negativity: Insights from the broaden-and-build theory and affective neuroscience on the treatment of emotion dysfunctions and deficits in psychopathology. *Clinical Psychology Review, 30*, 849-864.

Garvey, C. (1977). Play. Cambridge: MA: Harvard University Press.

Gaskill, R. (2008). Mining report. Neuroscience and play therapy. *Association for Play Therapy United States*.

Gaskill, R. (2014). Empathy. In C. E. Scahaer, & A. A. Drewes (Eds.). *The Therapeutic Power of Play: 20 Core Agents of Change* (2nd Ed.), pp.195-209. New Jersey, NJ: John Wiley & Sons.

Gaskill, R. L. & Perry, B. D. (2017). A Neurosequential Therapeutics approach to guided play, play therapy, and activities for children who won't talk. In C. A. Malchiodi & D. A. Crenshaw (Eds.). *What to when children clam up in psychotherapy: Interventions to facilitate communication* (pp. 38-62). New York, NY: The Guilford Press.

Gates, K. M., Gatze-Kopp, L. M., Sandsten, M., & Blandon, A. Y. (2015). Estimating time-varying RSA to examine psychophysiological linkage of marital dyads. *Psychophysiology, 52*(8), 1059-1065.

Gatzke-Kopp, L. M., Greenberg, M., & Bierman, K. (2015). Children's parasympathetic reactivity to specific emotions moderates response to intervention for early-onset aggression. *Journal of Clinical Child and Adolescent Psychology, 44,* 291-304.

Geisler, F. C., Kubiak, T., Siewert, K., & Weber, H. (2013). Cardiac vagal tone is associated with social engagement and self-regulation. *Biological Psychology, 93*(2), 279-286.

Geller, S. M., & Porges, S. W. (2014). Therapeutic presence: Neurophysiological mechanisms mediating feeling safe in therapeutic relationships. *Journal of Psychotherapy Integration, 24*(3), 178-192.

Gentzler, A. M., Rottenberg, J., Kovacs, M., George, C. J., & Morey, J. N. (2012). Atypical development of resting respiratory sinus arrhythmia in children at high risk for depression. *Developmental Psychobiology, 54*(5), 556-567.

Gentzler, A. L., Santucci, A. K., Kovacs, M., & Fox, N. A. (2009). Respiratory sinus arrhythmia reactivity predicts emotion regulation and depressive symptoms in at-risk and control children. *Biological Psychology, 82*(2), 156-163.

Gerhardt, S. (2004). *Why love matters: How affection shapes a baby's brain*. New York, NY: Brunner-Routledge.

Gharabaghi, K. (2008). Reclaiming our “toughest” youth. *Reclaiming Children and Youth*, *17*(3), 30-32.

Gill, E. (2006). *Helping abused and traumatised children. Integrating directive and nondirective approaches*. New York, NY: The Guilford Press.

Ginott, H. G. (1961). *Group Psychotherapy with Children: The Theory and Practice of Play Therapy*. New York, NY: McGraw-Hill Book Company.

Ginot, E. (2007). Intersubjectivity and neuroscience. Understanding enactments and their therapeutic significance within emerging paradigms. *Psychoanalytic Psychology*, *24* (2), 317-332.

Goldberg, S., MacKay, Soroka, S., & Rochester, M. (1994). Affect, attachment, and maternal responsiveness. *Infant Behaviour and Development*, *17*, 335-339.

Goleman, D. (2006). *Emotional Intelligence*. New York, NY: Bantam.

Goldstein, S., Field, T., & Healy, B. (1989). Concordance of play behaviour and physiology in preschool friends. *Journal of Applied Developmental Psychology, 10*(3), 337-351.

Goodyear-Brown, P. (2010). *Play therapy with traumatised children: A prescriptive approach.* New Jersey, NJ: John Wiley & Sons, Inc.

Gordan, N. S., Kollack-Walker, S., Akil, H., & Panksepp, J. (2002). Expression of c-fos gene activation during rough and tumble play in juvenile rats. *Brain Research Bulletin, 57,* 17-20.

Gordan, N. S., Burke, S., Akil, H., & Panksepp, J. (2003). Socially-induced brain 'fertilisation': Play promotes brain derived neurotrophic factor transcription in the amygdala and dorsolateral frontal cortex in juvenile rats. *Neuroscience Letters, 341*(1), 17-20.

Goto, S., Bono, H., Ogata, H., Fujibuchi, W., Nishioka, T., Sato, K., & Kanehisa, M. (1997). Organising and computing metabolic pathway data in terms of binary relations. *Pacific Symposium on Biocomputing*, 175-186.

Gottman, J. M., & Katz, L. F. (2002). Children's emotional reactions to stressful parent-child interactions: The link between emotion regulation and vagal tone. *Marriage and Family Review, 34*(3-4), 265-283.

Gray, A. E. & Porges, S. W. (2017). Polyvagal-informed dance/movement therapy with children who shut down: Restoring core rhythmicity. *What to when children clam up in psychotherapy: Interventions to facilitate communication*. New York, NY: The Guilford Press.

Graziano, P., & Derefinko, K. (2013). Cardiac vagal tone and children's adaptive functioning: a meta-analysis. *Biological Psychology*, *94*(1), 22-37.

Graziano, P., Keane, S. P., & Calkins, S. D. (2007). Cardiac vagal regulation and early peer status. *Child Development, 78*, 264-278.

Green, E. J., Crenshaw, D. A., & Langtiw, C. L. (2009). Play theme-based research with children. *The Family Journal: Counselling and Therapy for Couples and Families*, *17*(4), 312-317.

Green, E. J., Crenshaw, D. A., & Kolos, A. C. (2010). Counselling children with preverbal trauma. *Psychotherapy and Psychotherapeutic Counselling*, *19*(2), 95-105.

Grossman, P., Karemaker, J., & Wieling, W. (1991). Prediction of tonic parasympathetic cardiac control using respiratory sinus arrhythmia: the need for respiratory control. *Psychophysiology, 28*(2), 201-216.

Grossman, P., Niemann, L., Schmidt, S., & Walach, H. (2004). Mindfulness-based stress reduction and health benefits. A meta-analysis. *Journal of Psychosomatic Research, 57*(1), 35-43.

Grossman, P., & Taylor, E. W. (2007). Toward understanding respiratory sinus arrhythmia: relations to cardiac vagal tone, evolution and biobehavioural functions. *Biological Psychology, 74*(2), 263-285.

Guerney, L. E. (1983). Client-centred (non-directive) play therapy. In C. E. Schaefer and K. J. O'Connor (Eds.). *Handbook of Play Therapy* (pp.21-64). New York, NY: Wiley.

Gurman, A. S. (1977). The patient's perceptions of the therapeutic relationship. In A. S. Gurman & A. M. Razin (Eds.). *Effective psychotherapy: A handbook of research* (pp. 503-542). New York, NY: Pergamon Press.

Hahn, P., Mayer, H., & Stanek, D. (1973). Biometric findings on cardiac neurosis: I.

Character and clinical aspects of cardiac neurosis. *Psychotherapy and Psychosomatics, 22*(2-6), 276-282.

Haley, D. W., & Stansbury, K. (2003). Infant stress and parent responsiveness: Regulation of physiology and behaviour during still-face reunion. *Child Development*, *74*(5), 1534-1546.

Ham, J., & Tronick, E. (2009). Relational psychophysiology: Lessons from mother-infant physiology research on dyadically expanded states of consciousness. *Psychotherapy Research*, *19*(6), 619-632.

Hamilton, J. L., & Alloy, L. B. (2016). Atypical reactivity of heart rate variability to stress and depression across development: Systematic review of the literature and directions for future research. *Clinical Psychology Review, 50,* 67-79.

Hansen, A. L., Johnsen, B. H., & Thayer, J. F. (2003). Vagal influence on working memory and attention. *International Journal of Psychophysiology, 48*(3), 263-274.

Harris, D. A. (2009). The paradox of expressing speechless terror: Ritual liminality in the creative arts therapies' treatment of posttraumatic distress. *The Arts in Psychotherapy*, *36*(2), 94-104.

Hastings, P. D., Nuselovici, J. N., Utendale, W. T., Coutya, J., McShane, K. E., & Sullivan, C. (2008). Applying the polyvagal theory to children's emotion regulation: Social context, socialisation, and adjustment. *Biological Psychology*, *79*, 299-306.

Hawley, P. H., & Little, T. D. (2003). Modelling intraindividual variability and change in bio-behavioural developmental processes. In B. Pugesek & A. A. Tomer (Eds.), *Structural equations modelling: Applications in ecological and evolutionary biology research* (pp. 143-170). Cambridge University Press.

Hazan, C., Campa, M., & Gur-Yaish, N. (2006). What is adult attachment? In M. Mikulincer & G. S. Goodman (Eds.), *Dynamics of romantic love: Attachment, caregiving, and sex* (pp. 47-70). New York, NY: Guildford Press.

Heilman, K. J., Connolly, S. D. Padilla, W. O. Wrzosek, M. I., Graczyk, P. A. & Porges, S.W. (2012). Sluggish vagal brake reactivity to physical exercise challenge in children with selective mutism. *Development and Psychopathology*, *24*, 241-250.

Heim, C., Newport, D. J., Mletzko, T., Miller, A., & Nemeroff, C. (2008). The link between childhood trauma and depression: Insights from HPA axis studies in humans. *Psychoneuroendocrinology*, *33*(6), 693-710.

Heller, L. & LaPierre, A. (2012). *Healing Developmental Trauma*. California: North Atlantic Books.

Helm, J. L., Sbarra, D. A., & Ferrer, E. (2014). Coregulation of respiratory sinus arrhythmia in adult romantic partners. *Emotion, 14*(3), 522-531.

Hill-Soderlund, A. L., Mills-Koonce, W. R., Propper, C., Calkins, S. D., Granger, D. A., Moore, G. A., Gariepy, J. L., & Cox, M. J. (2008). Parasympathetic and sympathetic responses to the strange situation in infants and mothers from avoidant and securely attached dyads. *Developmental Psychobiology, 59*(4), 361-376.

Hinnant, B., & El-Sheikh, M. (2009). Children’s externalising and internalising symptoms over time: The role of individual differences in patterns of RSA responding. *Journal of Abnormal Child Psychology, 37*(8), 1049-1061.

Hodges, J., Steele, M., Hillman, S., Henderson, K., & Kaniuk, J. (2003). Changes in attachment representations over the first year of adoptive placement: Narratives of maltreated children. *Clinical Child Psychology and Psychiatry*, *8*(3), 351-367.

Hofer, M. A. (1994). Early relationships as regulators of infant physiology and behaviour. *Acta Paediatricia, 397*(Suppl.), 9-18.

Holt-Lunstad, J., Uchino, B. N., Smith, T. W., & Hicks, A. (2007). On the importance of relationship quality: The impact of ambivalence in friendships on cardiovascular functioning. *Annals of Behavioural Medicine*, *33*(3), 278-194.

Holt-Lunstad, J., Birmingham, W. A., & Light, K. C. (2008). Influence of a "warm touch" support enhancement intervention among married couples on ambulatory blood pressure, oxytocin, alpha amylase, and cortisol. *Psychosomatic Medicine*, *70*(9), 976-985.

Hong, R. & Mason, M. (2016). Becoming a neurobiologically-informed play therapist. *International Journal of Play Therapy*, *25*(1), 35-44.

Horsten, M., Ericson, M., Perski, A., Wamala, S. P., Schenek-Gustafsson, K., & Orth-Gomer, K. (1999). Psychosocial factors in heart rate variability in healthy women. *Psychosomatic Medicine, 61*(1), 49-57.

Houtveen, J. H., Groot, P. F., De Geus, E. J. (2005). Effects of variation in posture and respiration on RSA and pre-ejection period. *Psychophysiology*, *42*(6),713-719.

Houtveen, J. H., Rietveld, S., Geus, E. J. (2002). Contribution of tonic vagal modulation of heart rate, central respiratory drive, respiratory depth, and respiratory frequency to respiratory sinus arrhythmia during mental stress and physical exercise. *Psychophysiology, 39*, 427-436.

Huffman, L. C., Bryan, Y. E., del Carmen, R., Pedersen, F. A., Doussard-Roosevelt, J. A., & Porges, S.W. (1998). Infant temperament and cardiac vagal tone: Assessments at twelve weeks of age. *Child Development, 69,* 624-635.

Hughes, A. E., Crowell, S. E., Vyeji, L. L., & Coan, J. (2012). A developmental neuroscience of borderline pathology: Emotion dysregulation and social baseline theory. *Journal Abnormal Child Psychology, 40,* 21-33.

Ingjaldsson, J. T., Laberg, J. C., & Thayer, J. F. (2003). Reduced heart rate variability in chronic alcohol abuse: relationship with negative mood, chronic thought suppression and compulsive drinking. *Biological Psychiatry, 54*(12), 1427-1436.

Izard, C. E., Porges, S. W., Simons, R. F., Parisi, M., Haynes, O. M., & Cohen, B. (1991). Infant cardiac activity: Developmental changes and relations with attachment. *Developmental Psychology, 27*, 432-439.

James, B. (1989). *Treating traumatised children: New insights and creative interventions*. Lexington, MA: Lexington Books.

James, J. E. (1994). Heath care, psychology, and the scientist-practitioner model. *Australian Psychologist*, *29*, 5-11.

Jansen, H. T., & Dellinger, J. A. (1988). Effects of atropine on respiratory sinus arrhythmia (RSA) in the rhesus macaque. *Neurotoxicology and Teratology, 10*(2), 169-174.

Jennings, J. R., Kamarck, T., Eddy, M., & Johnson, P. (1992). Alternate cardiovascular baseline assessment techniques: Vanilla or resting baseline. *Psychophysiology, 29*(6), 742-750.

Jones, E. E. (1993). Introduction to special section: Single-case research in psychology. *Journal of Consulting and Clinical Psychology, 61,* 371-372.

Jones, C. J. & Nesselroade, J. R. (1990). Multivariate, replicated, single-subject, repeated measures designs and p-technique factor analysis: A rewire of intra-individual change studies. *Experimental Aging Research*, *16*(4), 171-183.

Jutte, S., Bentley, H., Tallis, D., Mayes, J., Jetha N., O'Hagan, O., Brooks, H., & McConnell, N. (2015). *How safe are our children? The most comprehensive overview of child protection in the UK*. London: NSPCC.

Kaplow, J. B., Saxe, G., Putnam, F., Pynoos, R., & Lieberman, A. (2006). The long-term consequences of early childhood trauma: A case study and discussion. *Psychiatry, 69*, 362-375.

Katz, L. F. (2001). Living in a hostile world: Toward an integrated model of family, peer and physiological processes in aggressive pre-schoolers. In Kerns, K. A., Contreras, J., & Neal-Barnett, A. M. (Eds.). *Linking two social worlds: Family and* *peers* (pp.115-136). Westport, CT: Praeger Publishers.

Katz, L. F. (2007) Domestic violence and vagal reactivity to peer provocation. *Biological Psychology*, *74*, 154-164.

Kazdin, A. E. (1982). *Single-case research designs: Methods for clinical and applied settings*. Oxford: Oxford University Press.

Kazdin, A. E. (1993). Adolescent mental health. *American Psychologist*, *48*, 127-141.

Kazdin, A. E. (2009). Understanding how and why psychotherapy leads to change. *Psychotherapy Research*, *19,* 418-428.

Kempes, M., Matthys, W., de Vries, H., & van Engeland, H. (2005). Reactive and proactive aggression in children. A review of theory, findings and the relevance for child and adolescent psychiatry. *European Child and Adolescent Psychiatry*, *14* (1), 11-19.

Kendler, K. S., Bulik, C. M., Silberg, J., Hettema, J. M., Myers, J., & Prescott, C. A. (2000). Childhood sexual abuse and adult psychiatric and substance use disorders in women: An epidemiological and cotwin control analysis. *Archives of General Psychiatry*, *57*(10), 953-959.

Kestly, T. A. (2014). *The interpersonal neurobiology of play: Brain-building interventions for emotional well-being*. New York, NY: W. W. Norton & Company, Inc.

Kestly, T. A. (2016). Presence and play: Why mindfulness matters. *International Journal of Play Therapy*, *25*(1), 14-23.

Kestly, T. (2017). Play therapy through the lens of interpersonal neurobiology: Up and over the mountain. In C. A. Malchiodi & D. A. Crenshaw, *What to when children clam up in psychotherapy: Interventions to facilitate communication* (pp. 137-155). New York, NY: The Guilford Press.

Khan, R. (1963). The concept of cumulative trauma. *The Psychoanalytic Study of the Child*, *18*(1), 286-306.

Kibler, J. L., Prosser, V. L., & Ma, M. (2004). Cardiovascular correlates of misconduct in children and adolescents. *Journal of Psychophysiology*, *18*(4), 184-189.

Kleinbub, J. R., Messina, I., Bordin, D., & Palmieri, A. (2012). Synchronisation of skin conductance levels in therapeutic dyads. *International Journal of Psychophysiology*, *86*(3), 383-383.

Kleinbub, J. R. (2017). State of the art of interpersonal physiology in psychotherapy: A systematic review. *Frontiers in Psychology*, *8*, 2053.

Kok, B. E., & Fredrickson, B. L. (2010). Corrigendum to "Upward spirals of the heart: Autonomic flexibility, as indexed by vagal tone, reciprocally and prospectively predicts positive emotions and social connectedness." *Biological Psychology*, *85*(3), 432-436.

Koss, M.P., & Marks, J.S. (1998). Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. *American Journal of Preventative Medicine*, *14*(4), 245-258.

Kot, S., Landreth, G. L., & Giordano, M. (1998). Intensive child-centred play therapy with child witnesses of domestic violence. *International Journal of Play Therapy, 7*(2), 17-36.

Kotch, J. B., Lewis, T., Hussey, J.M., English, D., Thompson, R., Litronwnik, A.J., et al. (2008). Importance of early neglect for childhood aggression. *Paediatrics*, *121*, 14-180.

Kowalewski, M. N., & Urban, M. (2004). Short- and long-term reproducibility of autonomic measures in supine and standing positions. *Clinical Science, 106*, 61-66.

Laborde, S., Mosley, E., & Thayer, J. (2017). Heart rate variability and cardiac vagal tone in psychophysiological research: Recommendations for experiment planning, data analysis, and data reporting. *Frontiers in Psychology, 8*, 213-230.

Lacey, B. C., & Lacey, J. I (1974). Studies of heart rate and other bodily processes in sensorimotor behaviour. In P. A. Obrist, A. H. Black, J. Brenener, & L. V. DiCara (Eds.), *Cardiovascular psychophysiology: Current issues in response mechanisms, biofeedback and methodology* (pp. 538-564). New Brunswick: Aldine Transaction.

Lambert, M. J., & Barley, D. E. (2001). Research summary on the therapeutic relationship and psychotherapy outcome. *Psychotherapy: Theory, Research, Practice, Training*, *38*, 357-361.

Landreth, G. L. (2002). *Play Therapy: The Art of the Relationship* (2nd Ed.). New York, NY: Brunner-Routledge.

Lang, P. J., & Bradley, M. M. (2010). Emotion and the motivational brain. *Biological Psychology, 84*(3), 437-450.

LeBlanc, M., & Ritchie, M. (2001). A meta-analysis of play therapy outcomes. *Counselling Psychology Quarterly*, *14*, 149-163.

LeDoux, J. (1998). *The Emotional Brain*. New York, NY: Simon & Schuster.

Leicht, A. S., & Allen, G. D. (2008). Moderate-term reproducibility of heart rate variability during rest and light to moderate exercise in children. *Brazilian Journal of Medical and Biological Research, 41*(7), 627-633.

LePore, S. J. Silver, R. C., Wortman, C. B., & Wayment, H. A. (1996). Social constraints, intrusive thoughts, and depressive symptoms among bereaved mothers. *Journal of Personality and Social Psychology*, *70*, 271-282.

Levenson, R. W., & Gottman, J. M. (1983). Marital interaction: Physiological linkage and affective exchange. *Journal of Personality and Social Psychology, 45*(3), 587-597.

Levenson, R. W., & Ruef, A. M. (1992). Empathy: A physiological substrate. *Journal of Personality and Social Psychology, 63*(2), 234-246.

Levine, P. A. (1997). *Waking the Tiger. Healing Trauma*. Berkley, California: North Atlantic Books.

Levine, P.A. & Kline, M. (2007). *Trauma Through a Child's Eyes*. Berkeley, California: North Atlantic Books.

Liew, J., Eisenberg, N., Spinrad, T. J., Eggum, N. D., Haugen, R., Kupfer, A…Baham, M. E., (2011). Physiological regulation and fearfulness as predictors of young children's empathy-related reactions. *Social Development*, *20*, 111-143.

Light, K., Kothandapani, R., & Allen, M. (1998). Enhanced cardiovascular and catecholamine responses in women with depressive symptoms. *International Journal of Psychophysiology, 28*(2), 157-166.

Ligiero, D. P., & Gelso, C. (2002). Countertransference, attachment, and the working alliance: The therapist's contribution. *Psychotherapy: Theory, Research, Practice, Training*, *39,* 3-11.

Liotti, G. (2004). Trauma, dissociation, and disorganised attachment: Three strands of a single braid. *Psychotherapy: Theory, Research, and Practice*, *41*(4), 472-486.

Liotti, G. (2011) Attachment disorganisation and the controlling strategies: An illustration of the contributions of attachment theory to developmental psychopathology and to psychotherapy integration. *Journal of Psychotherapy Integration*, *21* (3), 232-252.

Liotti, G., & Gilbert, P. (2011). Mentalising, motivation, and social mentalities:

Theoretical considerations and implications for psychotherapy. *Psychology and Psychotherapy: Theory, Research and Practice, 84,* 9-25.

Little, T. D., Slegers, D. W., & Card, N. A. (2006). A non-arbitrary method of identifying and scaling latent variables in SEM and MACS models. *Structural Equation Modeling a Multidisciplinary Journal, 13*(1)*,* 59-72.

Lougheed, J. P., Hollenstein, T., & Lewis, M. D. (2016). Maternal regulation of daughters' emotion during conflicts from early to mid-adolescence. *Journal of Research on Adolescence, 26*(3), 610-616.

Lunkenheimer, E., Tiberio, S. S., Buss, K. A., Lucas-Thompson, R. G., Boker, S. M., & Timpe, Z. C. (2015). Coregulation or respiratory sinus arrhythmia between parents and pre-schoolers: Differences by children's externalising problems. *Developmental Psychobiology*, *57*(8), 994-1003.

Lynch, M. (2000). The role of the body as the medium in child psychotherapy: snapshots of therapy with an 11-year-old, severely abused, multiply placed girl. *Journal of Psychotherapy, 26* (2), 159-181.

Main, M., Kaplan, N., & Cassidy, J. (1985). Security in infancy, childhood, and adulthood: A move to the level of representation. *Monographs of the Society for Research in Child Development, 50, 66-104.*

Main, M., & Solomon, J. (1986). Discovery of an insecure-disorganised/disoriented attachment pattern. In T.B. Brazelton & M.W. Yogman (Eds.), *Affective Development in Infancy* (pp. 95-124). Westport, CT: Ablex Publishing.

Malchiodi, C. A. (2008). Creative interventions and childhood trauma. In C. A. Malchiodi (Ed.), *Creative interventions with Traumatised Children* (pp. 3-22). New York, NY: The Guilford Press.

Manuck, S. B., Kaspowicz, A. L., & Muldoon, M. F. (1990). Behaviourally-evoked cardiovascular reactivity and hypertension: Conceptual issues and potential associations. *Annals of Behavioural Medicine*, *12*(1), 17-29.

Marci, C. D., Ham, J., Moran, E., & Orr, S. P. (2007). Physiologic correlates of perceived therapist empathy and social-emotional process during psychotherapy. *The Journal of Nervous and Mental Disease, 195*(2), 103-111.

Marci, C. D., & Orr, S. P. (2006). The effect of emotional distance on psychophysiologic concordance and perceived empathy between patient and interviewer. *Applied Psychophysiology and Biofeedback*, *31*, 115-128.

Marci, C., & Riess, H. (2005). The clinical relevance of psychophysiology: Support for the psychobiology of empathy and psychodynamic process. *American Journal of Psychotherapy*, *59*(3), 213-226.

Markese, S. (2007). Taping together broken bones: Treatment of the trauma of infant abuse. *Journal of Infant, Child and Adolescent Psychotherapy*, *6*(4), 309-326.

Marmarosh, C. L., Kivlighan, D. M., Bieri, K., La Fauci Schutt, J. M., Barone, C., & Choi, J. (2014). The insecure psychotherapy base: Using client and therapist attachment styles to understand early alliance. *Psychotherapy*, *51*(3), 404-412.

Matsunaga, M., Isowa, T., Kimura, K., Miuakoshi, M., Kanayama, N., Murakami, H.,…Ohira, H. (2009). Associations among positive mood, brain, and cardiovascular activities in an affectively positive situation. *Brain Research*, *1263*, 93-103.

McAssey, M. P., Helm, J., Hsiech, F., Sbarra, D., & Ferrer, E. (2013). Methodological advances for detecting physiological synchrony during dyadic interactions. *Methodology, 9*, 41-53.

McCraty, R., Atkinson, M., Tiller, W. A., Rein, G., & Watkins, A. D. (1995). The effects of emotions on short-term power spectrum analysis of heart rate variability. *The American Journal of Cardiology*, *76*(14), 1089-1093.

McCraty, R., Barrios-Choplin, B., Rozman, D., Atkinson, M., & Watkins, A. D. (1998). The impact of a new emotional self-management program on stress, emotions, heart rate variability, DHEA and cortisol. *Integrative Physiological and Behavioural Science, 33*(2), 151-170.

McLaughlin, K. A., Rith-Najarian, L., Dirks, M. A., & Sheridan, M. A. (2015). Low vagal tone magnifies the association between psychosocial stress exposure and internalising psychopathology in adolescents. *Journal of Clinical Child and Adolescent Psychopathology: The Official Journal for the Society of Clinical Child and Adolescent Psychology, American Psychological Association, Division 53, 44*(2), 314-328.

McLauglin, K. A., Sheridan, M. A., Tibu, R., Fox, N. A., Zeanah, C. H., & Nelson, C. A. (2015). Causal effects of the early caregiving environment on development of stress response systems in children. *Proceedings of the National Academy of Sciences*, *112*(18), 5637-5642.

McNeil, C. B., Capage, L. C., Bahl, A., & Blanc, H. (1999). Importance of early intervention for disruptive behaviour problems: Comparisons of treatment and wait-list control groups. *Early Education and Development*, *10,* 445-454.

Mearnes, R. (2005). *The Metaphor of Play. Original Breakdown of Personal Being* (3rd Ed.). London: Rutledge.

Messina, I., Sambin, M., Palmieri, A., & Viviani, R. (2013). Neural correlates of psychotherapy in anxiety and depression: A meta-analysis. *PLoS ONE 8*(9): e74657.

Michels, N., Clays, E., De Buyzere, M., Huybrechts, I., Marild, S., Vanaelst, B., De Henauw, S., & Sioen, I. (2013). Determinants and reference values of short-term heart rate variability in children. *European Journal of Applied Physiology, 113*(6), 1477-1488.

Mikulincer, M. & Shaver, P. R. (2005). Attachment theory and emotions in close relationships: Exploring the attachment-related dynamics of emotional reactions to relational events. *Personal Relationships*, *12,* 149-168.

Miller, J. G., Chocol, C., Nuselovici, J. N., Utendale, W. T., Simard, M., & Hastings, P. D. (2013). Children's dynamic RSA change during anger and its relations with parenting, temperament, and control of aggression. *Biological Psychology, 92*, 417-425.

Mohr, J. J., Gelso, C. J., & Hill, C. E. (2005). Client and counsellor trainee attachment as predictors of session evaluation and countertransference behaviour in first counselling session. *Journal of Counselling Psychology, 52*, 298-309.

Molenaar, P. C. M. (1985). A dynamic factor model for the analysis of multivariate time series. *Psychometrika, 59*(2), 181-202.

Moore, G. A., & Calkins, S. D. (2004). Infants' vagal regulation in the still-face paradigm is related to dyadic coordination of mother-infant interaction. *Developmental Science, 40*(6), 1068-1080.

Moore, G. A., Hill-Soderlund, A. L., Propper, C. B., Calkins, S. D., Mills-Koonce, W. R., & Cox, M. J. (2009). Mother-infant vagal regulation in the Face-to-Face Still-Face Paradigm is moderated by maternal sensitivity. *Child Development, 80*(1), 209-223.

Morgan, W. D., & Morgan, S. T. (2005). Cultivating attention and empathy. In C. K. Germer, R. D. Siegel and P. R. Fulton (Eds.) *Mindfulness and Psychotherapy* (pp.73-79). New York, NY: Guildford Press.

Moustakas, C. E. (1955). Emotional adjustment and the play therapy process. *Journal of Genetic Psychology*, *86*(1), 79-99.

Muraven, M., & Baumesiter, R. F. (2000). Self-regulation and depletion of limited resources: Does self-control resemble a muscle? *Psychological Bulletin, 126*(2), 247-259.

Music, G. (2011). *Nurturing Natures. Attachment and Children's Emotional, Sociocultural and Brain Development*. Hove & New York: Psychology Press.

Musser , E. B., Backs, R. W., Schmitt, C. F., Ablow, J. C., Measelle, J. R., & Nigg, J.T. (2011). Emotion regulation via the autonomic nervous system in children with attention-deficit/ hyperactivity disorder (ADHD). *Journal of Abnormal Child Psychology, 39*(6), 841-852.

Nelson, T. D., Aylward, B. S., & Rausch, J. R. (2011). Dynamic p-technique for modelling patterns of data: applications to paediatric psychology research. *Journal Paediatric Psychology, 36*(9), 959-968.

Norton, B., Ferriegel, M., & Norton, C. (2011). Somatic expressions of trauma in experiential play therapy. *International Journal of Play Therapy*, *20*(3), 138-152.

NSPCC (2016). *It's time: Campaign report*. London: NSPCC

Obradovic, J., Bush, N. R., Stamperdahl, J., Adler, N. E., & Boyce, W. T. (2010). Biological sensitivity to context: The interactive effects of stress reactivity and family adversity on socioemotional behaviour and school readiness. *Child Development*, *81*(1), 270-289.

Obradovic, J., Bush, N., & Boyce, W. (2011). The interactive effect of marital conflict and stress reactivity on externalising and internalising symptoms: The role of laboratory stressors. *Development and Psychopathology*, *23*(1), 101-114.

Ogawa, Y. (2004). Childhood trauma and play therapy intervention for traumatised children. *Journal of Professional Counselling: Practice, Theory & Research*, *32* (1), 19-29.

Ogden, P., Minton, K., & Pain, C. (2006). *Trauma and the Body: A Sensorimotor Approach to Psychotherapy*. New York, NY: W. W. Norton & Company.

Oppenheimer, J. E., Measelle, J. R., Laurent, H. K., & Ablow, J. C. (2013). Mothers' vagal regulation during the Still-Face Paradigm: Normative reactivity and impact of depression symptoms. *Infant Behaviour and Development, 26*(2), 255-267.

Osofsky, J. (Ed.) (2004). *Young Children and Trauma*. New York, NY: Guildford Press.

Panksepp, J. (1998). *Affective neuroscience: The foundations of human and animal emotions*. New York, NY: Oxford University Press.

Panksepp, J. (2003). At the interface of the affective, behavioural, and cognitive neurosciences: Decoding the emotional feelings of the brain. *Brain and Cognition*, *52*, 4-14.

Panksepp, J. (2007). Can PLAY diminish ADHD and facilitate the construction of the social brain? *Journal of the Canadian Academy of Child and Adolescent Psychiatry, 10*, 57-66.

Panksepp, J., & Biven, L. (2012). *The Archaeology of the Mind. Neuroevolutionary Origins of Human Emotions*. New York, NY: W. W. Norton & Company, Inc.

Pankseep, J., & Scott, E. (2012). Reflections on rough and tumble play, social development, and attention-deficit disorders (ADHD). In A. L. Myer and T. P. Gullotta (Eds.), *Physical Activity Across the Lifespan, Issues in Children's and Families' Lives*. New York, NY: Springer.

Pankseep, J., Siviy, S. M., & Normansell, L. (1984). The psychobiology of play: theoretical and methodological perspectives. *Neuroscience Biobehavioural Reviews*, *8*(4), 465-492.

Papousek, M. (2007). Communication in early infancy: AN arena of intersubjective learning. *Infant Behaviour and Development*, *30*, 258-266.

Park, G., Vasey, M., Van Bavel, J., & Thayer, J. (2014). When tonic cardiac vagal tone predicts changes in phasic vagal tone: The role of fear and perceptual load. *Psychophysiology*, *51*(5), 419-426.

Patwardhan, A., Evans, J., Bruce, E., & Knapp, C. (2001). Toward understanding respiratory sinus arrhythmia: relations to cardiac vagal tone, evolution and biobehavioural functions. *Interactive Physiological and Behavioural Science. 36*(2), 109-120.

Pawan, C., Chow, S. M., & Li, I. (2013). Saliva cortisol and heart rate variability as biomarkers in understanding emotional reaction and regulation of young children. A review. *Psychology*, *4*(6), 19–26.

Pellis, S. M., & Pellis, V. C. (2009). *The Playful Brain: Venturing to the Limits of Neursocience*. London: Oneworld Publications.

Perry, B. D., Pollard, R. A., Blackley, T. L., Baker, W. L., & Vigilante, D. (1995). Childhood trauma, the neurobiology of adaptation and "use-dependent" development of the brain: How "states" become "traits." *Infant Journal of Mental Health*, *16*(4), 271-291.

Perry, B. (2006). Applying principals of neurodevelopment to clinical work with maltreated and traumatized children. In Webb, N.B., (Ed.), *Working with Traumatized Children in Child Welfare.* New York, NY: Guilford Press.

Perry, B. (2009). Examining child maltreatment through a neurodevelopmental lens: Clinical applications of the Neurosequential Model of Therapeutics. *Journal of Loss and Trauma*, *14*, 240-255.

Perry, B. D., & Szalavitz, M. (2010). *Born for Love: Why Empathy is Essential and Endangered.* New York, NY: HarperCollins Publishers.

Phillips, R. D. (1985). Whistling in the dark? A review of play therapy research. *Psychotherapy*, *22*(4), 752-760.

Phillips, R. D. (2010). How firm is our foundation? Current play therapy research. *International Journal of Play Therapy*, *18*(1), 13-25.

Piaget, J. (1962). *Play, Dreams, and Imitation in Childhood*. New York, NY: Norton and Company, Inc.

Pinna, G., Maestri, R., Torunski, A., Danilowicz-Szymanowicz, L., Szwoch, D., La Rovere, M. T., & Raczak, G. (2007). Heart rate variability measures: A fresh look at reliability. *Clinical Science, 113*(3), 131-140.

Pitzalis, M. V., Mastropasqua, F., Massari, F., Forleo, C., Di Maggio, M., Passantino, A., et al. (1996). Short- and long-term reproducibility of time and frequency domain heart rate variability measurements in normal subjects. *Cardiovascular Research, 32*(2), 226-233.

Porges, S. W. (1985). *Method and apparatus for evaluation rhythmic oscillations in aperiodic physiological response systems*. Patent Number: 4,510,944. Washington DC: U.S. Patent Office. April 16, 1985.

Porges, S. W. (1995). Cardiac vagal tone: A physiological index of stress. *Neuroscience and Biobehavioural Reviews, 19*, 225-233.

Porges, S. W. (1996). Physiological regulation in high-risk infants: A model for assessment and potential intervention. *Development and Psychopathology*, *8*, 43-58.

Porges, S. W. (2001). The Polyvagal Theory: Phylogenetic substrates of a social nervous system. *International Journal of Psychophysiology*, *42*, 123-146.

Porges, S. W (2007). The Polyvagal perspective. *Biological Psychology*, *74*, 116-143.

Porges, S. W. (2011). *The Polyvagal Theory: Neurophysiological Foundations of Emotions, Attachment, Communication, Self-regulation*. New York, NY: W.W. Norton & Company.

Porges, S. W. (2015). Making the world safe for our children: Down-regulating defence and up-regulating social engagement to 'optimise' the human experience. *Children Australia, 40* (2), 114-123.

Porges, S. W. (2017). *The Pocket Guide to the Polyvagal Theory: The transformative power of feeling safe*. New York, NY: W.W. Norton & Company.

Porges, S. W., & Bohrer, R. E. (1990). Analysese of periodic processes in psychophysiological research. In J. T. Cacioppo and L. G. Tassinary (Eds.). *Principles of Psychophysiology: Physical, Social and Inferential Elements*. New York, NY: Cambridge University Press, 708-753.

Porges, S. W., Doussard-Roosevelt, J. A., Portales, A. L., & Greenspan, S. I. (1996). Infant regulation of the vagal "brake" predicts child behaviour problems: A psychobiological model of social behaviour. *Developmental Psychobiology*, *29,* 697-712.

Porter, C. L., Wouden-Miller, M., Silva, S. S. (2003). Marital harmony and conflict linked to infants' emotional regulation and cardiac vagal tone. *Infancy*, *4,* 297-307.

Quintana, D. S., & Heathers, J. A. J. (2014). Considerations in the assessment of heart rate variability in biobehavioural research. *Frontiers in Psychology, 5,* 805.

Rainville, P., Bechara, A., Naqvi, N., & Damasio, A. R. (2006). Basic emotions are associated with distinct patterns of cardiorespiratory activity. *International Journal of Psychophysiology, 61,* 5-18.

Ray, D., Bratton, S., Rhine, T., & Jones, L. (2001). The effectiveness of play therapy:

Responding to the critics. *International Journal of Play Therapy*, *10*, 85-108.

Ray, D. (2004). Supervision of basic and advanced skills in play therapy. *Journal of Professional Counseling: Practice, Theory and Research*, *32*(2), 28-41.

Read, J., Perry, B. D., Moskowitz, A., & Connolly, J. (2001). The contribution of early traumatic events to schizophrenia in some patients: A traumagenic neurodevelopmental model. *Psychiatry*, *64*(4), 319-145.

Reddy, L. A., Files-Hall, T. M., & Schaefer, C. E. (Eds.). (2005) *Empirically based play interventions for children*. Washington, DC: American Psychological Association.

Reddy, L. A., Spencer, P., Hall, T. M., & Rubel, E. (2001). Use of developmentally appropriate games in a child group training program for young children with attention-deficit/ hyperactivity disorder. In A. A. Drews., L. J. Carey, & C. E. Scaefer (Eds.). *School-based Play Therapy* (pp. 256-274). New York, NY: Wiley.

Ribeiro, E., Ribeiro, A. P. Goncalves, M. M., Horvath, A. O., & Stiles, W. B. (2012). How collaboration in therapy becomes therapeutic: The therapeutic collaboration coding system. *Psychology and Psychotherapy: Theory, Research and Practice*, *86*, 294-314.

Robson, C. (1993). *Real World Research: a Resource for Social Scientists and Practitioner-Researchers*. Oxford: Blackwell.

Rogers, C. R. (1951). *Client-centred Therapy*. Boston: Houghton Mifflin.

Rogers, C. R. (1955). Personality changes in psychotherapy. *International Journal of Social Psychiatry*, *1*(1), 31-41.

Rogers, C. R. (1980). *A Way of Being.* Boston: Houghton Mifflin.

Romano, V., Fitzpatrick, M., & Janzen, J. (2008). The secure-base hypothesis: Global attachment to counsellor, and session exploration in psychotherapy. *Journal of Counselling Psychology*, *55*, 495-504.

Rothschild, B. (2000). *The Body Remembers: The Psychophysiology of Trauma and Trauma Treatment*. New York, NY: W.W. Norton & Company.

Rottenberg, J., Salomon, K., Gross, J., & Gotlib, I. (2005). Vagal withdrawal to a sad film predicts subsequent recovery from depression. *Psychophysiology*, *42*(3), 277-281.

Rottenberg, J., Ray, R. D., & Gross, J. J. (2007). Emotion elicitation using films. In J. A. Coan & J. J. B. Allen (Eds.), *The Handbook of Emotion Elicitation and Assessment* (pp. 9-28). London: Oxford University Press.

Rubino, G., Barker, C., Roth, T., & Fearon, P. (2000). Therapist empathy and depth of interpretation in response to potential alliance ruptures: The role of therapist and patient attachment styles. *Psychotherapy Research*, *10*, 408-420.

Ruff, H. A., & Rothbart, M. K. (1996). *Attention in Early Development: Themes and Variations.* New York, NY: Oxford University Press.

Russ, S. W. (1995). Play psychotherapy research: State of the science. In T. H. Ollendick & R. J. Prinz (Eds.). *Advances in Clinical Child Psychology*. Plenum Press, New York.

Russ, S. A. & Fehr, K. K. (2016). Use of pretend play to overcome anxiety in school-age children. In Drewes, A. A. & Schaefer, C. E. (Eds.). *Play Therapy in Middle Childhood.* Washington, DC: American Psychological Association.

Russ, S. A., (2004). *Play in child development and psychotherapy. Toward empirically supported practice*. New Jersey: Lawrence Erlbaum Associates, Publishers.

Russell, R. L. (1995). Multivariate psychotherapy process research: Structure and change in the talking cure. *Journal of Consulting and Clinical Psychology*, *63,* 3-5.

Russell, R. L., Jones, M. E. & Miller, S. A. (2007). Core process components in psychotherapy: A synthetic review of P-technique studies. *Psychotherapy Research*, *17*(3), 271-288.

Ryan, V., & Edge, A. (2011). The role of play themes in non-directive play therapy. *Clinical Child Psychology and Psychiatry*, *17*(3), 354-369.

Salomon, K. (2005). Respiratory sinus arrhythmia during stress predicts resting respiratory sinus arrhythmia 3 years later in a pediatric sample. *Health Psychology*, *24*(1), 68-76.

Sauer, E. M. Lopez, F. G. & Gromley, B. (2003). Respective contributions of therapist and client adult attachment orientations to the development of the early working alliance: A preliminary growth modelling study. *Psychotherapy Research*, *13*, 371-382.

Sbarra, D. A., & Hazan, C. (2008). Coregulation, self-regulation: An integrative analysis and empirical agenda for understanding adult attachment, separation, loss and recovery. *Personality and Social Science Review, 12*(2), 141-167.

Scaer, R. (2001). The neurophysiology of dissociation and chronic disease. *Applied Psychophysiological Feedback*, *26*(1), 73-91.

Scaer, R. (2005). *The Trauma Spectrum: Hidden Wounds and Human Resiliency*. New York, NY: W. W. Norton & Norton & Company, Inc.

Scaer, R. (2014). *The Body Bears the Burden: Trauma, Dissociation and Disease* (3rd Ed.). New York, NY: Routledge.

Schaefer, C. E. & Drewes, A. A. (2014). *The Therapeutic Power of Play: 20 Core Agents of Change* (2nd Ed.). New Jersey: John Wiley and Sons.

Scheeringa, M. S., Zeanah, C. H., Myers, L., & Putnam, F. (2004). Heart period and variability findings in preschool children with posttraumatic stress symptoms. *Biological Psychiatry*, *55*(7), 685-691.

Schore, A. N. (1994). *Affect Regulation and the Origins of the Self: The Neurobiology of Emotional Development*. Hillsdale, NJ: Erlbaum.

Schore, A. N. (2001). Effects of a secure attachment relationship on right brain development, affect regulation, and infant mental health. *Infant Mental Health Journal*, *22*(1-2), 7-66.

Schore, A. N. (2003). *Affect Dysregulation and Disorders of the Self*. New York, NY: W. W. Norton and Company, Inc.

Schore, A. N. (2012). *The Science and Art of Psychotherapy*. New York, NY: W. W. Norton and Company, Inc.

Schore, J. R. & Schore, A. N. (2008). Modern attachment theory: The central role of affect regulation in development and treatment. *Clinical Social Work Journal*, *36*, 9-20.

Schottelkorb, A. A., Swan, K. L., Jahn, L., Haas, S., & Hacker, J. (2015). Effectiveness of play therapy on problematic behaviours of preschool children with somatization. *Journal of Child and Adolescent Counseling, 1*(1), 3-16.

Schuengel, C., Oosterman, M., & Sterkenburg, P. S. (2009). Children with disrupted attachment histories: Interventions and psychophysiological indices of effects. *Child and Adolescent Psychiatry and Mental Health, 3*(1), 1-26.

Schwerdtfeger, A., & Friedrich-Mai, P. (2009). Social interaction moderates the relationship between depressive mood and heart rate variability: evidence from an ambulatory monitoring study. *Health Psychology, 28*(4), 501-509.

Segerstrom, S., & Nes, L. (2007). Heart rate variability reflects self-regulatory strength, effort, and fatigue. *Psychological Science, 18*(3), 275-281.

Seikkula, J., Karvonen, A., Kykyri, V., Kaartinen, J., & Penttonen, M. (2015). The embodied attunement of therapists and a couple with dialogical psychotherapy: An introduction to the relational mind research project. *Family Process, 54*(4), 703-715.

Seppala, E., Rossomando, T., & Doty, J. (2013). Social connection and compassion: Important predictors of health and well-being. *Social Research, 80*(2), 411-430.

Seppala, S., Laitinen, T., Tarvainen, M. P., Tompuri, T., Veijalainen, A., Savonen, K., & Lakka, T. (2014). Normal values for heart rate variability parameters in children 6-8 years of age: the PANIC study. *Clinical Physiology and Functional Imaging, 34*(4), 290-296.

Shaffer, F., McCraty, & R., Zerr, C. L. (2014). A healthy heart is not a metronome: an integrative review of the heart's anatomy and heart rate variability. *Frontiers in Psychology, 5*, 1040.

Shahrestani, S., Stewart, E. M., Quintana, D. S., Hickie, I. B., & Guastella, A. J. (2014). Heart rate variability during social interactions in children with and without psychopathology: A meta-analysis. *Journal of Child Psychology and Psychiatry*, *55*(9), 981-989.

Shahrestani, S., Stewart, E. M., Quintana, D. S., Hickie, I. B., & Guastella, A. J. (2015). Heart rate variability during adolescent and adult social interactions: A meta-analysis. *Biological Psychology, 105*, 43-50.

Shaver, P., & Mikulincer, M. (2007). Boosting attachment security to promote mental health, prosocial values, and inter-group tolerance. *Psychological Inquiry*, *18*(3), 139-156.

Shelby, J. S., & Felix, E. D. (2005). Posttraumatic Play Therapy: The Need for an Integrated Model of Directive and Nondirective Approaches. In L. A. Reddy, T. M. Files-Hall, & C. E. Schaefer (Eds.), *Empirically based play interventions for children* (pp. 79-103). Washington, DC, US: American Psychological Association.

Shirk, S. R., Karver, M. S., & Brown, R. (2011). The alliance in youth psychotherapy. *Psychotherapy, 48*(1), 17-24.

Shirk, S. R., & Russell, R. L. (1996). *Change Processes in Child Psychotherapy: Revitalising Treatment and Research*. New York, NY: Guildford Press.

Shonkoff, J. P., & Garner, A. S. (2012). The lifelong effects of early childhood adversity and toxic stress. *Paediatrics*, *129*(1), 232-246.

Siegel, D. (1999). *The Developing Mind*. New York, NY: Guilford Press.

Siegel, D. (2007). Mindfulness training and neural integration: differentiation of distinct streams of awareness and the cultivation of well-being. *Social Cognitive and Affective Neuroscience*, *2*(4), 259-263.

Siegel, D. (2010). *The Mindful Therapist: A Clinician's Guide to Mindsight and Neural Integration*. New York, NY: W. W. Norton and Company.

Singer & Singer (1990). *The House of Make-believe: Children's Play and the*

Developing Imagination. Harvard university Press: Cambridge.

Skowron, E. A., Loken, E., Gatzke-Kopp, L. M., Cipriano-Essel, E. A., Woehrle, P. L., Van Epps, J. J…Ammerman, R. T. (2011). Mapping cardiac physiology and parenting processes in maltreating mother-child dyads. *Journal of Family Psychology, 25*(2), 663-674.

Slade, A. (1994). Making meaning and making believe: Their role in the clinical process. In A. Slade & D. P. Wolf (Eds.), *Children at Play* (pp. 81-107). New York, NY: Oxford University Press.

Sloan, R. P., Shaprio, P. A., Bigger, J. T., & Gorman, J. M. (1994). Cardiac autonomic control and hostility in healthy subjects. *The American Journal of Cardiology, 74*(3), 298-300.

Sroufe, L. A. (1997). Psychopathology as an outcome of development. *Development Psychopathology, 9*, 251-268.

Stadler, C., Grasmann, D., Fegert, J. M., Holtmann, M., Poustka, F., and Schmeck, K. (2008). Heart rate and treatment effect in children with disruptive behavior disorders. *Child Psychiatry and Human* Development, 39, 299–309.

Steele. M., Hodges, J., Kaniuk, J., & Steele, H. (2010). Mental representation and change: Developing attachment relationships in an adoption context. *Psychoanalytic Inquiry*, *30*, 25-40.

Steele. W., & Malchiodi, C. A. (2012). *Trauma-informed Practice with Children and*

Adolescents. New York, NY: Routledge.

Stern, D. (1998). *The Interpersonal World of the Infant: A View from Psychoanalysis and Developmental Psychology*. Karnac Books.

Stewart, A. L., Field, T. A. & Echterling, L. G. (2016). Neuroscience and the magic of play therapy. *International Journal of Play Therapy*, *25* (1), 4-13.

Stewart, A. L. & Echterling, L. G. (2017). The sound of silence in play therapy. In C. A. Malchiodi & D. A. Crenshaw, *What to when children clam up in psychotherapy: Interventions to facilitate communication* (pp. 69-85). New York, NY: The Guilford Press.

Straus, M. B. (2017). Treating adolescent attachment trauma: Ten ways to co-regulate and stay connected. In C. A. Malchiodi & D. A. Crenshaw, *What to when children clam up in psychotherapy: Interventions to facilitate communication* (pp. 157-174). New York, NY: The Guilford Press.

Suess, P. E., Porges, S. W. & Plude, D. J. (1994). Cardiac vagal tone and sustained attention in school-aged children. *Psychophysiology*, *31*, 17-22.

Task Force of the European Society of Cardiology and the North Amercian Society of Pacing and Electrophysiology (1996). Heart rate variability: standards of measurement, physiological interpretation and clinical use. *Circulation, 93*(5), 1043-1065.

Terr, L. (1990). *Too Scared to Cry. How trauma affects children and ultimately us all*. New York, NY: Basic Books.

Terr, L. C. (1991). Childhood traumas: an outline and overview. *The American Journal of Psychiatry, 148*(1), 10-20.

Thayer, J. F., & Brosschot, J. F. (2005). Psychosomatics and psychopathology: looking up and down from the brain. *Psychoneuroendocrinology*, *30*(10), 1050-1058.

Thayer, J. F., Friedman B., & Borkovec, T. (1996). Autonomic characteristics of generalised anxiety disorder and worry. *Biological Psychiatry*, *39*(4), 255-266.

Thayer, J. F., Hansen, A. L., Saus-Rose, E., & Johnsen, B. H. (2009). Heart rate variability, prefrontal neural function and cognitive performance: the neurovisceral integration perspective on self-regulation, adaptation and health. *Annuals of Behavioural Medicine*, *37*(2), 141-153.

Thayer, J. F., & Lane, R. D. (2000). A model of neurovisceral integration in emotion regulation and dysregulation. *Journal of Affective Disorders, 61*, 201-216.

Thayer, J. F., & Lane, R. D. (2009). Claude Bernard and the heart-brain connection: further elaboration of a model of neurovisceral integration. *Neuroscience & Biobehavioural Reviews, 32*(2), 81-88.

Trezza, V., Baarendse, P. J., & Vanderschuren, L. J. (2010). The pleasures of play: pharmacological insights into social reward mechanisms. *Trends Pharmacological Science, 31*(10), 463-469.

Tugade, M. M., & Fredrickson, B. I. (2004). Resilient individuals use positive emotions to bounce back from negative emotional experiences. *Journal of Personality and Social Psychology, 86*(2), 320-333.

Tyrrell, C. L., Dozier, M., Teague, G. B., & Fallot, R. D. (1999). Effective treatment relationships for persons with serious psychiatric disorders: The importance of attachment states of mind. *Journal of Consulting and Clinical Psychology, 67,* 725-733.

U. N. Charter art. 31. (1990).

Urquiza, A. (2010). The future of play therapy: Elevating credibility through play therapy research. *International Journal of Play Therapy*, *19*(1), 4-12.

van der Kolk, B. A. (1996). The complexity of adaptation to trauma: Self-regulation, stimulus discrimination, and characterological development. In B. A. van der Kolk, A. C. McFarlane, & L. Weisaeth (Eds.), *Traumatic Stress: The effects of overwhelming experience on mind, body, and society* (pp. 182-213). New York, NY: Guilford Press.

van der Kolk, B. A. (2005). Developmental Trauma Disorder: Towards a Rational Diagnosis for Children with Complex Trauma Histories. *Psychiatric Annals*, *35*(5), 401-108.

Varkas, T. (1998). Childhood trauma and posttraumatic play. *Journal of Analytic Social Work*, *5*(3), 29-50.

Von Klitzing, K., Kestley, K., Emde, R., Robinson, J., & Schmitz, S. (2000). Gender-specific characteristics of 5-year olds' play narratives and associations with behaviour ratings, *Journal of American Academy of Child and Adolescent Psychiatry*, *39*, 1017-1023.

Wagner, D. (2015). Polyvagal theory and peek-a-boo: How the therapeutic pas de deux heals attachment trauma. *Body, Movement and Dance in Psychotherapy*, *10*(4), 256-265.

Wallis, L. A., Healy, M., Undy, M. B., & Maconochie, I. (2005). Age related reference ranges for respiration rate and heart rate from 4 to 16 years. *Archives of Disease in Childhood, 90*, 1117-1121.

Warner, E., Cook, A., Westcot, E., & Koomar, J. (2011). *SMART. Sensory motor arousal regulation treatment. A manual for therapist working with children and adolescents: A "bottom-up" approach to treatment of complex trauma*. Brookline, Massachusetts: The Trauma Centre at JRI.

Weingarten, C. P., & Strauman, T. J. (2015). Neuroimaging for psychotherapy research: Current trends. *Psychotherapy Research*, *25*(2), 185-213.

West, J. (1992). *Child-Centred Play Therapy*. London: Edward Arnold.

Whelan, W. F. & Stewart, A. L. (2014). Attachment. In Scahefer, C. E. & Drewes, A. A. (Eds.), *The therapeutic power of play: 20 core agents of change* (2nd Ed., pp.171-183). New Jersey: John Wiley and Sons.

Wilbarger, P., & Wilbarger, J. (1997). *Sensory Defensiveness and Related*

Social/Emotional and Neurological Problems. Van Nuys, CA: Wilbarger.

Willeman, A. M., Schuengel, C., & Koot, H. M. (2009). Physiological regulation of stress in referred adolescents: The role of the parent-adolescent relationship. *Journal of Child Psychology and Psychiatry*, *50*(4), 482-490.

Wilson, G. F. (1992). Applied use of cardiac and respiration measures: Practical considerations and precautions. *Biological Psychology, 34*(2-3), 163-178.

Wilson, K., & Ryan, V. (2005). *Play Therapy: A non-directive approach for children and adolescents* (2nd Ed.). Oxford: Elsevier.

Winnicott, D. (1953). Transitional objects and transitional phenomena. A study of the first "not-me" possession. *International Journal of Psychoanalysis, 34*, 89-97.

Winnicott, D. (1971). *Playing and Reality*. London: Tavistock.

Woody, M. L., Feuer, C., Sosoo, E. E., Hastings, P. D., & Gibb, B. E. (2016). Synchrony of physiological activity during mother-child interaction: Moderation by maternal history of major depressive disorder. *Journal of Psychological Psychiatry, 57*(7), 843-850.

Yamada, M., & Decety, J. (2009). Unconscious affective processing and empathy: an investigation of subliminal priming on the detection of painful facial expressions. *Pain*, *143*(1-2), 71-75.

Yarolslavsky, L., Bylsma, L. M. Rottenberg, J., Kovacs, M. (2013). Combinations of resting RSA and RSA reactivity impact maladaptive mood repair and depression symptoms. *Biological Psychology, 94*, 272-281.