CHILDREN'S COPING WITH NEEDLE-RELATED PROCEDURES: PARENT AND CHILD CONCURRENT AND LONGITUDINAL PREDICTORS

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ABSTRACT

Coping with needle-related procedures during childhood is a complex and dynamic process that must be viewed in the context of the parent as well as the child's stage of development. This dissertation consists of three studies that present a comprehensive and in-depth investigation of children's coping with needle-related procedures. Study 1 is a published systematic review that synthesizes the literature on children's coping during needle-related procedures in the context of the parent. Studies 2 and 3 were published within one extended manuscript based on an ongoing longitudinal cohort (OUCH Cohort) of caregiver-child dyads followed over vaccination appointments during the first five years of life (12-month vaccination [n=548], preschool vaccination [n=302], preschool psychological assessment [n=172]). Study 2 employed a cross-lagged path analysis to investigate the dynamic and reciprocal relationships between children's coping responses and coping outcomes at the preschool vaccination. Study 3 used four longitudinal path models to examine the prediction of preschool children's coping responses and coping outcomes during vaccination (using an array of caregiver and child variables from the 12-month and preschool stage). Study 1 found that combinations of children's coping responses were more predictive of coping outcomes than individual coping responses alone and, similarly, that combinations of parent behaviours were more predictive of children's coping responses and outcomes than any individual parent behaviour. Study 2 demonstrated that coping responses and coping outcomes during the preschool vaccination are separate, but interrelated, aspects of the coping process and that the relationships between them are dynamic. Study 3 showed that parents play an important role in preschool children's coping during vaccination and that this role is both longitudinal and concurrent. It was also found that parent

behaviours during the 12-month vaccination predicted broader child cognitive abilities at preschool. Clinical implications and suggestions for future research are discussed.

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PUBLICATION DISCLOSURE

The works submitted within this dissertation (specifically Chapter 2 and Chapter 4) has been published/is in press. Due to copyright authorizations, we are unable to include the published manuscript and include the equivalent pre-publication accepted manuscripts. The published citations are:

Campbell, L., DiLorenzo, M., Atkinson, N., & Pillai, Riddell, R., (2017). Systematic Review: A Systematic Review of the Interrelationships Among Children's Coping Responses, Children's Coping Outcomes, and Parent Cognitive-Affective, Behavioral, and Contextual Variables in the Needle-Related Procedures Context. *Journal of Pediatric Psychology*, https://doi.org/10.1093/jpepsy/jsx054.

Campbell, L., Pillai Riddell, R., Cribbie, R., Garfield, H., Greenberg, S. (in press). Preschool Children's Coping Responses and Outcomes in the Vaccination Context: Child and Caregiver Transactional and Longitudinal Relationships. *PAIN*.

BRIEF SYNOPSIS OF DISSERTATION

A challenge in the pediatric pain and coping literature has been a lack of clarity and consensus in conceptualizing the different components of the coping process (Blount et al., 1997; Rudolph, Dennig, & Weisz, 1995). Specifically, the term 'coping' has been used as a "catch-all" term referring both to behaviours that reduce pain-related distress (i.e., deep breathing) as well as to the actual reduction of pain-related distress. Needle-related procedures are a source of pain and distress for most children and thus can serve as an important paradigm for the study of coping. Moreover, the parent marks one of the most important social contexts relevant to the study of children's coping (Compas, 1987). No studies to date on children's coping with needle-related procedures have used a longitudinal design nor concurrently examined other cognitive subsystems that are likely at play (e.g., language or executive functioning) while also examining these relationships in the context of the parent. In order to fill these gaps in the literature, two broad research aims shaped the development of this dissertation: (1) Systematically review the existing literature on children's coping with pain from needle-related procedures according to the specific relationships examined between: children's coping responses, children's coping outcomes, and parent variables; (2) Informed by current gaps in the literature, conduct comprehensive longitudinal analyses predicting children's coping responses and outcomes at the preschool vaccination using a broad array of parent and child predictors. These research aims were addressed in three separate studies within two published journal papers (Campbell et al., 2017; Campbell et al., in press). For reader ease, Appendix A contains a 2-page summary of all analyses contained within the dissertation.

The first study was a large-scale systematic literature review that organized and synthesized the literature on children's coping during needle-related procedures in the context of

parent variables. The findings of this review then informed the analyses of the second and third study. In the systematic review (Study 1), a narrative synthesis of the evidence showed that parent coping-promoting and distress-promoting behaviours are the most consistent predictors of optimal children's coping responses, and less optimal children's coping outcomes, respectively.

For the second and third study, participants were part of an ongoing Canadian longitudinal study (The OUCH cohort) that followed parents and children from infancy to preschool. Data were obtained from the 12-month vaccination wave (n=548), the preschool vaccination wave (n=302; ages 4-5 years), and the preschool assessment wave (n=172; ages 4-5 years) where families agreed to participate in a full day psychological assessment at our laboratory after their preschool vaccination. Structural equation modeling (SEM) was used for all research aims.

Study 2 focused only on the preschool child's coping responses and outcomes during the preschool vaccination. Analyses for Study 2 demonstrated that higher levels of preschooler coping responses were related to more optimal coping outcomes at 1 minute prior to the first needle and at 1 minute following the last needle, and that children's coping outcomes (pain-related distress) strongly predicted forward across all phases of the vaccination. In Study 3, longitudinal pathways of preschoolers' coping were elucidated. Specifically, parent sensitivity and proximal soothing at the 12-month vaccination had important developmental influences not only on children's coping responses at the preschool vaccination but also on their broader cognitive development. In addition, the parent behaviours that related most strongly to children's coping responses and outcomes at the preschool vaccination were those taking place concurrently. Moreover, parent distress-promoting behaviours were found to be more unhelpful

(in terms of children's coping) than parent coping-promoting behaviours were found to be beneficial.

This three-study work marks an important milestone in the literature on coping with pediatric acute pain. In addition to providing the field with a methodologically sound review of the literature, sophisticated longitudinal and concurrent pathways to children's coping with needle-related pain have been elucidated through complex multivariate modeling.

Chapter 1: Introduction to the Study of Children's Pain Coping

Coping with Stress During Childhood

Stress has been defined as an event or experience that expends the resources of an individual (Blount et al., 2008). Across development, most children will be faced with an array of different stressors that may challenge their resources. Given that exposure to stressful events has been linked to negative cognitive and socioemotional sequela, as well as to physical illness (Blount et al., 2008; Boyce, 2007; Boyce et al., 2001; Burchinal, Roberts, Hooper, & Zeisel, 2000; Cummings & Davies, 2002; Essex, Klein, Cho, & Kalin, 2002; Masten & Shaffer, 2006), it is important for children to acquire the skills to navigate potential life stressors as successfully as possible. In tandem with the study of stress comes the study of coping. Effective coping behaviours have been shown to minimize the likelihood of deleterious outcomes related to stress (Blount et al., 2007).

What is Coping?

Coping is a subset of a broader domain of self-regulatory processes through which people respond to stress (Compas et al., 2001). Thus, coping and self-regulation are separate, but related constructs. Coping has been defined and operationalized in a multitude of ways. Lazarus (1993) defines coping as a goal-directed process in which thoughts and behaviours are oriented towards the goals of resolving the course of stress as well as regulating one's response to stress. Coping cannot be simplified into a particular behaviour or a specific belief that an individual holds (Skinner, Edge, Altman, & Sherwood, 2003). Rather, coping is a complex process that is comprised of myriad different dimensions and functions at a number of levels, including those involved in perception, cognition, and behaviour (Pearlin & Schooler, 1978). According to Compas (1998) and Compas, Connor-Smith, Saltzman, Harding Thomsen, and Wadsworth

(2001), coping is an ongoing and dynamic process that changes in response to changing demands in an environment perceived as stressful.

Coping as a complex and dynamic process must also be viewed in the context of one's environment and transactions within it (Lazarus & Folkman, 1987). Accordingly, it is important for coping to also be viewed as a relational process in which the individual and his/her environment participate in a dynamic, mutually influential relationship (Folkman, 1984). The importance of the social context to coping is extremely important in young children. Arguably, one of the most important social contexts relevant to the study of children's coping is that of the parent (Compas, 1987). Equally imperative to the study of children's coping is to adopt a developmental perspective (Compas, 1998). These two important aspects of children's coping (i.e., developmental considerations and the parent) will be discussed further in the sections below.

Coping with Needle-Related Procedures during Childhood

Frightening and painful needle-related procedures are a source of stress for most children and, thus, can serve as an important paradigm for the study of coping. In addition, research on children's coping with acute pain-related distress has important clinical implications, given the long-term negative sequelae associated with unaddressed needle-related pain (e.g., pre-procedural anxiety in the future, fear of needles, healthcare avoidance behaviours) (Taddio et al., 2010). Examples of commonplace needle-related procedures include immunization injections and venipunctures. In addition, children with chronic medical conditions such as cancer also face routine bone marrow aspirations (BMA), lumbar punctures (LP), intravenous starts, and central line placements.

The "Knotty Conceptual Issue" of Children's Pain Coping

In parallel to the broader coping literature (Compas et al., 2001), the pediatric pain literature has been challenged by a lack of clarity and consensus in conceptualizing different components of the coping process. Specifically, and in line with the broader literature, the term 'coping' has been used in the field as a "catch-all" term, referring both to behaviours that reduce pain-related distress (e.g., taking deep breaths) as well as to the actual reduction of pain-related distress. While this "knotty conceptual issue" (Blount et al., 1997) has been recognized in the field of pediatric pain (Blount et al., 1997), the majority of research to date has yet to systematically acknowledge this differentiation empirically. Drawing on frameworks proposed by Lazarus and Folkman (1984), Rudolph, Dennig, and Weisz (1995) published a conceptual review and argued that, in order for the field of pediatric pain to move forward, a clear differentiation be made between "coping responses" and "coping outcomes." Coping responses were defined as intentional physical or mental actions initiated in response to a perceived stressor (e.g., taking deep breaths, using humour) and coping outcomes were defined as the specific consequences of the coping responses (e.g., the reduction of crying).

Children's Pain Coping: Coping Responses and Coping Outcomes

A host of previous research has shown that children's coping responses (although not always explicitly or consistently categorized as such) relate to children's coping outcomes (e.g., pain-related distress reduction) in the context of needle-related procedures. In general, coping responses linked to lower pain-related distress include distraction (e.g., playing with toys, singing songs, playing video games), engaging in nonprocedural talk (e.g., talking about subject matter unrelated to the medical procedure), using humour (e.g., telling jokes), making coping statements (e.g., "I'll be ok"), and breathing deeply. Coping responses linked to greater pain-

related distress include internalizing and catastrophizing (Blount et al., 1992, 1994, 2008; Blount, Davis, Powers, & Roberts, 1991; Young, 2005). The majority of previous research has examined children's coping responses and coping outcomes summed across an entire painful procedure, as opposed to conducting a more fine grained analysis of how these two aspects of coping might interrelate dynamically within and across different phases of a painful procedure.

Children's Pain Coping: Developmental Considerations

Given the steep trajectory of development that occurs across childhood, it is critical for research on children's coping to adopt a developmental perspective (Compas, 1998). A conceptual review in the broader coping literature has highlighted the need to examine not only different developmental pathways that may *lead* to children's coping (i.e., longitudinally over time), but also to examine different developmental subsystems that may *underlie* the construct of children's coping at a given point in time (e.g., executive functioning, language) (Skinner & Zimmer-Gembeck, 2007). No research to date in the area of children's coping with needle-related procedures has examined either of these important areas. However, given that coping responses are enacted with the aim of self-regulation in response to stress (Compas, 2009; Eisenberg, Fabes, & Guthrie, 1997), research on the development of self-regulation of pain-related distress can be informative.

Developmental pathways. In terms of developmental pathways that may lead to children's coping, both parent as well as child contributors should be considered.

Parent. Given the well-established influence of parents on the development of children's self-regulatory abilities (Campos, Campos, & Barrett, 1989; Grolnick & Farkas, 2002; Saarni, 1997; Sroufe, 1996; Volling, McElwain, Notaro, & Herrera, 2002), the role of parental factors is important to consider in understanding the development of children's coping with

needle-related procedures. Similarly, it has been repeatedly emphasized that parents play a crucial role in young children's pain regulation (Pillai Riddell & Chambers, 2007; Pillai Riddell, Racine, Craig, & Campbell, 2013). In both the pediatric pain and broader developmental literature, the particular importance of parents in the infancy period has been highlighted (Bowlby, 1969/1982; Pillai Riddell & Racine, 2009). In the vaccination setting, research has consistently found that parent behaviours such as proximal soothing and verbal reassurance relate to infant pain (Campbell, Pillai Riddell, Garfield, & Greenberg, 2013; Racine, Pillai Riddell, Flora, Garfield, & Greenberg, 2012). However, the relationships observed have been smaller than expected. It has been postulated that the full impact of parent behaviours during infant vaccinations may be more fully actualized at later developmental stages, such as early childhood (Campbell et al., 2013; Pillai Riddell, Gennis, Taddio, & Racine, 2016). Accordingly, it may be that proximal soothing and verbal reassurance during needle-related procedures in infancy may be related to children's coping with needle-related procedures at later stages of development.

Parent behaviours during later stages of development (i.e., early and middle childhood) are also important to consider in the context of children's coping with needle-related procedures. A series of studies conducted by Blount and colleagues (Blount et al., 1992, 1997; Blount, Davis, Powers, & Roberts; 1991; Blount, Powers, Cotter, Swan, & Free, 1994; Blount, Sturges, & Powers, 1991) has shown that a specific set of parent behaviours enacted in combination during needle-related procedures (i.e., referred to as "coping-promoting") relate to children's coping in an optimal manner and a specific set of parent behaviours enacted in combination (i.e., referred to as "distress-promoting) relate to children's coping in a less optimal manner. "Coping-promoting" behaviours include directing humour toward the child, engaging in non-procedure-

related talk, and commanding the child to use coping strategies. "Distress-promoting" behaviours include criticizing the child, reassuring the child, giving control to the child, apologizing, and expressing empathy.

In addition to parent behaviours, broader parenting constructs, such as parent sensitivity, have also been linked to the development of young children's self-regulation in pain-related and non pain-related contexts (Braungart-Rieker, Garwood, Powers, & Notaro, 1998; Din Osmun, Pillai Riddell, & Flora, 2013; Leerkes, 2010; Pillai Riddell et al., 2011). Instead of focusing on the quantity of discrete parenting behaviours, parent sensitivity taps into the quality of parental interactive behaviour and can be thought of as the parent's ability to understand the child, perceive his or her signals accurately, and respond to them appropriately (Ainsworth, 1973). Overall, higher parent sensitivity has been related to more optimal self-regulation in young children. Accordingly, the construct of parent sensitivity may also warrant attention when considering the development of children's coping with needle-related procedures.

Finally, parent cognitive-affective variables are also important to consider. In the broader child development literature, parent cognitive-affective variables such as parenting stress (Papoušek & von Hofacker, 1998), beliefs about the child (McKenzie & McDonough, 2009), and parenting self-efficacy (Jones & Prinz, 2005) have all been linked to children's self-regulation. Thus, parent cognitive-affective variables in the context of children's coping with needle-related procedures should also be considered.

Child. As previously alluded to, self-regulation and coping are interrelated. Specifically, self-regulatory capacities have been posited to contribute towards the skills required for adaptive coping (Eisenberg, Valiente, & Sulik, 2009). Accordingly, it is possible that infant regulatory capacity during needle-related procedures may serve as a

precursor for children's coping with needle-related procedures at later stages of development. In fact, it has been suggested that a promising area for future research is to longitudinally investigate children's self-regulatory and coping capacities and how they may relate to one another across time (Eisenberg, Valiente, & Sulik, 2009).

Developmental Subsystems. A child's developmental level will both contribute to the resources that he or she has available for coping, as well as limit the types of coping responses that he or she can employ (Compas et al., 2001). It is becoming increasingly recognized that coping involves an organized set of processes (Compas, 2009). As aforementioned, developmental subsystems such as executive functioning and language have been postulated to underlie the construct of children's coping (Skinner & Zimmer-Gembeck, 2007). In other words, these underlying subsystems may serve as underlying mechanisms related to coping. However, despite this theorization, research on children's coping has tended to focus on age rather than more direct indices of developmental capacities (Compas, 1998). This tendency has been mirrored in the pediatric pain and coping literature. Specifically, no research to date on children's coping with pain has examined developmental subsystems that may serve as underlying mechanisms of the coping process.

Executive Functioning. Executive functions refer to higher-order self-regulatory cognitive processes and tend to emerge during early childhood (Carlson, Mandell, & Williams, 2004). These cognitive processes include working memory, planning, sequencing, and inhibitory control and have been posited to serve as a foundation for coping and emotion regulation (Compas, 2006). Executive functioning ability continues to develop throughout childhood and adolescence and into young adulthood (Luna & Sweeney, 2004). Consequently, the capacity for the use of increasingly complex strategies for coping and emotion regulation will

continue to develop from early childhood onward (Compas, 2009). As previously noted, no research on children's coping with pain has examined the role of executive functioning.

Language. An additional area of cognitive functioning related to coping is language ability (Compas et al., 2001). It has been argued that, as language abilities continue to develop throughout childhood, so, too, do coping processes (Skinner & Zimmer Gembeck, 2007). Similarly, Fields and Prinz (1997) postulated that coping responses depend heavily on language development, both in terms of the communicative aspects of coping and in terms of the internal use of language in cognitions and self-instruction. In the pediatric pain literature, it has been put forth that developmental processes (including language) influence young children's ability to cope with painful procedures (Branson & Craig, 1988; Young, 2005). While child verbalizations related to coping in medical contexts have been extensively studied (Blount et al., 1992, 1997; Blount, Davis, Powers, & Roberts; 1991; Blount, Powers, Cotter, Swan, & Free, 1994; Blount, Sturges, & Powers, 1991), no research to date on children's coping in the acute pain context has explicitly examined the role of language ability (i.e., using an aptitude measure of this cognitive capacity).

Current Dissertation

In the broader children's coping literature, several reviews have emphasized the importance of parents in the context of children's coping (Compas, 1998; Power, 2004; Skinner & Zimmer-Gembeck, 2007). However, literature on the role of parents in the context of children's coping responses and outcomes with needle-related procedures has yet to be comprehensively and systematically reviewed. In addition, despite the conceptual importance of disentangling children's coping responses from coping outcomes during pain-related contexts and examining how the two interact dynamically, these transactions have yet to be empirically

examined using advanced modeling techniques in a longitudinal context. Accordingly, three studies were conducted for the current dissertation with the following primary aims:

(1) Study 1: Conduct a systematic review to organize and synthesize the coping with pain from needle-related procedures literature (using the explicit distinction of coping responses versus coping outcomes) in the context of parent variables.

(2) Study 2: Examine the relationships between differentially timed children's coping responses and coping outcomes across the preschool vaccination.

(3) Study 3: Use participants from a longitudinal cohort of children receiving vaccinations across the first five years of life to examine a variety of parent and child predictors (from infancy and preschool) of preschooler coping responses and outcomes at the preschool vaccination.

Thus, this dissertation is the compilation of three studies over two journal manuscripts (1 published; 1 in press) that correspond to the three aims listed above. The first manuscript (Study 1, Chapter 2) is the author-version of a formal systematic review (Campbell et al., 2017) of the interrelationships between children's coping responses, children's coping outcomes, and parent cognitive-affective, behavioural, and contextual variables during needle-related procedures. The second manuscript (Study 2 and Study 3, Chapter 4) is the author-version of an extended manuscript (Campbell et al., in press) based on two companion studies that used data from an ongoing longitudinal study (The OUCH cohort) that followed parents and children during routine vaccinations from infancy to preschool. Study 2 examined the transactional relationships between preschool children's coping responses and coping outcomes during vaccination. Study 3 examined a variety of potential parent and child predictors (from infancy and preschool) of preschooler coping responses and outcomes during vaccination. All research aims, analyses, and results pertaining to these three studies are summarized in a two-paged outline for readers of this

dissertation (see Appendix A). Chapter 3 provides a bridge that explains how Study 2 and 3 of the dissertation build upon Study 1. Dissertation references for the Introduction (Chapter 1), the bridge (Chapter 3) and the conclusion (Chapter 5) can be found at the end of the dissertation preceding the Appendix.

Of note, several of the figures and tables in Chapter 2 (Study 1) are referred to as "supplementary" or "online supplementary." The editors for the journal that published this manuscript requested that these materials be provided as supplementary rather than within the manuscript. Due to copyright authorizations, the exact language from the accepted pre-published manuscript was kept. However, for ease of reader review, all supplementary figures and tables have been inserted at the end of Chapter 2.

Chapter 2: A Systematic Review of the Interrelationships among Children's Coping Responses, Children's Coping Outcomes, and Parent Cognitive-Affective, Behavioral, and Contextual Variables in the Needle-related Procedures Context[1]

Several systematic reviews have examined parent-related variables and pediatric needle pain, including non-pharmacological (Pillai Riddell et al., 2015) and procedural and physical pain management techniques (Taddio et al., 2015), as well as child and parent variables related to children's anticipatory distress (Racine et al., 2016). To our knowledge, the construct of children's coping in relation to the parent in this context has yet to be examined in a systematic review.

Lazarus (1993) defines coping as a goal-directed process in which thoughts and behaviors are oriented towards the goals of resolving the course of stress as well as regulating one's response to stress. Coping is considered a complex and dynamic process in which one's thoughts and behaviors are continuously changing in response to specific demands appraised as stressful (Lazarus & Folkman, 1984; Pearlin & Schooler, 1978).

Despite the importance of studying children's coping with painful needle-related procedures, the question of how to define coping in this context has presented itself as a major issue in the field of pediatric psychology, with researchers exhibiting discrepant views on what behaviors actually constitute this construct (Manne, Bakeman, Jacobsen, & Redd, 1993). In the literature, the term 'coping' has been used to not only reflect behaviors that reduce distress but also to reflect the actual reduction of distress. For example, in discussing this "knotty conceptual

[1] This is the author's version of the published manuscript:
Campbell, L., DiLorenzo, M., Atkinson, N., & Riddell, R. P. (2017). Systematic Review: A Systematic Review of the Interrelationships Among Children's Coping Responses, Children's Coping Outcomes, and Parent Cognitive-Affective, Behavioral, and Contextual Variables in the Needle-Related Procedures Context. *Journal of Pediatric Psychology*, jsx054.

issue", Blount et al. (1997) defined children's pain coping as specific behaviors that are inconsistent with distress. On the other hand, other researchers have conceptualized children's pain coping using measures of distress, or lack thereof, as indicators of coping (Taylor, Sellick & Greenwood, 2011).

In response to the inconsistencies in the pediatric pain and coping literature, Rudolph, Dennig, & Weisz (1995) published a conceptual review and argued that, in order for the field to move forward, a clear differentiation be made between "coping responses" and "coping outcomes." The former was defined as intentional physical or mental actions initiated in response to a perceived stressor (e.g., distraction, deep breathing) and the latter was defined as the specific consequences of the coping responses (e.g., crying or screaming). This differentiation is in line with the broader coping literature (Lazarus & Folkman, 1984). Despite this initiation to move the field forward, an empirical lag in the field of pediatric pain remains, with few studies to date explicitly acknowledging this differentiation. From an implication perspective, it follows logically that findings from the pediatric pain and coping literature may be limited, as different aspects of this complex construct have not been clearly and consistently operationalized.

In addition to the need to differentiate between coping responses and coping outcomes, coping must also be viewed as a relational process, in which the individual and his/her environment participate in a dynamic, mutually influential relationship (Folkman, 1984). Arguably, one of the most important environmental factors to consider in the context of children's coping is the role of the parent (Compas, 1987) which, in the pediatric pain literature, has been put forth as paramount (Pillai Riddell, Craig, Racine, & Campbell, 2013). A helpful theoretical framework for considering the role of the parent in this context is the Proximal Distal Model of Coping and Distress which posits that parent cognitive-affective and behavioral

variables (e.g., negative affectivity, coping style, behaviors during the procedure) influence children's coping responses and outcomes (i.e., distress) during acute medical procedures (Blount, Bunke, & Zaff, 1999).

Current Review

The overarching goal of the present study was to organize and synthesize the coping with pain from needle related procedures literature in the context of parental factors. Thus, our aim was to conceptually organize previous literature according to the specific relationships examined between children's coping responses, children's coping outcomes, and parent cognitive-affective, behavioral, and contextual variables. Accordingly, prior to synthesis, coping variables were clearly categorized (See online Supplemental Table 10) as either an outcome or a response. In addition, whenever possible, in-text descriptions were included to indicate if a coping response was discrete (i.e., one response) or a composite (i.e., multiple responses). The same was done for behavioral parent variables. The literature did not substantiate categorizing children's coping outcomes in a similar manner. Based on the literature, children's coping outcomes were classified as self-report, other-report, behavioral, or physiological.

Methods

Search Strategy

The OVIDSP platform was used to run the search strategy in MEDLINE and EMBASE; ProQuest was used for PsycINFO; EBSCOHost was used for CINAHL. Articles indexed from inception to January 12, 2015 were included in the initial search and the search was updated in January 2016. There were no limitations in terms of publication dates. Search terms related to coping, procedural pain, and children were systematically paired (see online Supplementary Appendix 1). Search terms used to identify studies for inclusion were determined by the authors

based on their content expertise in this area and in consultation with a librarian from a tertiary hospital who has specialized training in conducting systematic reviews. Additional studies were identified from references lists of included studies. The present review adhered to an a priori protocol according to the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009). The review protocol was registered on the international prospective register of systematic reviews PROSPERO website prior to data extraction (registration number CRD42016035673).

Inclusion/Exclusion Criteria and Study Selection

To be included, it was required that the study examined a painful needle-related procedure in children from 3-12 years of age, included a measure of a children's coping response (e.g., distraction, information-seeking, catastrophizing), a measure of a children's coping outcome (e.g., self-reported pain-related distress, parent report of anxiety, cortisol levels), and a measure of a parent cognitive-affective, behavioral, or contextual variable analyzed in relation to one or both of the aforementioned two children's coping variables. Parent behavioral variables could include those from experimental studies attempting to modify parent behaviors through training. This was deemed appropriate as excluding these studies would have resulted in the omission of important studies relevant to the goals of this study. Exclusion criteria for studies were: not a needle-related procedure, incorrect age (i.e., not children 3-12 years), and published in a non-English language. Conference abstracts, editorials, newsletters, dissertations, and qualitative studies were also excluded. Given the substantially different pain experience arising from post-operative and chronic pain, these studies were excluded. Observational studies and controlled trials were considered eligible for the review. Supplementary Figure 1 presents the included study flow chart following the Preferred Reporting Items for Systematic Reviews and

Meta-Analyses (PRISMA) guidelines. Two reviewers screened the results from initial searches (L.C., N.A.) and worked with the senior author to hone the search strategy and outcome focus (R.P.R.). Twenty percent of studies were double coded for reliability purposes. Percentage agreement between the reviewers was 99.6%. Any disagreements between reviewers were resolved through consensus.

Data Extraction

Two reviewers (L.C.; M.D.) conducted data extraction independently for all included studies using a structured form (n= 20). One hundred percent of the studies were extracted by both reviewers given that every coping variable had to be classified as either a response or an outcome. Discrepancies were minimal and resolved through consensus.

Quality Assessment

Because a gold-standard measure is not available for assessing the methodological quality of observational studies (Sanderson, Tatt, & Higgins, 2007), a modification of the checklists used by Downs and Black (1998) and Crombie (1997) was used (see online Supplementary Appendix 2). This modified checklist has been previously used in a systematic review on observational studies (Macfarlane, Glenny, & Wothington, 2001) that examined the prevalence and associated risk factors for oro-facial pain. Percentage agreement between the two principal evaluators was 94.3%. Disagreements were discussed via consensus. Twenty items pertaining to methodological criteria were scored as ‘yes’ (1), ‘no’ (0) or ‘unable to determine’. Positively scored criteria was summed in order to obtain a total quality score (max=20) for each study. Examples of items include: “Is the design of the study described?”; “was the sample size justified?”

Data Synthesis

Due to the range of different outcome measures, participant ages, types of needle-related procedures, and types of study designs (i.e., experimental versus observational), a meta-analytic approach was not appropriate for this review. Instead, a narrative synthesis framework (Popay et al., 2005) was employed. Data of included studies were classified in three different ways and subsequently synthesized:

First, variables were classified as a children's coping response, a children's coping outcome, or a parent cognitive-affective, behavioral, or contextual variable. These classifications were mutually exclusive. Children's coping responses were operationalized as any cognitive and/or behavioral efforts to manage the distress associated with the procedure and were further subclassified as behavioral or cognitive. Children's coping outcomes were operationalized as distress-related variables (e.g., pain, fear) obtained either prior to, during, or after the painful procedures and subclassified as self-report, other-report, behavioral, or physiological. Parent cognitive-affective, behavioral, or contextual variables were operationalized as any variables fitting within these categories that were analyzed in relation to children's coping responses and/or coping outcomes and were subclassified as cognitive-affective, behavioral or contextual.

Based on the available literature, studies were organized according to three relationship clusters (Children's Coping Responses with Children's Coping Outcomes; Parent Cognitive-Affective, Behavioral, and Contextual Variables with Children's Coping Responses; Parent Cognitive-Affective, Behavioral, and Contextual Variables with Children's Coping Outcomes) and then synthesized according to their primary analytic technique (i.e., bivariate correlations, sequential analyses, regression analyses and/or between group analyses). In the case of "Parent Cognitive-Affective, Behavioral, and Contextual Variables with Children's Coping Outcomes",

the studies were further synthesized according to how the children's outcome was measured: self-report, other-report, behavioral, or physiological. For each of the three relationship clusters, age, health status of the sample, sample size, and quality score for each study was examined to add further insight to the synthesized results. This was done by examining the findings within a given relationship cluster (See Online Supplemental Tables 1-9), in conjunction with Table 1 which provides the data on age, health status of the sample, etc. Articles were differentiated according to each of these factors (i.e., as high vs. low quality, clinical vs. healthy samples) and re-examined to determine if the synthesis differed according to these divisions. In the face of conflicting results, conclusions were made based on what the majority of studies found.

Results

Studies Included

After removal of duplicates, 6081 articles were identified. Two reviewers screened the titles and abstracts according to the inclusion/exclusion criteria. Seventy-eight full-text articles were reviewed and 19 studies fulfilled the inclusion criteria. As aforementioned, the systematic search was re-run in January 2016 in order to update the review. This search yielded 801 new articles, one of which ended up meeting criteria for inclusion. Thus, 20 studies in total (n=1595 participants) were included in this review.

Study Characteristics

Demographics. A comprehensive overview of the included studies is presented in Table 1. Information regarding the study's country of origin, sample size, age range, location, type of needle-related procedure, type of study, and health status of the sample is presented. For studies where the health status of the sample was Clinical, the specific clinical condition is listed. Of note, a small number of studies (n=5) had age ranges that went beyond 12 years of age (i.e., 3-18

years, 8-15 years). These studies were still included because the authors did not want to miss relevant data pertaining to children in the sample whose ages fell within the target age range.

In summary, the vast majority of studies (85%) were from the United States. The majority of studies were observational (70%) as opposed to experimental (30%). About half the studies encompassed a wide developmental age range (i.e., age differences spanning from 6 to 15 years), and about half of the studies were focused on the preschool/early elementary age range (i.e., 3-7 years). Sixty percent of the studies were comprised of healthy samples undergoing routine procedures (predominantly immunizations) and forty percent of the studies consisted of clinical samples undergoing a wider range of procedures. All studies were cross-sectional in design. Only three studies (Blount et al., 1990; Manne et al., 1992; Manne et al., 1994; Gonzalez et al., 1989) took the phase of the needle-related procedure into account for analytic purposes.

Quality of Studies. The final column in Table 1 presents the quality assessment scores for each study. Scores ranged from 10/20 to 16/20. The mean, median, and mode were 14.2, 15, and 15, respectively. The authors who previously used this measure (Macfarlane, Glenny, & Wothington, 2001) used the median score as their cut-off point for "high" versus "low" quality but cautioned that this cut-off point was arbitrary. In line with recommendations from the Cochrane Handbook for Systematic Reviews of Interventions (Higgins & Green, 2008), the present authors used their judgment to critically examine the items endorsed on the checklist for each study, followed by a conceptual discussion. This resulted in the decision that studies with quality scores ≥15 be considered "higher" in quality and those with scores < 15 be considered relatively "lower" as the former group tended to only include endorsements of items that were not considered as methodologically concerning as others (e.g., points were lost because authors did not state that the sample was representative of the populations; did not describe participant

follow-up).

Interrelationships between Children's Coping Responses, Children's Coping Outcomes, and Parent Cognitive-Affective, Behavioral, and Contextual Variables

Below is a summary of the interrelationships among the three relationship clusters. Online Supplementary Tables 1-9 summarize study findings pertaining to the interrelationships between children's coping responses, children's coping outcomes, and parent cognitive-affective, behavioral, and contextual variables. Online Supplementary Table 10 serves as a detailed catalogue of each study's operationalization of the aforementioned variables.

Relationship Cluster I: Children's Coping Responses and Children's Coping Outcomes.

Bivariate correlations. Broad behavioral composite measures of children's coping responses (i.e., measures that summed multiple coping responses such as deep breathing, non-procedural talk, making coping statements, and using humor) were generally related to improved coping outcomes. In two of three studies (Blount et al., 1997; Blount et al., 2001) broad behavioral composite measures of children's coping responses were related to more optimal coping outcomes while, in the other study, the same broad behavioral composite measure was not (Frank et al., 1995). Discrete behavioral child coping responses (i.e., distraction, deep breathing, non-procedure-related activity, and blowing into a party blower) had mixed findings within and across the two studies that examined these variables (Manne et al., 1992; Manne et al., 1994), at times relating to more improved coping outcomes, while at other times being unrelated. Findings pertaining to the cognitive coping response of children's catastrophizing were mixed based on outcome. Specifically, child pain catastrophizing was related to higher levels of children's fear, but unrelated to child- and parent-report of pain (Vervoort et al., 2011).

Pain catastrophizing is defined as an exaggerated negative orientation instigated by actual or anticipated pain experience, in which the threat value or seriousness of one's pain sensations is magnified or exaggerated by the individual (Sullivan et al., 2001). Online Supplementary Table 1 summarizes the aforementioned findings.

Relationship Cluster II: Parent Cognitive-Affective, Behavioral, and Contextual Variables and Children's Coping Responses.

Bivariate correlations. Broad behavioral composite measures of parent "coping-promoting behaviors" (i.e., measures that summed multiple parent behaviors such as non procedural talk, humor, and commands to use coping strategies) were consistently positively related to broad behavioral composite measures of children's coping responses (Blount et al., 1997; Frank et al., 1995). Broad behavioral composite measures of parent "distress-promoting behaviors" (i.e., measures that summed multiple parent behaviors such as reassuring, criticizing, apologizing, giving control) had mixed findings. Specifically, one study found a negative relationship with broad behavioral composite measures of children's coping responses (Blount et al., 2001) while another study found no relationship (Frank et al., 1995). Discrete (i.e., unitary) parent coping-promoting behaviors generally related to higher levels of the parallel children's coping response [i.e., parents coaching children to use a party blower related to higher frequencies of children using the party blower, parent non-procedure-related talk related to higher frequencies of children engaging in non-procedure-related talk, etc. (Blount et al., 1990; Manne et al., 1994). Discrete parent behaviors comprising the aforementioned coping-promoting and distress-promoting composites were unrelated to broad behavioral composite measures of children's coping responses (Cohen et al., 2000). The cognitive-affective parent variables of catastrophizing about their child's pain and fear during the procedure were unrelated to the

discrete children's coping response of catastrophizing (Vervoort et al., 2011), and the cognitive-affective parent variable of trait anxiety was unrelated to a broad behavioral composite measure of children's coping responses (Frank et al., 1995). Online Supplementary Table 2 summarizes the aforementioned findings.

Sequential analyses. Sequential analyses capture moment-to-moment temporal relations between variables (Manne et al., 1992). As opposed to correlations, sequential analyses provide insight into whether the relationship between two variables is unidirectional or bidirectional (Spagrud et al., 2008). A broad view of the studies that used sequential analysis (Blount et al., 1989; Blount et al., 1991; Manne et al., 1992; Spagrud et al., 2008; Taylor et al., 2011) was taken, as specific synthesis was not possible due to the multiplicity of different directions and combinations. Overall, a bidirectional relationship between parent behaviors and children's coping responses was suggested across studies. However, children's coping responses were more likely to follow parent behaviors than vice versa. Online Supplementary Table 3 summarizes the aforementioned findings.

Multiple regressions/partial correlations. In terms of the relationships between parent cognitive-affective, behavioral, and contextual variables and broad behavioral composite measures of children's coping responses, one study found that neither parent coping-promoting nor distress-promoting behavioral composite measures explained unique variance when nurse behaviors were accounted for (Cohen et al., 2002). On the other hand, Frank et al. (1995) found that a parent coping-promoting behavioral composite measure explained unique variance (positive relationship) in a broad behavioral composite measure of children's coping responses when accounting for medical staff behaviors and parent trait anxiety. When controlling for gender, Spagrud et al. (2008) found the same relationship as above, in addition to finding that a

parent distress-promoting behavioral composite measure negatively predicted unique variance in a broad behavioral composite measure of children's coping responses. In the one study that examined the relationship between a parent variable and a discrete behavioral child coping response, parent coaching the child to breathe was related to higher levels of the child breathing when controlling for the age of the child (Manne et al., 1994). Online Supplementary Table 4 summarizes the aforementioned findings.

T-tests/ANOVAs. In terms of studies that examined a causal relationship between parent variables and discrete measures of children's coping responses using experimental designs, parent behavioral training programs led to greater children's use of a party blower (Blount et al., 1992) and deep breathing (Cohen at al., 2015), but did not lead to changes in levels of child distraction (Cohen et al., 2015), information-seeking (Gonzalez et al., 1989; Manimala et al., 2000), verbal resistance (Gonzalez et al., 1993; Manimala et al., 2000), or requesting emotional support (Gonzalez et al., 1993; Manimala et al., 2000). Findings were split pertaining to broad behavioral composite measures of children's coping responses, with one study finding that a parent training program did not lead to higher children's coping response composite scores (Cohen et al., 1997) and the other study finding a causal relationship (Manimala et al., 2000). The contextual parent variable of presence versus absence did not have a causal relationship with the discrete child coping responses of information-seeking (pre-procedure or during the procedure), verbal resistance (pre-procedure or during the procedure), or seeking emotional support during the procedure. However, parent absence predicted higher levels of children seeking emotional support pre-needle (Gonzalez et al., 1989). Online Supplementary Table 5 summarizes the aforementioned findings.

<u>Relationship Cluster III</u>: Parent Cognitive-Affective, Behavioral, and Contextual

Variables and Children's Coping Outcomes.

Bivariate correlations. Three studies examined the bivariate relationships between broad behavioral composite measures of parent "coping-promoting behaviors" and children's coping outcomes. Two of the three studies found no relationship (Blount et al., 1997; Frank et al., 1995) and one of the three obtained mixed findings (Blount et al., 2001), depending on the coping outcome type of measurement. Four studies examined the bivariate relationships between broad behavioral composite measures of parent "distress-promoting behaviors" and children's coping outcomes. Two studies found a positive relationship (i.e., related to less optimal children's coping outcomes) across all coping outcomes (Cohen et al., 2002; Frank et al., 1995) and the two other studies found the same relationship for the vast majority of children's coping outcomes (Blount et al., 1997; Blount et al., 2001). Discrete parent-coping promoting behaviors such as coaching a child to breathe, commanding a child to use a coping strategy, and using non procedure-related talk were generally unrelated to children's coping outcomes (Cohen et al., 2000; Manne et al., 1994). Discrete parent distress-promoting behaviors such as apologizing, verbal reassurance, criticism, and empathy were generally related to less optimal coping outcomes (Cohen et al., 2000; Manne et al., 1992). Findings pertaining to the cognitive-affective parent variables of catastrophizing about their child's pain and fear during the procedure were mixed. Specifically, both were unrelated to child reports of pain, and related to higher levels of child reported fear, and parent reports of child pain (Vervoort et al., 2011). Online Supplementary Table 6 summarizes the aforementioned findings.

Sequential analyses. For the same rationale as aforementioned, a broad synthesis is provided. In summary, a bidirectional relationship between parent behaviors and children's coping outcomes was indicated. Verbal reassurance emerged as the most likely parent behavior

to both follow and precede less optimal child coping outcomes (Blount et al., 1989; Blount et al., 1991; Manne et al., 1992; Taylor et al., 2011). Online Supplementary Table 7 summarizes the aforementioned findings.

Multiple regressions/partial correlations. Due to the large number of analyses conducted pertaining to this relationship (i.e., most studies conducted several regressions), findings reported below have been organized according to the type of children's outcome variable used as an outcome measure (i.e., self-report, other-report, behavioral, or physiological). Online Supplementary Table 8 summarizes the findings below.

Children's coping outcome: self-report. Broad behavioral composite measures of parent coping-promoting behaviors were consistently unrelated to child self-report of coping outcomes such as fear of future procedures and pain (Cohen et al., 2002; Spagrud et al., 2008). Broad behavioral composite measures of parent distress-promoting behaviors were consistently related in a less optimal manner to these variables (Cohen et al., 2002; Spagrud et al. 2008). The discrete parent coping-promoting behavior of distraction was unrelated to child self-report of pain (McCarthy et al., 2010). In terms of cognitive-affective parent variables, parent catastrophizing about their child's pain had varied findings, as it was related to higher levels of child self-report of fear but not pain (Vervoort et al., 2011). Moreover, parent expectation of child distress was related to higher levels of child self-report of pain (McCarthy et al., 2010).

Children's coping outcome: other-report. All studies used parent report of child pain. Broad behavioral composite measures of parent coping-promoting behaviors suggested a positive relationship with parent report of child pain (Cohen et al., 2002) as well as no relationship (Spagrud et al., 2008). Broad behavioral composite measures of parent distress-promoting behaviors were also both related (Spagrud et al., 2008) and unrelated to parent report of child

pain (Cohen et al., 2002). In the case of Spagrud et al. (2008), higher levels of parent distress-promoting behaviors related to higher parent report of children's pain. The cognitive-affective parent variable of catastrophizing about their child's pain was related to higher parent report of children's pain (Vervoort et al., 2011).

Children's coping outcome: behavioral. Broad behavioral composite measures of parent coping-promoting behaviors were unrelated to behavioral distress in two studies (Frank et al., 1995; Spagrud et al., 2008) and related to higher levels of behavioral distress in one study (Cohen et al., 2002). Broad behavioral composite measures of parent distress-promoting behaviors were consistently related to higher levels of behavioral distress (Cohen et al., 2002; Frank et al., 1995; Spagrud et al., 2008). The discrete parent coping-promoting behavior of distraction was unrelated. In terms of cognitive-affective parent variables, parent trait anxiety was unrelated (Frank et al., 1995), whereas parent expectation of child distress was both unrelated (Spagrud et al., 2008) and positively related to children's behavioral distress (McCarthy et al., 2010).

Children's coping outcome: physiological. One very large study examined physiological measures. The discrete parent coping-promoting behavior of distraction was unrelated to child cortisol levels (McCarthy et al., 2010). The cognitive-affective parent variable of perception of child distress the morning of the procedure was related to higher levels of child cortisol. The authors used child cortisol levels to operationalize biological distress.

T-tests/ANOVAs. A number of studies used an experimental design to examine a causal relationship between parent behavioral variables and children's coping outcomes. As a whole, parent training on coaching children to cope did not consistently predict more optimal children's coping outcomes within and across studies, spanning across self-report, other-report, and

physiological domains (Blount et al., 1992; Cohen et al., 1997, 2015; Gonzalez et al., 1993; Manimala et al., 2000). However, several of these studies did observe at least one causal relationship (in an optimal direction) with behavioral measures of children's coping outcomes (Blount et al., 1992; Gonzalez et al., 1993; Manimala et al., 2000). The contextual parent variable of presence versus absence showed mixed results, depending on the type of children's outcome measured (Gonzalez et al., 1989). Online Supplementary Table 9 summarizes the aforementioned findings.

Discussion

This systematic review serves to help inform the field by offering four key findings that emerged regardless of age, health status of the sample, sample size, and quality of each study. First, combinations of parent behaviors (for better or for worse) are more predictive of children's coping responses and outcomes than are individual parent behaviors alone. Second, parent coping-promoting behaviors enacted in combination are the most consistent predictors of optimal children's coping responses and parent distress-promoting behaviors enacted in combination are the most consistent predictors of children's distress (i.e., less optimal coping outcomes). Third, less optimal parent cognitive-affective variables predict less optimal cognitive-affective children's coping outcomes and this finding is most consistent for parent negative expectation of child distress. Finally, parent verbal reassurance is a suboptimal parent behavior that appears to have a cyclical relationship with children's distress, whereby verbal reassurance occurs both before and after children's distress.

Relationship Cluster I: Children's Coping Responses and Children's Coping Outcomes

Composite measures of children's coping responses combining an assortment of coping behaviors were most consistently linked to more optimal children's coping outcomes. Thus, it

appears that children who employ a variety of coping responses fare the best in terms of levels of distress. In the cognitive domain, children's catastrophizing appeared to be differentially related to more negative emotional (i.e., fear) versus sensory (i.e., pain from the physical stimulus) sequelae of the needle-related procedure. This pattern of findings did not vary based on age, health status of the sample, sample size, or quality of each study.

Relationship Cluster II: Parent Cognitive-Affective, Behavioral, and Contextual Variables and Children's Coping Responses

Parent "coping-promoting behaviors" (i.e., non procedural talk, humor, commands to use coping strategies) engaged in combination as well as individually were consistently associated with children's use of optimal coping responses that "paralleled " the parents' behaviors, with this relationship persisting when accounting for a range of other factors (contextual, child demographic, and parent cognitive-affective). A particularly interesting finding was that cognitive-affective parent variables such as catastrophizing about their child's pain, fear during the procedure, and having an anxious predisposition were unrelated to children's coping responses. These findings suggest that what parents do in the distressing context of needle-related procedures (particularly pertaining to constructive "coping-promoting behaviors" enacted towards their child) is more influential from a child coping response perspective than how parents may be feeling about or perceiving the stressful situation involving their children. In terms of parent training programs, these appear particularly helpful for promoting children's breathing-related coping responses. Finally, the relationship between parent behaviors and children's behavioral coping responses appears to be bidirectional. As with Relationship Cluster II, these patterns of findings did not vary when considering age, health status of the sample, sample size, or quality of each study.

<u>Relationship Cluster III</u>: Parent Cognitive-Affective, Behavioral, and Contextual Variables and Children's Coping Outcomes

Composite measures of parent "distress-promoting behaviors" comprised of a range of different behaviors were most consistently associated with less optimal children's coping outcomes, with this relationship persisting when controlling for a range of other factors (contextual, child demographic, and parent cognitive-affective). Within the domain of "distress-promoting" behaviors, parent verbal reassurance consistently emerged as a key discrete behavior linked in a bidirectional manner (i.e., parent to child; child to parent) with less optimal children's coping outcomes. Findings pertaining to cognitive-affective parent variables were particularly nuanced, based on type of parent variable, type of coping outcome, as well as the health status and age-range of the sample. Synthesizing these factors, it appears that the link between parent cognitive-affective variables and children's coping outcomes is strongest when the child coping outcomes "parallel" the parent variable (i.e., are also "cognitive-affective", such as children's fear or parent perception of children's pain, rather than children's actual report of pain from the physical stimulus). Another interesting pattern was that the most consistent link between cognitive-affective parent variables (i.e., spanning across self-report, behavioral, and physiological child coping outcomes) was when parents had negative expectations about their children's distress their child had more distress. A possible explanation could be that parents with less positive expectations may be acting in less constructive/supportive manners towards their children, thus contributing towards greater child distress. Findings from experimental studies suggest that parent training programs can be helpful for reducing behavioral indicators of child distress. This finding provides further support for the use of multidimensional pain assessment measures (i.e., that include a behavioral component), rather than just self- or other-

report. As with Relationship Clusters I and II, these patterns of findings did not vary when considering age, health status of the sample, sample size, or quality of each study.

Clinical Implications

Parents and medical professionals should be encouraged to support children in employing a variety of coping responses (i.e., deep breathing, non-procedural talk, making coping statements, and using humor) during needle-related procedures. Not only do these behaviors employed in conjunction appear to be beneficial, but providing a variety of options to children will likely be helpful in what can be an overwhelming context. Parents should be encouraged and empowered to engage in a variety of coping-promoting behaviors and taught explicitly to avoid distress-promoting behaviors. These recommendations can be applied by healthcare professionals not only during the procedures, but also proactively by way of parent training programs as well as other instructional materials (e.g., pamphlets, DVDs). It may be particularly helpful to inform parents who appear anxious, fearful, or who tend to catastrophize of the benefits of engaging in coping-promoting behaviors and support them in engaging in these behaviors. Additionally, parent negative expectation of child distress should be screened for and, in relevant cases, attempts should be made by healthcare practitioners to work with parents to promote more positive expectations (i.e., through discussion with parents and reminder of the strategies that can be employed to support children's coping).

Limitations

The vast majority of studies were American (85%), many of which were from an affiliated group of researchers. Thus, the generalizability of findings from the present review may be limited. Additionally, the wide age ranges in the majority of studies may have resulted in important developmental differences being missed. Moreover, the lower quality of several

studies must be taken into consideration, as well as that all studies were cross-sectional in design. Finally, because the study focused on the relationship of parent variables with children's coping, studies were required to include a children's coping response, a children's coping outcome, and a parent variable. Accordingly, studies that included two of the three but not all three variables were not included. As such, not all studies in the literature with informative findings pertaining to each of the three individual relationships were included.

Directions for Future Research

In light of the findings from the present review, several recommendations are put forth. First, renewing classic criticisms from previous reviews, future researchers are encouraged to move away from simply using "coping" as a catch-all term, and explicitly disentangle coping responses from coping outcomes. Second, future studies should consider analyzing the relationships between children's coping responses, coping outcomes, and parent variables according to different phases of the needle-related procedure (i.e., prior to, during, and after the procedure). Doing so may facilitate a more nuanced understanding of the complex and dynamic processes involved. Third, future research should be comprised of samples with tighter age ranges to account for the steep cognitive and behavioral developmental trajectory that occurs across childhood and the differential role of parents in coping from infancy to adolescence. Moreover, when examining findings across our results tables and considering patterns among age, it was hard to find patterns due to paucity of data. This may reflect the lack of literature rather than an actual reflection of lack of age patterns.

Novel directions for future research should include adopting a more *developmental* conceptualization of children's coping (Skinner & Zimmer-Gembeck, 2007) by concurrently examining other developing subsystems that may underlie this construct (i.e., cognition,

language, attention) as infants transition from being wholly regulated from distress by parents to autonomous self-regulation in adolescence.

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Table 1. Study characteristics

Study	Country	N	Age	Location	Needle-related Procedure	Type of Study	Health Status of Sample	If Clinical, Condition	Quality score
Blount (1989)	USA	23	5-13	Hospital	BMA/LP	Observational	Clinical	ALL	11
Blount (1990)	USA	22	5-13	Hospital	BMA/LP	Observational	Clinical	ALL	12
Blount (1991)	USA	22	5-13	Hospital	BMA/LP	Observational	Clinical	ALL	12
Blount (1992)	USA	60	3-7	Primary Health Care Clinic	Immunization	Experimental	Healthy		14
Blount (1997)	USA	77	4-7	Primary Health Care Clinic	Immunization	Observational	Healthy		12
Blount (2001)	USA	60	3-7	Primary Health Care Clinic	Immunization	Observational	Healthy		16
Cohen (1997)	USA	92	4-6	Primary Health Care Clinic	Immunization	Experimental	Healthy		15
Cohen (2000)	USA	55	4-6	Primary Health Care Clinic	Immunization	Observational	Healthy		16
Cohen (2002)	USA	61	3-7	Primary Health Care Clinic	Immunization	Experimental	Healthy		16
Cohen (2015)	USA	90	4-6	Primary Health Care Clinic	Immunization	Experimental	Healthy		14
Frank (1995)	USA	77	4-7	Primary Health Care Clinic	Immunization	Observational	Healthy		15
Gonzalez (1989)	USA	47	1-8	Primary Health Care Clinic	Immunization	Experimental	Healthy		15
Gonzalez (1993)	USA	42	3-7	Primary Health Care Clinic	Immunization	Experimental	Healthy		15
Manimala (2000)	USA	82	4-6	Primary Health Care Clinic	Immunization	Experimental	Healthy		15
Manne (1992)	USA	43	3-9	Hospital	Venipuncture	Observational	Clinical	Cancer	15
Manne (1994)	USA	35	3-9	Hospital	Venipuncture	Observational	Clinical	Cancer	10
McCarthy (2010)	USA	542	4-10	Hospital	IV insertion	Observational	Healthy		16
Spagrud (2008)	Canada	55	3-18	Hospital	Venipuncture	Observational	Clinical	Cancer	16
Taylor (2011)	Australia	66	3-12	Hospital	Venipuncture	Observational	Clinical	Acute Illness	15
Vervoort (2011)	Belgium	44	8-15	Hospital	Finger Prick	Observational	Clinical	Type I Diabetes	14

Note. **BMA/LP** = Bone Marrow Aspiration/Lumbar Puncture; **ALL** = Acute Lymphocytic Leukemia

Online Supplementary Table 1. Studies examining the bivariate relationship between child coping responses and coping outcomes

Study	Coping response(s) broader domain	Coping outcome(s) type of measurement	If multiple, types	Summary of Finding
Blount (1997)	Behavioral	Multiple	•Self-report •Other-report •Multiple	
Blount (2001)	Behavioral	Multiple	•Self-report •Other-report •Behavioral	
Frank (1995)	Behavioral	Behavioral	N/A	❖
Manne (1992)	Behavioral	Behavioral	N/A	❖
Manne (1994)	Behavioral	Behavioral	N/A	❖
Vervoort (2011)	Cognitive	Multiple	•Self-report •Other-report	❖

Note. ✓ = coping response(s) related to coping outcome(s); ✕ = coping response(s) not related to coping outcome(s); ❖=mixed findings

Online Supplementary Table 2. Studies examining the bivariate relationship between parent variables and children's coping responses (correlations)

Study	Coping response(s) broader domain	Parent variable(s) broader domain	If multiple, types	Summary of finding
Blount (1997)	Behavioral	Behavioral	N/A	❖
Blount (2001)	Behavioral	Behavioral	N/A	
Cohen (2000)	Behavioral	Behavioral	N/A	
Frank (1995)	Behavioral	Multiple	•Cognitive-Affective •Behavioral	❖
Manne (1994)	Behavioral	Behavioral	N/A	❖
Vervoort (2011)	Cognitive	Multiple	•Cognitive •Cognitive-Affective	

Note. ✓ = parent variable(s) related to coping response(s); ✕ = parent variable(s) not related to coping response(s); ❖= mixed findings

Online Supplementary Table 3. Studies examining the bivariate relationship between parent variables and children's coping responses (sequential analyses)

Study	Coping response(s) broader domain	Parent variable(s) broader domain	If multiple, types	Summary of finding
Blount (1989)	Behavioral	Behavioral	N/A	❖
Blount (1991)	Behavioral	Behavioral	N/A	❖
Manne (1992)	Behavioral	Behavioral	N/A	❖
Spagrud (2008)	Behavioral	Multiple	•Cognitive-Affective •Behavioral	
Taylor (2011)	Behavioral	Behavioral	N/A	❖

Note. ✓ = parent variable(s) related to coping response(s); ✕ = parent variable(s) not related to coping response(s); ❖= mixed findings

Online Supplementary Table 4. Studies examining the relationship between parent variables and children's coping responses with other variables accounted for

Study	Coping response(s) broader domain	Parent variable(s) broader domain	If multiple, types	Summary of finding
Cohen (2002)	Behavioral	Behavioral	N/A	
Frank (1995)	Behavioral	Multiple	•Cognitive-Affective •Behavioral	❖
Manne (1994)	Behavioral	Behavioral	N/A	
Spagrud (2008)	Behavioral	Multiple	•Cognitive-Affective •Behavioral	❖

Note. ✓= parent variable(s) uniquely related to child coping response(s) when other variables were accounted for; ✕=parent variables did not uniquely relate to child coping response(s) when other variables were accounted for; ❖=mixed findings

Online Supplementary Table 5. Studies examining a causal relationship between parent variables and children's coping responses

Study	Coping response(s) broader domain	Parent variable(s) broader domain	If multiple, types	Summary of finding
Blount (1992)	Behavioral	Behavioral	N/A	❖
Cohen (1997)	Behavioral	Behavioral	N/A	
Cohen (2015)	Behavioral	Behavioral	N/A	
Gonzalez (1989)	Behavioral	Contextual	N/A	❖
Gonzalez (1993)	Behavioral	Behavioral	N/A	
Manimala (2000)	Behavioral	Behavioral	N/A	❖

Note. ✓=parent variable(s) had a causal relationship with child coping response(s); ✕=parent variable(s) did not have a causal relationship with child coping responses; ❖=mixed findings

Online Supplementary Table 6. Studies examining the bivariate relationship between parent variables and children's coping outcomes (correlations)

Study	Coping outcome(s) type of measurement	If multiple, types	Parent variable(s) broader domain	If multiple, types	Summary of Finding
Blount (1997)	Multiple	•Self-report •Other-report •Multiple	Behavioral	N/A	❖
Blount (2001)	Multiple	•Self-report •Other-report •Behavioral	Behavioral	N/A	❖
Cohen (2000)	Behavioral	N/A	Behavioral	N/A	❖
Cohen (2002)	Multiple	•Self-report •Other-report •Behavioral	Behavioral	N/A	
Frank (1995)	Behavioral	N/A	Multiple	•Cognitive-Affective •Behavioral	❖
Manne (1992)	Behavioral	N/A	Behavioral	N/A	❖
Manne (1994)	Behavioral	N/A	Behavioral	N/A	
Vervoort (2011)	Multiple	•Self-report •Other-report	Cognitive-Affective	N/A	❖

Note. ✓ = parent variable(s) related to coping outcome(s); ✕ = parent variable(s) not related to coping outcome(s); ❖= mixed findings

Online Supplementary Table 7. Studies examining the bivariate relationship between parent variables and children's coping outcomes (sequential analyses)

Study	Coping outcome(s) type of measurement	If multiple, types	Parent variable(s) broader domain	If multiple, types	Summary of Finding
Blount (1989)	Behavioral	N/A	Behavioral	N/A	❖
Blount (1991)	Behavioral	N/A	Behavioral	N/A	
Manne (1992)	Behavioral	N/A	Behavioral	N/A	❖
Taylor (2011)	Behavioral	N/A	Behavioral	N/A	❖

Note. ✓ = parent variable(s) related to coping outcome(s); ✕ = parent variable(s) not related to coping outcome(s); ❖= mixed findings

Online Supplementary Table 8. Studies examining the relationship between parent variables and children's coping outcomes with other variables accounted for

Study	Coping outcome(s) type of measurement	If multiple, types	Parent variable(s) broader domain	If multiple, types	Summary of Finding
Cohen (2002)	Multiple	•Self-report •Other-report •Behavioral	Behavioral	N/A	❖
Frank (1995)	Behavioral	N/A	Multiple	•Cognitive-affective •Behavioral	❖
Manne (1994)	Behavioral	N/A	Behavioral	N/A	
McCarthy (2010)	Multiple	•Self-report •Other-report •Behavioral •Physiological	Multiple	•Cognitive-affective •Behavioral	❖
Spagrud (2008)	Multiple	•Self-report •Other-report •Behavioral	Multiple	•Cognitive-affective •Behavioral	❖
Vervoort (2011)	Multiple	•Self-report •Other-report	Cognitive-affective	•N/A	❖

Note. ✓= parent variable(s) uniquely related to child coping outcome(s) when other variables were accounted for; ✕=parent variable(s) did not uniquely relate to child coping outcome(s) when other variables were accounted for; ❖=mixed findings

Online Supplementary Table 9. Studies examining a causal relationship between parent variables and children's coping outcomes

Study	Coping outcome(s) type of measurement	If multiple, types	Parent factor(s) broader domain	If multiple, types	Summary of finding
Blount (1992)	Multiple	•Self-report •Other-report •Behavioral	Behavioral	N/A	❖
Cohen (1997)	Multiple	•Self-report •Other-report •Behavioral	Behavioral	N/A	
Cohen (2015)	Multiple	•Self-report •Other-report •Behavioral	Behavioral	N/A	
Gonzalez (1989)	Multiple	•Behavioral •Physiological	Contextual	N/A	❖
Gonzalez (1993)	Multiple	•Self-report •Behavioral	Behavioral	N/A	❖
Manimala (2000)	Multiple	•Self-report •Behavioral	Behavioral	N/A	❖

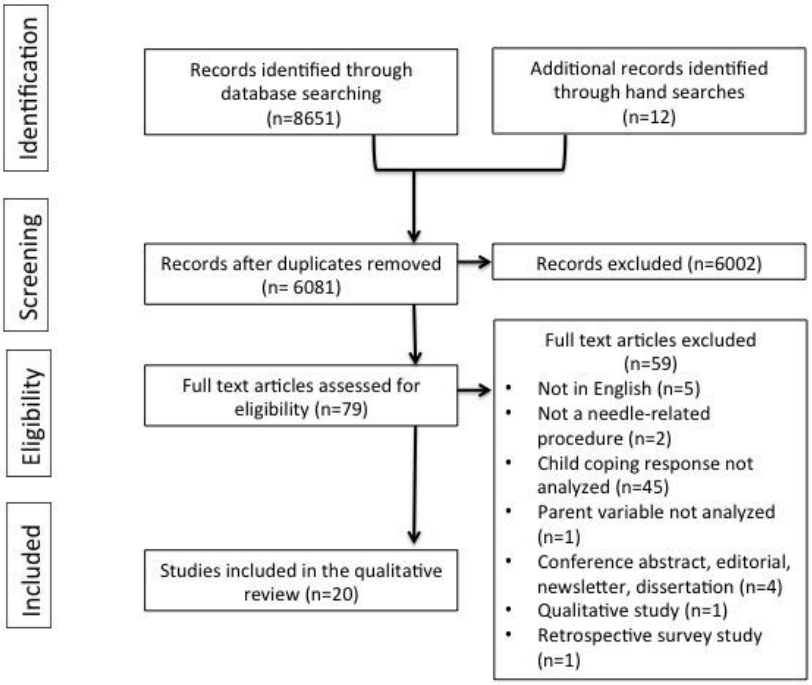
Note. ✓=parent variable(s) had a causal relationship with child coping outcome(s) ✕=parent variable(s) did not have a causal relationship with child coping outcome(s); ❖=mixed findings

Online Supplementary Table 10. Operationalization of Study Variables

Study	Operationalization of coping response(s)	Operationalization of coping outcome(s)	Operationalization of parent variable(s)
Blount (1989)	•Child-Adult Medical Procedure Interaction Scale (CAMPIS; Blount et al., 1987)- *specific behavioral subscales*	•Child-Adult Medical Procedure Interaction Scale (CAMPIS; Blount et al., 1987)- *specific behavioral subscales (crying and screaming)*	•Child-Adult Medical Procedure Interaction Scale (CAMPIS; Blount et al., 1987)- *specific behavioral subscales*
Blount (1990)	•Child-Adult Medical Procedure Interaction Scale-Revised (CAMPIS-R; Blount et al., 1990)- *Child Verbal Coping Composite and Child Audible Deep Breathing Composite*	•Child-Adult Medical Procedure Interaction Scale-Revised (CAMPIS-R; Blount et al., 1990)- *Child Distress Composite*	•Child-Adult Medical Procedure Interaction Scale-Revised (CAMPIS-R; Blount et al., 1990)- *Parent Distress-Promoting Behaviors Composite, Parent Non Procedural talk + humour composite, parent commands to use coping strategies*
Blount (1991)	•Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1990)- *Child Coping Composite*	•Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1990)- *Child Distress Composite*	•Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1990)-*Parent coping-promoting, parent distress- promoting, and parent neutral composites*
Blount (1992)	•Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1990)-*Audible Deep Breathing Subscale* •Behavioral Approach-Avoidance and Distress Scale (BAADS; Hubert et al., 1988)- *Approach/Avoidance Subscale*	•Child self-report of pain (LeBaron et al., 1984) •Child self-report of fear pre-needle (LeBaron et al., 1984) •Parent report of child pain- Visual Analog Scale •Parent report of child fear pre-needle- Visual Analog Scale •Nurse report of child pain- Visual Analog Scale •Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1990)- *Child Distress Composite* •Behavioral Approach-Avoidance and Distress Scale (BAADS; Hubert et al., 1988)- *Distress Subscale* •Observational Scale of Behavioral Distress (OSBD; Jay et al., 1984)- *Total Distress Score Composite*	•Parent behavioral training program
Blount (1997)	•Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1997)- *Child Coping Composite* •Behavioral Approach-Avoidance and Distress Scale (BAADS; Hubert et al., 1988)- *Approach/Avoidance Subscale*	•Child self-report of fear (LeBaron et al., 1984) •Child self-report of pain (LeBaron et al., 1984) •Nurse report of child distress- Visual Analog Scale •Parent report of child fear- Visual Analog Scale •Parent report of child pain- Visual Analog Scale •Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1990)-*Child Distress Composite* •Behavioral Approach-Avoidance and Distress Scale (BAADS; Hubert et al., 1988)- *Distress Subscale* •Observational Scale of Behavioral Distress (OSBD; Jay et al., 1984)	•Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1990)-*Parent coping-promoting, parent distress- promoting, and parent neutral composites*
Blount (2001)	•Child-Adult Medical Procedure Interaction Scale-Short Form (CAMPIS-SF; Blount et al., 2001)- *Child Coping Composite* •Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1990)- *Child Coping Composite*	•Child self-report of fear (LeBaron et al., 1984) •Child self-report of pain (LeBaron et al., 1984) •Nurse report of child distress- Visual Analog Scale •Parent report of child fear- Visual Analog Scale	•Child-Adult Medical Procedure Interaction Scale-Short Form (CAMPIS-SF; Blount et al., 2001)- *Parent coping-promoting and parent distress-promoting composites*

	•Behavioral Approach-Avoidance and Distress Scale (BAADS; Hubert et al., 1988)- *Approach/Avoidance Subscale*	•Parent report of child pain- Visual Analog Scale •Child-Adult Medical Procedure Interaction Scale-Short Form (CAMPIS-SF; Blount et al., 2001)- *Child Distress Composite* •Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1997)-Child Distress Composite •Behavioral Approach-Avoidance and Distress Scale (BAADS; Hubert et al., 1988)- *Distress Subscale* •Observational Scale of Behavioral Distress (OSBD; Jay et al., 1983)	•Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1990)- *Parent coping-promoting and distress- promoting composites*
Cohen (1997)	•Modified version of child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1997)- *Child Coping Composite*	•Child self-report of pain (FACES scale; LeBaron et al., 1984) •Parent report of child distress- Visual Analog Scale •Nurse report of child distress- Visual Analog Scale •Modified Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1997)- *Child Distress Composite*	•Parent behavioral training program
Cohen (2000)	•Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1997)- *Child Coping Composite*	•Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1997)- *Child Distress Composite*	•Child-Adult Medical Procedure Interaction Scale (CAMPIS; Blount et al., 1989)- *Specific Behavioral Subscales*
Cohen (2002)	•Child-Adult Medical Procedure Interaction Scale-Short Form (CAMPIS-SF; Blount et al., 2001)- *Child Coping Composite*	•Child self-report of fear (unspecified measure of computer-generated "smiley" faces) •Child self-report of pain (unspecified measure of computer-generated "smiley" faces) •Child self-report of distress (unspecified measure of computer-generated "smiley" faces) •Parent report of child distress- Visual Analog Scale •Nurse report of child distress- Visual Analog Scale	•Child-Adult Medical Procedure Interaction Scale-Short Form (CAMPIS-SF; Blount et al., 2001)- *Parent coping-promoting and distress-promoting composites*
Cohen (2015)	•Behaviors selected from commonly coded behaviors in the literature (Blount et al., 1989; Cohen et al., 2005; Elliot et al., 1987)- *Distraction, deep breathing*	•Child self-report of pain- Children's Anxiety and Pain Scales (CAPS; Kuttner et al., 1989) •Parent report of child pain- Visual Analog Scale •Nurse report of child pain- Visual Analog Scale	•Parent behavioral training program
Frank (1995)	•Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1990)- *Child coping and child neutral composites*	•Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1990)- *Child distress composite*	•State and Trait Anxiety Inventory (STAI; Spielberger et al., 1970)- Parent self-report of trait anxiety •Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1990)- *Parent coping-promoting, distress-promoting, and neutral composites*
Gonzalez (1989)	•Observational Scale of Behavioral Distress (OSBD-R; Jay et al., 1983)- *Information-seeking, verbal resistance, and emotional support subscales*	•Modified Frankl Behavior Rating Scale (Shaw et al., 1982) •Observational Scale of Behavioral Distress (OSBD-R; Jay et al., 1983)- *Total distress score and individual behaviors* •Electrocardiogram (ECG)	•Parent presence versus absence
Gonzalez (1993)	•Observational Scale of Behavioral Distress-Revised (OSBD-R; Elliot et al., 1987)- *Information-seeking, verbal resistance, and emotional support subscales*	•Child self-report of pain- Oucher Pain Rating Scale (Byer et al., 1986) •Modified Frankl Behavior Rating Scale (Shaw et al., 1982) •Observational Scale of Behavioral Distress-Revised (OSBD-R; Elliot et al., 1987)- *Total distress score and individual behaviors*	•Parent behavioral training program

Manimala (2000)	•Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1997)- *Child Coping Composite*	•Child self-report of fear pre-needle- (FACES scale; LeBaron et al., 1984) •Child-Adult Medical Procedure Interaction Scale Revised (CAMPIS-R; Blount et al., 1997)- *specific behavioral subscales*	•Parent behavioral training program
Manne (1992)	•Adapted scale from the Procedure Behavior Rating Scale-Venipuncture Version (Jacobsen et al., 1990) and the CAMPIS; Blount et al., 1990)	•Adapted scale from the Procedure Behavior Rating Scale-Venipuncture Version (Jacobsen et al., 1990) and the CAMPIS; Blount et al., 1990)	•Adapted scale from the Procedure Behavior Rating Scale-Venipuncture Version (Jacobsen et al., 1990) and the CAMPIS; Blount et al., 1990)
Manne (1994)	•Modified scale developed for study (based on work by Jacobsen et al., 1990, Manne et al., 1992, and CAMPIS; Blount et al., 1989)	•Modified scale developed for study (based on work by Jacobsen et al., 1990, Manne et al., 1992, and CAMPIS; Blount et al., 1989)	•Modified scale developed for study (based on work by Jacobsen et al., 1990, Manne et al., 1992, and CAMPIS; Blount et al., 1989)
McCarthy (2010)	•Child report of coping style- Child Behavior Style Scale (CBSS; Miller et al, 1995)- *Monitoring versus blunting subscales* •Child self-report of coping style (Watch versus look away) •Parent report of child coping style (Watch versus look away) •Parent report of child coping style (Silent versus emotional)	•Child self-report of pain- Oucher Pain Scale (Aradine et al., 1988) •Parent report of child distress (Likert scale) •Observational Scale of Behavioral Distres Revised (OSBD-R; Jay et al., 1986)- *Total Distress Score Composite* •Cortisol responsivity	•Parent expectation of child's distress during procedure (Likert scale) •Parent percpetion of how distressed child becomes during routine visits (Likert scale) •Parent perception of how distressed child is the morning of the procedure (Likert scale) •Parent report of how actively involved would like to be during procedure (Likert scale) •Stait-Trait Anxiety Inventory (STAI; Spielberger, 1983)- *Trait subscale only* •Distraction Coaching Index (DCI, Kleiber et al., 2007) •Parent previous use of distraction (yes or no question)
Spagrud (2008)	•Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1997)- *Child Coping Composite*	•Faces Pain Scale Revised (FPS-R; Hicks et al., 2001)- Child self-report of pain, nurse report of child pain, parent report of child pain •Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1997)- *Child Distress Composite*	•Faces Pain Scale Revised (FPS-R; Hicks et al., 2001)- Parent report pre-needle of how much pain they expected child to be in •Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1997)- *Parent coping-promoting and distress-promoting composites*
Taylor (2011)	•Modification of the Child-Adult Medical Procedure Interaction Scale (CAMPIS; Blount et al., 1989)	•Modification of the Child-Adult Medical Procedure Interaction Scale (CAMPIS; Blount et al., 1989)	•Modification of the Child-Adult Medical Procedure Interaction Scale (CAMPIS; Blount et al., 1989)
Vervoort (2011)	•Situation-specific measure developed based upon the original Pain Catastrophizing Scale for Children (PCS-C; Crombez et al., 2003)	•Visual Analog Scale- Child self-report of fear, child self-report of pain, parent report of child pain	•Situation-specific measure developed based upon the Pain Catastrophizing Scale for Parents (PCS-P; Goubert et al., 2006) •Parent self-report of fear- Visual Analog Scale



Supplementary Figure 1. Included study flow chart following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines

Chapter 3: Bridging Study 1 (Chapter 2) with Studies 2 and 3 (Chapter 4)

One area for future research suggested in Study 1 was to use samples with tighter age ranges. This suggestion is in line with the idea of examining coping according to different developmental periods due to the steep trajectories of development that occur early in life. Given the dearth of research examining preschool coping with acutely painful medical procedures, and that the preschool age has been put forth as an important developmental stage to investigate in the context of coping (Skinner & Zimmer-Gembeck, 2007), Study 2 and Study 3 (Chapter 4) focused on the preschool stage of development. For the first time in the literature, longitudinal data from infancy were brought into the preschool analyses.

The preschool sample was a subsample of the OUCH cohort. The preschool wave is a subsample of 760 parent-infant dyads who were videotaped when the infants were two, four, six, and/or 12 months of age during their routine immunizations. Study 2 focuses on a subsample of 302 children from the cohort who were seen at the preschool vaccination (ages 4-5 years). Study 3 focused on members of the cohort who were analyzed at the 12-month vaccination, the preschool vaccination, and at the time of a preschool psychological assessment. Specifically, 548 caregiver-infant dyads were seen at 12-month vaccination, 302 caregiver-child dyads were seen at the preschool vaccination (ages 4-5 years), and 172 children participated in a preschool assessment at our laboratory after their preschool vaccination. Further details are provided below.

An important finding from Study 1 (Systematic Review) was that combinations of children's coping responses (i.e., measures that summed multiple coping responses such as deep breathing, nonprocedural talk, making coping statements, and using humor) were

generally related to improved coping outcomes. However, a detailed examination of studies in the review indicated that none of the studies that evaluated this relationship did so according to different phases within the needle-related procedure (e.g., prior to the procedure versus during the procedure versus following the procedure, etc.) Specifically, these studies combined both coping responses and coping outcomes across various phases of the needle-related procedure into aggregate variables and then examined the relationship between the two.

Relating back to the importance of studying coping as an ongoing and dynamic process that changes in response to changing demands in an environment perceived as stressful (Compas, 1998; Compas et al., 2001), examining these relationships through a *transactional* lens may be informative. In order to do so, measuring coping responses and coping outcomes at multiple phases of a needle-related procedure (i.e., prior to, during, and after the procedure) and subsequently examining the various interrelationships within and across time would be needed. This rationale is in line with Lazarus and Folkman (1987) who argued that, when studying coping from a transactional perspective, "coping must be measured over a number of slices of time" (p. 143). Accordingly, Study 2 aimed to conduct a fine-grained analysis of the transactions between composite measures of preschooler's coping responses and preschooler's coping outcomes within the preschool vaccination appointment to better understand this dynamic process as it unfolds within a vaccination appointment. The method used to conduct this analysis was cross-lagged path analysis (e.g., Kessler & Greenberg, 1981). No studies to date have examined the interrelationships between children's coping responses and coping outcomes using this analytical approach. In a single analysis, this technique enables the examination of the

various relationships between two different variables measured over time, while controlling for all other interrelationships between variables. Preschooler coping responses were measured at three different 60-second phases within the vaccination appointment (Pre-needle, 1 Minute, 2 Minutes; see phases in Appendix D). Preschooler coping outcomes were measured at the same three 60-second phases (see phases in Appendix D). Appendix D also shows the phases of the vaccination when additional preschool measures were obtained.

Another important finding from Study 1 (Systematic Review) was that parent behavioural and cognitive-affective variables were related to children's coping with needle-related procedures. Specifically, parent "coping-promoting behaviours" (i.e., nonprocedural talk, humor, commands to use coping strategies) engaged in combination were associated with children's use of optimal coping responses and parent "distress-promoting behaviours" (i.e., reassuring, criticizing, apologizing, giving control) engaged in combination were associated with less optimal children's coping outcomes. In terms of parent cognitive-affective variables, the most consistent link found was that when parents had negative expectations about their children's distress, their child showed more distress. In addition, Study 1 argued for future research to take a developmental approach to studying children's coping with needle-related procedures by concurrently examining other developing subsystems that may underlie the coping process. The importance of using longitudinal designs to examine developmental pathways of children's coping with needle-related procedures was also specified.

Taking these findings from Study 1 (Systematic Review) and Study 2 (cross-lagged analysis of preschooler coping responses and coping outcomes) together, the goal

of Study 3 was to conduct comprehensive longitudinal analyses predicting preschool-aged children's coping responses and coping outcomes during vaccination using a variety of different cognitive-affective and behavioural parent and child predictors from the 12-month vaccination and the preschool vaccination. Appendix E shows the phases from the infant vaccination as operationalized for this study.

In terms of parent predictors, similar to many studies in Study 1 (Chapter 2), the analyses in Study 3 included parent "coping-promoting" and "distress-promoting" behaviours coded using the Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R; Blount et al., 1997; see Appendices H and I). This scale is considered an exemplar in measuring parent and child verbalizations related to coping in medical contexts. These codes were based off parent behaviours enacted during the preschool vaccination. The cognitive-affective variable of parent worry prior to the needle was also evaluated as a potential predictor of children's coping responses and coping outcomes. Given that parent negative expectation about their child's distress emerged as an important variable related to children's coping in Study 1, it was of interest to evaluate whether parent worry prior to the needle also played a role (see Appendix G). Finally, for the first time in the field to date, the role of parent sensitivity in predicting children's coping with needle-related pain at preschool was investigated. Specifically, parent sensitivity at the 12-month vaccination (see Appendix K) as well as during the preschooler's vaccination (see Appendix N) was also included in the analyses. In addition to parent sensitivity at the 12-month vaccination, the parent behaviours of proximal soothing and verbal reassurance at the 12-month vaccination were included as longitudinal predictors (see Appendix L).

In regard to child predictors of children's coping, two cognitive subsystems were investigated that have been postulated to underlie the processes involved in coping (Skinner & Zimmer-Gembeck, 2007) but have yet to be empirically examined in the acute pain context. These two cognitive subsystems were executive functioning and language, data for which were obtained at the preschool assessment. As aforementioned, executive functions refer to higher-order self-regulatory cognitive processes (e.g., working memory, planning, sequencing, and inhibitory control) and have been posited to serve as a foundation for coping and emotion regulation (Compas, 2006). In terms of language, it has been posited that coping responses depend heavily on language development, both in terms of the communicative aspects of coping, and in terms of the internal use of language in cognitions and self-instruction (Fields & Prinz, 1997). Finally, given that self-regulatory capacities have been posited to contribute towards the skills required for competent coping (Eisenberg, Valiente, & Sulik, 2009), infant pain-related distress from the 12-month vaccination was included as a longitudinal predictor (see Appendix M).

For Study 3, four longitudinal path analyses were employed, predicting preschooler coping responses (see Appendix H) and preschooler coping outcomes (see Appendix J) separately at two different time points (the one-minute period following the last needle and the second one-minute period following the last needle). Study 3 is the first study to date to examine the development of children's coping with needle-related pain over time, using a longitudinal design.

Thus, in conclusion the ultimate goal of the next chapter (Chapter 4; Study 2 and 3) was to conduct an in-depth dynamic analysis of preschooler coping with vaccination pain, taking into account timing, the parent, and the child's development.

Chapter 4: Preschool Children's Coping Responses and Outcomes in the Vaccination Context: Child and Caregiver Transactional and Longitudinal Relationships (Study 2 and Study 3)[2]

1. Introduction

In the pediatric pain and coping literature, the use of the term "coping" has been a "knotty conceptual issue" in the field [11]. Specifically, the term "coping" has been used as a catch-all term referring to behaviors that reduce distress [e.g., 11,12,19,25] as well as to the actual reduction of distress [44,50]. Almost 25 years ago, Rudolph and colleagues [43] argued that in order for the field of pediatric pain and coping to move forward, a clear differentiation must be made between "coping responses" and "coping outcomes." The former was defined as intentional physical or mental actions (e.g., deep breathing, distraction) initiated in response to a perceived stressor and the latter was defined as the specific consequences of one's coping responses (e.g., crying or screaming). However, despite a well-argued review, few studies have acknowledged this differentiation. In order to increase clarity in the field of pediatric pain and coping, it is critical to explicitly disentangle coping responses from coping outcomes (and to use these terms specifically).

A new systematic review recently sorted and synthesized coping responses and coping outcomes in children aged 3 to 12 years [17]. This review highlighted the paucity of studies that took the phase of the needle-related procedure into account, the lack of

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[2] This chapter is the author version of the following 'in press' manuscript:
Campbell, L., Pillai Riddell, R., Cribbie, R., Garfield, H., Greenberg, S. (in press). Preschool Children's Coping Responses and Outcomes in the Vaccination Context: Child and Caregiver Transactional and Longitudinal Relationships. Manuscript in press *PAIN.*

Please also note that the Study labeled as 'Study 1' in this manuscript, is the 2nd study of the dissertation. The Study labeled as 'Study 2' in this chapter is the 3rd and final study of the dissertation.

developmental (age-related) considerations, and that no studies have used a longitudinal design. The review [17] also underscored the importance of caregiver cognitive-affective and behavioural variables, as well as the need to consider children's developing cognitive abilities (e.g., language and executive functioning), which may come into play more strongly during preschool.

The current paper includes two companion studies: the first examined the dynamic and reciprocal relationships between children's coping responses and coping outcomes during the preschool vaccination. The second examined the prediction of preschool children's coping responses and coping outcomes (during the first two minutes post-vaccination; 4 models total) using a broad array of caregiver and child variables from both the 12-month and preschool stage.

For the first study, it was hypothesized that within the preschool vaccination appointment: (1) preceding coping responses would positively predict forward to subsequent coping responses; (2) preceding coping outcomes would positively predict forward to subsequent coping outcomes; (3) concurrent coping responses and coping outcomes would be negatively related; (4) preceding coping responses would negatively predict subsequent coping outcomes; (5) preceding coping outcomes would negatively predict subsequent coping responses.

For the second study, utilizing parent and infant variables from the 12-month vaccination and data from a full-day preschooler psychological assessment, preschool vaccination coping responses and outcomes were modeled. Four broad hypotheses shaped the predictive pathways across the four models:

(1) *Caregiver Behavior During 12-month Vaccination to Caregiver Behavior During Preschool Vaccination to Preschooler Vaccination Behavior Pathways*: Caregiver behavioral variables from the 12-month vaccination (caregiver sensitivity, proximal soothing, verbal reassurance) would predict parallel caregiver behavioral variables at their child's preschool vaccination (caregiver sensitivity, coping-promoting behaviors, distress-promoting behaviors), which in turn would predict the preschooler's vaccination behavior (coping responses and outcomes).

(2) *Caregiver Behavior During 12-month Vaccination to Preschooler Cognitive Ability to Preschooler Vaccination Behavior Pathways*: Higher caregiver sensitivity and proximal soothing (caregiver behavior) during the 12-month vaccination would predict more optimal preschooler cognitive skills (executive functioning and language abilities) which would then predict more optimal preschooler coping responses and outcomes.

The rationale for this hypothesis stems from a synthesis of previous research and theory. Specifically, sensitive caregiving and physical touch have been associated with stronger cognitive skills in young children [6,9,15,31,36,37] and coping experts have theorized that cognitive skills (such as executive functioning and language) likely subsume the construct of children's coping [45]. In terms of caregiver behaviors in the vaccination predicting children's cognitive skills, caregiver behavior during immunization is thought to be representative of broader patterns of caregiver behavior.

(3) *12-month Vaccination Behavior to Caregiver Cognition at Preschool Vaccination to Caregiver Behavior at Preschool Vaccination to Preschooler Vaccination Behavior Pathway*: Higher infant pain-related distress would predict less optimal caregiver cognition (worry) at the preschool vaccination which in turn would predict less

optimal caregiver behavior (more distress-promoting behaviors, less caregiver coping-promoting behaviors, and lower caregiver sensitivity) which in turn would predict less optimal preschooler's coping responses and outcomes.

(4) *12-month Vaccination Behavior to Preschooler Vaccination Behavior Pathway*: Higher infant pain-related distress would predict less optimal preschooler coping responses and outcomes.

2. Methods

2.1. Study population

The data from the present study are a part of an ongoing Canadian longitudinal study (The OUCH cohort) that followed caregivers and children from infancy to preschool. The OUCH Cohort is a sample of 760 caregiver-child dyads who were videotaped over the first year of life during their routine vaccinations. Infants were included in the OUCH cohort if the infant had no suspected developmental delays or impairments, had no chronic illnesses, had never been admitted to a neonatal intensive care unit, and was born no more than three weeks preterm. It was required that caregivers could read and speak English.

The current study focuses on the 12-month vaccination wave (n=548), the preschool vaccination wave (n=302; ages 4-5 years), and the preschool assessment wave (n=172; ages 4-5 years) where families agreed to participate in a full day psychological assessment at our laboratory after their preschool vaccination. No previously published or planned/submitted manuscripts from this cohort have hypotheses or analyses that overlap with the current study. A comprehensive inventory of all OUCH Cohort publications can be found at www.yorku.ca/ouchlab.

Children were 47.7% female and 52.3% male and were an average age of 4.65 years (SD = .55) at the preschool vaccination. All children were considered healthy, from middle class families, low-risk, and developmentally typical. Most children received two needles, but on occasion, children received one (6.7%) or three (5.1%) needles. 4.6% of children were given Tylenol or EMLA prior to the vaccination. Caregivers were predominantly mothers (85.1%) with some fathers (13.9%) and other caregivers (1.0%). The mean age of caregivers was 39.22 (SD = 4.12). Caregiver self-reported heritage culture was diverse. 40.8% of caregivers identified their heritage culture as European, 20.7% as Asian, 17.7% as Canadian/American, 9.2% as Jewish, 4.8% as African/Middle Eastern, 4.4% as South/Latin American, and 2.4% as Other.

2.2. Procedure

Details of the vaccination procedure from the infant and preschool waves of the study have been published elsewhere [39,42]. Below we describe the procedure for the preschool psychological assessment only as this is the first publication using this data.

Caregivers who participated in the preschool vaccination were asked by a research assistant if they would be interested in participating in the preschool assessment phase (comprised of a comprehensive battery of cognitive, psychosocial, and academic achievement). Caregivers were told that they would be provided with a psychological report from a registered psychologist (R.P.R) and a feedback session upon request. If they agreed, caregivers were contacted by phone by a research assistant to schedule the assessment within 8 weeks of the vaccination appointment. The assessment took place over a 4-5 hour period at the OUCH laboratory with a one-hour lunch break. Every assessment was conducted by a qualified doctoral trainee and was supervised by the

senior author (R.P.R). Families were given a free parking voucher, a $20.00 on-campus food voucher for lunch on the day of testing, and were provided with a psychological report interpreting their findings within 3 months of the assessment.

2.3. Measures

The measures used in both studies will be described in five groups: *Caregiver demographic information, Child coping responses and coping outcomes, Predictors from the 12-month vaccination* (caregiver sensitivity, caregiver soothing behavior, and infant pain-related distress), *Predictors from the preschool vaccination* (caregiver worry, caregiver sensitivity, caregiver distress-promoting and coping-promoting behavior, and child pre-needle distress), and *Predictors from the preschool psychological assessment* (child language and executive functioning). For all measures, coders were trained to reliability by the original scale developer or by experts in the field who were trained with the scale developers. The technique of maximum likelihood estimation (described below) allowed us to include longitudinal data for all participants in our model, including those with incomplete data for certain time points or measures.

2.3.1. Caregiver demographic information

Caregivers were asked to complete a short demographic questionnaire that asked questions such as age, relation to the child, self-reported heritage culture, as well as child age and gender.

2.3.2. Child coping responses and outcomes.

2.3.2.1. Child coping responses- coping composite

Child verbalizations during the vaccination were transcribed and later coded using the Child-Adult Medical Procedure Interaction Scale-Revised (CAMPIS-R) [11]. These

verbalizations were: making coping statements, engaging in non procedure-related talk, and using humor. Child engaging in audible deep breathing was also coded. Scores were summed to form a child coping response composite, which was calculated as the sum of coping behaviors divided by the total number of behaviors in a given phase. Child coping responses were coded according to three 60-second phases: (1) the one-minute period prior to the first needle, (2) the one-minute period following the last needle, (3) the second one-minute period following the last needle.

The three composite scores from these phases were: (1) *Preschooler Coping Responses Pre-Needle,* (2) *Preschooler Coping Responses 1 Minute,* (3) *Preschooler Coping Responses 2 Minutes.* Higher scores reflect more child coping responses. The primary coder for the study was trained by researchers trained by the scale developer's lab. For coping responses, percent agreements were calculated from the transcripts that were coded with an average percent agreement of 85% with a range of 71% to 98% agreement. Slightly over thirty percent (n=102) of the 302 children seen at the preschool vaccination did not have data coded for coping responses (pre-needle, 1 and 2 minutes). While coping response data for these children is available, it was not feasible to code additional participants due to time and resource limitations.

2.3.2.2. Child coping outcome- distress expression composite.

The child coping outcomes were operationalized as the amount of preschool pain-related distress. The Face, Legs, Activity, Cry, Consolability coding system (FLACC) [35] was used to assess the degree of pain-related distress. Five categories of pain-related behaviors (face, legs, activity, cry, consolability) were coded for four 15-second epochs immediately prior to the first needle, four 15-second epochs one minute after the last

needle, and for four 15-second epochs two minutes after the last needle. Each category was scored on a scale of 0-2 and then summed, which resulted in a total score between 0 and 10 for each 15-second epoch. The four 15-second epochs were summed to form a composite score.

The three composite scores based on the FLACC were: (1) *Preschooler Coping Outcome Pre-Needle*, (2) *Preschooler Coping Outcome 1 Minute*, (2) *Preschooler Coping Outcome 2 Minutes.* Because each composite was comprised of four total scores between 0 and 10, the total possible score for each composite was 40. Higher scores reflect poorer child coping outcomes (i.e., higher pain-related distress). Inter-rater reliability was high (all intraclass correlations exceeded .85 for the five total behavior indices). Of the 302 children seen at the preschool vaccination, six, four, and seven percent did not have data for the Preschooler Coping Outcome Pre-Needle, 1 Minute, and 2 Minutes, respectively. This was due to missing or uncodable video footage.

As established with latent growth curve analysis at the preschool vaccination, the selection of the one-minute period following the last needle and the second one-minute period following the last needle as separate time points for coping responses and coping outcomes was purposeful [51]. This selection was made because of the importance of differentiating between reactivity and regulation [40]. The first one-minute period following the last needle includes the preschooler's initial reactions post-needle (i.e., the first 0-15 seconds and thereafter), whereas the second one-minute period encompasses a regulatory time period.

2.3.3. Predictors from the 12-month vaccination

2.3.3.1. Caregiver sensitivity at the 12-month vaccination

Caregiver sensitivity at the 12-month vaccination was coded using the Infancy/Early Childhood Version of the Emotional Availability Scales–Fourth Edition (EAS) [7]. Rather than using frequency counts of caregiver behaviors, the EAS is a global clinical judgment of caregiving behavior that is contextualized by the infant's reaction to those behaviors. The total score is a clinical judgment based on objective parameters regarding the quality of the caregiver behaviors. The EAS has been well validated in a variety of distressing non pain-related contexts [8] as well as in pain-related contexts [23,24,39,41]. For a caregiver to have a high score, he or she would have to consistently enact behaviors (regardless of what those specific behaviors are) that sensitively and effectively address the infant's pain-related distress. The EAS total score sums caregiver behavior on four different subscales: sensitivity, structuring, nonintrusiveness, and nonhostility. Caregiver sensitivity included the caregiver's ability to interpret and respond to the infant's cues while displaying appropriate affect and respecting the developmental level of the infant (e.g., sensitively and contingently responding to the infant's pain cues). Caregiver structuring referred to the caregiver's ability to structure the environment in a manner that leads the infant in a positive direction (e.g., using toys to distract the baby from the pain). Caregiver nonintrusiveness referred to the caregiver's ability to be available and avoid intrusive, overstimulating, or overpowering behaviors (e.g., getting in the infant's face and intrusively kissing the infant while the infant is highly distressed). Finally, caregiver nonhostility referred to the caregiver's ability to refrain from antagonistic or impatient behaviors (e.g., expressing frustration about the infant's pain-related crying). The EAS rating was based on video footage from the time the caregiver and infant entered the clinic room until they left.

After viewing the entire filmed interaction, a coder provided a rating on each of the emotional availability subscales (potential score ranges: 7 to 29). These subscales were subsequently summed to form a composite emotional availability score on a scale that potentially ranges from 28 to 116. On all scales, higher scores represented more optimal interactions. When more than one caregiver accompanied the infant for the vaccination appointment, the caregiver who did the majority of the caregiving was coded. When both caregivers provided equal care during the clinic visit, both caregivers were coded and an average was obtained. Four coders coded the videotaped vaccination appointments for this study and were blind to study hypotheses. Interrater reliability was calculated among every permutation of the 4 coders (e.g., coder A with B, B with C, A with D, etc.). Intraclass correlations for the caregiver EAS composite score ranged from .80 to .93. A small percentage (<1%) of the 548 infants seen at the 12-month vaccination had missing data for caregiver sensitivity. This was due to missing or uncodable video footage.

There was no significant difference in caregiver sensitivity scores between caregivers who participated in the preschool time points (M=93.57, SD=10.29) and caregivers who only participated in the 12 month time point (M=91.97, SD=11.68) conditions; t (544)=1.69, p = 0.09.

2.3.3.2 Caregiver proximal soothing and verbal reassurance at the 12-month vaccination

Caregiver proximal soothing and verbal reassurance were coded using the Measure of Adult and Infant Soothing and Distress (MAISD) [20]. The MAISD obtains reliable and valid scores of behavioral observations scale and was developed to evaluate the behaviors of infants, caregivers, and health care professionals during painful pediatric medical procedures [20]. To build the most parsimonious model possible, only three

MAISD caregiver behaviors were used (rocking, physical comfort, verbal reassurance). Further details on our decision to use these three MAISD caregiver behaviors, specifically is provided below (See Data Analysis section). Seven coders, trained to reliability under supervision of the scale developer, coded the data. Inter-rater reliability was calculated among different permutation of coders (e.g., coder A with B, B with C, A with D, etc.). The intraclass correlations ranged from .75 to .95.

Rocking, physical comfort and verbal reassurance were all coded as either present or absent for five-second epochs during the following three 60-second phases: (1) the one minute prior to the first needle, (2) the one minute period following the last needle and (3) the second one-minute period following the last needle. Index scores representing the proportion of time each behavior was present was calculated by adding the total number of five-second epochs during which each behavior was displayed in a phase and dividing by the total number of codable epochs in the phase. The index score for each behavior is a continuous proportion score, ranging from 0 to 1, with higher scores reflecting a greater proportion of epochs in which the behavior was present.

Physical comfort was coded when any physical (i.e., nonverbal) behavior was conducted in an attempt to comfort the infant. This included: rubbing, massaging, patting, hugging, or kissing the infant. Rocking was coded when the caregiver swayed, rocked, or bounced the infant.

Rocking and physical comfort were combined to create a proximal soothing variable. To obtain a composite score of caregiver proximal soothing over the three phases at the 12-month vaccination, the index scores for rocking and physical comfort for each phase were summed.

Verbal reassurance was coded whenever caregivers made reassuring comments towards the infant (e.g., "it is okay", "we are almost done", "it's alright, baby", "I'm sorry"). Similarly, the verbal reassurance scores for each of the three phases were summed to create a total verbal reassurance score for the 12-month vaccination.

A small percentage (7%) of the 548 infants seen at the 12-month vaccination had missing data for proximal soothing and verbal reassurance. This was due to missing or uncodable video footage.

2.3.3.3. Infant pain-related distress at the 12-month vaccination

Infant pain-related distress was coded using the Modified Behavior Pain Scale (MBPS) [48]. The MBPS assesses the degree of an infant's pain-related distress over 15-second epochs. Coders rate the severity of distress reflected in three types of infant pain behaviors (facial expression [range 0-3], crying [range 0-4], and body movement [range 0-3]) and obtain a score from 0-10. Two separate 15-second epochs were analyzed for this study to examine infant pain-related distress: the one-minute period after the needle [MBPS1], and the subsequent one-minute period after the needle [MBPS2]). For the purposes of the present study, infant pain-related distress was operationalized as the sum of MBPS1 and MBPS2. Higher scores reflect greater pain expressed during the first two minutes after the last needle). Inter-rater reliability between the coders was high (intraclass correlations between .93 and .96). A small percentage (9%) of the 548 infants seen at the 12-month vaccination had missing data for pain-related distress. This was due to missing or uncodable video footage.

2.3.4. Predictors from the preschool vaccination

2.3.4.1. Caregiver worry pre-needle at the preschool vaccination

While in the waiting room before the child's preschool vaccination, caregivers were asked to rate their own worry about the child's needle pain using a scale from 0 to 10, where 0 was no worry and 10 was the most worry possible. A small percentage (<1%) of the 302 caregivers seen at the preschool vaccination had missing data for caregiver worry. This was due to the research assistant being unable to obtain this data.

2.3.4.2. Caregiver sensitivity at the preschool vaccination

Caregiver sensitivity at the preschool vaccination was measured using the Maternal Behaviour Q-Set Short Version (MBQS) [49]. The MBQS is a 25-item version of the 90-item Maternal Behaviour Q-Set (MBQS) [38]. The 25 MBQS items tap into various features related to the construct of caregiver sensitivity including: response to distress, monitoring of the child's expression of emotions and behavior, attentiveness to the child's cues, appropriateness of caregiver affect, and support in negative or distressful situations. These items are rated on a Likert-type scale from -2 ("not at all") to +2 ("very much like") a prototypical sensitive caregiver. The final sensitivity score is a Pearson's r-value that is generated from the 25 item-by-item correlation coefficients between the score derived from the caregiver's behavior and an aggregate score of a prototypically sensitive caregiver's behavior. Twenty-four percent of the 302 caregivers seen at the preschool vaccination did not have data for caregiver sensitivity. This was due to fact that data collection for the preschool vaccination continued beyond the point at which coding for caregiver sensitivity was completed.

Two coders coded MBQS (n=215) over a four-year period. Sixty-seven percent of videos (n=145) were double-coded (i.e., independently coded by the two coders) for reliability purposes. Scores for every case that was double-coded were compared across

both coders. For any case where coders' scores differed by an absolute value of .2 or greater, the coders met, re-watched the video, discussed the case, and reached a consensus score. Inter-rater reliability was strong, with an overall intraclass correlation of .82.

2.3.4.3. Caregiver coping-promoting and distress-promoting behaviors at the preschool vaccination

Caregiver verbalizations during the preschool vaccination were transcribed and later coded using the Child-Adult Medical Procedure Interaction Scale-Revised (CAMPIS-R) [11] to operationalize caregiver coping-promoting and distress-promoting behaviors in the models. Three caregiver verbalizations were used to obtain a summed composite of caregiver coping-promoting behaviors. These verbalizations were: humor directed to the child, non procedure-related talk to the child, and command to use coping strategy. Five caregiver verbalizations were used to obtain a summed composite of caregiver distress-promoting behaviors. These verbalizations were: criticism, making a reassuring comment, giving control to the child, apologizing, and expressing empathy. Verbalizations were coded according to three 60-second phases: (1) the one minute prior to the first needle, (2) the one minute period following the last needle and (3) the second one-minute period following the last needle. Scores for caregiver coping-promoting and distress-promoting behaviors were calculated as the sum of coping-promoting and distress-promoting behaviors divided by the total number of behaviors in a given phase. The six composite scores of caregiver coping-promoting and distress-promoting behaviors were as follows: (1) *Caregiver Coping-Promoting Behaviors 1 Minute Pre-Needle*; (2) *Caregiver Coping-Promoting Behaviors 1 Minute Post-Needle*; (3) *Caregiver*

Coping-Promoting Behaviors 2 Minutes Post-Needle; (4) *Caregiver Distress-Promoting Behaviors 1 Minute Pre-Needle; (5) Caregiver Distress-Promoting Behaviors 1 Minute Post-Needle; (6) Caregiver Distress-Promoting Behaviors 2 Minutes Post-Needle.* The Observer XT (Noldus Inc.) was used to facilitate coding the video data.

For verbal behaviors, percent agreements were calculated from the transcripts that were coded with an average percent agreement of 85% with a range of 71% to 98% agreement. Slightly over thirty percent of the 302 caregivers seen at the preschool vaccination did not have data for caregiver coping-promoting and distress-promoting behavior. The explanation has been previously described in the above section on child coping responses (for which the same intensive coding system was used).

2.3.4.4. Child pre-needle distress at the preschool vaccination

The Face, Legs, Activity, Cry, Consolability coding system (FLACC) [35] was used to assess the degree of preschool pain-related pre-needle distress. Five types of pain-related behaviors (face, legs, activity, cry, consolability) were coded for 15 seconds prior to the needle. Each category was scored on a scale of 0-2, which resulted in a total score between 0 and 10. Inter-rater reliability was high (all intraclass correlations exceeded .85 for the five total behavior indices). Six percent of the 302 children seen at the preschool vaccination did not have data for pre-needle distress. This was due to missing or uncodable video footage.

2.3.5. Predictors from the preschool psychological assessment

2.3.5.1. Preschooler executive functioning

Preschooler's executive functioning was measured during the preschool assessment using the Behavior Rating Inventory of Executive Function- Preschool

(Parent Version) (BRIEF-P) [26]. The BRIEF-P is a questionnaire, with established reliability and validity, for caregivers of children between 2 and 5 years of age that evaluates executive function challenges in preschoolers. Executive functioning is an overarching term that refers to neuropsychological processes that enable physical, cognitive, and emotional self-control [22], constructs critical to both coping responses and outcomes. The BRIEF-P provides scores on five domains of potential challenge with executive function (Inhibition, Shifting, Emotional Control, Working Memory, and Planning/Organizing) and a Global Executive Composite T-score. The composite was used for analyses in the present study. Higher scores reflect higher executive functioning challenges. Two percent of the 172 children seen at the preschool assessment did not have data for executive functioning. This was due to a small handful of parents not completing the questionnaire.

2.3.5.2. Preschooler language

Preschooler's language ability was measured during the preschool assessment using the General Language Composite (GLC) of the Wechsler Preschool and Primary Scale of Intelligence- Third Edition (WPPSI-III) [52]. This is a gold standard battery in the field of child assessment, with established validity and reliability. The WPPSI-III is a commonly used intelligence test for preschool children ages 2.6 to 7.3 years. The GLC is derived from a child's scores on the receptive vocabulary subtest (i.e., how well they understand words) and picture naming subtest (i.e., how well they can express words) on the WPPSI-III. This composite was selected because the coping response was in essence a measure of coping language. A standard score is provided with a mean of 100 and a standard deviation of 15. Higher scores reflect higher language ability. Four percent of

the 172 children seen at the preschool assessment did not have data for language ability. This was due to a small handful of parent-child dyads being unable to complete the entire assessment.

2.4. Data analysis

2.4.1. Study 1: The Relationships Between Preschool Children's Coping Responses and Outcomes in the Vaccination Context

In order to simultaneously address reciprocal influences on coping responses and coping outcomes, an autoregressive cross-lagged path model (e.g., [29]) (Figure 1) was fitted to the data using structural equation modeling software. This model included parameters such that for both child coping responses and child coping outcomes, three types of relationships were examined simultaneously: (1) the prediction of each child coping response composite (or child coping outcome composite) from the child coping response composite (or child coping outcome composite) that directly preceded it (e.g., child coping response composite pre-needle predicting child coping response composite at 1 minute); (2) the prediction of each child coping outcome composite (or child coping response composite) from the child coping response composite (or child coping outcome composite) that directly preceded it (e.g., child coping response composite at 1 minute at predicting child coping outcome composite at 2 minutes); and (3) the concurrent residual relationships between child coping responses and child coping outcomes at each of the three different 60-second phases within the vaccination appointment (e.g., child coping responses pre-needle with child coping outcomes pre-needle).

2.4.2. Study 2: Preschool Children's Coping Responses and Outcomes in the Vaccination Context: Caregiver and Child Predictors from Infancy and Preschool

Four path models (see Figures 2-5) were fitted to the data using structural equation modeling software. When testing hypotheses pertaining to antecedent-consequence relationships, such as those in the present study, path analysis is considered an optimal method of choice [14,33]. The first two path analyses examined infant and preschool variables predicting preschooler coping *responses* at 1 and 2 minutes post-needle. The third and fourth path analyses were similar with one exception. In path models 3 and 4, preschooler coping *outcomes* at 1 and 2 Minutes post-needle were the dependent variables of interest.

Finally, for each model, the preschool caregiver behaviors (coping-promoting, distress-promoting) and preschooler distress behaviors (i.e., FLACC) used as predictors pertained to the time epoch directly preceding the dependent variable. Thus, Model 1 and Model 3 used variables from the preschool pre-needle epoch (to predict preschooler coping responses and outcomes at 1 Minute, respectively) and Model 2 and 4 used variables from the preschool 1 Minute epoch (to predict preschooler coping responses and outcomes at 2 Minutes, respectively). In terms of entering child distress behaviors from the directly preceding time epoch into the models, this choice was made because a critical assumption in creating the path models was that young children's pain responding during painful procedures has been established to predict subsequent pain responding to that procedure [1,18,27]. Thus, all path models included a predictor variable of preschooler's pain-related distress from the closest time point preceding each dependent variable of interest. To parallel this, the same was done with both coping-promoting and distress-promoting caregiver variables. Correlations among all potential predictor

variables were first examined for all four models in order to determine which relationships between predictors to include in the final path models.

Based on previous research on the MAISD behaviors at the 12-month vaccination [32], the four most commonly occurring caregiver behaviors were selected a priori for our path models: rocking, physical comfort, verbal reassurance, and distraction. These four behaviors were selected (as opposed to all eight behaviors on the scale) in order to create the most parsimonious model possible. However, the caregiver behavior of distraction was not included in our final models because this variable was not correlated with any other variable in the model and was impacting model fit. The pattern of relationships in the model did not change after removing the distraction variable.

All data analysis was conducted using Amos Version 19.0 statistical software [3]. To maximize information used in this study's analyses, direct maximum likelihood estimation [2] was used so that all cases, including those with missing data or without data for all three time points (i.e., 12 month vaccination, preschool vaccination, preschool assessment), contributed to model estimation. Goodness of fit for all models was evaluated using the chi-square significance test ($\alpha = .05$), the Comparative Fit Index (CFI) [5] and the Root Mean Square Error of Approximation (RMSEA) [47]. CFI values of 0.95 or higher and RMSEA values of 0.06 or less indicate that a model provides a good fit for the data [28].

2.4.2.1 Study 2: Post-hoc analyses

Our path analyses unexpectedly indicated that, with the exception of caregiver coping-promoting behaviors at 1 Minute post-needle at the preschool vaccination positively predicting the preschooler coping outcome at 2 Minutes post-needle, caregiver

coping-promoting and distress-promoting behaviors did not significantly predict subsequent preschooler coping responses or outcomes.

Accordingly, a series of post-hoc correlations were run to determine whether concurrent relationships between these variables existed (i.e., when these caregiver and preschooler variables were measured at the same point in time). While the research questions in the current study pertained to the non-concurrent relationships examined in the path models (i.e., the relationships between caregiver variables that precede children's coping variables in time and those children's coping variables), the decision to conduct these post-hoc correlations was made in an attempt to comprehensively explore the potential processes involved in coping in our sample.

3. Results

3.1. Study 1: The Relationships Between Preschool Children's Coping Responses and Outcomes in the Vaccination Context

The autoregressive cross-lagged path model was estimated (See Figure 1). The non-significant χ^2 test of overall model fit ($\chi^2 = .41$, $df = 4$, $p = .98$) and the combination of other fit indices (CFI = 1.00; RMSEA < .001) suggested that the model fit the data well. Standardized estimates of significant pathways are reported in the figure. Table 1 presents the overall means and standard deviations of all model variables and Table 2 presents the standard bivariate correlations among all the variables in the model. All standardized and unstandardized estimates are reported in Table 3.

The results will now turn to reporting pathway findings. For conceptual coherence, they will be organized according to the five hypotheses. Standardized estimates are reported in the text.

3.1.1. Hypothesis 1: Preceding coping responses would positively predict subsequent coping responses within the post-needle phases of the procedure

Preschooler coping responses pre-needle did not predict preschooler coping responses at 1 minute (B = .08, p = .280). Preschooler coping responses at 1 minute positively predicted preschooler coping responses at 2 minutes (B = .22, p = .002).

3.1.2. Hypothesis 2: Preceding coping outcomes would positively predict subsequent coping outcomes across all phases of the procedure

Preschooler coping outcomes pre-needle positively predicted preschooler coping outcomes at 1 minute (B = .53, p < .001). Preschooler coping outcomes at 1 minute positively predicted preschooler coping outcomes at 2 minutes (B = .65, p < .001).

3.1.3. Hypothesis 3: Concurrent coping responses and coping outcomes would be negatively related

Preschooler coping responses pre-needle were negatively related to preschooler coping outcomes pre-needle (B = -.31, p < .001). Preschooler coping responses at 1 minute were negatively related to preschooler coping outcomes at 1 minute (B = -.32, p < .001). Preschooler coping responses at 2 minutes were not significantly related to preschooler coping outcomes at 2 minutes (B = -.10, p = .198).

3.1.4. Hypothesis 4: Preceding coping responses would negatively predict subsequent coping outcomes

Preschooler coping responses pre-needle did not significantly predict preschooler coping outcomes at 1 minute (B = .07, p = .285). Preschooler coping responses at 1 minute did not significantly predict preschooler coping outcomes at 2 minutes (B = -.02, p = .695).

3.1.5. Hypothesis 5: Preceding coping outcomes would negatively predict subsequent coping responses

Preschooler coping outcomes pre-needle did not significantly predict preschooler coping responses at 1 minute (B = -.12, p = .111). Preschooler coping outcomes at 1 minute did not predict preschooler coping responses at 2 minutes (B = -.09, p = .206).

3.2. Study 2: Preschool Children's Coping Responses and Outcomes in the Vaccination Context: Caregiver and Child Predictors from Infancy and Preschool

Four separate path models were estimated as described above (See Figures 2–5). Standardized estimates of significant pathways are reported in the figures. Table 1 presents the overall means and standard deviations of all model variables, Table 2 presents the bivariate correlations among all model variables. All standardized and unstandardized estimates are reported in accompanying tables (see Tables 4-7).

Of note, prior to estimating the models, the bivariate correlations among all model variables were first examined. When it was indicated that there was not a bivariate relationship between two predictor variables, this relationship was not included in the path model. Finally, a requirement of structural equation modeling is that, regardless of relationships of interest in one's study, if a meaningful relationship exists between two variables, this relationship must be accounted for in the analysis to ensure model fit. Thus, the various significant relationships among the variables from the 12-month vaccination were accounted for in the models but because they have been previously examined and reported [4,39,18,41], they were not of interest and will not be described in the text below.

3.1. Path Models

3.1.1 Overall Model Fit and Accounted For Variance

Model 1 examined infant and preschool predictors of preschooler's coping responses at 1 Minute post-needle. The non-significant χ^2 test of overall model fit (χ^2 = 40.22, *df* = 42, *p* = .55) and the combination of other fit indices (CFI = 1.00; RMSEA < .001) suggested that Model 1 fit the data well. Figure 2 provides the corresponding model diagram (along with significant standardized parameter estimates) and Table 4 presents all standardized and unstandardized parameter estimates. The set of predictors in Model 1 accounted for 12% of the variance (R^2) in Preschooler's Coping Responses at 1 Minute post-needle.

Model 2 examined infant and preschool predictors of preschooler's coping responses at 2 Minutes post-needle. The non significant χ^2 test of overall model fit (χ^2 = 30.77, *df* = 42, *p* = .90) and the combination of other fit indices (CFI = 1.00; RMSEA < .001) suggested that Model 2 fit the data well. Figure 3 provides the corresponding model diagram (along with significant standardized parameter estimates) and Table 5 presents all standardized and unstandardized parameter estimates. The set of predictors in Model 2 accounted for 11% of the variance (R^2) in Preschooler's Coping Responses at 2 Minutes post-needle.

Model 3 examined infant and preschool predictors of the preschooler's coping outcome at 1 Minute post-needle. The non significant χ^2 test of overall model fit (χ^2 = 39.68, *df* = 42, *p* = .57) and the combination of other fit indices (CFI = 1.00; RMSEA < .001) suggested that Model 3 fit the data well. Figure 4 provides the corresponding model diagram (along with significant standardized parameter estimates) and Table 6 presents

all standardized and unstandardized parameter estimates. The set of predictors in Model 3 accounted for 29% of the variance (R^2) in the Preschooler Coping Outcome at 1 Minute post-needle.

Model 4 examined infant and preschool predictors of the preschooler's coping outcome at 2 Minutes post-needle. The non significant χ^2 test of overall model fit (χ^2 = 31.03, *df* = 42, *p* = .89) and the combination of other fit indices (CFI = 1.00; RMSEA < .001) suggested that Model 4 fit the data well. Figure 5 provides the corresponding model diagram (along with significant standardized parameter estimates) and Table 7 presents all standardized and unstandardized parameter estimates. The set of predictors in Model 4 accounted for 48% of the variance (R^2) in the Preschooler Coping Outcome at 2 Minutes post-needle.

The results will now turn to reporting pathway findings over the four models. Standardized estimates are reported in the text. For conceptual coherence, they will be organized according to the four overarching hypotheses that set up the analysis *a priori*. Only significant relationships will be described but all tested relationships appear in the figures and tables.

3.1.2. Caregiver Behavior During 12-month Vaccination to Caregiver Behavior During Preschool Vaccination to Preschooler Vaccination Behavior Pathways

Caregiver sensitivity at the 12-month vaccination positively predicted caregiver sensitivity at the preschool vaccination (*B* = .24, *p* < .001) across the four models. Caregiver sensitivity (preschool vaccination) did not in turn directly predict any of the child behavior dependent variables across the four models (coping responses or coping outcomes).

Caregiver proximal soothing at the 12-month vaccination positively predicted caregiver coping-promoting behaviors at 1 Minute post-needle in Model 2 and Model 4 (B = .32, p < .001; B = .31, p < .001, respectively). In turn, Model 4 displayed that coping-promoting behaviors at 1 Minute post-needle predicted higher coping outcome scores at 2 Minutes post-needle. Unexpectedly, Model 1 displayed that caregiver proximal soothing at the 12-month vaccination directly predicted preschooler coping responses at 1 Minute (B = .17, p = .036) (i.e., the relationship did not involve caregiver behavior at the preschool vaccination).

3.1.3. Caregiver Behavior During 12-month Vaccination to Preschooler Cognitive Ability to Preschooler Vaccination Behavior Pathways

Caregiver sensitivity from the 12-month vaccination positively predicted preschooler's language abilities across all four models (B = .18, p = .024; B = .18, p = .025; B = .17, p = .032; B = .18, p = .025, respectively). Caregiver verbal reassurance from the 12-month vaccination positively predicted preschooler's language abilities across all four models (B = .19, p = .020; B = .19, p = .017; B = .18, p = .022; B = .19, p = .017). Preschooler language ability in turn predicted preschooler coping responses at 1 Minute post-needle (Model 1; B = .23, p = .015).

Caregiver proximal soothing at the 12-month vaccination predicted more optimal preschooler executive functioning (B = -.24, p = .002). Executive functioning challenges in turn did not significantly predict any of the dependent variables across the four models.

3.1.4. 12-month Vaccination Behavior to Caregiver Cognition at Preschool Vaccination to Caregiver Behavior at Preschool Vaccination to Preschooler Vaccination Behavior Pathway

Infant pain-related distress at the 12-month vaccination positively predicted caregiver worry pre-needle at the preschool vaccination (B = .15, p = .016) across the four models, whereby higher pain at the 12-month vaccination predicted higher caregiver worry at the preschool vaccination. In turn, caregiver worry pre-needle at the preschool vaccination did not significantly predict any caregiver behaviors at the preschool vaccination across the four models. However, Model 2 unexpectedly demonstrated that caregiver pre-needle worry directly predicted preschooler coping responses at 2 Minutes post-needle (B = -.15, p = .016) (i.e., this relationship did not involve caregiver behavior at the preschool vaccination).

3.1.5. 12-month Vaccination Behavior to Preschooler Vaccination Behavior Pathway

Infant pain-related distress at the 12-month vaccination did not directly predict preschooler coping responses or outcomes in any model. However, Model 2 displayed that the preschooler coping outcome (i.e., pain-related distress) at 1 Minute did predict less coping responses at 2 Minutes post-needle (B = -.16, p = .044). Moreover, both Model 3 and Model 4 demonstrated that the preschooler coping outcome from the preceding epoch predicted the preschooler coping outcome at the following epoch (B = .48, p < .001; B = .67, p < .001, respectively).

3.2. Post-hoc analyses

Our path analyses unexpectedly indicated that, with the exception of caregiver coping-promoting behaviors at 1 Minute post-needle at the preschool vaccination positively predicting the preschooler coping outcome at 2 Minutes post-needle, caregiver coping-promoting and distress-promoting behaviors did not significantly predict subsequent preschooler coping responses or outcomes.

Accordingly, a series of post-hoc correlations were run to determine whether concurrent relationships between these variables existed (i.e., when these caregiver and preschooler variables were measured at the same point in time). Specifically, two sets of correlations were run between caregiver coping-promoting behaviors, distress-promoting behaviors, preschooler coping responses and preschooler coping outcomes. The first set of correlations pertained to the bivariate relationships between caregiver coping- and distress-promoting behaviors (at the preschool vaccination) and preschooler coping responses 1 Minute pre-needle, 1 Minute post-needle, and 2 Minutes post-needle. The second set of correlations pertained to the bivariate relationships between caregiver coping- and distress-promoting behaviors and preschooler coping outcomes 1 Minute pre-needle, 1 Minute post-needle, and 2 Minutes post-needle.

3.2.1. Set 1 of post-hoc correlations: Concurrent relationships between caregiver coping-promoting behaviors, distress-promoting behaviors, and preschooler coping responses

Prior to the first needle, caregiver coping-promoting behaviors were positively related to preschooler coping responses ($r = .44$, $p < .001$) and caregiver distress-promoting behaviors were negatively related to preschooler coping responses ($r = -.16$, $p = .021$). At 1 Minute following the last needle, caregiver coping-promoting behaviors were positively related to preschooler coping responses ($r = .20$, $p = .004$) and caregiver distress-promoting behaviors were negatively related to preschooler coping responses ($r = -.28$, $p < .001$, respectively). At 2 Minutes following the last needle, caregiver coping-promoting behaviors were positively related to preschooler coping responses ($r = .49$, $p < .001$) and caregiver distress-promoting behaviors were negatively related to preschooler coping responses ($r = -.24$, $p < .001$).

3.2.2. Set 2 of post-hoc correlations: Concurrent relationships between caregiver coping-promoting behaviors, distress-promoting behaviors, and preschooler coping outcomes

Prior to the first needle, caregiver coping-promoting behaviors were negatively related to the preschooler coping outcome (r = -.15, p = .037) and caregiver distress-promoting behaviors were positively related to the preschooler coping outcome (r = .42, < .001). At 1 and 2 Minutes following the last needle, caregiver distress-promoting behaviors were positively related to preschooler coping outcomes (r = .45, p < .001; r = .38, p < .001, respectively). Caregiver coping-promoting behaviors were not related to preschooler coping outcomes at 1 and 2 Minutes following the last needle (r = .05, p = .505; r = -.10, p = .177, respectively).

4. Discussion

This was the first paper to conduct an autoregressive cross-lagged path model to examine three types of relationships between children's coping responses and coping outcomes simultaneously (Study 1). Moreover, this paper was the first to use a longitudinal design that incorporated the potential influences of caregiver cognitive-affective and behavioral variables, as well as children's cognitive abilities (Study 2). Collectively, these two studies present a highly in-depth analysis of preschooler coping with vaccination pain and provide novel insights into this dynamic and multi-faceted construct.

4.1. Study 1: The Relationships Between Children's Coping Responses and Outcomes in the Preschool Vaccination Context

Ultimately, Study 1 demonstrated that coping responses and outcomes during needle-related procedures are separate, but interrelated, aspects of the coping process and

that the relationships between them are dynamic, changing over time. Unexpectedly, children's pain-related distress did not predict subsequent coping responses, nor did children's coping responses predict subsequent pain-related distress. A similar pattern was found for caregiver coping- and distress-promoting behaviors in Study 2. In line with previous research [1,18,27], children's pain strongly predicts subsequent children's pain prospectively. An integration of these findings with a focus on clinical implications will be presented in our conclusion.

4.2. Study 2: Preschool Children's Coping Responses and Outcomes in the Vaccination Context: Caregiver and Child Predictors from Infancy and Preschool

A host of novel relationships (both longitudinal and concurrent) were elucidated. First, higher levels of caregiver sensitivity and proximal soothing during the 12-month vaccination predicted parallel caregiver behaviors (caregiver sensitivity and coping-promoting behaviors, respectively) at the preschool vaccination. However, caregiver sensitivity at the preschool vaccination did not significantly predict preschooler coping responses or outcomes. Previous work from our cohort suggested consistency in caregiver sensitivity during vaccinations across the first year of life [39]. These results now extend this finding across the first five years of childhood. In regards to caregiver sensitivity at preschool not predicting children's coping responses and outcomes, this finding differs from the infant literature linking caregiver sensitivity to infant distress regulation [16,23,30,39]. This may reflect that the overall quality of caregiving is not as important during the preschool vaccination because of the child's developing self-regulatory abilities.

Second, proximal soothing during the 12-month vaccination positively predicted caregiver coping-promoting behaviors at 1 Minute during the preschool vaccination. This suggests a consistency between caregiver behaviors viewed as helpful in infancy and parallel caregiver behaviors viewed as helpful in childhood. Counter to predictions, caregiver coping-promoting and distress-promoting behaviors did not, as a whole, predict children's subsequent coping responses or outcomes. A possible explanation is provided when discussing the post-hoc correlations.

While it may seem counterintuitive at first, caregiver coping-promoting behaviors at 1 Minute positively predicted the coping outcome at 2 Minutes (i.e., higher distress). However, examining the model as a whole, caregiver coping-promoting behavior at 1 Minute appears to be involved in two different concurrent pathways leading to children's coping outcomes at 2 Minutes (one direct and one indirect). Specifically, caregiver coping-promoting behavior at 1 Minute directly predicts suboptimal coping outcomes at 2 Minutes and indirectly predicts more optimal coping outcomes at 2 Minutes through being related to lower caregiver distress-promoting behaviors at 1 Minute (which is related to lower pain-related distress at 1 Minute which then predicts forward to lower pain-related distress at 2 Minutes). Taken together, this finding speaks to the complex interplay between caregiver and child interactions in the context of coping. Taking any one type of caregiver behavior out of the context of the other behaviors he or she is concurrently engaging in leads to an incomplete picture. Coping-promoting behavior that is related to less distress-promoting behavior is what is critical to a reduction in subsequent pain expression in the preschooler.

Third, higher caregiver sensitivity and verbal reassurance at the 12-month vaccination both predicted better developed children's language abilities at preschool, while higher proximal soothing at the 12-month vaccination predicted more optimal executive functioning. Only preschooler language ability in turn predicted greater preschool coping responses at 1 Minute. Our finding that better developed children's language predicted more optimal children's coping responses provides novel evidence for the importance of language abilities in preschoolers' pain-related coping responses and early parental sensitivity for supporting this language development. Our finding that children's executive functioning was not predictive of coping was surprising. We speculate that preschooler coping in the needle-related context is not yet subsumed by the higher level cognitive processes involved in executive functioning.

Fourth, higher pain-related distress from the 12-month vaccination predicted higher caregiver worry at the preschool vaccination but caregiver worry did not then predict any caregiver behaviors at the preschool vaccination. Unexpectedly, worry directly negatively predicted preschooler coping responses at 2 Minutes. This suggests that more caregiver worry pre-needle predicts fewer child coping responses at 2 Minutes but that this is not related to caregiver verbal behaviors. Perhaps, it is caregivers' non-verbal behaviors at the preschool vaccination, such as proximal soothing, that provide the link between caregiver worry and preschooler coping responses.

Finally, pain-related distress from infancy did not predict preschooler coping responses or coping outcomes. In addition, both studies in this paper showed that preschooler coping outcomes predict subsequent coping outcomes. This finding replicates findings from the 12-month vaccination [39]. Taken together, these findings suggest that

over the first five years of early childhood, children's pain predicts children's pain prospectively in the short-term (i.e., within a vaccination appointment) but not longitudinally.

Our finding that caregiver coping- and distress-promoting behaviors at preschool did not predict subsequent preschoolers' coping responses or outcomes was surprising, given previous research [10,11,19,25,46]. However, when we conducted post-hoc correlations to examine concurrent relationships, important clarifications were found.

Concurrent relationships were observed between caregiver behaviors (both coping- and distress-promoting) and children's coping responses and outcomes. Specifically, caregiver coping-promoting behaviors related to optimal preschooler coping responses at all three epochs. This suggests the importance of encouraging ongoing coping responses in children for immediate benefits. Additionally, caregiver coping-promoting behaviors were only related to optimal coping outcomes during the pre-needle phase. On the other hand, caregiver distress-promoting behaviors related to less optimal preschooler coping responses and outcomes at all three epochs. Taking it one step further, there was also a difference in the strength of the relationships depending on whether it was coping- or distress-promoting behavior (distress-promoting behaviors had much stronger relationships with coping outcomes). Taken together, these findings suggest that having caregivers not engage in distress-promoting behaviors may be much more important than having caregivers engage in coping-promoting behaviors.

4.3. Conclusion

This paper has elucidated transactional and longitudinal pathways predicting preschooler coping responses and outcomes in the vaccination setting. Synthesizing across all models in both studies, three broad conclusions are offered.

First, preschooler's coping responses and coping outcomes during vaccination are separate, but interrelated, aspects of the coping process. The relationships between them are dynamic and change over time. Our findings provide empirical support for the value of investigating these two different aspects of children's coping across different phases of needle-related procedures (i.e., reactivity and regulation), which place different physical and psychological demands on the child.

Second, caregivers play an important role in preschool children's coping and this role is both longitudinal and concurrent. From a longitudinal perspective, caregiver sensitivity and proximal soothing during stressful infant events have important developmental influences not only on young children's coping responses at the preschool vaccination but also on broader cognitive development as well. In addition, the caregiver behaviors that related most strongly to preschooler coping responses and outcomes were those taking place concurrently. Furthermore, caregiver behavioral analysis should be multifaceted, with caregiver behavior being analyzed in the context of the other caregiver behaviors that are concurrently being enacted.

Third, the strongest relationships observed prospectively in the current paper were those pertaining to the same characteristic. Specifically, children's pain predicted children's pain across the preschooler immunization at the highest magnitude observed across all relationships.

Based on these conclusions, several clinical implications are offered. First, a preschooler's ability to cope is a powerful tool to reduce pain-related distress. However, coping responses must be encouraged to be ongoing throughout the vaccination until the distress has been regulated because results indicate that good coping during one time point does not predict lower pain-related distress at a subsequent time point. Second, proximal soothing and caregiver sensitivity during infancy is critical to encourage due to both short- and long-term implications to not just children's pain-related coping but also to broader cognitive abilities such as language and executive functioning. Third, it is as important or perhaps even more important for caregivers of preschoolers undergoing vaccination to be taught to avoid distress-promoting behaviors (such as criticism, reassurance), in addition to enacting coping-promoting behaviors. Fourth, synthesizing over both studies, it is crucial that caregiver coping-promoting behaviors and child coping responses be enacted continuously, and that caregiver distress-promoting behaviors be avoided continuously. Results suggest that these caregiver and child behaviors do not 'pay forward' to reduce pain-related distress or increase coping responses at subsequent time points. Finally, given our finding that children's pain predicts children's pain prospectively within a vaccination appointment, but not longitudinally, preschoolers during vaccination should have their distress reduced well before the needle pierces his or her skin and caregivers should not assume that their child's level of pain during the 12-month vaccination will be indicative of their level of pain at preschool.

4.3. Limitations and future directions

Generalizability will be affected by the education level of the sample and the self-selection bias associated with being a caregiver who agrees to be followed through the first year of vaccinations, again at the preschool vaccination, and participate in a comprehensive preschool assessment. It is also important to acknowledge the observational design of our study and, more specifically, that the relationships between the variables in our models are not necessarily causal. It is possible that the relationships between the variables in our model could be explained by unmeasured variables (e.g., temperament explaining the link between coping outcomes over time). In addition, the small to moderate size of several of the path coefficients must be kept in mind. All clinical implications offered above should be considered in the context of these points.

Future research should build on our findings by conducting similar multivariate longitudinal models. Re-examining the role of children's language and executive functioning at later developmental stages may shed further light on the influence of these developing subsystems. Other interesting avenues for future research would be to examine whether nonverbal caregiver behaviors (e.g., physical touch, nonverbal distraction) relate to young children's coping with pain and to investigate whether young children's coping with pain relates to other areas of wellbeing (e.g., socioemotional functioning). Finally, research in older children should examine more covert and cognitively advanced approaches to coping with pain (e.g., self-talk, distracting oneself, or cognitive reframing).

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Table 1
Overall Means and Standard Deviations of all Model Variables

	N	Mean	Standard Deviation	Scale Range
Caregiver Sensitivity (Infancy)	546	92.77	11.03	28-116
Caregiver Proximal Soothing (Infancy)	510	1.52	1.21	0-2
Caregiver Verbal Reassurance (Infancy)	509	.42	.45	0-1
Infant Pain-Related Distress	496	10.35	4.41	0-20
Caregiver Worry Pre-Needle (Preschool)	300	2.28	2.71	0-10
Caregiver Sensitivity (Preschool)	229	.32	.41	0-1
Caregiver C.P. Behaviors Pre-Needle (Preschool)	203	.29	.28	0-1
Caregiver D.P. Behaviors Pre-Needle (Preschool)	199	.10	.14	0-1
Preschooler Coping Response Pre-Needle	203	.22	.34	0-1
Preschooler Coping Outcome Pre-Needle	284	7.38	9.84	0-10
Preschooler Executive Functioning	169	48.30	9.56	0-100
Preschooler Language	165	107.44	13.82	40-160
Preschooler Coping Responses 1 Minute	203	.20	.33	0-1
Caregiver C.P. Behaviors 1 Minute (Preschool)	203	.10	.14	0-1
Caregiver D.P. Behaviors 1 Minute (Preschool)	203	.16	.16	0-1
Preschooler Coping Outcome 1 Minute	290	13.84	10.00	0-10
Preschooler Coping Responses 2 Minutes	203	.23	.33	
Preschooler Coping Outcome 2 Minutes	281	5.62	7.52	0-10

Note. C.P. = Coping-Promoting
Note. D.P. = Distress-Promoting

Table 2

Bivariate Correlations among all Model Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Caregiver Sensitivity (Infancy)	1	.03	-.05	-.20***	.02	.24**	.01	.17*	.11	.00		-.09	.11	.01	.02	.01	-.04	.02
		(.467)	(.291)	(.000)	(.749)	(.001)	(.887)	(.041)	(.134)	(.957)		(.172)	(.157)	(.886)	(.831)	(.860)	(.576)	(.809)
2. Caregiver Proximal Soothing		1	.18**	.27**	.08	.11	-.25**	.12	.00	-.00		-.06	.18*	.29***	-.04	-.02	.12	.09
(Infancy)			(.000)	(.000)	(.223)	(.123)	(.003)	(.157)	(.987)	(.977)		(.385)	(.020)	(.000)	(.643)	(.810)	(.111)	(.165)
3. Caregiver Verbal Reassurance			1	.20***	.06	.07	-.11	.21*	.04	.02		-.05	.10	.06	.03	.02	.19*	-.04
(Infancy)				(.000)	(.319)	(.339)	(.180)	(.013)	(.593)	(.784)		(.438)	(.180)	(.425)	(.727)	(.807)	(.015)	(.574)
4. Infant Pain-Related Distress				1	.16*	-.06	-.03	-.03	-.06	.11		.03	.02	.05	-.11	-.02	.13	-.02
					(.018)	(.403)	(.704)	(.712)	(.489)	(.170)		(.690)	(.804)	(.506)	(.197)	(.765)	(.119)	(.780)
5. Caregiver Worry Pre-Needle					1	.05	.15	-.10	.05	.00		.03	-.01	.03	-.03	.05	-.14*	.07
(Preschool)						(.415)	(.069)	(.206)	(.474)	(.969)		(.581)	(.933)	(.630)	(.706)	(.386)	(.046)	(.276)
6. Caregiver Sensitivity (Preschool)						1	-.10	.22**	.13	.10		-.07	.13	.05	.05	-.09	.10	-.04
							(.225)	(.008)	(.069)	(.177)		(.306)	(.069)	(.519)	(.546)	(.187)	(.189)	(.556)
7. Preschooler Executive Functioning							1	-.08	-.07	.02		.15	-.01	.00	-.06	.13	-.09	.01
								(.330)	(.447)	(.876)		(.062)	(.896)	(.987)	(.529)	(.114)	(.340)	(.871)
8. Preschooler Language								1	.12	-.03		.03	.28**	.12	-.07	-.09	.15	-.01
									(.232)	(.763)		(.730)	(.003)	(.226)	(.469)	(.300)	(.127)	(.931)
9. Caregiver C.P. Behaviors Pre-Needle (Preschool)									1	-.24**		-.15*	.09			-.10		
										(.001)		(.037)	(.183)			(.168)		
10. Caregiver D.P. Behaviors Pre-Needle (Preschool)										1		.42**	-.08			.29***		
												(.000)	(.248)			(.000)		
11. Preschooler Coping Responses Pre-Needle											1		-.29***	.11			-.10	
													(.000)	(.105)			(.192)	
12. Preschooler Coping Outcome Pre-Needle												1	-.15*			.51***		
													(.045)			(.000)		
13. Preschooler Coping Responses 1 Minute													1			-.33***	.26***	-.24**
																(.000)	(.000)	(.001)
14. Caregiver C.P. Behaviors 1 Minute (Preschool)														1	-.15*	.05	.13	.23**
															(.034)	(.505)	(.073)	(.002)
15. Caregiver D.P. Behaviors 1 Minute (Preschool)															1	.45***	-.09	.25***
																(.000)	(.220)	(.000)
16.Preschooler Coping Outcome 1 Minute																1	-.16*	.66***
																	(.030)	(.000)
17. Preschooler Coping Responses 2 Minutes																	1	-.18*
																		(.015)
18. Preschooler Coping Outcome 2 Minutes (Preschool)																		1

Note. C.P. = Coping-Promoting; D.P. = Distress-Promoting

Note. p values are in parentheses

Note. * $p < .05$. ** $p < .01$,*** $p < .001$ (two tailed).

Note. Grey shading refers to relationships that were not examined within any model

Table 3

Standardized and Unstandardized Estimates: *Autoregressive Cross-lagged Path Model: Relationships Between Preschool Children's Coping Responses and Outcomes.*

	Standardized Estimate	Unstandardized Estimate	z	P-value, 2 tailed
		Preschooler Coping Responses Pre-Needle		
Preschooler Coping Outcome Pre-Needle	-.31	-1.05	-4.23	< .001
		Preschooler Coping Responses 1 Minute		
Preschooler Coping Responses Pre-Needle	.08	.07	1.08	.280
Preschooler Coping Outcomes Pre-Needle	-.12	-.00	-1.59	.111
		Preschooler Coping Responses 2 Minutes		
Preschooler Coping Responses 1 Minute	.22	.23	3.11	.002
Preschooler Coping Outcomes 1 Minute	-.09	-.00	-1.27	.206
		Preschooler Coping Outcomes Pre-Needle		
Preschooler Coping Responses Pre-Needle	-.31	-1.05	-4.23	< .001
		Preschooler Coping Outcomes 1 Minute		
Preschooler Coping Responses Pre-Needle	.07	2.00	1.07	.285
Preschooler Coping Outcomes Pre-Needle	.53	.54	9.66	< .001
Preschooler Coping Responses 1 Minute	-.32	-.87	-4.32	< .001
		Preschooler Coping Outcomes 2 Minutes		
Preschooler Coping Responses 1 Minute	-.02	-.54	-.39	.695
Preschooler Coping Outcomes 1 Minute	.65	.49	13.01	< .001
Preschooler Coping Responses 2 Minutes	-.10	-.17	-1.29	.198

Table 4

Standardized and Unstandardized Estimates for Model 1: Predicting Preschool Coping Responses at 1 Minute Post-Vaccination From Infant and Preschool Predictors

	Standardized Estimate	Unstandardized Estimate	Z	P-value, 2 tailed
		Preschooler Coping Responses 1 Minute		
Caregiver Sensitivity (Infancy)	.03	.00	.44	.662
Caregiver Proximal Soothing (Infancy)	.17	.05	2.10	.036
Caregiver Verbal Reassurance (Infancy)	.01	.01	.13	.897
Infant Pain-Related Distress	-.02	-.00	-.18	.854
Caregiver Worry Pre-Needle (Preschool)	-.02	-.00	-.34	.735
Caregiver Sensitivity (Preschool)	.05	.04	.62	.536
Caregiver C.P. Behaviors Pre-Needle (Preschool)	.05	.05	.69	.494
Caregiver D.P. Behaviors Pre-Needle (Preschool)	-.02	-.05	-.29	.772
Preschooler Coping Outcome Pre-Needle	-.12	-.00	-1.51	.131
Preschooler Executive Functioning	.09	.00	.94	.348
Preschooler Language	.23	.01	2.43	.015
		Caregiver Sensitivity (Preschool)		
Caregiver Sensitivity (Infancy)	.24	.01	3.53	< .001
		Preschooler Language		
Caregiver Sensitivity (Infancy)	.18	.22	2.26	.024
Caregiver Verbal Reassurance (Infancy)	.19	5.72	2.33	.020
		Preschooler Executive Functioning		
Caregiver Proximal Soothing	-.24	-1.94	-3.06	.002
		Caregiver Worry Pre-Needle (Preschool)		
Infant Pain-Related Distress	.15	.09	2.40	.016

Note. C.P. = Coping-Promoting

Note. D.P. = Distress-Promoting

Table 5

Standardized and Unstandardized Estimates for Model 2: Predicting Preschool Coping Responses at 2 Minutes Post-Vaccination From Infant and Preschool Predictors

	Standardized Estimate	Unstandardized Estimate	z	P-value, 2 tailed
	Preschooler Coping Responses 2 Minutes			
Caregiver Sensitivity (Infancy)	-.03	-.00	-.35	.726
Caregiver Proximal Soothing (Infancy)	.04	.01	.48	.634
Caregiver Verbal Reassurance (Infancy)	.11	.09	1.47	.141
Infant Pain-Related Distress	.10	.01	1.21	.227
Caregiver Worry Pre-Needle (Preschool)	-.16	-.02	-2.40	.016
Caregiver Sensitivity (Preschool)	.09	.07	1.16	.245
Caregiver C.P. Behaviors 1 Minute (Preschool)	.10	.25	1.44	.149
Caregiver D.P. Behaviors 1 Minute (Preschool)	-.00	-.01	-.05	.960
Preschooler Coping Outcome 1 Minute	-.16	-.01	-2.02	.044
Preschooler Executive Functioning	-.02	-.00	-.17	.868
Preschooler Language	.02	.00	.24	.814
	Caregiver Sensitivity (Preschool)			
Caregiver Sensitivity (Infancy)	.24	.01	3.50	< .001
	Caregiver Coping-Promoting Behaviors 1 Minute (Preschool)			
Caregiver Proximal Soothing (Infancy)	.32	.04	4.50	< .001
	Preschooler Language			
Caregiver Sensitivity (Infancy)	.18	.22	2.24	.025
Caregiver Verbal Reassurance (Infancy)	.19	5.88	2.38	.017
	Preschooler Executive Functioning			
Caregiver Proximal Soothing	-.25	-1.98	-3.16	.002
	Caregiver Worry Pre-Needle (Preschool)			
Infant Pain-Related Distress	.15	.09	2.40	.016

Note. C.P. = Coping-Promoting

Note. D.P. = Distress-Promoting

Table 6

Standardized and Unstandardized Estimates for Model 3: Predicting Preschool Coping Outcomes at 1 Minute Post-Vaccination From Infant and Preschool Predictors

	Standardized Estimate	Unstandardized Estimate	z	P-value, 2 tailed
		Preschooler Coping Outcome 1 Minute		
Caregiver Sensitivity (Infancy)	.07	.06	1.22	.222
Caregiver Proximal Soothing (Infancy)	.05	.39	.78	.435
Caregiver Verbal Reassurance (Infancy)	.06	1.39	1.06	.292
Infant Pain-Related Distress	-.06	-.14	-1.00	.319
Caregiver Worry Pre-Needle (Preschool)	.04	.13	.69	.492
Caregiver Sensitivity (Preschool)	-.05	-1.16	-.77	.439
Caregiver C.P. Behaviors Pre-Needle (Preschool)	.01	.35	.16	.877
Caregiver D.P. Behaviors Pre-Needle (Preschool)	.07	5.13	1.05	.294
Preschooler Coping Outcome Pre-Needle	.48	.49	8.00	< .001
Preschooler Executive Functioning	.04	.05	.61	.541
Preschooler Language	-.11	-.08	-1.52	.129
		Caregiver Sensitivity (Preschool)		
Caregiver Sensitivity (Infancy)	.24	.01	3.48	< .001
		Preschooler Language		
Caregiver Sensitivity (Infancy)	.17	.21	2.15	.032
Caregiver Verbal Reassurance (Infancy)	.18	5.65	2.29	.022
		Preschooler Executive Functioning		
Caregiver Proximal Soothing	-.24	-1.92	-3.03	.002
		Caregiver Worry Pre-Needle (Preschool)		
Infant Pain-Related Distress	.16	.10	2.44	.015

Note. C.P. = Coping-Promoting

Note. D.P. = Distress-Promoting

Table 7

Standardized and Unstandardized Estimates for Model 4: Predicting Preschool Coping Outcomes at 2 Minutes Post-Vaccination From Infant and Preschool Predictors

	Standardized Estimate	Unstandardized Estimate	z	P-value, 2 tailed
		Preschooler Coping Outcome 2 Minutes		
Caregiver Sensitivity (Infancy)	-.00	-.00	-.07	.945
Caregiver Proximal Soothing (Infancy)	.05	.29	.83	.406
Caregiver Verbal Reassurance (Infancy)	-.05	-.91	-1.05	.293
Infant Pain-Related Distress	-.03	-.06	-.63	.527
Caregiver Worry Pre-Needle (Preschool)	.04	.10	.80	.426
Caregiver Sensitivity (Preschool)	-.02	-.31	-.32	.748
Caregiver C.P. Behaviors 1 Minute (Preschool)	.18	9.61	3.15	.002
Caregiver D.P. Behaviors 1 Minute (Preschool)	-.03	-1.34	-.47	.638
Preschooler Coping Outcome 1 Minute	.67	.50	12.80	< .001
Preschooler Executive Functioning	-.08	-.06	-1.28	.202
Preschooler Language	.06	.03	.92	.359
		Caregiver Sensitivity (Preschool)		
Caregiver Sensitivity (Infancy)	.24	.01	3.53	< .001
		Caregiver Coping-Promoting Behaviors 1 Minute (Preschool)		
Caregiver Proximal Soothing (Infancy)	.31	.04	4.41	< .001
		Preschooler Language		
Caregiver Sensitivity (Infancy)	.18	.22	2.24	.025
Caregiver Verbal Reassurance (Infancy)	.19	5.86	2.38	.017
		Preschooler Executive Functioning		
Caregiver Proximal Soothing	-.25	-1.98	-3.15	.002
		Caregiver Worry Pre-Needle (Preschool)		
Infant Pain-Related Distress	.16	.10	2.44	.015

Note. C.P. = Coping-Promoting

Note. D.P. = Distress-Promoting

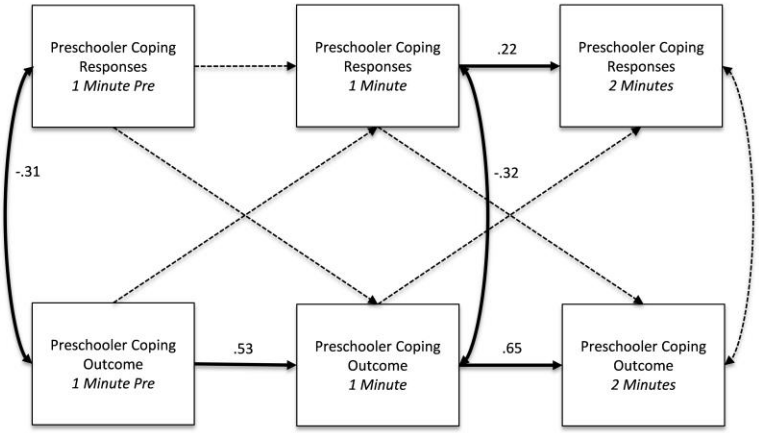

Figure 1. Autoregressive Cross-lagged Path Model: *Relationships Between Preschool Children's Coping Responses and Outcomes.* Solid paths and the corresponding correlations/standardized parameter estimates are significant at $p < .05$.

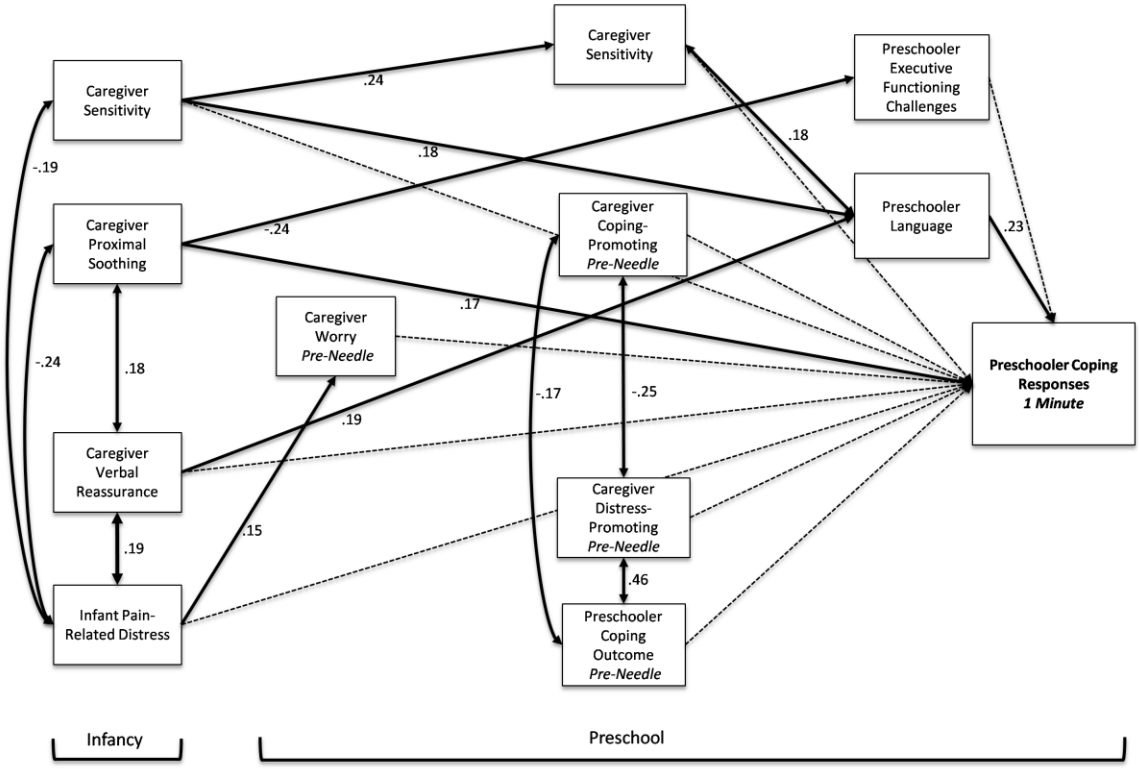

Figure 2. Model 1: *Predicting Preschool Coping Responses at 1 Minute Post-Vaccination From Infant and Preschool Predictors.* Solid paths and the corresponding correlations/standardized parameter estimates are significant at $p < .05$.

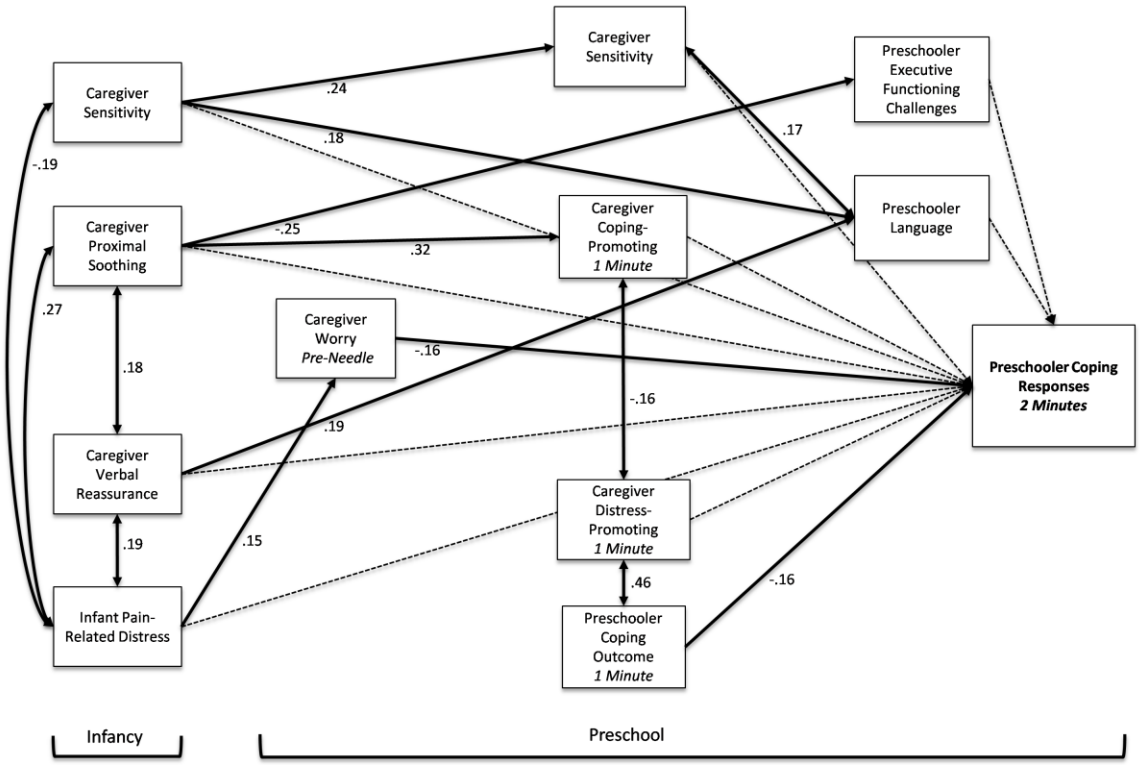

Figure 3. Model 2: *Predicting Preschool Coping Responses at 2 Minutes Post-Vaccination From Infant and Preschool Predictors.* Solid highlighted paths and the corresponding correlations/standardized parameter estimates are significant at $p < .05$.

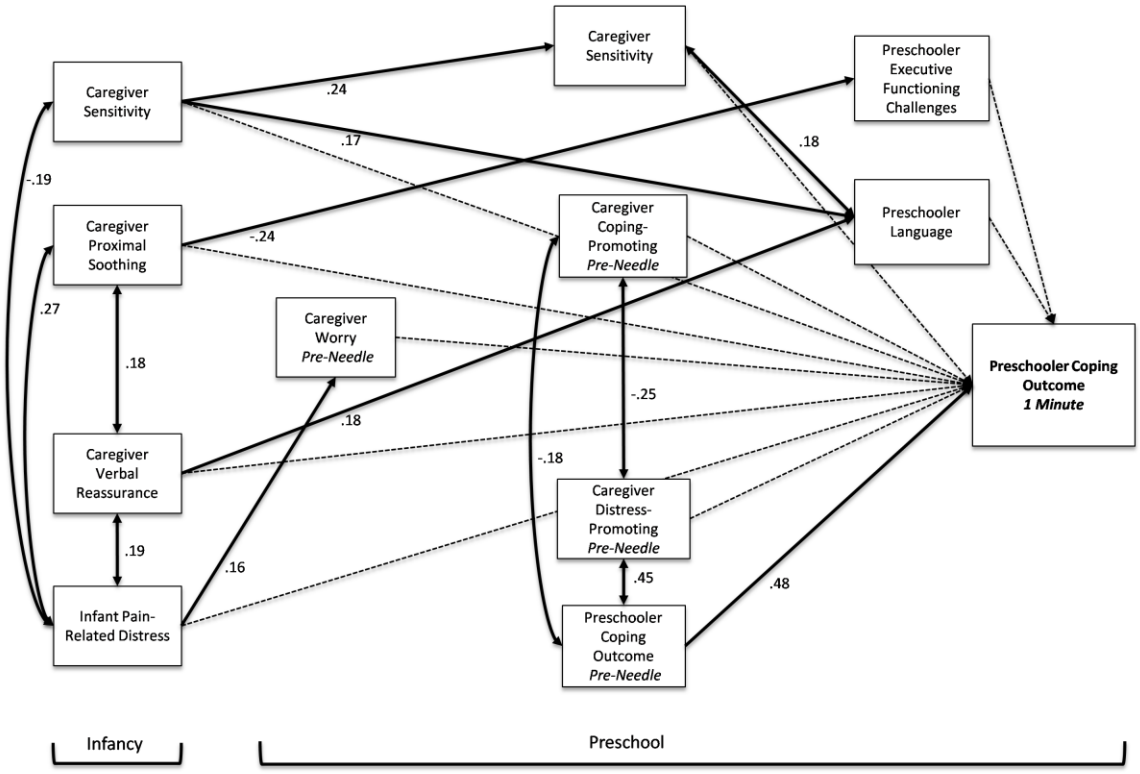

Figure 4. Model 3: *Predicting Preschool Coping Outcomes at 1 Minute Post-Vaccination From Infant and Preschool Predictors.* Solid highlighted paths and the corresponding correlations/standardized parameter estimates are significant at $p < .05$.

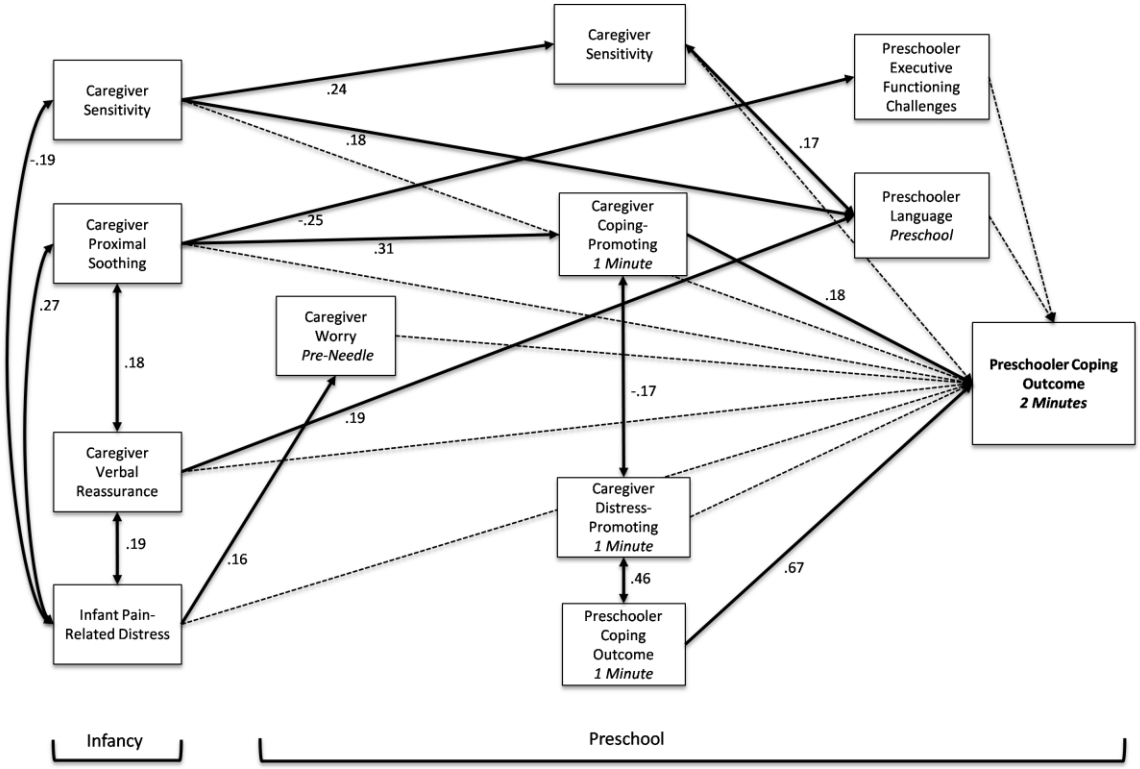

Figure 5. Model 4: *Predicting Preschool Coping Outcomes at 2 Minutes Post-Vaccination From Infant and Preschool Predictors.* Solid highlighted paths and the corresponding correlations/standardized parameter estimates are significant at $p < .05$.

Chapter 5: Conclusion

This dissertation is comprised of three separate, but interrelated studies that have programmatically built on one another. Individually and collectively, these studies make novel and innovative contributions to the field of pediatric pain and coping. Study 1 was a systematic review of the interrelationships between children's coping responses, children's coping outcomes, and parent cognitive-affective, behavioural, and contextual variables during needle-related procedures. The results of the review suggest that children's coping with needle-related procedures is a complex process involving a variety of different dimensions that interact in unison and that parents play an important role in this process. Study 2 built on Study 1 and adopted a dynamic and transactional perspective of coping, examining the reciprocal relationships between children's coping responses and coping outcomes during vaccination at preschool. An autoregressive cross-lagged path model was used and preschooler coping responses and coping outcomes were measured at three different 60-second phases within the vaccination appointment (Pre-needle, 1 Minute, 2 Minutes). Subsequently, Study 3 built on Studies 1 and 2, and focused on the prediction of preschool children's coping responses and coping outcomes using a variety of different potential parent and child predictors. Four longitudinal path analyses were employed. Each study chapter (i.e., Chapter 2 and Chapter 4) discussed the results of the study analyses individually. For ease of reader review, Appendix A presents a summary of the analyses and results for all three studies in point form.

In the sections that follow, the findings from each of the three studies will be briefly summarized. An integrative synthesis of all three studies, followed by a discussion of the clinical implications, limitations, and directions for future research is then presented.

Study 1: A Systematic Review of the Interrelationships Among Children's Coping Responses, Children's Coping Outcomes, and Parent Cognitive-Affective, Behavioural, and Contextual Variables in the Needle-Related Procedures Context

The overarching goal of Study 1 was to organize and synthesize the coping with pain from needle-related-procedure literature in the context of parental factors. More specifically, the aim was to conceptually organize previous literature according to the specific relationships examined between children's coping responses, children's coping outcomes, and parent cognitive-affective, behavioural, and contextual variables. Studies were organized according to three relationship clusters: 1) Children's Coping Responses with Children's Coping Outcomes; 2) Parent Cognitive-Affective, Behavioural, and Contextual Variables with Children's Coping Responses; 3) Parent Cognitive-Affective, Behavioural, and Contextual Variables with Children's Coping Outcomes.

Relationship Cluster I: Children's Coping Responses and Children's Coping Outcomes. Composite measures of children's coping responses combining an assortment of children's coping behaviours were most consistently linked to more optimal children's coping outcomes. Accordingly, it appears that children who use a variety of coping responses fare the best in terms of levels of distress. In the cognitive domain, children's catastrophizing was differentially related to more negative emotional (i.e., fear) versus sensory (i.e., pain from the physical stimulus) sequelae of the needle-related procedure.

Relationship Cluster II: Parent Cognitive-Affective, Behavioural, and Contextual Variables and Children's Coping Responses. Parent "coping-promoting behaviours" (i.e., nonprocedural talk, humour, commands to use coping strategies) engaged in combination as well as individually were consistently associated with children's use of optimal coping responses

that "paralleled" the parents' behaviours. Cognitive-affective parent variables such as catastrophizing about their child's pain, fear during the procedure, and having an anxious predisposition were unrelated to children's coping responses. In terms of parent training programs, these appear particularly helpful for promoting children's breathing-related coping responses. Finally, the relationship between parent behaviours and children's behavioural coping responses appears to be bidirectional.

Relationship Cluster III: Parent Cognitive-Affective, Behavioural, and Contextual Variables and Children's Coping Outcomes. Composite measures of parent "distress-promoting behaviours" composed of a range of different behaviours were most consistently associated with less optimal children's coping outcomes. Within the domain of "distress-promoting" behaviours, parent verbal reassurance consistently emerged as a key discrete behaviour linked in a bidirectional manner (i.e., parent to child; child to parent) with less optimal children's coping outcomes. It appears that the link between cognitive affective variables and children's coping outcomes is strongest when the child coping outcomes "parallel" the parent variable (i.e., are also "cognitive-affective, such as children's fear or parent perception of children's pain, rather than children's actual report of pain from the physical stimulus). The most consistent link between cognitive-affective parent variables was when parents had negative expectations about their children's distress, their child had more distress. Findings from experimental studies suggest that parent training programs can be helpful for reducing behavioural indicators of child distress.

Building upon this formal systematic review, this dissertation then conducted two sets of companion analyses in an in-depth and dynamic investigation of preschooler coping with vaccination pain.

Study 2: The Relationships Between Preschool Children's Coping Responses and Outcomes in the Vaccination Context

The goal of Study 2 was to examine the dynamic and reciprocal relationships between children's coping responses and coping outcomes during vaccination at the narrow and targeted age of preschool. The method used to conduct this analysis was cross-lagged path analysis (e.g., Kessler & Greenberg, 1981). No studies to date had examined the interrelationships between children's coping responses and coping outcomes using this analytical technique. Moreover, this was the first study of its kind to investigate the dynamic and reciprocal relationships between young children's coping responses and outcomes both within and over time across multiple phases of a painful needle-related procedure.

Preschooler coping responses and preschooler coping outcomes were measured at three different 60-second phases within the vaccination appointment (Pre-needle, 1 Minute, 2 Minutes). Study 2 focused on a subsample of 302 children from the OUCH cohort who were seen at the preschool vaccination (ages 4-5 years). To summarize the dynamic relationships observed during the preschool vaccination: 1) Pain-related distress predicts pain-related distress. The more pain-related distress a child expresses, the more he or she will continue to express; 2) Coping responses predict future coping responses. The more coping responses a child enacts after receiving a needle, the more he or she will continue to enact; 3) When distress is highest, child coping responses were consistently related to lower child distress; 4) After taking into account the strong relationships that both pain-related distress and coping responses have predicting subsequent pain-related distress or coping responses (respectively), children's pain-related distress does not predict subsequent coping responses, nor do children's coping responses predict subsequent pain-related distress.

Building on this cross-lagged path analysis, Study 3 took the next step and examined preschooler coping with vaccination pain from a broader perspective.

Study 3: Preschool Children's Coping Responses and Outcomes in the Vaccination Context: Caregiver and Child Predictors from Infancy and Preschool

Using a longitudinal approach, the goal of Study 3 was to examine potential predictors of preschooler coping responses and coping outcomes at the preschool vaccination. Caregiver and child variables from the child's 12-month and preschool vaccination were used as longitudinal or concurrent predictors. In addition, preschoolers' language and executive functioning abilities were obtained from a psychological assessment. Four path analyses were conducted. Two described predictors of preschooler coping responses (1 Minute or 2 Minutes post-needle). Two described predictors of preschooler coping outcomes (1 Minute or 2 Minutes post-needle). Study 3 used members of the OUCH Cohort who were seen at 12-month vaccination, the preschool vaccination (ages 4-5 years), and in a preschool assessment at our laboratory (shortly after the preschool vaccination).

For the first time in the literature, longitudinal infant-caregiver pathways predicting preschooler coping responses and outcomes were elucidated. Novel pathways were found, particularly for preschooler coping responses. Caregiver sensitivity and proximal soothing during infant vaccinations were shown to have important developmental influences on young children's coping responses at the preschool vaccination. Our results suggest possible pathways may be through supporting more optimal language development or by directly modeling more appropriate coping behaviours. Moreover, across both Study 2 and Study 3, parent and preschooler behaviours did not, as a whole, predict subsequent preschooler coping responses or outcomes (i.e., at later phases within the vaccination appointment). However, significant

relationships were found between concurrently measured parent/preschooler behaviours and preshooler's coping responses/outcomes.

An integrative synthesis of all three studies is next presented.

Integrative Synthesis

Informed by the broader coping literature, the goal of this dissertation was to conduct a comprehensive and in-depth investigation of children's coping with needle-related procedures. Integrating across all three studies comprising this dissertation, it appears that, similar to children's coping with other stressors, children's coping with needle-related procedures is a multidimensional and transactional process involving a variety of different cognitive-affective and behavioural child and parent dimensions that interact both concurrently within and longitudinally over time.

More specifically, in line with the notion from the broader coping literature that coping cannot be simplified into a particular behaviour or a specific belief that an individual holds (Skinner, Edge, Altman, & Sherwood, 2003), the same is true for children's coping with needle-related procedures. Collective results from this dissertation suggest that children's "coping" with needle-related procedures is better represented by a variety of child behaviours enacted in unison that are influenced by the child's language and parent behaviours enacted in unison (for better and for worse). Interestingly, we found that the relationship between parent behaviours and children's coping during the preschool vaccination is concurrent and specific to that epoch in time. Parent behaviours do not seem to 'pay forward' and need to be continuously enacted throughout the vaccination.

In addition to the influence of parent behaviours on children's coping with needle-related procedures being specific to a concurrent epoch in time, parent behaviours play a longitudinal

role on children's coping with needle-related pain that is indirect. Specifically, parent sensitivity and verbal reassurance during infancy predict more optimal language development at preschool, which, in turn, enhances coping responses. In the bigger picture, parent behaviours from infancy do seem to 'pay forward.' Likely these positive parental variables (e.g., more sensitivity during appointment) reflect parental behaviours outside the vaccination context.

In terms of the broader cognitive subsystem of children's language relating to children's coping responses with needle-related procedures, likely mechanisms explaining this relationship are children's internal use of language in self-instruction (e.g., to make a coping statement or to self-instruct to take a deep breath) and children's internal use of language in cognitions (e.g., to comprehend coping-promoting language from the parent to be able to respond accordingly).

Clinical Implications

Incorporating findings from all three studies together, several clinical implications are offered. First, validating earlier research, parents and medical professionals should be encouraged to support children in using a variety of coping responses (i.e., deep breathing, nonprocedural talk, making coping statements, and using humour) during needle-related procedures. This should begin well before the needle-related procedure is conducted. This can be promoted through caregiver and/or healthcare professional coaching of children to use coping responses proactively (e.g., making coping statements, engaging in non procedure-related talk, using humor, and engaging in audible deep breathing) from the moment the doctor's office is entered. These techniques can be practiced in advance when the child is not under stress. In addition, given the lack of consistency between preschooler coping responses prior to and following the needle (and that good coping during one time point does not predict lower pain-related distress at a subsequent time point), children should be coached and encouraged to cope

throughout the needle-related procedure and throughout the minutes following the needle. This coaching and encouragement may be particularly important for children in high levels of distress.

Second, parents should not only be encouraged and empowered to engage in a variety of coping-promoting behaviours but it seems even more important to teach parents to explicitly avoid distress-promoting behaviours. The magnitude of relationships in our models suggest that it is critical for parents of preschoolers undergoing vaccination to be taught to avoid distress-promoting behaviours (such as criticism, giving control, apologizing), in addition to enacting coping-promoting behaviours.

Third, parent negative expectation of child distress and parent worry about the child's needle pain should be screened for and, in relevant cases, attempts should be made by health care practitioners to work with parents to promote more positive expectations.

Fourth, proximal soothing and parent sensitivity during infancy is critical to encourage due to both short-term and long-term implications to not just child pain-related coping but also to broader cognitive abilities. Parents should be encouraged and empowered by healthcare professionals to engage in proximal soothing behaviours and coached in "sensitive" approaches to responding to their infant. This should be done proactively by way of parent training programs as well as other instructional materials (e.g., pamphlets, DVDs).

Finally, given that children's pain-related distress predicts children's pain-related distress prospectively within a vaccination appointment, but not longitudinally, preschoolers during vaccination should have their distress reduced well before the needle pierces their skin and parents should not assume that their child's level of pain-related distress during the 12-month vaccination will be indicative of their level of pain-related distress at preschool. Child

preparation prior to arriving to the physician or nurse's office can be critical as children who are less distressed before receiving the needle will express less pain-related distress after the needle.

Limitations

There are several limitations to note. In Study 1, the majority of studies included in the review were American (95%), many of which were from an affiliated group of researchers. Thus, the generalizability of findings from the review may be limited. Moreover, the lower quality of several studies must be taken into consideration, as well as that all studies were cross-sectional in design. For Study 2 and Study 3 (OUCH cohort), generalizability will be affected by the education level of the sample and the self-selection bias associated with being a caregiver who agrees to be followed through the first year of vaccinations, again at the preschool vaccination, and participate in a comprehensive assessment. The observational design of Study 2 and 3 should also be acknowledged and, more specifically, that the relationships between the variables in the path models are not necessarily causal. It is possible that the relationships between the variables could be explained by unmeasured variables (e.g., temperament explaining the link between coping outcomes over time). In addition, the small to moderate size of several of the path coefficients must be kept in mind. All clinical implications offered above should be considered in the context of these points.

Directions for Future Research

Several directions for future research stem from this dissertation. First, renewing classic criticisms from previous reviews, future researchers are encouraged to move away from simply using "coping" as a catch-all term, and explicitly disentangle coping responses from coping outcomes in the acute pain context. Second, it would be interesting and informative to replicate the analyses from Study 2 and 3 at middle and late childhood to obtain different "snapshots" of

children's coping at different developmental stages. Doing so would lend itself to an examination of potential change and continuity in children's coping with needle-related pain over time. Third, examining these topics in a variety of acute pain contexts (i.e., additional needle-related procedures such as BMA/LP, cold pressor task, etc.) may provide an even more comprehensive picture. Fourth, examining the role of children's catastrophizing as a suboptimal coping response would provide insight into important cognitive-affective factors at play. Fifth, examining whether nonverbal parent behaviours (e.g., physical touch, distracting the child nonverbally) relate to young children's coping with needle-related pain would serve to complement findings from this dissertation. Finally, this dissertation examined how developmental processes influence children's needle-related coping. A particularly novel direction for future research would be to examine how children's needle-related coping, in turn, influences children's broader development (e.g., socioemotional or academic functioning).

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Appendix A
Summary of Analyses and Results

Chapter 2 (Study 1): Campbell, L., DiLorenzo, M., Atkinson, N., & Riddell, R. P. (2017). Systematic Review: A Systematic Review of the Interrelationships Among Children's Coping Responses, Children's Coping Outcomes, and Parent Cognitive-Affective, Behavioral, and Contextual Variables in the Needle-Related Procedures Context. *Journal of Pediatric Psychology*, jsx054.

Research Aim: Conduct a systematic review to organize and synthesize the coping with pain from needle-related procedures literature (using the explicit distinction of coping responses versus coping outcomes) in the context of parent variables.

Analysis: A search yielded 6,081 studies, which were examined against inclusion criteria. 20 studies were included in the review.

Results: Narrative synthesis suggested four key findings.

- Combinations of parent behaviours (for better or for worse) are more predictive of children's coping responses and outcomes than are individual parent behaviours alone.
- Parent coping-promoting behaviours enacted in combination are the most consistent predictors of optimal children's coping responses and parent distress-promoting behaviours enacted in combination are the most consistent predictors of children's distress (i.e., less optimal coping outcomes).
- Less optimal parent cognitive-affective variables predict less optimal cognitive-affective children's coping outcomes and this finding is most consistent for parent negative expectation of child distress.
- Parent verbal reassurance is a suboptimal parent behaviour that appears to have a cyclical relationship with children's distress, whereby verbal reassurance occurs both before and after children's distress.

Chapter 4 (Study 2 and Study 3): Campbell, L., Pillai Riddell, R., Cribbie, R., Garfield, H., Greenberg, S. (in press). Preschool Children's Coping Responses and Outcomes in the Vaccination Context: Child and Caregiver Transactional and Longitudinal Relationships. *PAIN*.

a) Study 2: The Relationships Between Children's Coping Responses and Outcomes in the Preschool Vaccination Context

Research Aim: Examine the dynamic and reciprocal relationships between children's coping responses and coping outcomes during the preschool vaccination.

Analysis: Autoregressive cross-lagged path model within the structural equation modeling framework

Results:

- Children's coping outcomes (pain-related distress) did not predict subsequent coping responses.
- Children's coping responses did not predict subsequent coping outcomes (pain-related distress).
- Preceding coping responses positively predicted subsequent coping responses within the post-needle phases of the vaccination.
- Children's coping outcomes (pain-related distress) strongly predicts subsequent children's outcomes (pain-related distress) across all phases of the vaccination.
- At 1 minute prior to the first needle and at 1 minute following the last needle, higher levels of preschooler coping responses were related to lower levels of concurrent pain-related distress.

b) Study 3: Preschool Children's Coping Responses and Outcomes in the Vaccination Context: Caregiver and Child Predictors from Infancy and Preschool

Research Aim: Examine the prediction of preschool children's coping responses and coping outcomes using a broad array of caregiver and child variables from both the 12-month and preschool stage.

Analysis: Four longitudinal path models within the structural equation modeling framework: preceding parent behaviours and child cognitive measures predicting child coping responses and coping outcomes. Post-hoc correlations: concurrent parent behaviours correlated to child coping responses and coping outcomes.

Results:

- Higher levels of caregiver sensitivity and proximal soothing during the 12-month vaccination predicted parallel caregiver behaviours (caregiver sensitivity and coping-promoting behaviours, respectively) at the preschool vaccination.
- Proximal soothing during the 12-month vaccination positively predicted caregiver coping-promoting behaviours at 1 Minute during the preschool vaccination.
- Caregiver coping-promoting and distress-promoting behaviours did not, as a whole, predict children's subsequent coping responses or outcomes.
- Caregiver coping-promoting behaviour at 1 Minute appears to be involved in two different <u>concurrent</u> pathways leading to children's coping outcomes at 2 Minutes (one direct and one indirect).
    - <u>Direct:</u> caregiver coping-promoting behaviour at 1 Minute directly predicts suboptimal coping outcomes at 2 Minutes.
    - <u>Indirect</u>: caregiver coping-promoting behaviour indirectly predicts more optimal coping outcomes at 2 Minutes through being related to lower caregiver distress-promoting behaviours at 1 Minute (which is related to lower pain-related distress at 1 Minute which then predicts forward to lower pain-related distress at 2 Minutes).
- Higher caregiver sensitivity and verbal reassurance at the 12-month vaccination both predicted better developed children's language abilities at preschool.
- Higher proximal soothing at the 12-month vaccination predicted more optimal executive functioning.
- Preschooler language ability predicted greater preschool coping responses at 1 Minute.
- Higher pain-related distress from the 12-month vaccination predicted higher caregiver worry at the preschool vaccination but caregiver worry did not predict any caregiver behaviours at the preschool vaccination.
- Worry directly negatively predicted preschooler coping responses at 2 Minutes.
- Pain-related distress from infancy did not predict preschooler coping responses or outcomes.

<u>Post-hoc correlations:</u>

- Caregiver coping-promoting behaviours related to optimal preschooler coping responses at all three epochs.
- Caregiver coping-promoting behaviours were only related to optimal coping outcomes during the pre-needle phase.
- Caregiver distress-promoting behaviours related to less optimal preschooler coping responses and outcomes at all three epochs.
- Caregiver distress-promoting behaviours and preschooler coping outcomes were the most strongly related of all the significant post-hoc correlations.

Appendix B

Cinahl Search Strategy

#	Query	Limiters/Expanders	Results
S36	S22 AND S35	Search modes - Boolean/Phrase	1,243
S35	S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34	Search modes - Boolean/Phrase	294,541
S34	(MH "Distraction")	Search modes - Boolean/Phrase	784
S33	TX ("adaptive behavio?r" or breathing or catastrophiz* or coping or distract* or humo?r or internaliz* or laughter or music* or stress)	Search modes - Boolean/Phrase	124,691
S32	TX (parent* or mother* or father*)	Search modes - Boolean/Phrase	128,118
S31	TX "non-procedur* talk"	Search modes - Boolean/Phrase	2
S30	(MH "Professional-Patient Relations+")	Search modes - Boolean/Phrase	52,385
S29	(MH "Parent-Child Relations+")	Search modes - Boolean/Phrase	14,745
S28	(MH "Maternal Behavior") OR (MH "Paternal Behavior") OR (MH "Parental Behavior")	Search modes - Boolean/Phrase	1,989
S27	(MH "Parents+")	Search modes - Boolean/Phrase	43,443
S26	(MH "Breathing Exercises+")	Search modes - Boolean/Phrase	1,116
S25	(MH "Stress, Psychological")	Search modes - Boolean/Phrase	19,341
S24	(MH "Coping+")	Search modes - Boolean/Phrase	20,243
S23	(MH "Adaptation, Psychological")	Search modes - Boolean/Phrase	13,583
S22	S19 OR S21	Search modes - Boolean/Phrase	4,350
S21	S18 AND S20	Search modes - Boolean/Phrase	4,350
S20	TX (child* or preschool* or "pre-school*" or boy* or girl* or paediatric* or pediatric*)	Search modes - Boolean/Phrase	559,794
S19	S16 OR S17	Limiters - Age Groups: Child, Preschool: 2-5 years, Child: 6-12	1,658

		years Search modes - Boolean/Phrase	
S18	S16 OR S17	Search modes - Boolean/Phrase	17,547
S17	TX (procedur* N4 pain*)	Search modes - Boolean/Phrase	1,856
S16	S12 AND S15	Search modes - Boolean/Phrase	16,353
S15	S13 OR S14	Search modes - Boolean/Phrase	149,369
S14	TX pain*	Search modes - Boolean/Phrase	149,369
S13	(MH "Pain")	Search modes - Boolean/Phrase	34,896
S12	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11	Search modes - Boolean/Phrase	152,569
S11	TX (bone marrow N4 (aspirat* or biops*))	Search modes - Boolean/Phrase	387
S10	TX ("arterial line*" or "arterial puncture*" or "blood sampl*" or "blood specimen collection" or booster* or catheter* or "central line*" or "drip infusion*" or epidural* or extradural* or immunization* or "immunologic* sensitization*" or "immunologic* stimulation*" or immunostimulation* or immunotherap* or "infusion drip*" or inject* or inoculat* or "intraarterial line*" or intravenous or "intra-venous" or laceration* or "lumbar puncture*" or microinjection* or needle* or paracentes* or pericardiocentes* or peridural or phlebotom* or "port-a-cath" or revaccinat* or "spinal puncture*" or "spinal tap*" or suture* or thoracocentes* or vaccin* or variolation* or "vascular access device*" or "vascular access port*" or venepuncture* or venesection* or venipuncture* or "venous cannulat*" or "venous reservoir*")	Search modes - Boolean/Phrase	151,165
S9	(MH "Catheters+")	Search modes - Boolean/Phrase	6,870

S8	(MH "Catheterization") OR (MH "Catheter Placement Determination")	Search modes - Boolean/Phrase	1,956
S7	(MH "Injections, Intravenous") OR (MH "Injections, Intraarterial")	Search modes - Boolean/Phrase	1,991
S6	(MH "Infusions, Intraarterial") OR (MH "Infusions, Intravenous")	Search modes - Boolean/Phrase	4,745
S5	(MH "Punctures+")	Search modes - Boolean/Phrase	7,375
S4	(MH "Sutures")	Search modes - Boolean/Phrase	895
S3	(MH "Immunization")	Search modes - Boolean/Phrase	11,627
S2	(MH "Blood Specimen Collection") OR (MH "Arterial Puncture") OR (MH "Venipuncture") OR (MH "Phlebotomy")	Search modes - Boolean/Phrase	3,270
S1	(MH "Needles")	Search modes - Boolean/Phrase	2,174

EMBASE Search Strategy

1 exp needle/ (39576)

2 blood sampling/ (138528)

3 phlebotomy/ (8753)

4 exp immunization/ (242109)

5 exp suture/ (45618)

6 laceration/ (7929)

7 puncture/ or vein puncture/ (27796)

8 exp intravascular drug administration/ (391746)

9 exp catheterization/ (142553)

10 exp injection/ (180756)

11 exp catheter/ (116886)

12 paracentesis/ (5320)

13 pericardiocentesis/ (3739)

14 thoracocentesis/ (5111)

15 ("arterial line*" or "arterial puncture*" or "blood sampl*" or "blood specimen collection" or booster* or catheter* or "central line*" or "drip infusion*" or epidural* or extradural* or immunization* or "immunologic* sensitization*" or "immunologic* stimulation*" or immunostimulation* or immunotherap* or "infusion drip*" or inject* or inoculat* or "intraarterial line*" or intravenous or "intra-venous" or laceration* or "lumbar puncture*" or microinjection* or needle* or paracentes* or pericardiocentes* or peridural or phlebotom* or "port-a-cath" or revaccinat* or "spinal puncture*" or "spinal tap*" or suture* or thoracocentes* or vaccin* or variolation* or "vascular access device*" or "vascular access port*" or venepuncture* or venesection* or venipuncture* or "venous cannulat*" or "venous reservoir*").mp. (2748538)

16 (bone marrow adj4 (aspirat* or biops*)).mp. (34831)

17 or/1-16 (2821709)

18 exp pain/ or application site pain/ or injection pain/ or injection site pain/ (917902)

19 pain*.mp. (925518)

20 18 or 19 (1176778)

21 17 and 20 (210391)

22 (procedur* adj4 pain*).mp. (15629)

23 21 or 22 (220128)

24 child/ or boy/ or girl/ or hospitalized child/ or preschool child/ or school child/ (1742722)

25 (child* or preschool* or "pre-school*" or boy* or girl* or p?ediatric*).mp. (2453045)

26 24 or 25 (2453045)

27 23 and 26 (24944)

28 limit 23 to (child <unspecified age> or preschool child <1 to 6 years> or school child <7 to 12 years>) (16024)

29 27 or 28 (24944)

30 exp coping behavior/ (39412)

31 stress/ or acute stress/ or emotional stress/ or mental stress/ (179771)

32 breathing exercise/ (5543)

33 parent/ or exp father/ or exp mother/ (199841)

34 exp child parent relation/ (67756)

35 doctor patient relation/ or nurse patient relationship/ (111081)
36 "non-procedur* talk".mp. (1)

37 (parent* or mother* or father*).mp. (642095)

38 ("adaptive behavio?r" or breathing or catastrophiz* or coping or distract* or humo?r or internaliz* or laughter or music* or stress).mp. (1172796)

39 or/30-38 (1885168)

40 29 and 39 (4089)

Medline Search Strategy

1 Needles/ (11455)
2 blood specimen collection/ or phlebotomy/ (12664)
3 exp Immunization/ (140818)
4 Sutures/ (13153)
5 Lacerations/ (1959)
6 Spinal Puncture/ (5325)
7 infusions, intravenous/ or injections, intravenous/ (126298)
8 exp Catheterization/ (194381)
9 exp Injections/ (253248)
10 exp Catheters/ (19701)
11 paracentesis/ or pericardiocentesis/ (2230)
12 ("arterial line*" or "arterial puncture*" or "blood sampl*" or "blood specimen collection" or booster* or catheter* or "drip infusion*" or epidural* or extradural* or immunization* or "immunologic* sensitization*" or "immunologic* stimulation*" or immunostimulation* or immunotherap* or "infusion drip*" or inject* or inoculat* or "intraarterial line*" or intravenous or "intra-venous" or laceration* or "lumbar puncture*" or microinjection* or needle* or paracentes* or pericardiocentes* or peridural or phlebotom* or "port-a-cath" or revaccinat* or "spinal puncture*" or "spinal tap*" or suture* or thoracocentes* or vaccin* or variolation* or "vascular access device*" or "vascular access port*" or venepuncture* or venesection* or venipuncture* or "venous cannulat*" or "venous reservoir*").mp. (1843531)
13 (bone marrow adj4 (aspirat* or biops*)).mp. (9732)
14 or/1-13 (1902213)
15 pain/ or acute pain/ (114638)
16 pain*.mp. (518297)
17 15 or 16 (518297)
18 14 and 17 (88354)
19 (procedur* adj4 pain*).mp. (5978)
20 18 or 19 (92168)
21 limit 20 to ("preschool child (2 to 5 years)" or "child (6 to 12 years)") (7379)
22 (child* or preschool* or "pre-school*" or boy* or girl* or p?ediatric*).mp. (2022850)
23 20 and 22 (9525)
24 21 or 23 (9525)
25 Adaptation, Psychological/ (78488)
26 Stress, Psychological/ (92829)
27 breathing exercises/ or laughter therapy/ (2976)
28 exp Parents/ (77269)
29 maternal behavior/ or exp parent-child relations/ or paternal behavior/ (56028)
30 professional-patient relations/ or dentist-patient relations/ or nurse-patient relations/ or physician-patient relations/ (124246)
31 "non-procedur* talk".mp. (1)
32 (parent* or mother* or father*).mp. (495542)
33 ("adaptive behavio?r" or breathing or catastrophiz* or coping or distract* or humo?r or internaliz* or laughter or music* or stress).mp. (746785)
34 or/25-33 (1362714)
35 24 and 34 (1845)

PsychInfo Search Strategy

1 exp injections/ (3958)

2 immunization/ (2930)

3 catheterization/ (258)

4 "medical treatment (general)"/ (4071)

5 ("arterial line*" or "arterial puncture*" or "blood sampl*" or "blood specimen collection" or booster* or catheter* or "central line*" or "drip infusion*" or epidural* or extradural* or immunization* or "immunologic* sensitization*" or "immunologic* stimulation*" or immunostimulation* or immunotherap* or "infusion drip*" or inject* or inoculat* or "intraarterial line*" or intravenous or "intra-venous" or laceration* or "lumbar puncture*" or microinjection* or needle* or paracentes* or pericardiocentes* or peridural or phlebotom* or "port-a-cath" or revaccinat* or "spinal puncture*" or "spinal tap*" or suture* or thoracocentes* or vaccin* or variolation* or "vascular access device*" or "vascular access port*" or venepuncture* or venesection* or venipuncture* or "venous cannulat*" or "venous reservoir*").mp. (71963)

6 (bone marrow adj4 (aspirat* or biops*)).mp. (126)

7 or/1-6 (75906)

8 pain/ (18481)

9 pain*.mp. (81518)

10 8 or 9 (81518)

11 7 and 10 (7131)

12 (procedur* adj4 pain*).mp. (1142)

13 11 or 12 (7959)

14 (child* or preschool* or "pre-school*" or boy* or girl* or p?ediatric*).mp. (585707)

15 13 and 14 (936)

16 coping behavior/ or "adaptability (personality)"/ or "resilience (psychological)"/ (46422)

17 stress/ or psychological stress/ or stress reactions/ (58962)

18 stress management/ or anxiety management/ (4559)

19 humor/ (3654)

20 parents/ or exp fathers/ or exp mothers/ (68014)

21 exp parent child relations/ (56262)

22 therapeutic processes/ (19091)

23 "non-procedur* talk".mp. (3)

24 (parent* or mother* or father*).mp. (276751)

25 ("adaptive behavio?r" or breathing or catastrophiz* or coping or distract* or humo?r or internaliz* or laughter or music* or stress).mp. (291125)

26 ((physician* or doctor* or nurse* or professional*) adj4 relation* adj4 patient*).mp. (4227)

27 or/16-26 (553166)

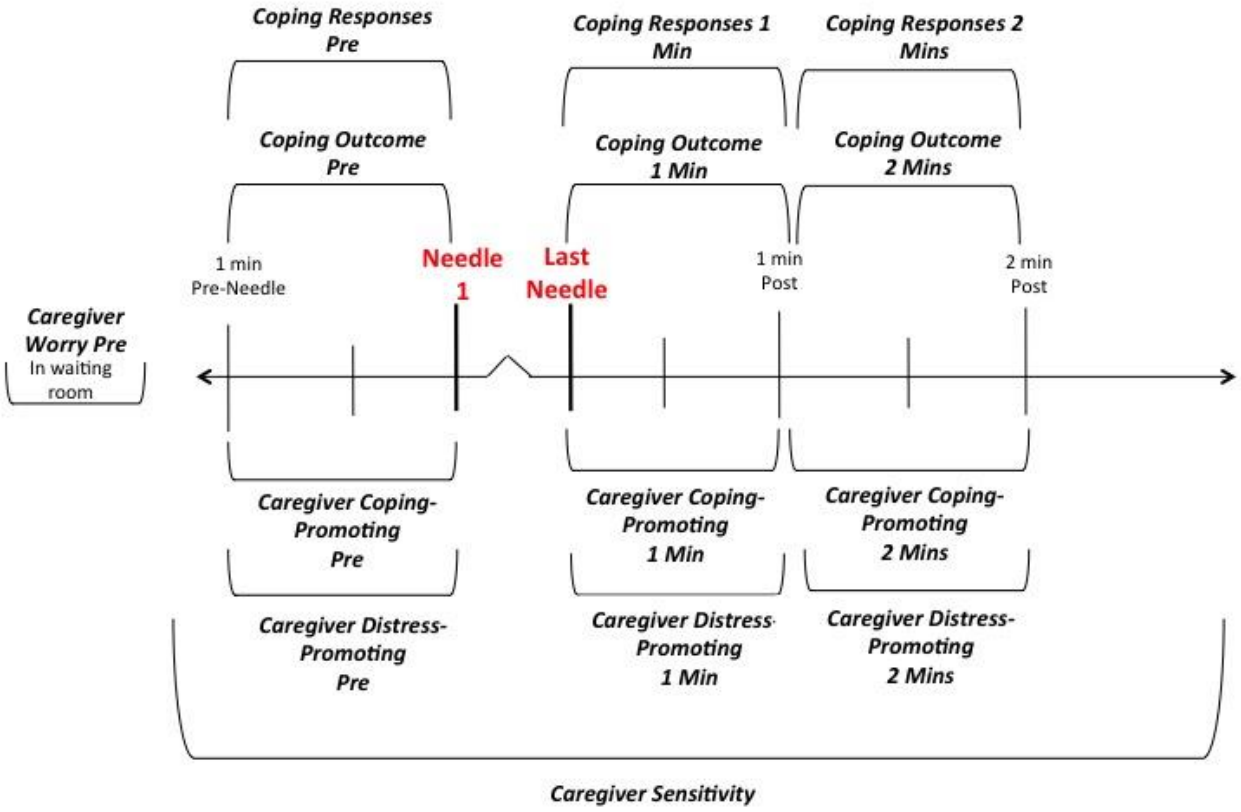
28 15 and 27 (528)

Appendix C

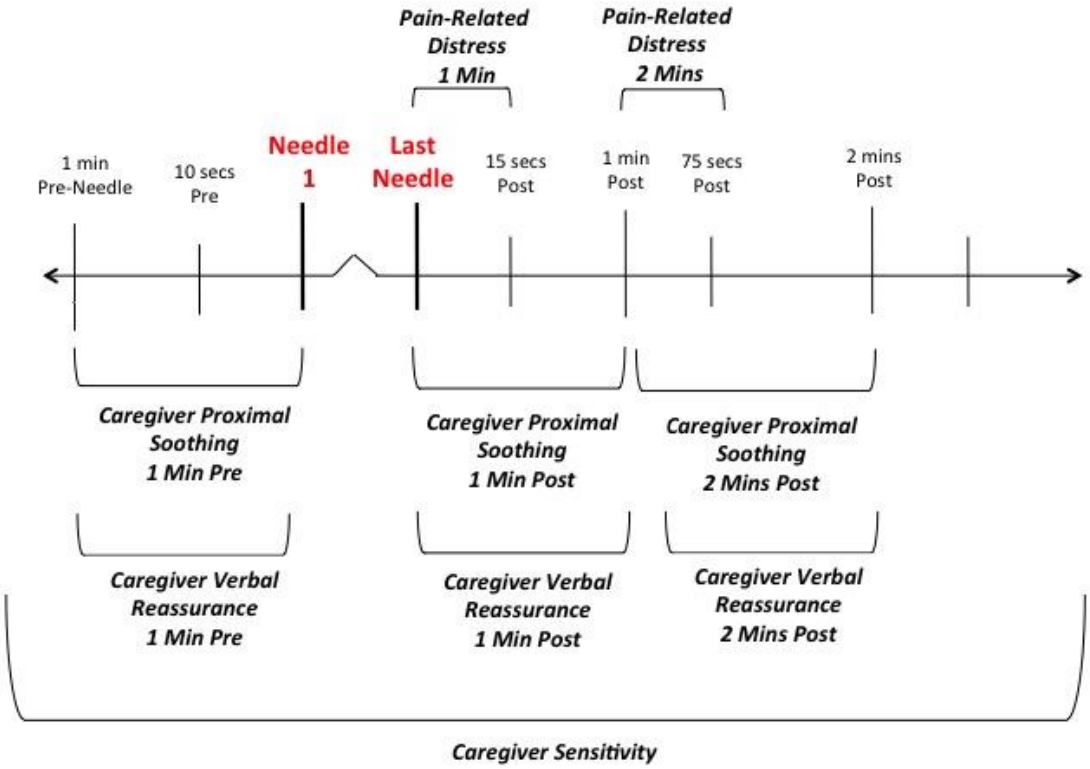
Quality Assessment Measure

1. Is the hypothesis/aim/objective of the study clearly described?
2. Are the main outcomes to be measured clearly described in the Introduction or Methods section?
3. Is the design of the study described?
4. Is the setting of the study described?
5. Is the source of the subjects studied stated?
6. Is the distribution of the study population by age described?
7. Is the distribution of the study population by gender described?
8. Is the sample size stated?
9. Is the participation/follow up described?
10. Are non-participants/subjects lost to follow up described?
11. Are the main findings of the study clearly described?
12. Are the statistical methods described?
13. Have actual probability values been reported (e.g., 0.035 rather than < 0.05) for the main outcomes except where the probability value is less than 0.001?
14. Are confidence intervals/standard deviations given?
15. Are any conclusions stated?
16. Were the subjects asked to participate in the study representative of the entire population from which they were recruited?
17. Were the subjects who were prepared to participate in the study representative of the entire population from which they were recruited?
18. Was the participation/follow-up rate > 80%?
19. Were the main outcome measures used accurate (valid and reliable)?
20. Was the sample size justified?

Appendix D
Preschool Vaccination Timeline



Appendix E
Infant Vaccination Timeline



Appendix F
Information Package for Participating Parents

Who are we?

The Opportunities to Understand Childhood Hurt Laboratory, is located at York University. It opened in Summer 2004. Since then, under the leadership of Dr. Pillai Riddell, the lab has produced innovative research with infants and how they experience pain, particularly in the context of caregiver interactions.

Some of our previous participants.

YORK UNIVERSITÉ UNIVERSITY
redefine THE POSSIBLE.

Ouch Lab
Opportunities to Understand Childhood Hurt Laboratory

Opportunities to Understand Childhood Hurt Laboratory

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Here we grow... Again!

The O.U.C.H. Cohort

Next Steps

What we've done so far...

Since 2007, across the GTA, The O.U.C.H. Lab team has ambitiously followed over 750 babies during immunizations over their first year of life.

Almost 130 of these families also agreed to take part in another novel study to help us learn more about parent-infant attachment and pain behaviours.

Now our cohort babies have grown up! We are interested in looking at how they are developing at the end of early childhood. We need parents who participated in the first longitudinal study to contact us to register for the new study. The great thing for our cohort parents is that parents get the major benefit of getting a full preschool psychoeducational report on how their child learns best!

Final Steps...

The most innovative aspect of our research is yet to come. We would like to understand how your 4-6 year old functions in a variety of settings. This will tell us how infant behaviours during a stressful time relate to their functioning later in childhood, and what parent behaviours are important in optimizing this functioning.

Our new study involves videotaping their 4 to 6 year old immunization appointment, parent questionnaires, and a psycho-educational assessment at York University. We would also like to contact your child's teacher via telephone with a few questionnaires to learn more about how your child behaves in an educational setting.

Why participate?

1. This is a **once-in-a-lifetime opportunity** to be a part of the largest immunization cohort in the world examining pain in the context of parent behaviour.
2. The results of this longitudinal project are expected to provide novel insights into child development and we hope will **help improve outcomes** for children who struggle early.
3. Finally, after participating, you will receive **a summary psychoeducational report** (from a registered psychologist). These reports contain valid measures of your child's intelligence (IQ), academic achievement, and social and emotional functioning. Reports can be used to help your child optimize their learning potential.

Want to register?

Please email our Cohort Assessment Coordinator at **cohort@yorku.ca** or call at 416 736-2100, ext. 20177!

Appendix G

Participant ID: _____ **Date:** _____

PARTICIPANT INFORMATION SHEET - PARENT

PART 1: PARENT QUESTIONS – *These questions refer to the parent who will be most responsible for soothing child during needle.* (*If possible, all questions to be asked by Clinic RA)*

1. **Your birth date** (dd/mm/yyyy) _____

2. **Your relationship to child: Mother Father Other** _____

3. **Your current marital status** (circle one number):
   1. Married/Common Law
   2. Divorced/Separated
   3. Remarried
   4. Widowed
   5. Never Married
   6. Other _____

4. a) **Number of family members living in your household**: Adults _____ Children _____
   b) **For each child in your family, please list their age and sex**
   Age of child brought in today: _____ (years, months) **Male Female**
   Birth date of child (dd/mm/yyyy):_____

   Ages & genders of your other children
   Age: _____ Male Female
   Age: _____ Male Female
   Age: _____ Male Female
   Age: _____ Male Female

5. **a) Which caregivers are present at this immunization?** (circle one number):

1. Mom only
2. Dad only
3. Mom and Dad
4. Nanny
5. Grandparent(s)
6. Parent (s) and Nanny
7. Parent (s) and Grandparent(s)
8. Other _____
9. Parent(s) and Other _____

b) How many other children are present, if any? (do not include child getting immunized): _____

6. **Has your child been given EMLA or TYLENOL prior to appointment?:**
   EMLA TYLENOL NONE

7. Since your child turned one, have you taken any parenting classes/workshops? **Yes No**
   If <u>yes</u>, how many parenting classes/workshops? _____

8. Since your child turned one, have you read any infant parenting books or watched parenting videos?
   Yes No
   If <u>yes</u>, how many books or videos? _____

9. Since your child turned one, approximately how often do you visit parenting websites?:

Never	Once a day	Once a week	Once every few weeks	Once a month	Once a year

10. Since your child turned one, have you received any guidance from an organization or professional to help with parenting your children (e.g., health unit nurse, midwife, Early Years Centre, Healthy Babies Healthy Children, Hincks-Dellcrest, Jessie's Place)? **Yes No**
    If <u>yes</u>, from how many organizations/professionals? _____

11. Please estimate the amount of time in a typical day (in hours) that your infant **currently** spends under the primary responsibility of the following caregivers:

How many days do you currently work outside the home? _____

	Days When <u>you are working</u> at your job, how many hours in a typical day is infant under the primary care of….	**Days When <u>you are NOT working</u> at your job, how many hours in a typical day is infant under the primary care of….**
Mother		
Father		
Professional Daycare Facility		

School (JK, SK, Grade 1)		
Other (please describe)		
	TOTAL must equal 24 hours	**TOTAL must equal24 hours**

12. Who is currently the primary caregiver of your child?

Mother **Father** **Equally between Mother & Father** **Other** **_____**

13. Since one year of age, has your child been separated from his/her primary caregiver for longer than 24 hours (e.g., infant hospitalization, parent hospitalization, Children's Aid involvement, parent travel, family emergency)?

Circle: **YES** **NO**

***If you circled YES*:**

Approximately, how many separations longer than 24 hours have occurred? _____

How long was the longest period of separation? _____ (days)

14. **Child's Medical History:**

Please check next to any illness or condition that your child has had **since one year of age**. When you check an item, also note the approximate date of the illness or your child's age at illness.

Illness or Condition	Age(s)	Illness or Condition	Age(s)
☐ Measles	_____	☐ Visual problems	_____
☐ German Measles	_____	☐ Fainting spells	_____
☐ Mumps	_____	☐ Loss of consciousness	
☐ Chicken Pox	_____	*(please specify cause)*	_____
☐ Whooping Cough	_____	☐ Lead poisoning	_____
☐ Diphtheria	_____	☐ Ear problems	_____
☐ Scarlet Fever	_____	☐ TB	_____
☐ Meningitis	_____	☐ Bone or joint disease	_____
☐ Pneumonia	_____	☐ Anemia	_____
☐ Encephalitis	_____	☐ Jaundice/Hepatitis	_____
☐ High Fever		☐ Cancer	_____
(>41°C or 105.8°F)	_____	☐ Heart Disease	_____
☐ Seizure	_____	☐ Asthma	_____
☐ Allergy	_____	☐ Bleeding problems	_____
☐ Hay Fever	_____	☐ Eczema or hives	_____
☐ Injuries to head	_____	☐ Paralysis	_____

- ☐ Broken Bones _____
- ☐ Hospitalization *(please specify reason)* _____
- ☐ Operations *(please specify)* _____
- ☐ Otitis media _____
- ☐ Stomach pumped _____
- ☐ Thrush _____
- ☐ Circumcision _____

15. Has your child been diagnosed with any other chronic illnesses not listed above? **Yes** **No**
If <u>yes</u>, which chronic illness and at what age were they diagnosed? _____
_____

16. Has your child ever taken any medication long-term (i.e., longer than 2 weeks)? **Yes** **No**
If <u>yes</u>, please list. _____
_____

PART 2: PARENT RATINGS (PRE-IMMUNIZATION)

Pre-Immunization **Child Worry** Rating
On a scale from 0 to 10, how worried about the needle pain do you think your child is, right now, before the needle, where 0 is "no fear at all" and 10 is "the most worry possible"?

_____

Pre-Immunization **Self Worry** Rating
*On a scale from 0 to 10, how worried about the needle pain are **YOU**, right now, before the needle, where 0 is "no fear at all" and 10 is "the most fear possible"?*

_____

PART 3: PARENT RATINGS (POST-IMMUNIZATION)

To be done approximately 5 minutes after last needle!

Post-Immunization **Child Pain** Rating
On a scale from 0 to 10, how much pain do you think your child experienced from the needles they just received, where 0 is "no pain at all" and 10 is "the worst pain possible"?

_____

Post-Immunization **Child Worry** Rating
On a scale from 0 to 10, how worried about the needle pain do you think your child is, right now, after the needle, where 0 is "no fear at all" and 10 is "the worst fear possible"?

_____

Post-Immunization **Self Worry** Rating
*On a scale from 0 to 10, how worried about the needle pain are **YOU**, right now, after the needle, where 0 is "no fear at all" and 10 is "the most fear possible"?*

_____

Post-Immunization **Needle Awareness** Check
Did your child know they would receive a needle prior to coming to the doctor's office?

Yes **No**

How long after last needle were these ratings obtained?

_____ minutes

PART 4: VACCINES GIVEN BY IMMUNIZATION NEEDLE

RA to fill out (ask nurse or doctor for vaccine name and trade name)

		Company/Brand Name	Disease it Protects Against
☐	DTaP-IPV	_____	_____
☐	MMRV	_____	_____
☐	Varicella only	_____	_____
☐	MMR only	_____	_____
☐	Other _____	_____	_____

How many needles total?: _____

In order of administration:

1. Vaccines in needle #1: _____

Participant Information Sheet – CHILD CHILD RATINGS *(RA to fill out with child)*

**While parent is filling out Consent form/parent questions, please do Poker Chip Method with the child.

PRE-IMMUNIZATION

Note: The pre-immunization poker chip question will establish a baseline AND act as a "practice round" for this tool, i.e., to be sure the child understands how to answer when we ask again AFTER the needle.

Using the Poker Chip Method, begin with: "These chips represent how much ouchie you feel…

…where no chips means no ouchie, one chip means a little bit of ouchie, two chips means a little bit more ouchie, three chips means more ouchie, and four chips is the worst ouchie possible. How much ouchie do you feel right now?"

Rating (0-4): _____

Try to get the child to say "No chips." If child says anything but "No chips," probe to get them to "No chips" i.e., asking about why they feel hurt. If they respond with a genuinely painful experience (e.g., just fell down), please make note of that.

POST-IMMUNIZATION

Using the Poker Chip Method: "These chips represent how much ouchie you feel…
…where no chips means no ouchie, one chip means a little bit of ouchie, two chips means a little bit more ouchie, three chips means more ouchie, and four chips is the worst ouchie possible. How much ouchie do you feel right now?"

Rating (0-4): _____

How much did the needle hurt when it came out?

Rating (0-4): _____

Appendix H

Coding Manual

Child-Adult Medical Procedure Interaction Scale- Revised (CAMPIS-R)

Blount, R.L., Cohen, L.L., Frank, N.C., Bachanas, P.J., Smith, A.J., Manimala, M.R., Pate, J.T. (1997) The Child-Adult Medical Procedure Interaction Scale–Revised: An Assessment of Validity. *Journal of Pediatric Psychology*, *22*(1):73-88.

General Coding Instructions

1. Being calm and focused is an important part of coding. Be sure to take regular breaks while coding.
2. Coding will be conducted using the Observer XT software. This software is loaded on all the coding computers in Sherman 2004.
3. Be sure to let Nicole know if there are any problems. If something seems unclear or confusing, it's always best to double-check.
4. You will need your coding manual for reference while coding. This will be kept in the cubby above the coding computers.
5. Reliability will be conducted on 20% of all cases. These cases will be assigned, will need to be transcribed and coded by both Maria and Nicole.
6. All tapes will be transcribed
7. All tapes will be coded for 3 minutes before needle and 2 minutes after needle.

ADULT VERBAL BEHAVIOUS (POINT)

ADULT TO ADULT

1. HMA Humor Directed to Adults
2. NPTA Nonprocedure-Related Talk to Adults
3. PTA Procedure-Related Talk to Adults
4. SMC Commands For Managing Child's Behavior

ADULT TO CHILD (or OTHER CHILD)

5. HMC Humor Directed to Child
6. NPTC Nonprocedure-Related Talk to Child
7. CCS Command to Use Coping Strategy
8. CPA Command to Engage In Procedural Activity
9. PRAS Praise
10. CRIT Criticism
11. NPC Notice of Procedure to Come
12. REASU Reassuring Comment
13. GCC Giving Control to the Child
14. APOL Apology
15. BCC Behavioral Commands to the Child
16. CST Checking Child's Status
17. NSC Negative Status Check*
18. EMP Empathy
19. NPE Notice of Procedure End*
20. PPT Positive/Neutral Procedural Talk*
21. NPT Negative Procedural Talk*
22. REF Reframing*

ADULT TO EITHER ADULT OR CHILD (or OTHER CHILD)

23. CGCT Child's General Condition Related Talk
24. CGSC Current General Status Comments

ADULT NON-VERBAL (STATE)

25. EMPT Empathic Touch*
26. FT Functional Touch*
27. REST Restraint*

CHILD VOCALIZATIONS (POINT)

28. VRES Verbal Resistance
29. EMSUP Emotional Support
30. VFEAR Verbal Fear
31. VPAIN Verbal Pain
32. VEMOT Verbal Emotion
33. INSEK Information Seeking
34. CIA Child Informs About Status
35. RRD Request Relief from Nonprocedural Discomfort
36. MCOP Making Coping Statement

37. NPTC Nonprocedural-Related Talk by the child
38. APV Assertive Procedural Verbalizations
39. CGCT Child's General Condition Related Talk
40. BRTH Audible Deep Breathing
41. HUM Humor by the Child
42. PTC Procedural Talk Child

CHILD NON-VERBAL (STATE)

43. CRY Cry
44. SCR Scream
45. PHY Physical Resistance*

*Behaviours that have been added in addition to the CAMPIS original codes.

Speaker Codes:
P- Parent/Primary Caregiver
C-Child
D-Doctor
S-Sibling

Needle Start Code
Needle Stop Code

Point Behaviours: Behaviours where the onset is noted

State Behaviours: Capture the start, stop, and duration of behaviours (e.g., cry).
Parent Present

0- Mom
1- Dad
2- Mom and Dad
3- Nanny
4- Grandparent

Sibling Present

0-no siblings
1- 1 sibling
2- 2 siblings
3- 3 siblings

Codes for Parent Verbal Behaviors (Point Behaviours)

CODE	DESCRIPTION	EXAMPLES
Humor directed to adults (HMA) Observer Codes:	Any statement that is clearly intended to be humorous and is primarily lighthearted in tone. Humor is often accompanied by laughter from the person making the statement may evoke laughter in the patient or in other staff members. Sarcasm may be coded as humor if it is accompanied by laughter on the part of the speaker or on the part of the listener. Sarcasm is not coded as humor if it is accompanied by an angry or harsh tone of voice.	1. Outright jokes of the "one-liner" variety. 2. Statements that suggest purely facetious, outlandish or outrageous ideas. 3. Statements that emphasize the humorous aspects of a situation or problem. 4. Statements which present lighthearted criticism of someone else in such a manner that would be lightly received (e.g., oh you silly duck) 5. "Sure, working on Sunday is my top priority" 6. Laugher (generally coded + for affect)
Humor directed to child (HMC) Observer Codes:	Any statement that is clearly intended to be humorous and is primarily lighthearted in tone. Humor is often accompanied by laughter from the person making the statement may evoke laughter in the patient or in other staff members. Sarcasm may be coded as humor if it is accompanied by laughter on the part of the speaker or on the part of the listener. Sarcasm is not coded as humor if it is accompanied by an angry or harsh tone of voice.	1. Outright jokes of the "one-liner" variety. 2. Statements that suggest purely facetious, outlandish or outrageous ideas. 3. Statements that emphasize the humorous aspects of a situation or problem. 4. Statements which present lighthearted criticism of someone else in such a manner that would be lightly received (e.g., oh you silly duck) 5. "Sure, working on Sunday is my top priority"

		6. Laugher (generally coded + for affect)
Non procedure-related talk directed toward child (NPTC) Observer Code:	Talk that does not pertain to the treatment procedure or about the child's illness.	1. Conversation about the child's pet, siblings, parents, school, toys, etc. 2. Questions, unrelated to the child's illness or treatment, about the child's plans, wants, desires 3. Conversations about activities on the ward or about other children or staff members on the ward
Non-procedure related talk directed toward other adults (NPTA) Observer Code:	Talk that does not pertain to the treatment procedure or the child's medical well being.	1. "Did you drive in this morning" 2. "How is the new baby doing" 3. Questions about a parents other child, spouse, home, etc. 4. "Susie embarrassed me last night with her comment about the lady across the hall"
Procedure-related talk-Adult to Adult (PTA) Observer Code:	Any talk that directly pertains to the current needle procedures. Comments about past treatment procedures are included in this category only if they related to what is going on now. Commands included in this category may be related to actual physical manipulation of the child (ex. Help curl up in a ball), as this related to the ongoing procedures and is not issues as a result of child distress behavior. Not included in this category are commands or suggestions related to managing the child's distress behavior during the procedures ("hold his legs"). The implication is that he is moving about and should be restrained- Code this as Commands or	1. "Hand me the swab, please" 2. "How many needles is she getting" 3. "When are the next needles?" 4. "How much spinal fluid do you need" 5. "Is it dripping? 6. "Are you using lidocaine today" 7. "It's not dripped yet" 8. "I'm Dr. Smith. I will be doing the procedure today." 9. "You need to stand over "

	suggestions for Managing the Child's Behavior).	10. "Would you had me some #7 gloves" 11. "How many of these tubes do we use?" 12. "This isn't the usual bone marrow procedure!" 13. "Is it dripping yet?" 14. "Roll him over" 15. "Curl him up in a ball"
Child's general physical condition related talk (CGCT) Observer Code:	Questions or comments about the child's history or future health care. For example, comments could refer to the BMA if that procedure is done and resident is currently conducting the LP. These comments must relate to the child's illness or treatment. This is other medical talk not pertaining to current needles.	1. Questions about the child's history 2. Parents request for information -how long does it take to get results back? -will she have to come back tomorrow? -She thought she was going to have to have this every week -How many visits do we have to make? -When does Dr. Gush believe her medication will change? -does Janie have to have chemo next time? 3. Child comments such as: -that time it took a long time -the other doctor washed too hard last time
Current general status comments (CGSC) Observer Code:	Comments by adults regarding the child's current physical, emotional and/or behavioral status. Merely an observation rather than a comment directed toward changing that which is observed would qualify for this category.	1. She seems to have labored breathing today 2. He has stiff muscles 3. Johnny, your muscles are tight 4. He is upset today 5. Boy is she out of it
Command to use coping strategy (CCS) Observer Code:	Any orders, suggestions, or statements of a rule, which direct the child to engage in a coping behavior. These strategies are generally issues immediately prior to a painful event, and may suggest one (but not exclusively one) of the following: relaxation,	1. Use your deep breathing now 2. Would you like to count backwards from 10 very slowly? 3. Imagine you are Superman and this is a test of your strength

	distraction, use of coping statements, or deep breathing. An example such as "Can you breath now" is coded CCS in spite of it giving the impression of control to the child (GCC)	4. Squeeze your mother's hand when you feel the bumble bee 5. Just relax, alright? 6. Count to three…
Command to engage in procedure-related activity (CPA) Observer Code:	Any orders, suggestions or statements of a rule, which directs the child to engage in some procedure-related activity. Common commands might include asking the child to prepare his/her pajamas for the wash, telling the child to curl up for the LP, asking a child to move a part of his/her body, or asking the child to tell them when something hurts.	1. It's time to roll up in a ball for the LP 2. Could you move your hand so that I can fix the IV 3. You need to turn over for the wash 4. Tell me when this hurts, ok?
Praising (PRAS) Observer Code:	Any statement referring to the child or the child's prior, ongoing, or future behavior that is positive in evaluation, shows approval or is rewarding	1. The positive behavior is specified (e.g., you used your deep breathing very well) 2. The positive behavior is not specified: e.g., "Great" or "there you go" 3. Descriptions of child's behavior denoting better-than average performance: e.g., "Tommy is doing so well!" or "you are really being braver than ever"
Criticism (CRT) Observer Code:	Any verbalization that finds fault or implies fault with a) activities, b) products, or c) attributes of the child. Criticism includes negatively evaluative adjectives or adverbs referring to the child, statements of disapproval, statements pointing out something wrong about the child or the child's behavior, and statements pointing out that the child is not doing something positive. Also included as Criticism are obvious sarcastic statements, if these are	1. Timmy has not been going to school the way he should have 2. Boy, you are in a bad mood today 3. That was not a very nice thing to say 4. That was not very funny 5. You didn't use your breathing that time like I told you to 6. Boy, you really controlled yourself

	unaccompanied by laughter on the part of either the speaker or listeners. Usually criticism is accompanied by a harsh voice tone.	that time (after a big scream) 7. You're being a pain.
Notification of procedure to come (NPC) Observer Code:	Any statement denoting that a procedure is about to occur, including the wash, the stick, etc. If the same information is repeated by the parents or staff, either without the child's request for reassurance or emotional support, or with the child asking for mere repetition of the information, code the subsequent notification as NPC.	1. Okay here comes the wash 2. Now, it's just gonna be a little bee sting 3. One more stick 4. This is going to feel cold 5. Dr. Powell is going to put on her gloves now, O.K. 6. It's that soap 7. I'm going to give you a little break.
Reassuring Comment (REASUR) Observer Code:	Procedures related comments that are directed toward the child with the intent of reassuring the child about his/her condition, or the course of the procedure. These may be volunteered by staff and/or parents and may be in response to questions by the child or may reflect the child's comments. If procedure related information is repeated in response to the child's request for reassurance or emotional support, code these procedural notifications as REASU	1. "A little bit of exercise will take care of that" 2. "You're okay" 3. "It's almost over" 4. "We're hurrying" 5. "Honey, it's just soap, okay?" 6. "I'm not doing anything" 7. "Just touching honey"
Giving control to child (GCC) Observer Code:	Any statement to child denoting that child has control over some event to occur with relation to the procedure. Generally this includes staff suggestions where the child is given a choice about the procedure. "Can you breath now?" is coded CCS even though it has the impression of giving control to the child.	1. "Let me know when you are ready to start." 2. "Which side would you like to lie one?" 3. Do you want a pillow for your head? 4. Do you like it better when we tell you or don't tell you? 5. Can you start now?

		6. Are you ready?
Apologizes (APOL) Observer Code:	Any statement relating a sense of sorrow or a sense of responsibility for the pain the child is expressing. These statements may occur prior to, during, or after a painful event, and may occur in conjunction with other verbal codes.	1. "Timmy, we don't like doing this either" 2. "I'm sorry this is taking so long" 3. "I wish I didn't have to hurt you"
Commands or suggestions for managing child's distress behavior (SMC) Observer Code:	Statements suggesting methods for controlling the child's behavior while in the treatment room. Suggestions may include direct demands to treat the child in a particular way, or stating alternatives for managing the child such as referring to methods that have or have not worked well in the past or "wondering aloud" whether different methods might result in less stress.	1. "I think she does better when she knows what is going to happen" 2. "When he gets too upset, if you'll just stop a few seconds he'll calm down" 3. He does best with Dr. Horne" 4. "Hold his legs"
Behavioral commands to the child (BCC) Observer Code:	Commands by adults toward the child which direct the child to change some aspect of his or her behavior. This category is designed to include the limits that parents typically set on their child's behavior and behavioral request/commands of the child. This category is distinguished from CRIT in that the focus of BBC is toward managing the child's behavior, whereas the focus of CRIT is to find fault with the child and/or has an evaluative nature to the verbalizations. BBC is distinguished from CPA in that CPA is directed toward some specific procedural activities	1. "No, don't hurt your mom" 2. " Don't slap me, you've not allowed to hit me" 3. "Shhhhh…" 4. "Wipe the tears" 5. "Ralph, you need to talk to us." 6. "Ralph, talk to your dad." 7. "Ralph, you have to behave" 8. "Sit down and be quiet"
Checking child's status (CST) Observer Code:	Any question directed toward child which asks for his or her opinion about his or her status. Inquiries may refer to how the child is feeling, whether the child is afraid, whether the pain is too bad, etc. Also included are reflections of the child's answers to adults' questions regarding his	1. "Did you feel that?" 2. "Do you think your sleepy medicine is wearing off?" 3. "Are you comfortable?" 4. "That didn't hurt, did it?"

	or her status. Examples such as "Can you breathe now?" even though they do in a sense inquire about the child's condition, are coded as CCS because they are suggesting to the child the use of a coping strategy.	5. Reflecting to the child, "Sore all back there" in response to the child's comment about being sore.
Negative Status Check Observer Code: Neg Stat Check	Inquiries about emotion or sensation that include negative words (yucky, sick, scared, bad) This code involves a suggestion of negative state. (Chorney, 2013)	"Does your stomach feel yucky?" "Do you feel sick?" "Are you scared?" "Is it bothering you?" "Does it hurt?" "Do you think it will hurt?"
Empathy (EMP). Observer Code:	Statements which show an appreciation for the frame of reference of the person being spoken to.	1. "I know this is hard" 2. "I know this is taking a long time" 3. "I know it hurts" 4. "This must be hard" 5. "You must be getting tired" 6. "You must be getting sick of this"
Other (OT) Observer Code:	Code other whenever verbal behavior does not fit any other categories. This includes verbalizations that are not clear enough for accurate recording, sentences that are cut off in mid-stream before the meaning can be ascertained. Use this as a last result when audible, complete sentences are issues. Excluded from this category are "yes", "no", "shoot", "huh" "Aw-shoot", "what", etc. These should be coded according to the context of the conversation if possible.	1. "Can you…" 2. "ummmm" 3. Mumbling 4. "I think that you" 5. "Honey"

Notification of procedure end (NPE) Observer Code:	Verbal statement to let the child know that the procedure is over.	1. "It's over" 2. "It's finished" 3. "You're all done"
Positive/ Neutral Procedural; Talk by Adult Observer Code:	The parent engages in talk that is related to the current or past procedure to the child in a way that is neutral or positive. Does	1. "It will be one poke here, and one poke here and be over very quickly"

	NOT include negative pain or fear words.	2. "It will hurt, but only for a short time" 3. "It will be a poke just like a bumble bee or just like last time" 4. Talking about the needle 5. Talking about another child or adult having to get a needle 6. Talking about blood
Negative Procedural Talk by Adult Observer Code:	The parent engages in talk that is related to the current or past procedure to the child in a way that is negative.	1. It's really gonna hurt 2. It's going to be really scary 3. Remember how scared/hurt/how much you cried last time?
Reframing	When an adult reframes getting the experience in a positive way. When an adult changes a procedural negative to a neutral or a positive. For example, if somehow the parent makes talking about blood a positive.	1. Look at that blood, isn't it cool? 2. You have two Band-Aids on your arms just like a super hero 3. You were so brave

Codes for Parent Non-Verbal Behaviors (State Behaviours)

Empathic Touch	momentary empathic touches (e.g., patting, rubbing a back) (Chorney, 2013)	
Functional Touch	Adults touching child in a way that was needed to get the procedure done (positioning them) (Chorney, 2013)	
Restraint	Adult has to hold down the child or hold them in a hug positive in order to keep them still because they are distressed. (Chorney, 2013)	

Codes for Child Verbal Behaviors (Point Behaviours)

CODE	DESCRIPTION	EXAMPLES

Verbal Resístanse (VRES) Observer Code:	Any verbal expression of delay, termination, or resistance. It must be intelligible.	1. "stop" 2. "no more" 3. "don't" 4. "let me rest" 5. "take the needle out" 6. "I don't want it" 7. "Take me home" 8. "I have to go to the bathroom"
Emotional Support (EMSUP) Observer Code:	Verbal solicitation of hugs, hand holding, physical or verbal comfort by the child. Do not code EMSUP for "mommy" if part of statement requires another code. For example "Mommy, get me out of here" is coded as VRES.	1. "Hold me" 2. "mommy and daddy" 3. "momma please" 4. "Help me" 5. "I want my pacifier"
Verbal fear (VFEAR) Observer Code:	Statements of being apprehensive or in fear. The statement must be intelligible.	1. "I'm afraid" 2. "I'm scared"
Verbal pain (VPAIN) Observer Code:	Statement of pain, damage or being hurt. May be in any tense. Can be anticipatory as well as actual. Has to be a statement, not a question.	1. "That hurts" 2. "It stings" 3. "owwwwh" or "Owwhee" 4. "You're killing me" 5. "You are pinching me" 6. "Don't hurt me"
Verbal emotion (VEMOT) Observer Code:	Statements other than VFEAR or VRES which express the child's emotional state. Anger, self-pity, or resentment would be emotions conveyed here. This category is reserved for negative emotions only.	1. "Why does this have to happen to me" 2. "I hate you" 3. "I don't like doing this"
Information seeking (INSEK) Observer Code:	The child asks questions about medical procedures	1. "when will you stick me" 2. "when will you be finished" 3. "will you let me know when you're ready to start" 4. "will you tell me when you are going to do something" 5. "Is the needle in?" 6. "Is the drip coming?"

Child informs about status (CIA) Observer Code:	The child either volunteers or answers questions about his or her current status	1. "I'm sore back there" 2. "I'm sleepy" or "yes, a little" in response to the question "are you sleepy" 3. "yes" or "no" to the question "are you numb yet" or "can you still feel it"
Request relief from nonprocedural discomfort (RRD) Observer Code:	The child request relief from something that is clearly not procedurally related	1. "prop up my pillow" 2. "my elbow hurts" 3. "the lights too bright" 4. "You're squeezing my hand too hard" 5. "I can't move my foot"
Making coping statements (MCOP) Observer Code:	The child makes some statements which indicates courage or attempts to soothe himself or herself verbally	1. "I'll be okay" 2. "I'm superman/woman" 3. "I can take it" 4. "It won't hurt" 5. "It won't last long" 6. "Superman would not cry" 7. "I can get an ice cream afterward" 8. "I get a Band-Aid" 9. "I did good"
Nonprocedure related talk by child (NPTC) Observer Code:	The child engages in talk that is no way related to his or her current physical condition or the procedure	1. "That cat was a girl" 2. "I was watching He-man the other day" 3. "school is going okay" 4. "we exercise some at home"
Procedure Talk by Child (PTC) Observer Code:	The child engages in talk that is related to the current or past. Can be positive or negative.	1. That's weird that we have blood. 2. The last time I got a needle it was in this arm. 3. Even Julie had to get a needle. 4. I always see Dr. Greenberg for my needles
Assertive procedural verbalization (APV)	Commands, statements, or requests by the child which seek	1. "Don't mash too hard"

Observer Code:	to direct the course of the procedure or some aspect of the adult's behavior as it related to the procedure, without attempting to terminate the procedure or some aspect of the procedure. The essence of what is being targeted here is the child exercising some aspect of control over the course of the procedure without trying to terminate the procedure.	2. "Count to three then stick it in there, okay?" 3. "Push it in fast" 4. "Please tell me when you are ready" 5. "Can you hurry" 6. "go slow"
Child's general condition related talk (CGCT). Observer Code:	This is the same category as in the Codes for Staff/Parent behavior, but with the child doing the talking.	
Audible deep breathing (BRTH) Observer Code:	Deep breathing that is used to cope with the procedures. Breathing that is part of the child's distress does not count as B.	
Humor (HUM) Observer Code:	This is the same category as in the codes for staff/parent but with the child doing the talking.	

Procedure-Related Talk by Child (PTC) Observer Code:	The child engages in talk that is no way related to his or her current physical condition or the procedure	1. Talking about the needle 2. Talking about another child or adult having to get a needle 3. Talking about blood

Codes for Child Non-Verbal Behaviors (State Behaviours)

CODE	DESCRIPTION	EXAMPLES
Cry (CRY)- Observer Code:	Crying sounds-usually unintelligible but can be double coded with verbal categories. Sobbing, whimpering. Coded when crying is audible, child may be moaning or whining. Normally subject will be visibly distressed. Stop code when cry/moan is no longer audible (do not stop if child is	1. "Sobbing" 2. "Boohooohoo" 3. Crying sounds

	taking a breath while crying). Verbalizations such as "No!", "I don't want to." that occur during crying/whining are coded simultaneously.	
<u>Scream (SCRM)-</u> Observer Code:	Vocal expression of pain at high pitch/intensity, usually unintelligible but can be coded with other verbal categories. Not included in this category is loud yelling at a low pitch. Must be higher pitch than crying. Normally subject will be visibly distressed. Stop code when scream is no longer audible (do not stop if child is taking a breath while screaming). Verbalizations such as "No!", "I don't want to." that occur during screaming are coded simultaneously.	1. Sharp, shrill, harsh, high tones 2. Shrieks 3. "owwwwwh"
Physical Resistance	If the child moves around, will not stay in position or tries to climb off table (PBCL definition) Also coded if the child is guarding the area that is going to receive the needles. (PBCL, Zeltzer)	

Appendix I

CAMPIS Coding

ID: _____ Name: _____ Date of Coding: _____

Needle Time: _____

Coding start time (3 minutes before needle): _____

Coding end time (2 minutes after needle): _____

#	Verbalization	Child (C) or Parent (P), Doctor (D)	CAMPIS Code
1			
2			
3			
4			
5			
6			
7			
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9			
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11			
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38			

Appendix J

Merkel, S., Voepel-Lewis, T., Shayevitz, J.R., Malviya, S. (1997). The FLACC: A behavioral scale for scoring postoperative pain in young children. *Pediatric Nursing, 23*(3):293-297.

FLACC CODING SHEET

Date Coded: _____ Coder Name: _____ Participant ID: _____

Coding Time: _____ to _____ Clip Start: _____ Clip Finish: _____

Cleaning Time: **Needle #1 Time:** **Needle #2 Time:**	**BASELINE** **(1 min. before Needle 1)** START:_____ FINISH:_____				**POST NEEDLE 1** **(1 min. after last needle)** START:_____ FINISH:_____				**POST NEEDLE 2** **(2 min. after last needle)** START:_____ FINISH:_____				**POST NEEDLE 3** **(3 min. after the last needle)** START:_____ FINISH:_____			
Epoch Times (15 sec):																
FACE *0 - no expression or smile* *1 - occasional grimace, frown, withdrawn* *2 - frequent to constant frown, clenched jaw, quivering chin*																
LEGS *0 - normal position or relaxed* *1 - uneasy, restless, tense* *2 - kicking or legs drawn up*																
ACTIVITY *0 - Lying quietly, normal position, moves easily* *1 - squirming, shifting back and forth, tense* *2 - arched, rigid, or jerking*																
CRY *0 - no cry* *1 - moans or whimpers, occasional complaint* *2 - Crying steadily, screams or sobs, frequent complaints*																
CONSOLIBILITY *0 - content, relaxed* *1 - reassured by occasional touching, hugging, or being talked to, distractable* *2 - difficult to console or comfort*																

Appendix K

Emotional Availability Scale- 4th Edition

Biringen, Z. (2008). The Emotional Availability (EA) Scales Manual (4th ed.). Retrieved from www.emotionalavailability.com.

EAS Coding

Participant ID:

Date:

Rater:

Observation time:

Describe who is in the immunization room:

Clinical Screener

Clinical Screener Score	

EA Adult Sensitivity

#	Subscale	Range	Score
1	Affect	1-7	
2	Clarity of perceptions…	1-7	
3	Awareness of timing	1-3	
4	Flexibility, variety, and…	1-3	
5	Acceptance	1-3	
6	Amount of Interaction	1-3	
7	Conflict Situations	1-3	
-	Total	-	

EA Adult Structuring

#	Subscale	Range	Score
1	Provides appropriate guidance…	1-7	
2	Success of attempts	1-7	
3	Amount of Structure	1-3	
4	Limit setting, setting boundaries.	1-3	
5	Remaining firm in the face of	1-3	
6	Verbal vs. nonverbal structuring	1-3	
7	Peer vs. adult role	1-3	
-	Total	-	

EA Adult Nonintrusiveness

#	Subscale	Range	Score
1	Follow child's lead:	1-7	
2	Non-interruptive ports of entry	1-7	
3	Commands, directives:	1-3	
4	Adult talking:	1-3	
5	Didactic teaching:	1-3	

6	Physical vs. verbal interferences	1-3	
7	The adult is made to “feel” or	1-3	
-	Total	-	

EA Adult Nonhostility

#	Subscale	Range	Score
1	Adult lacks negativity in face or	1-7	
2	Lack of mocking, ridiculing, or	1-7	
3	Lack of threats of separation:	1-3	
4	Does not lose cool during low	1-3	
5	Frightening behavior/tendencies:	1-3	
6	Silence	1-3	
7	Themes or play themes hostile	1-3	
-	Total	-	

EA Child Responsiveness

#	Subscale	Range	Score
1	Affect/emotion regulation/	1-7	
2	Responsiveness:	1-7	
3	Age-appropriate autonomy-	1-3	
4	Positive physical positioning	1-3	
5	Lack of role reversal/over-	1-3	
6	Lack of avoidance	1-3	
7	Task oriented/concentrate	1-3	
-	Total	-	

EA Child Involvement

#	Subscale	Range	Score
1	Simple Initiative:	1-7	
2	Elaborative initiative:	1-7	
3	Use of adult:	1-3	
4	Lack of over-involvement	1-3	
5	Eye contact, looking, postural	1-3	
6	Verbal involvement:	1-3	
7	Body positioning	1-3	
-	Total	-	

EA Dimensional sum:_____

Appendix L
Measure of Adult and Infant Soothing and Distress Coding System

Adult Category	***Definition and Examples***
Distraction	Behaviors intended to distract the infant. This may include the use of props (e.g., holding up toys, pointing to posters on the wall) or not (e.g., making funny faces, clapping). This is still coded even if the child does not appear to be distracted by the behavior.
Offer Toy	If the adult simply hands (or attempts to hand) the child a toy-like object in an effort to comfort or distract him/her. If the parent uses the toy to interact with the child, code Distraction and not Offer Toy. Often an adult may hand the child a toy so that the child will soothe him/herself.
Offer Pacifier	If the parent either hands the infant the pacifier or puts the pacifier in the infant's mouth. This is still coded if the infant does not accept the pacifier.
Offer Food	Feeding can include handing the child a bottle, cracker, other food. Code even if the child rejects the food.
Nursing	Nursing- when the mother breastfeeds the infant.
Physical Comfort	Any physical (i.e., nonverbal) behavior conducted in an attempt to comfort the child. This may include: rubbing, massaging, or patting the child (may be on the head, back, or other body part), kissing the child, or a comforting hug. If the adult is simply holding the child so that the procedure may be performed, do not code hug. This has to be an obvious and blatant squeeze.
Rocking	If the parent remains in the chair and begins to sway, rock, or bounce the child. When the adult stands up and rocks, sways, or bounces, or when the adult moves around the room while holding the child.
Verbal Reassurance	Reassuring comments (e.g., "it is okay" "we are almost done" "it's alright, baby" "I'm sorry").

Appendix M

Modified Behaviour Pain Scale

Taddio, A., Nulman, I., Koren, B.S., Stevens, B., Koren, G (1995). A revised measure of acute pain in infants. *Journal of Pain Symptom Management, 10*(6):456-463. doi:10.1016/0885-3924(95)00058-7.

Infant Position **during** Immunization
1 = Infant lying on doctor's table
2 = Infant Held in mother's arms - mother standing
3 = Infant Held in Mother's arms - mother sitting
4 = Infant standing in between mother's legs - mother sitting
5 = other: Specify_____

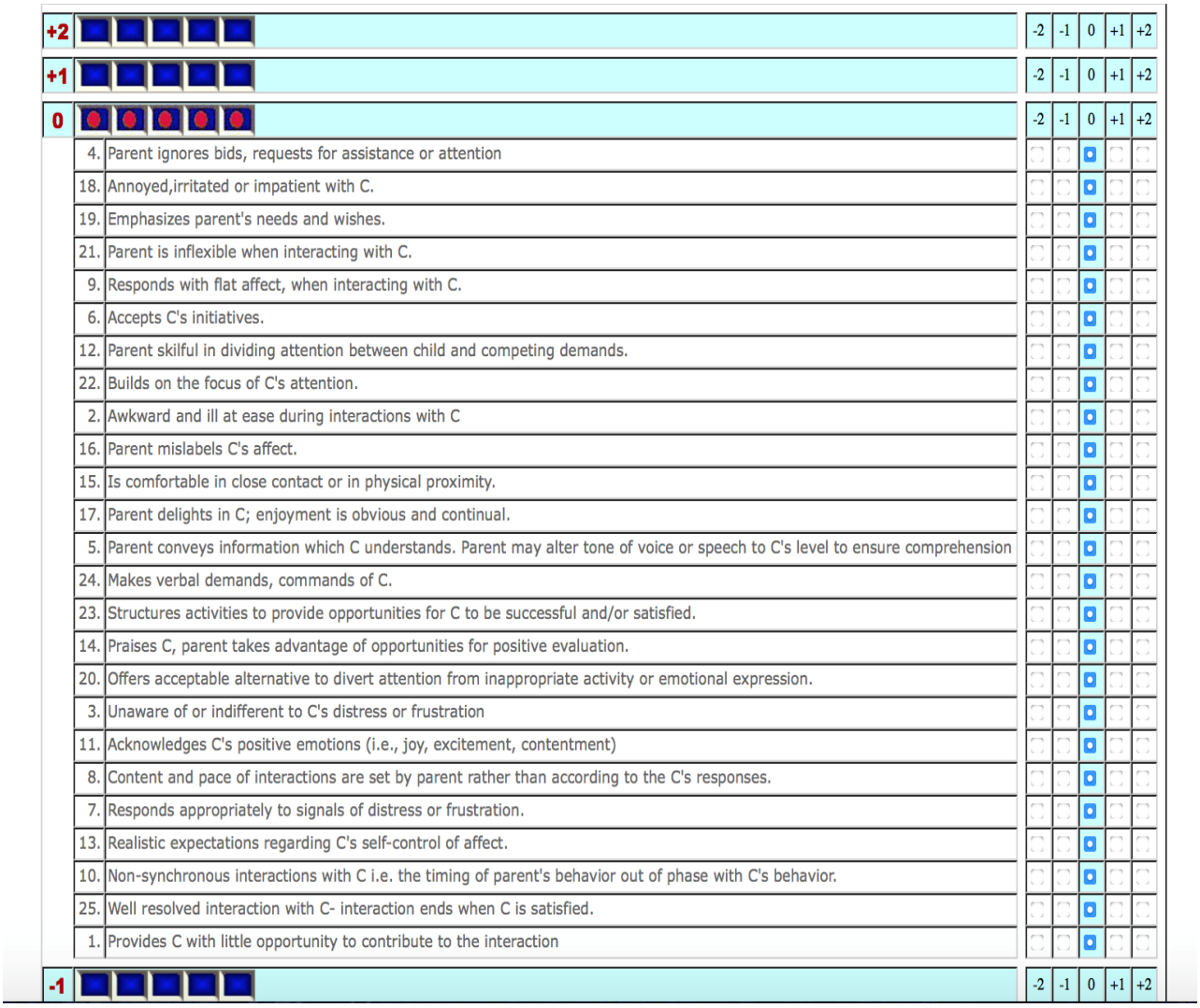
Modified Behavioral Pain Scale (Longitudinal Study)

Coder Name: _____ Coding Time: _____ to _____
Date: _____ Participant ID: _____
Clip Start: _____ Clip Finish: _____

Needle #1 Time: **Needle #2 Time:**	**BASLINE (15 sec. before Needle #1)** START:_____ FINISH:_____	**POST-NEEDLE (15 sec. after the last needle)** START:_____ FINISH:_____	**RECOVERY 1 (75 sec. after last needle for 15 sec. period)** START:_____ FINISH:_____	**RECOVERY 2 (135 sec. after last needle for 15 sec. period)** START:_____ FINISH:_____	**RECOVERY 3 (195 sec. after last needle for 15 sec. period)** START:_____ FINISH:_____
FACIAL EXPRESSION 0- *definite positive expression (smiling)* 1- *neutral expression* 2- *slightly negative expression (grimace; BB; NLF)* 3- *Definite neg. exp. (BB, NLF, EC, open lips, maybe RF)*					
CRY 0- *laughing or giggling* 1- not crying 2- *moaning, quiet vocalizing, gentle or whimpering cry* 3- *full lunged cry or sobbing* 4- *full lunged cry, more than baseline cry* ***(only if infant crying during baseline)***					
MOVEMENTS 0- *usual* movements/activity or resting /relaxed *2 – partial movement or attempt to avoid pain by withdrawing the limb from puncture (squirming, arching, limb tensing/clenching)* *3- Agitation with complex movements involving the head, torso OR the other limbs OR rigidity (generalized limb and/or body movements, or rigidity)*					

Appendix N

Maternal Behaviour Q-Set Short Version



		-2	-1	0	+1	+2
+2						
+1						
0						
4.	Parent ignores bids, requests for assistance or attention			■		
18.	Annoyed,irritated or impatient with C.			■		
19.	Emphasizes parent's needs and wishes.			■		
21.	Parent is inflexible when interacting with C.			■		
9.	Responds with flat affect, when interacting with C.			■		
6.	Accepts C's initiatives.			■		
12.	Parent skilful in dividing attention between child and competing demands.			■		
22.	Builds on the focus of C's attention.			■		
2.	Awkward and ill at ease during interactions with C			■		
16.	Parent mislabels C's affect.			■		
15.	Is comfortable in close contact or in physical proximity.			■		
17.	Parent delights in C; enjoyment is obvious and continual.			■		
5.	Parent conveys information which C understands. Parent may alter tone of voice or speech to C's level to ensure comprehension			■		
24.	Makes verbal demands, commands of C.			■		
23.	Structures activities to provide opportunities for C to be successful and/or satisfied.			■		
14.	Praises C, parent takes advantage of opportunities for positive evaluation.			■		
20.	Offers acceptable alternative to divert attention from inappropriate activity or emotional expression.			■		
3.	Unaware of or indifferent to C's distress or frustration			■		
11.	Acknowledges C's positive emotions (i.e., joy, excitement, contentment)			■		
8.	Content and pace of interactions are set by parent rather than according to the C's responses.			■		
7.	Responds appropriately to signals of distress or frustration.			■		
13.	Realistic expectations regarding C's self-control of affect.			■		
10.	Non-synchronous interactions with C i.e. the timing of parent's behavior out of phase with C's behavior.			■		
25.	Well resolved interaction with C- interaction ends when C is satisfied.			■		
1.	Provides C with little opportunity to contribute to the interaction			■		
-1						