

Emotion Dynamics Among Pre-Adolescents Getting to Know Each Other:

Dyadic Associations with Shyness

by

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### **Author's Declaration**

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## Abstract

**Background.** Shy children have difficulty forming new friendships. Central to friendship initiation are emotion exchanges between new social partners. Past research based on trait and global measures of emotion suggest that shyness is associated with higher expressions of negative emotions. Given the dyadic and dynamic nature of emotions that peers express in real-life, it is crucial to uncover how emotions unfold *moment-to-moment* as children are getting to know each other to support the development of friendships for highly shy children.

**Objectives.** Grid-sequence (Brinberg et al., 2018) and state space grid analyses (Hollenstein et al., 2013) were used to examine how individual differences in shyness and similarity in shyness influence the content (i.e., dyadic emotion patterns) and structure (i.e., emotional variability) of children's momentary emotion exchanges with a new peer. Specifically, the present study sought to 1) describe intradyad differences in children's pattern of emotion expressions, 2) examine whether these intradyad differences were associated with shyness, 3) explore the influence of a child's own and their unfamiliar partner's shyness on their emotional variability (i.e., the range and shifts in and out of emotion), and 4) investigate the extent to which dyadic similarity in shyness influences emotional variability and dyadic emotion patterns among unfamiliar peers.

**Method.** The positive, negative, and neutral emotions of age- and gender-matched unfamiliar dyads ( $N=30$ ,  $M_{\text{age}} = 10.13$  years, 75.8% White) were observed during a 5-minute in-lab task, in which dyads were simply instructed to 'get to know each other' (Usher et al., 2015). Shyness was assessed using parent and child reports (Capaldi & Rothbarth, 1992; Crozier, 1995).

**Results.** 1) We identified three interdyad patterns of emotion that unfolded moment-to-moment as dyads were getting to know each other: (a) frequent expressions of shared positive affect and dyadic turn taking between neutral and positive affect ( $n = 18$ ), (b) frequent expressions of

shared neutral and dyadic turn taking between neutral and negative affect ( $n = 11$ ), and (c) frequent expressions of shared negative affect and dyadic turn taking between neutral and negative affect ( $n = 5$ ). 2) Relative to children in pattern (a) children in pattern (c) were higher in parent and self-reported shyness. 3) Actor-partner Interdependence models showed that higher child (but not parent) reports of shyness were related to lower emotional variability. However, a child's emotional variability was not related to their partner's shyness. 4) Children that were more similar in their levels of child-reported shyness displayed less emotional variability, regardless of whether pairings were of two shy versus two non-shy children.

**Implications.** This study capitalized on recent methodological innovations and found that shyness may impair both children's emotion dynamics the first time they meet, holding critical implications for bolstering friendship formation for both shy and non-shy children.

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## Introduction

Forming positive peer relationships is central to children's development, especially as they prepare to enter adolescence. Reciprocal peer relationships provide pre-adolescents with a crucial context for learning to regulate emotions and communicate ideas, foster a sense of belonging, serve emotional and social support functions, buffer experiences of mental health problems, influence academic achievement, and set the stage for later dyadic relationships (Baumeister & Leary, 1995; Baardstu et al., 2019; Blieszner, 2015; De Goede et al., 2009; Furman & Rose, 2015; Smirnov & Thurner, 2020). Despite the significance of peers, little research has investigated the intra-and inter-personal processes that support the initiation of friendships during pre-adolescence. The crucial first step in forming a friendship is interacting with an unfamiliar peer, wherein the quality of the interaction shapes future encounters and hence, the likelihood that a friendship will develop (Hartup 1996; Hinde & Stevenson-Hinde 1987). Interpersonal and personality theories of development suggest that the quality of initial peer interactions or whether children "hit it off" the first time they meet is molded by transactions between children's own and their new social partner's temperament (Hinde, 1997; Henderson et al., 2018). Further, dyadic similarity in children's temperament may promote (or hinder) socially competent behaviours and emotional displays in novel peer settings.

While important steps forward have been made in providing evidence for these theoretical accounts (e.g., Walker et al., 2015; Andrews et al., 2018; McElwain et al., 2014), there remains much to be learned about the *dynamic* manner in which children's behaviours and emotions unfold as they are getting to know a new peer. Previous research examining peer interactions has generally employed two approaches. One approach involves associating temperament to child-and parent-reports of how children *generally* act or feel with peers (e.g.,

Eggum et al., 2012). A second approach is conducting behavioural observations of unfamiliar peer dyads and using global codes that aggregate behaviours and emotions across time into total frequency or durations statistics (e.g., Almas et al., 2011). Although valuable, both these approaches obscure the *moment-to-moment* changes in behaviours and emotions that occur during an initial social exchange with a peer. It is crucial to examine these momentary processes to better understand individual differences in the ways children interact the first time they meet a new peer. Therefore, we integrated dyadic and dynamic system approaches to 1) describe interdyad differences in children's pattern of emotion expressions during an initial interaction, 2) examine whether these interdyad differences were associated with child temperament, 3) explore the influence of a child's own and their unfamiliar partner's temperament on their emotional variability, and 4) investigate the extent to which dyadic similarity in shyness influences dyadic emotion patterns and emotional variability among unfamiliar peers.

### **Shyness and Interpersonal Processes**

A central premise of Hinde's (1997) interpersonal theory is that behaviours and emotions expressed during a social interaction depend on the characteristics of the individual *and* their social partner and that such interdependence is at the root of relationship formation. A temperament trait of central importance in novel interpersonal contexts is shyness. Shyness is characterized by inhibition and anxiousness in response to novel social situations or perceived social evaluation and is moderately stable across the lifespan (Kagan et al., 1988; Rubin et al., 2009). Underlying shyness is a motivational conflict between wanting to approach and interact with others but feeling too fearful or uncertain to fulfill this desire (Asendorpf, 1990; Hassan et al., 2021). At the individual-level, shyness is associated with poorer social competence, lower self-esteem and social self-efficacy, higher levels of internalizing symptoms (particularly social

anxiety), as well as limited spontaneous affect, reticence, and less assertive and more indirect communication styles with unfamiliar peers (Class & Blackford, 2012; Coplan et al., 2013; Crozier, 1995; Fox et al., 2001; Kochanska & Radke-Yarrow, 1992; LoBue & Pérez-Edgar, 2014; McElwain et al., 2014; Rubin et al., 2009). Given the impact shyness has on children's psychosocial adjustment and observable emotions and behaviours, it's not surprising that shy children evoke changes in their partner's perceptions and behaviours. Interpersonally, children high in shyness are perceived more negatively by peers in hypothetical vignettes (Coplan & Armer, 2007; Zava et al., 2020), and report experiencing more peer rejection, exclusion, and victimization than non-shy counterparts (Gazelle, 2006; Rubin et al., 2009; Tang, 2020). Additionally, compared to non-shy children, highly shy children report that their relationships are of a lower quality (i.e., less supportive, intimate, and helpful; Rubin et al., 2006). Together, these studies demonstrate that shyness impacts the quality of peer interactions for both children.

It is thus particularly important to understand the within-child and dyadic processes that facilitate (or impede) friendship initiation for children varying on the temperament dimension of shyness. Henderson et al. (2018) theorize that the core traits of shyness influence the way a highly shy child interprets and behaves with new peers, and in turn shapes how their new social partner perceives and responds to them. Together these transactions influence the quality of initial peer interactions, and the likelihood that a friendship will initiate. Aligning with this transactional perspective, a few studies have examined the dyadic effects of shyness on young children's behaviours with an unfamiliar play partner. Walker et al., (2015) found that higher maternal reports of social fear (a correlate of shyness) at 24 months were associated with less observed social engagement (interest, positive affect, activity level) and more dysregulation (negative affect and aggression) in not only children's own but their unfamiliar play partner's

behaviour at 36 months. Conversely, McElwain et al. (2014) found that toddlers' own parent-reported social fear at 33 months but not their unfamiliar play partners' social fear was associated with less assertiveness at 39 months, and that the dyadic effect of social fear did not change over three repeated play interactions between these same previously unfamiliar peer dyads. Therefore, the discrepant partner effect finding could be due to differences in the observed play behaviour (i.e., social engagement versus assertiveness), indicating the need to replicate these results with various indicators of social engagement and communication (such as observed emotion expressions). Accordingly, we adopted a dyadic lens to examine whether a child's own (i.e., actor effect) and an unfamiliar partner's (i.e., partner effect) shyness influenced the child's emotions using an unstructured task in which dyads were instructed to simply get to know each other (Usher et al., 2015).

### **Shyness and Emotion Expressions**

Emotions serve as critical social-communicative indicators of the quality of social exchanges and may be a crucial way that shyness disrupts interactions between new peers. Preeminent theories of emotion suggest that emotions communicate important information about a child's own and their social partner's receptivity to friendship (Keltner & Kring, 1998; Fischer, & Manstead, 2008). Positive emotion expressions (e.g., smiling) signal a social orientation of affiliation and are associated with approach behaviours (Campos et al., 2015), high perceived partner responsiveness (Reis et al., 1998), building social resources (Fredrickson, 1998), increases in relationship intimacy, interest for future contact and desire to form a friendship with a previously unfamiliar social partner (Pearlstein et al., 2019), and higher relationship quality (Griffith et al., 2019; Ramsey & Gentzler, 2015). In contrast, negative emotion expressions (e.g., frowning, scrunching eyebrows) communicate social distancing motives and may lead peers to

avoid the expresser (Dougherty, 2006; Hubbard & Dearing, 2004). Most studies endorse this dichotomy (i.e., positive versus negative emotions), excluding the critical role of neutral affect in initial encounters. However, the ambiguity of neutral affect has been shown to precipitate socially anxious adult's negative interpretations (Peschard & Philippot, 2017). Thus, we focused our investigations on how shyness influences children's expressions of positive, negative, and neutral emotions during an initial dyadic interaction.

A natural hypothesis that follows the above literature is that more expressions of positive and fewer expressions of negative affect may increase the likelihood that a friendship will develop and yet, shyness generally increases negative emotions and dampens positive emotions. Two main lines of evidence support the notion that emotion expressions may be a crucial way shyness impacts social exchanges. First, research based on trait measurements demonstrates concurrent and longitudinal associations between shyness and higher negative and lower positive affect in childhood (Coplan et al., 2004, 2006; Eggum et al., 2012; Eisenberg et al., 1995, 2001; Findlay et al., 2009; Viana et al., 2017). Eggum et al. (2012) found that higher parent-and teacher-reports of shyness at 6 years of age were associated with lower teacher-rated anger, lower teacher-rated positive emotionality, and higher parent-rated anger two years later. Second, a few observational studies have investigated the influence of shyness on global codes of emotions expressions averaged across the entire initial encounter (Almas et al., 2011; Pearlstein et al., 2019). Pearlstein et al. (2019) found that adults high in social anxiety symptoms, on average, display less frequent and less intense positive emotions with a confederate during an initial interaction, and in turn, these blunted expressions were associated with lower confederate-reported desires for future interaction. Although this work is informative about how shyness influences individual's *general* emotionality, these methods collapse across time, using trait

measures or summary variables (e.g., frequencies, averages), that mask the transactional and dynamic nature of emotions that peers express in real-life, and how both children's shyness impacts these moment-to-moment changes.

### **Emotion Dynamics**

Dynamic systems theory (Butler, 2011; Granic, 2005) would address this meaningful lacuna through its emphasis on the temporal and interpersonal qualities of emotion. From a dynamic systems perspective, each partner's moment-to-moment emotions (or ebb and flow of emotions) interact with the other's, creating a dyadic system in which emotions are interpersonally expressed and regulated over time. Bulter (2011) refers to these dyadic systems as temporal interpersonal emotion systems (TIES). The present study conceptualized unfamiliar peer dyads as TIES. TIES are thought to develop through the self-organization of the dyad's characteristics, such as each child's shyness and their combination. Within an interaction, emotions change at the dyadic level as a function of prior dyadic states and the interaction between elements of the system (e.g., observed emotions, physiological arousal). Over repeated interactions, stable patterns of dyad-level emotions are thought to emerge and constrain future interpersonal dynamics within TIES (Butler, 2011; Granic, 2005). In other words, the emotion dynamics of unfamiliar peer dyads are co-constructed in the moment, and, over time, these in-the-moment patterns may stabilize into dyadic tendencies that build the foundation of friendship quality (Butler, 2011). Therefore, to build on previous work examining the associations between shyness and emotion expressions, we adopted a dynamic systems perspective to unmask the moment-to-moment changes in emotions between unfamiliar peers.

Guided by dynamic systems theory, we examined both the content (i.e., specific dyadic emotion patterns) and structure (i.e., variability) of dyadic interactions among unfamiliar peers.

With regards to the content, we identified dyadic sequences of emotion expressions. These sequences or patterns are the temporally ordered emotions expressed moment-to-moment throughout the entire initial peer encounter. Imagine the following 3-step emotion pattern during a peer interaction in which dyad members begin by (1) expressing negative emotions, then (2) one child makes a joke and laughs, which is then (3) reciprocated by the other child also smiling. To identify these sequences, we employed an emerging method called grid-sequence analysis (Brinberg et al., 2017; 2018). Grid-sequence analysis is an innovative approach that amalgamates state-space grid (Hollenstein, 2013) and sequence analysis (Kruskall, 1983). State space grids are a dynamic systems approach that maps an individual's or dyad's change in emotions over time. Sequence analysis is typically used to identify groups of biological sequences (e.g., DNA). To date, no study has employed this methodology to describe the emotion dynamics between peers despite their importance to children's development.

In addition to the type of emotions expressed during initial peer interactions, the *variability* of emotion states is thought to provide crucial information about the underlying structure of the dyadic system. Emotional variability is defined as the range and shifts in and out of emotion states across time and can be derived from state-space grid analyses (Hollenstein, 2013). Only one study has observed the emotional variability of triadic peers' interactions among acquainted kindergarteners and found that emotional variability was not associated with sociometric ratings of peer liking or teacher-reported internalizing problems (Lavioire et al., 2012). Yet a plethora of studies that have examined emotional variability in the context of parent-child relationships suggest that investigating the rise and fall of emotion states irrespective of their valence is a key indicator of functioning (e.g., Van der Giessen et al., 2015; Lunkenheimer et al., 2012). We extended previous work by examining unfamiliar pre-adolescent



dyads, and by exploring the dyadic effect of shyness on emotional variability. Collectively, the examination of specific dyadic emotion patterns and emotional variability among unfamiliar pre-adolescents will provide a nuanced understanding of its associations with temperamental shyness and important relational information about how shyness impacts the quality of initial peer interactions.

### **Dyadic Similarity in Shyness**

An equally important dyadic processes to consider in the context of initial peer interactions is temperamental similarity between novel peers. Byrne's (1971) theory of interpersonal attraction purports that individuals are attracted to and befriend similar others through a process referred to as homophily. This extends to shy children, with evidence from sociometric peer nominations suggesting that in middle school, friends report more similar levels of shyness than non-friends (Haselager et al., 1998; Rubin et al., 2006). A longitudinal social network study showed that Chinese adolescents tended to befriend a similarly shy classmate in Grade 7 and remain friends one year later (Yang et al., 2021). Shy children are thought to select friends who are similarly shy because similarity implies that they have shared experiences (e.g., peer may have also experienced peer rejection), which may facilitate communication and reduce shy children's fears of negative evaluations (Bruch et al., 1989; McPherson et al., 2001). In contrast, shy children may feel less comfortable engaging with a highly extraverted because of their disjunct communication styles. Another possibility is that shy children befriend similar others due to passive selection (e.g., no one else want to be friends with them). Studies have predominantly investigated dyadic similarity in shyness in the context of established friendships. However, given that similarity in friendships could also be a function of selection, socialization

or both, it is important to understand how dyadic similarity in shyness influences initial emotion communication with a peer.

To date, only one study has examined the role of dyadic similarity in social fear (a correlate of shyness) on children's observed interaction quality (shared positive affect, coordination, and social play complexity) among unfamiliar play mates at 39 months of age, and found null results (McElwain et al., 2016). However, as temperamentally shy children reach late childhood, the wariness associated with shyness may be amplified due to advancements in children's cognitive development (e.g., self-and social awareness) and increases in the importance of peer acceptance (Poole et al., 2018). Thus, pre-adolescence may be a particularly important developmental period in which to investigate how dyadic similarity in shyness influences dyadic emotion sequences and emotional variability in a novel peer setting.

### **Current Study: Objectives and Hypotheses**

The present thesis is informed by the confluence of two theoretical perspectives: interpersonal theory of development (Hinde, 1997; Henderson et al., 2018) and dynamic systems theory (Butler, 2011; Granic, 2005; Hollenstein et al., 2013) that in conjunction with advances in statistical modeling allow for the investigation of individual differences in the real-time expression of emotions between unfamiliar children (Brinberg et al., 2018; Kenny et al., 2006; Hollenstein et al., 2013). Given that the momentary features of interpersonal dynamics are theorized to coalesce into broader psychosocial functioning and relationship quality (Granic, 2005), "zooming in" on pre-adolescents' first interaction with each other will move developmental science closer to uncovering the mechanisms underlying difficulties in friendship formation experienced by highly shy children. We integrated dyadic and dynamic system approaches to examine four objectives, described below.

First, we sought to describe sequences of dyadic emotion expressions. This aim was exploratory as no research to date (to our knowledge) has examined dyadic emotion patterns in unfamiliar peer dyads. Nonetheless, given past findings on individual differences in global emotion expressions (e.g., Sallquist et al., 2009), we hypothesized that some dyads would be more likely to show stable patterns of shared negative affect, whereas others would be more likely to display of recurrent positive affect. Second, we examined whether interdyad differences in emotion patterns were associated with shyness. Given research suggesting that shy children display more negative and neutral affect (e.g., Almas et al., 2011; Schneider, 2009), we hypothesized that dyadic emotion sequences characterized by frequent negative and neutral affect would be associated with higher shyness. Third, we investigated the influence of a child's own and their unfamiliar partner's shyness on their emotion variability (i.e., range and shifts in and out of emotion states across time). Guided by tenets of interpersonal theory (i.e., Hinde, 1997; Henderson et al., 2018) and evidence suggesting that shy children lack spontaneity in their expressions (i.e., Kochanska & Radke-Yarrow, 1992), we predicted that higher reports of a child's own and their unfamiliar partner's shyness would be associated with less emotion variability. Finally, we investigated the extent to which dyadic similarity in shyness influences emotion variability and dyadic emotion sequences. Based on evidence indicating that similarity is common in friendships (e.g., Rubin et al., 2006) and facilitates communication, we hypothesized that dyads that were more similar in their levels of shyness would show more emotion variability and display frequent displays of positive affect.

## Method

This study was part of a larger project examining physiological, behavioural, and socio-cognitive correlates of child temperament. Approval for the current study was obtained from the Research Ethics Board at the University of Waterloo (ORE# 31900).

### Participants

Participants were a community sample of 62 children between the ages of 9.00 to 11.92 ( $M = 10.13$ ,  $SD = 0.78$ ; 41 girls). In addition to targeting previous participants, recruitment posters were distributed around the community and posted online (e.g., Facebook, Kijiji), as well as in-person at various community events and public centers in the Waterloo region. Eligibility criteria included no formal diagnosis of attention deficit hyperactive disorder or autism spectrum disorder; no use of medications containing cortisone, antidepressants, or antipsychotic drugs; no history of comas or accidents that involved loss of consciousness/head trauma; no allergies or sensitivities to gels, adhesives, or sanitizing agents; no personal or familial history of epilepsy or seizures and having normal or corrected vision. Recruitment for this project was ongoing at the commencement of the COVID-19 pandemic in Canada, and hence, the desired a-priori sample size of 80 participants was not achieved.

Regarding the demographics of the sample, the ethnic breakdown was: 75.9% White, 1.7% Black, 5.2% Asian, 1.7% Latin American, 1.7% South/West Asian or Arabian, and 13.8% Mixed Ethnicity. Most parents were highly educated: 32.8% of mothers and 32.8% of fathers had an advanced professional degree, 43.1% of mothers and 32.8% of fathers had graduated from a 4-year university, 12.1% of mothers and 17.2% fathers had graduated from a 2-year college, 8.6% of mothers and 12.1% of fathers had completed some University/College, and 3.4% of mothers and 5.2% of fathers had graduated from high school. Median household income was

predominantly over \$100,000 per year, with the following income distribution: \$25,000 to \$49,999 (1.7%), \$50,000–\$74,999 (13.8%), \$75,000–\$99,999 (29.3%), over \$100,000 (53.4%), and unreported (1.5%).

## **Procedure**

As part of the larger study, children attended two laboratory visits: a dyadic visit and an individual electroencephalogram (EEG) visit. At the beginning of each visit, parents and children completed informed consent and assent procedures, respectively. The focus of the present study is on the dyadic visit, wherein children were randomly paired with an unfamiliar peer of the same gender and age (within 6-months), but of different elementary schools. To ensure unfamiliarity, informed consent and assent were gathered individually, and parents applied physiological sensors to their child in separate rooms to measure their heart rate and respiration throughout the visit. Children then sat quietly and independently while watching a neutral nature film clip for approximately 3.5 minutes to assess their resting physiological states. Dyadic physiology data is not examined in the present study. Prior to meeting the unfamiliar peer, parents and children completed a battery of questionnaires pertaining to family demographics, child temperament, and child socio-cognitive functioning<sup>1</sup>.

The dyadic portion of the visit took place in a quiet observation room, which was equipped with two video cameras that were monitored from an adjacent room. Participants were seated at a table across from each other and instructed to ‘get to know each other’ for 5-minutes (Usher et al., 2015). Children’s observed emotion expressions during this unstructured interaction were coded offline. Following this interaction, dyads completed additional structured

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<sup>1</sup> The order of visits depended on families’ scheduling availability. Some families completed questionnaires during the dyadic visit, while others completed them during the EEG visit (not reported here). Time between visits varied between 0 and 3 months, with an average of 2 weeks between visits.

dyadic tasks not reported here. At the end of the laboratory session, all participants were debriefed and remunerated a \$15.00 gift card to Indigo or Mastermind Toys.

## **Measures**

### ***Shyness questionnaires***

**Self-reported shyness.** Children completed the *Children's Shyness Questionnaire* (CSQ) (Crozier, 1995), a 26-item self-report measure that assesses behavioural, emotional, and physiological indices of childhood shyness in novel and familiar situations with peers and adults. Children are asked to respond “No”, “Sometimes”, and “Yes” to each item. Sample items include: “I usually talk to only one or two close friends” and “I find it hard to talk to someone I don't know”. All the items are summed to compute a total score, with higher scores indicating more self-reported shyness. The CSQ has established good convergent validity and reliability amongst children aged 9-12 years old (Crozier, 1995). In the current sample, the CSQ had good internal consistency with a Cronbach's alpha of .88. Note, four children were missing data on the CSQ. These children did not differ significantly from children that completed the CSQ on gender, age, ethnicity, family income, or parent-reported shyness ( $p$ 's < .052).

**Parent-reported child shyness.** Parents completed the *Early Adolescent Temperament Questionnaire—Revised* (EATQ-R; Ellis & Rothbart, 2001), a 62-item parent-report measure that assesses 10 facets of child temperament. Parents rated how accurate each item was of their child on a 5-point Likert scale ranging from 1 “Almost always untrue” to 5 “Almost always true.” Given the present study's focus on shyness, only the shyness dimension was included. The shyness subscale included 5 items relating social novelty (e.g., “Feels shy about meeting new people” and “Is shy”). Items are averaged, with higher scores reflecting higher levels of child

shyness. The shyness subscale of the EATQ-R has exhibited good internal consistency (Ellis & Rothbart, 2001), and in the current sample, the Cronbach's alpha was good ( $\alpha = .88$ )

**Shyness Composite.** To derive a multi-informant measure of shyness, a shyness composite was computed by aggregating child report on the CSQ and parent report on the EATQ shyness subscale. These were moderately correlated ( $r = .540, p = .001$ ). The composite was used to compute dyadic similarity of shyness scores by subtracting the absolute difference between partners shyness scores. Higher scores indicate a higher *dissimilarity* between partners.

### ***Laboratory Measures***

**Observed emotions.** A modified version of the Specific Affect Coding System (Coan & Gottman, 2007) was created to assess children's displays of emotions during the Get to know you task (see Appendix A). This coding system measured the presence or absence of three mutually exclusive codes: Positive, Neutral, and Negative Affect. To capture the momentary changes in affective tone, codes were based on a combination of facial expressions, verbal characteristics (e.g., content, voice tone), and body language (e.g., gestures, posture). Trained observers coded each child separately using event-based coding in Mangold INTERACT (Mangold, 2020). Specifically, the onset and offset times of each emotion behaviour were coded continuously in real time resulting in two time-synchronized streams of emotion for each dyad.

In terms of training and coding procedures, the primary author trained two undergraduate research assistants to reach an average percent agreement of 70% ( $K = .73$ ) across all codes using 5 randomly selected dyads prior to the start of coding. After this was achieved, 30% of interactions were coded by both observers to compute reliability. To minimize coder drift and resolve disagreements in overlapping videos, the primary author and the two observers engaged in weekly calibration checks and discussions. Interrater reliability was adequate for the

frequency ( $ICC_{\text{mean}}=.87$ ;  $ICC_{\text{range}}=.79-.94$ ) and duration ( $ICC_{\text{mean}}=.95$ ;  $ICC_{\text{range}}=.90-.98$ ) of all codes. Notably, due to technical problems with the video recordings, 1 dyad was excluded from the final analyses. These children did not significantly differ from those included in the study on age, gender, ethnicity, or family income ( $p$ 's < .305).

**Emotional Variability.** Two indices of emotional variability were derived at the individual-level by plotting children's own observed emotions on both the x-axis and the y-axis of state-space grids in GridWare: Dispersion and Transitions (Hollenstein, 2013; Lamey et al., 2004; Van der Giessen et al., 2014). One index of emotional variability is dispersion, which refers to the range or distribution of emotion states across the grid (i.e., the degree to which children expressed a variety of emotions). It was calculated in GridWare as the sum of the squared proportional duration across all cells adjusted for the total number of cells in the grid. Dispersion values range from "0" indicating no dispersion (all behaviors occurred in one cell) to "1" indicating maximum dispersion (behaviors were equally distributed across the grid). Higher scores indicate a broader emotional spread and therefore more emotional variability. Another index of emotional variability is transitions, which reflects the number of changes between cells per minute on the grid. Higher values indicate more frequent changes per minute between states and therefore more emotional variability. Given the high and significant correlation between the aforementioned measures of emotional variability ( $r = .836$ ,  $p < .001$ ), Z-scored dispersion and transitions values were averaged to create an emotional variability composite. See Figure 1a for an example of a high variability child, and Figure 1b for a low variability child.

### **Data Analytic Plan**

We conducted grid-sequence analysis in R (Brinberg et al., 2017; R Core Team, 2018) to identify interdyad differences in unfamiliar children's emotion patterns (hypothesis 1). Grid



sequence analysis involves two stages: 1) visualizing and quantifying *intrad*yad emotion sequences using state-space grids, 2) identifying *interdy*ad differences in sequences using hierarchical clustering analysis.

**Stage 1: *Intrad*yad analyses.** First, to visualize dyads' observed emotion patterns over the course of the get to know you task we plotted them on a state space grid, with a child's own and their unfamiliar partner's expressed emotions mapped on the x-and y-axis, respectively (see Figure 2A). This yielded 3 by 3 grids consisting of 9 cells, which depicted all possible combinations of children's dyadic emotion states. Grids were created by using the *base*, *reshape*, and *ggplot2* packages in R. As depicted in Figure 2A, each of the cells in the grid were labelled with letters. Due to the indistinguishable nature of the dyad members in the present study, a symmetrical labeling scheme was applied, wherein cells opposite of the diagonal are considered equivalent (e.g., cell in the top-left and bottom-right are both labelled "A"). Next, to quantify *intrad*yad emotion patterns we extracted the sequence of letters from the grid in the temporal order that the emotion states occurred using the *seqdef* function of the *TraMineR* package (see Figure 2B). This created a time-ordered "sequence" of emotions for each dyad (see Figure 3).

**Stage 2: *Interdy*ad analyses.** To identify *interdy*ad differences in the sequences that were extracted in stage 2 (i.e., clusters of sequences), we first calculated the dissimilarities or "distance" between all possible pairs of sequences. This was done by quantifying the length of the longest common subsequence (LCS) using the *TraMineR* and *TraMineRextras* packages in R (Gabadinho et al., 2011). In the LCS method, longer common subsequences denote greater similarity between pairs of sequences. An example of the LCS process for three hypothetical dyads is illustrated in Figure 2C. This process engendered a dissimilarity matrix, which was used to identify underlying subgroups or clusters of sequences using agglomerative hierarchical

cluster analysis via the *cluster* package in R (Maechler et al., 2019; Ward 1963). Agglomerative hierarchical cluster analysis identifies clusters by minimizing the dissimilarities of sequences within a cluster and maximizing the dissimilarities of sequences between clusters.

We used Kenny and colleagues' (2006) Actor-Partner Interdependence model (APIM) to test hypotheses 3 and 4. The APIM accounts for the interdependence between dyad members and has two main components: the *actor* and *partner* effects. An actor effect measures how much a child's own shyness is associated with their own behaviour. Partner effects measure how much a partner's shyness influences the actor's behaviour. Guided by the APIM framework, we conducted multilevel models for indistinguishable dyads using the *nlme* and *dyadr* packages in R. Prior to running analyses, shyness was grand-mean centered.

## Results

### Research Question 1: Interdyad Differences in Patterns of Children's Emotion Expressions

*Selection number of clusters.* Results from the grid-sequence analysis and plots used for the identification of the optimal number of clusters are represented in Figure 4. To delineate the optimal number of clusters we used three strategies. First, employing the “elbow method”, we plotted the number of clusters by the within-cluster sum of squares (Tibshirani et al., 2001). As depicted in Figure 4A, an elbow occurs at the three-cluster solution, suggesting that this may be the best fit for the data. Second, we fit a series of multidimensional scaling models ranging from 1 to 4 cluster solutions, and derived measures of “stress”. Stress is a fit index that indicates the relative misfit between the estimated distance matrix and the observed distance matrix, values closer to 0 denote better fit (Kruskal, 1964). The results were as follows: one-cluster solution (0.383), two-cluster solution (.208), three-cluster solution (.143), and four-cluster solution (.102). These stress values suggest that the four-cluster solution may be the best fit for the data. Third, we examined the results of the cluster analysis using a dendrogram. Dendrograms plot the distances between clusters based on LCS dissimilarity matrix, with longer horizontal lines indicating greater dissimilarity between clusters. The vertical lines represent potential cluster divisions. Given these results and the goal to select the most parsimonious model, we selected the three-cluster solution. Figure 4B shows the cut points for the three-cluster solution.

*Characteristics of the clusters.* Table 1 shows the five most frequent subsequences within each cluster. We labelled the first cluster “Reciprocal and Stable Negative Affect” ( $n = 5$ ). It was primarily characterized by reciprocal negative affect expressions between children (C). In this cluster, three of the dyads did not transition out of negative affect for the entire interaction. The two dyads that did shift out of negative affect, transitioned into dyadic turn taking between

neutral and negative affect (B). We labelled the second cluster, “Moderately Variable and Shared Neutral Affect” ( $n = 7$ ). The most frequent subsequences in the Moderately Variable and Shared Neutral Affect pattern included shared neutral affect expressions (E), dyadic turn taking between neutral and negative affect (B), and dyadic turn-taking between positive and neutral affect expressions (D). We named the third cluster, “Flexible and Shared Positive Affect” ( $n = 18$ ). The most frequent subsequences that characterized this dyadic pattern are shared positive affect expressions (G), shared neutral affect expressions (E), and dyadic turn-taking between positive and neutral affect expressions (D).

### **Research Question 2: Interdyad Differences in Shyness**

We conducted linear regressions to examine whether interdyad differences in emotion sequences were associated with shyness and dyadic similarity in shyness.

Overall, differences between dyad’s emotion patterns (i.e., Reciprocal and Stable Negative Affect, Moderately Variable and Shared Neutral Affect, and Flexible and Shared Positive Affect) did not emerge as a significant predictor of shyness,  $R^2 = .09$ ,  $F(2, 53) = 2.48$ ,  $p = .094$ . However, exploratory post-hoc linear regression analyses revealed that the cluster characterized by reciprocal patterns of negative affect and dyadic turn-taking between negative and neutral affect was associated with higher reports of shyness than the cluster characterized by shared positive affect expressions and dyadic turn-taking between positive and neutral affect expressions,  $B = 9.16$ ,  $SE = 4.27$ ,  $p = .037$ . There were no significant differences in shyness between the Flexible and Shared Positive Affect pattern and the Moderately Variable and Shared Neutral Affect pattern,  $B = 5.35$ ,  $SE = 3.21$ ,  $p = .102$ , or the Moderately Variable and Shared Neutral Affect pattern and the Reciprocal and Stable Negative Affect,  $B = -3.81$ ,  $SE = 3.69$ ,  $p = .307$ .

In terms of dyadic similarity in shyness, overall interdyad differences in emotion patterns emerged as a significant predictor,  $R^2 = .27$ ,  $F(2, 23) = 4.14$ ,  $p = .029$ . Compared to dyads in the Moderately Variable and Shared Neutral Affect pattern, children in the Flexible and Shared Positive Affect pattern were more distinct in their levels of shyness,  $B = 11.74$ ,  $SE = 4.10$ ,  $p = .009$ . There were no significant differences between the Shared and Flexible Positive Affect and Reciprocal and Stable Negative Affect,  $B = 4.19$ ,  $SE = 5.52$ ,  $p = .456$ , or the Moderately Variable and Shared Neutral Affect pattern and the Reciprocal and Stable Negative Affect pattern,  $B = 7.56$ ,  $SE = 5.65$ ,  $p = .195$ .

#### **Research Question 3 and 4: Dyadic Associations between Shyness and Emotion Variability**

Results of the APIM examining the influence of a child's own (actor effect) and their unfamiliar partner's (partner effect) shyness on their emotional variability, and the effect of dyadic similarity in shyness on emotional variability are illustrated in Figure 4. The partial intraclass correlation for Emotional Variability while controlling for actor, partner, and dyadic similarity in shyness effects was .73, suggesting that approximately 73% of the variance in Emotional Variability was attributable to between-versus within-dyad differences. No effects emerged as statistically significant with the shyness composite.

**Exploratory analyses.** Exploratory APIM analyses were conducted separately using child-and parent report of shyness. Actor, partner, and dyadic similarity in parent-reported shyness did not emerge as statistically significant effects.

Results of the APIM examining the influence of a child's own (actor effect) and their unfamiliar partner's (partner effect) *child-reported* shyness on their emotional variability, and the effect of dyadic similarity in shyness on emotional variability are illustrated in Figure 5. The partial intraclass correlation for Emotional Variability while controlling for actor, partner, and

dyadic similarity in shyness effects was .55, indicating that approximately 55% of the variance in Emotional Variability was attributable to between-versus within-dyad differences and that the two children within a dyad display similar Emotional Variability. Children that reported higher levels of shyness than the mean of the sample displayed less emotional variability (i.e., a restricted spread of emotional states and fewer transitions between emotion states). No partner effect of shyness emerged. However, children that were more similar in their levels of self-reported shyness displayed less emotional variability.

## **Discussion**

This investigation was grounded in emotion and relational theories of development (Bulter, 2011; Hinde, 1997; Henderson et al., 2018), with unfamiliar peer dyads conceptualized as temporal interpersonal emotion systems (TIES), providing a nuanced examination of how shyness and dyadic similarity in shyness influences pre-adolescents' emotion dynamics with a previously unacquainted peer. Specifically, we investigated the content (i.e., dyadic emotion sequences) and structure (i.e., emotion variability) of children's emotion exchanges as they were getting to know each other. Our novel application of grid-sequence analysis yielded three dyadic sequences of emotion expressions (i.e., Flexible and Shared Positive Affect pattern, Moderately Variable and Shared Neutral Affect pattern, and Reciprocal and Stable Negative Affect pattern) that were differentially associated with child shyness. We also found that children's own but not their partner's shyness influenced their emotional variability and that children more distinct in their levels of shyness showed a greater range and more shifts in and out of emotions during their first interaction with each other. These findings will be discussed with the implications of emotion dynamics for relationship development among children varying in shyness in mind.

### **Dyadic Emotion Patterns and Shyness**

This is the first study to identify dyadic emotion patterns in a normative sample of pre-adolescents as they are getting to know each other. Most dyads (approximately 60%) showed patterns characterized by frequent mutual expressions of positive and neutral affect, with dyadic turn-taking between positive and neutral affect (i.e., Flexible and Shared Positive Affect pattern). Given the recurrent expressions of shared positive affect in this pattern, it may be that these dyads are communicating mutual enjoyment facilitating communication and relationship formation. However, future research will need to examine whether this dyadic emotion pattern is

associated with better first impressions and friendship formation outside the lab. It will also be important to extend our work to different developmental ages to elucidate how children's emotion interaction styles with a new peer change across development. Further, to broaden our understanding of dyadic emotion patterns among peers getting to know each other our work should be extended to dyads with varying levels of clinical symptomology (e.g., two children diagnosed social anxiety, or one child diagnosed with social anxiety and the other child is not).

About 35% of dyads showed patterns characterized by mostly shared expressions of neutral affect with one child shifting into negative or positive affect (i.e., Moderately Variable and Shared Neutral Affect pattern). Lastly, a small subset of dyads (approximately 17%) displayed frequent mutual expressions of negative affect with one child shifting into neutral affect (i.e., Reciprocal and Stable Negative Affect pattern). Notably, all three dyadic emotions patterns included shifts to neutral affect. The social role of neutral affect may depend on which emotions it is displayed in combination with (e.g., neutral and positive expressions versus neutral and negative expressions). If we had used traditional methods to quantifying emotion and aggregated our emotion codes across time into frequency counts or durations, we would have been restricted to understanding the associations between overall levels of children's emotions and shyness and obscured all temporal processes.

Past research using trait measures and global observations of emotion among new peers demonstrate that shyness is associated with more expressions of neutral and negative affect (e.g., Almas et al., 2011; Eggum et al., 2012). Coinciding with this evidence, we found that dyads that displayed recurrent shared expressions of negative affect and dyadic turn-taking between negative and neutral affect (i.e., Reciprocal and Stable Negative Affect pattern) were comprised of children rated higher in shyness relative to children in the dyads that showed frequent and



reciprocal positive and neutral affect expressions (i.e., Flexible and Shared Positive Affect pattern). However, given that *overall* dyadic emotion sequences did not predict differences in shyness, this finding should be interpreted with caution. Nonetheless, a possible interpretation of this finding is that highly shy children's negative emotions and fears of being rejected by a new peer may spill over, inhibiting them from engaging in conversation or making negative topics more cognitively accessible, which they then express. The peer may perceive their expressions as disinterest in friendship or socially inappropriate and hence, respond by also expressing negative emotions. Future research should test this hypothesis by examining multiple modalities of emotion (e.g., subjective expressive, emotional expressions).

Interestingly, there were no differences in shyness between dyads in the Reciprocal and Stable Negative Affect pattern and dyads characterized by mutual expressions of neutral affect with one child shifting into negative or positive affect. Functionally, the expression of neutral affect may be one way that highly shy children mask their anxiousness, uncertainty, and express their hypervigilance while interacting with a new peer. This proposition is supported by research demonstrating that socially withdrawn adolescents display more neutral affect in structured tasks with a self-nominated close friend than community controls (Schneider et al. 2009), and that shy children who display neutral affect are more likely to use subtle, indirect communication strategies than sociable children (Stewart & Rubin, 1995). Additionally, evidence shows that socially anxious adults display “innocuous sociability” or a passive interaction style in social evaluative contexts (DePaulo et al., 1990; Leary, 2001), in which they act less friendly, seldomly self-disclose, and often simply nod and agree with a new conversation partner. Likewise, the combination of negative and neutral affect expressions (as observed in the Moderately Variable and Shared Neutral Affect pattern and the Reciprocal and Stable Negative Affect pattern) may

communicate mutual avoidance and/or boredom engendering a “dull” social exchange. Ultimately, this interaction style may limit both children’s desires to interact with each other again and form a friendship. To enhance our understanding of the functional and social roles of neutral affect in relation to shyness, an important future avenue will be to uncover the physiological mechanisms underlying neutral affect expressions in novel peer settings.

### **Actor and Partner Effects of Shyness on Emotional Variability**

Interpersonal models of development (Hinde, 1997; Henderson et al., 2018) emphasize that behaviours and emotions during social interactions depend on the characteristics of the individual *and* the social partner, which together determine the quality of the interaction. Partially coinciding with this theoretical notion and our hypothesis, we found that children who self-reported higher shyness displayed a narrower range and fewer transitions in and out of emotion states while interacting with a new peer. This finding is in accordance with research showing that five-year-old children high in behavioural inhibition (observational assessment) display less frequent expressions of affect during an initial “getting acquainted” segment with a playmate (Kochanska & Radke-Yarrow, 1992). This complements our above finding about the content of highly shy children’s interactions (i.e., recurrent expressions of negative and neutral affect), and shows that highly shy children tend to have rigid and negative interaction styles with a new peer. By becoming “stuck” in one or two emotion states, shy children’s social partners are not “getting anything” from them lowering the quality of their interaction and the likelihood a friendship will develop. Consistently, research suggests that shy children tend to show more onlooking (e.g., watching others but not joining) and unoccupied behaviours (i.e., staring into space) in the presence of peers (Coplan 2004).

It is important to note that our finding was not consistent across informants as parent reports of shyness did not predict children's own emotional variability. Likewise, Lavioire and colleagues (2012) found that familiar kindergarteners' emotional variability was not associated with parent-reports of internalizing problems during unstructured triadic free play. Since shyness is an internalized characteristic, it is possible that self-reports of shyness are better able to capture the essence of shyness than parent reports of shyness. In pre-adolescence, children start to gain independence from the family and thus, parents may not observe their child in contexts that would elicit shyness (e.g., meeting new peers, giving presentations). Indeed, research has noted a discrepancy between child-and parent-reports of social anxiety in childhood and adolescence, with parent's under-estimating social anxiety symptoms relative to their child's reports (Behrens et al., 2019; Rappaport et al., 2017). Thus, future research should replicate the current work using multi-assessments (e.g., observations) and informants of shyness.

Extending previous research (i.e., Kochanska & Radke-Yarrow, 1992; LaVictorie et al., 2012), we examined whether a child's emotional variability was influenced by their partner's shyness. Contradicting our hypothesis, we found no evidence of a partner effect. We may not have found a partner effect of shyness for methodological reasons. First, our 'getting to know you' paradigm was relatively short (i.e., 5-minutes). It may be that it takes a longer for child's emotional variability to be influenced by their new social partner's shyness. A fruitful direction for future studies may be to extend the period of the observed initial interaction and investigate the partner effect over repeated interactions with the same previously unfamiliar peer. Also, although we view our focus on emotions as a strength due to their social communicative value, it may be that a partner effect would have emerged if we had focused on other behaviours that

are also important to social engagement in initial encounters (e.g., seeking and sharing information).

### **Dyadic Similarity in Shyness**

Byrne (1971) theorizes that youth are attracted to individuals who behave similar to them and that this homophily forms the basis of friendship. Indeed, past research demonstrates that shy children tend to befriend others that are similarly shy (Haselager et al., 1998; Rubin et al., 2006; Yang et al., 2021). However, this may be due to selection, socialization, or both. At initial acquaintanceship, McElwain et al (2016) found that dyadic similarity in parent-reported social fearfulness at age 33 months of age was not associated with observed positive interaction quality (shared positive affect, coordination, and social play complexity) during free play with a previously unacquainted playmate at 39 months. In contrast, our findings provide evidence that higher dyadic similarity in child-reported shyness among pre-adolescents is associated with lower emotional variability with a previously unfamiliar peer. It is important to note that we used an absolute difference to quantify dyadic similarity in shyness and thus, our finding suggests that two children high in shyness *or* two children low in shyness are less emotionally flexible in a novel peer setting. In other words, children tend to have more dynamic and flexible interaction styles when paired with a new peer that is different from them on the shyness temperament dimension. We also found that dyads in the pattern characterized by frequent mutual expressions of positive and neutral affect and dyadic turn-taking between positive and neutral affect were more distinct in their levels of shyness than dyads in the pattern characterized by mutual neutral affect and dyadic turn taking between neutral and negative and neutral and positive. It is possible that during initial interactions, there are benefits to interacting with someone distinct as it could

allow for a diverse repertoire of communication. Even in established friendships, negative effects of homophily have been documented (e.g., Hafen et al., 2011; Spencer & Bowker, 2013).

The discrepancy between our findings and those of McElwain et al (2016) may be due to differences in development (i.e., preschool versus pre-adolescent), informants of shyness (i.e., parent versus child-report), or quantification of dependent variables. With regards to the dependent variables, McElwain et al (2016) created a composite of positive interaction quality by summing codes across 30-second intervals and dividing by the number of intervals coded. Our use of dynamic system measures (i.e., emotional variability and dyadic emotion sequences) may have been able to capture some of the nuances in similarly shy children's interaction style that global measurements were not. Nonetheless, given that we did not examine peer perceptions of each other's likeability, future research is needed to delineate whether emotional variability or dyadic emotion sequences mediate the association between dyadic similarity in shyness and impression formation.

### **Limitations and Future Directions**

When interpreting the results of the present study it is important to note its limitations. First, our sample was relatively homogenous in terms of ethnicity and socioeconomic status tempering the generalizability of our findings. An important future direction will be to replicate the present findings using a more ethnically and economically diverse sample, especially given cultural variations in how shyness is displayed and interpreted (Chen, 2010) and culture-specific emotion display rules and emotion socialization practices (Matsumoto, 1993; Sosa-Hernandez et al., 2020). Second, although comparable sample sizes have been used in previous dyadic work (i.e., 23 dyads observed by Schuhmacher & Kärtner, 2015; 49 dyads observed by Loughheed et al., 2020), and research suggests that small-N study designs are useful for investigating within-

child processes and temporal dynamics (Mirman, 2019; Smith & Little, 2018), our sample size was relatively small. Thus, it is critical to regard the current work as preliminary/exploratory in nature with a need to be replicated with a larger sample of children. Third, because friendships in pre-adolescence are predominantly composed of same-sex children we matched children based on sex. However, the interaction dynamics noted in the present study may not extend to cross-sex peer dyads, warranting their investigation in future studies. Fourth, our research design was cross-sectional in nature; we observed children as they interacted with *one* social partner at a given point in time. However, evidence from social relations and one-with-many models (Ross & Lollis, 1989; Sosa-Hernandez et al., in prep) suggest that children do not behave in the same way across different unfamiliar play partners in early childhood. Further, relationship initiation is not a static process but rather is theorized to develop over repeated interactions with the same previously unacquainted peer (Hinde, 1997). Together, these limitations highlight interesting avenues for future research on relationship formation among peers.

### **Conclusion and Implications**

Our findings echoed principles of emotion and personality theories (Byrne, 1971; Hinde, 1997; Henderson et al., 2018; Butler, 2011; Hollenstein et al., 2013) that conceptualize interactions among unacquainted peers as dynamic, and transactionally influenced by the characteristics of both partners and their temperamental similarity. By moving beyond frequency statistics and “zooming in” on children’s real-time dynamics we were able to capture how shyness influences children’s emotions as they unfolded with a new peer. We found that shy children’s recurrently negative and neutral patterns of emotion expressions and inflexibility may deter the potential formation of a relationship. We also found evidence that dyads with disparate levels of shyness display patterns of frequently shared positive and neutral affect and are more

emotional flexibility. The identification of these interpersonal mechanisms hold important applied implications and create creative channels for new research. If our findings are replicated, relational interventions seeking to promote more positive peer interactions, may leverage our findings by pairing shy children with a child low in shyness so that both children could benefit from each other. Collectively, this research has the potential to aid both shy and not shy children in their development of friendships and inform theory on the dispositions and emotion dynamics that underlie friendship initiation.

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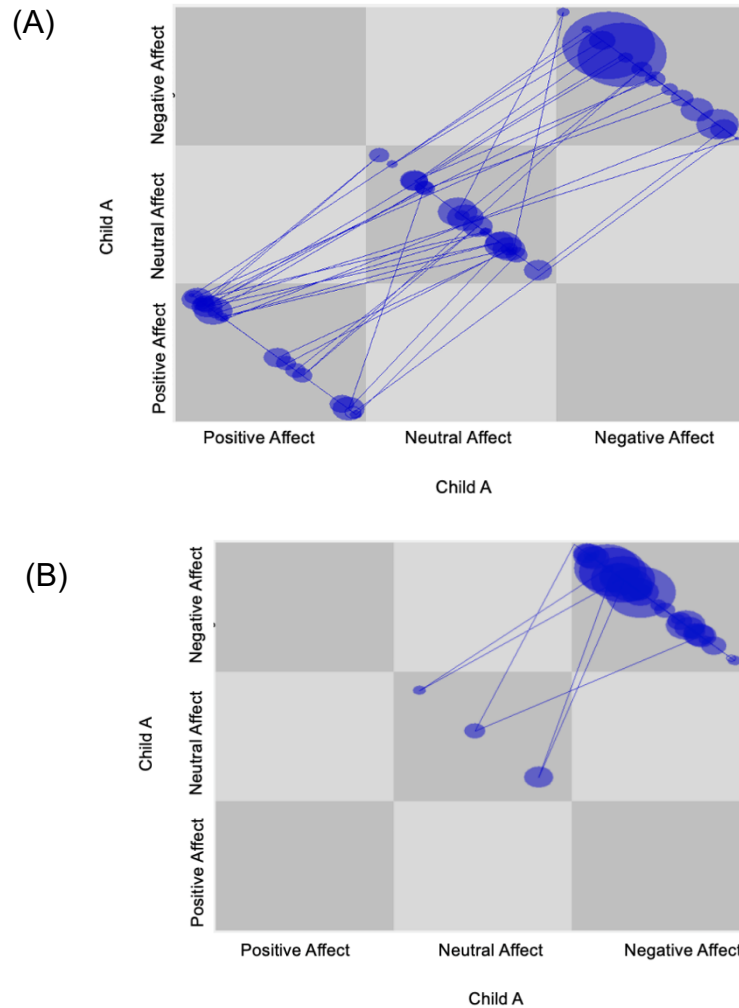
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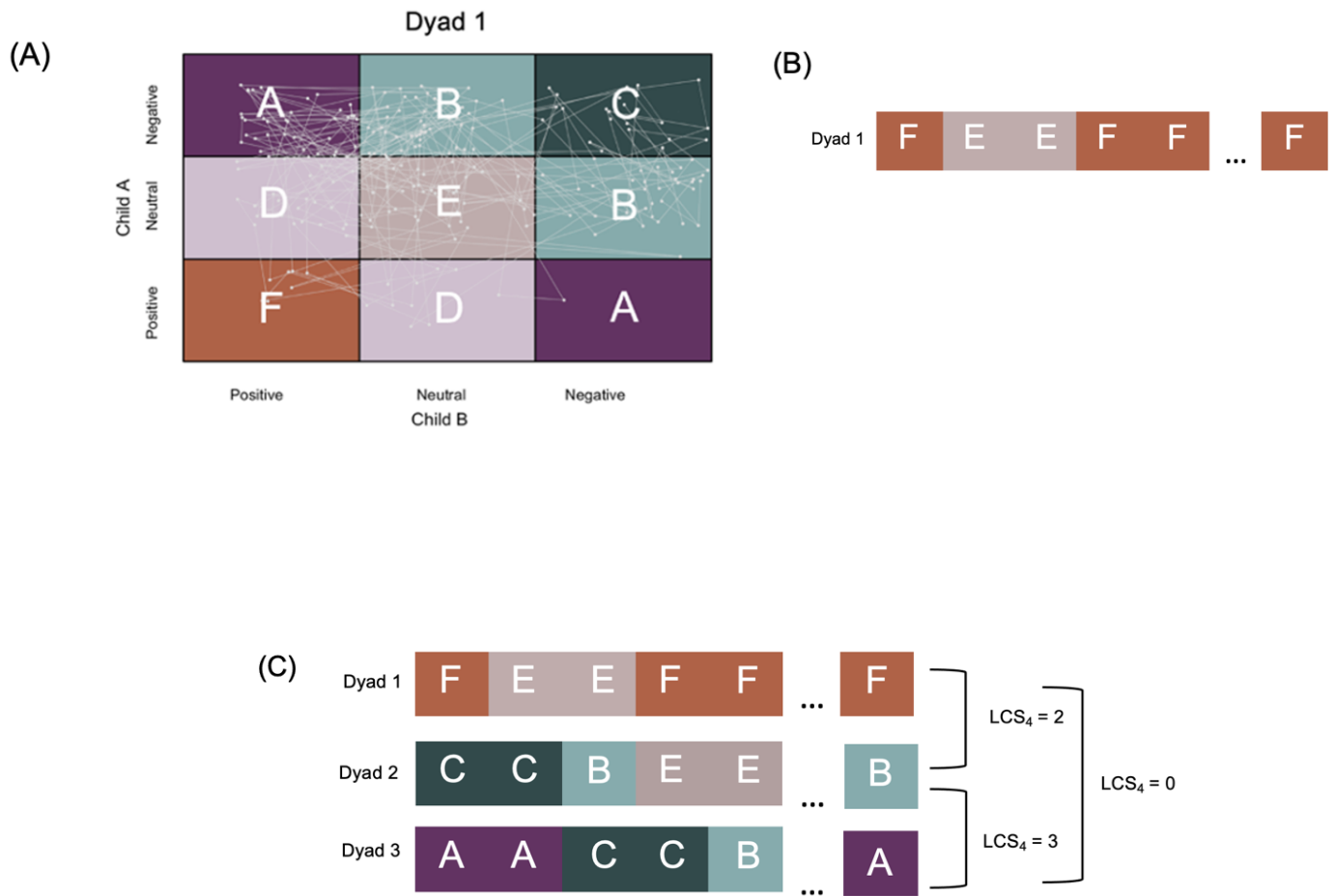
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## Appendices

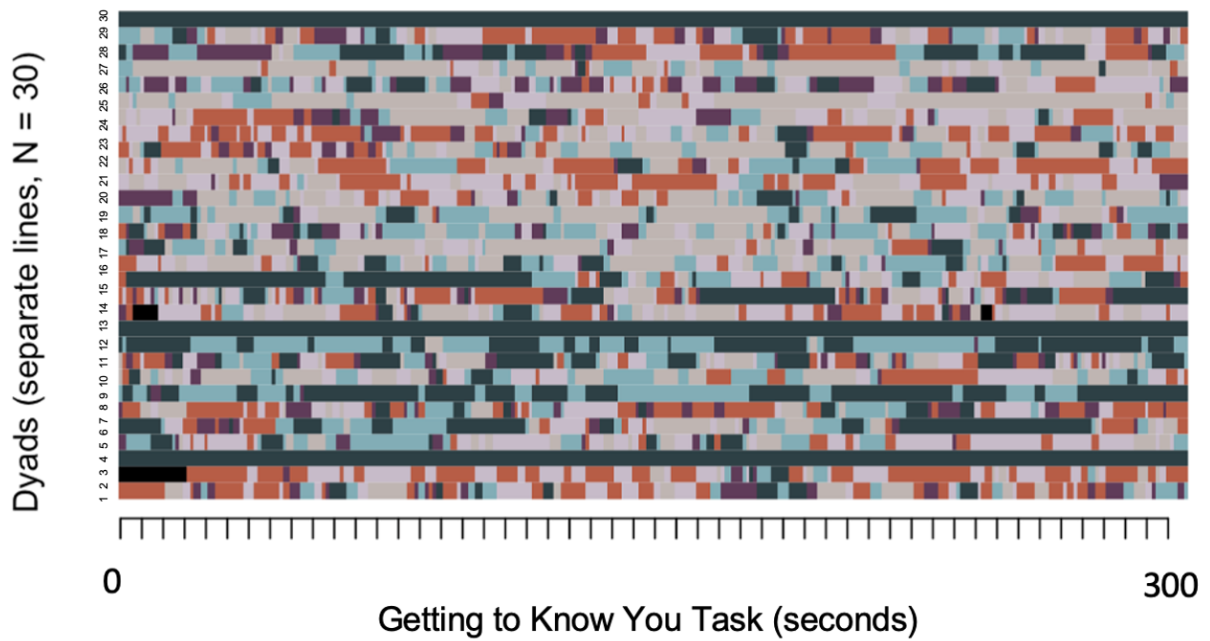
### Appendix A



*Figure 1.* Examples of state-space grids depicting high variability (a) and low variability (b). Grids were plotted at the individual-level with children’s own observed emotions on both the x-axis and the y-axis. Each cell on the grid represents a potential emotion, and a trajectory is plotted through the successive points on the grid in the same order they occurred in real times. The empty circle is the starting emotion state, and the larger the size of the circles the longer the duration of time that the child expressed that emotion. The arrows reflect the changes or transitions between emotions.

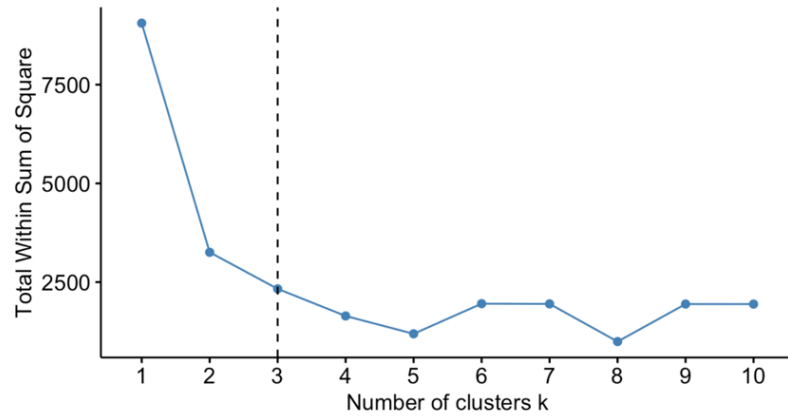


*Figure 2.* (A) A state space grid where an unfamiliar peer is plotted the x-and y-axis for one dyad. The movements from one dyadic state to the next are represented by the lines connecting the dots. (B) The categorical dyadic time series extracted from the state space grid for one dyad. (C) Sample calculation of the length of the longest common subsequence (LCS) for three hypothetical dyads' emotion sequences.

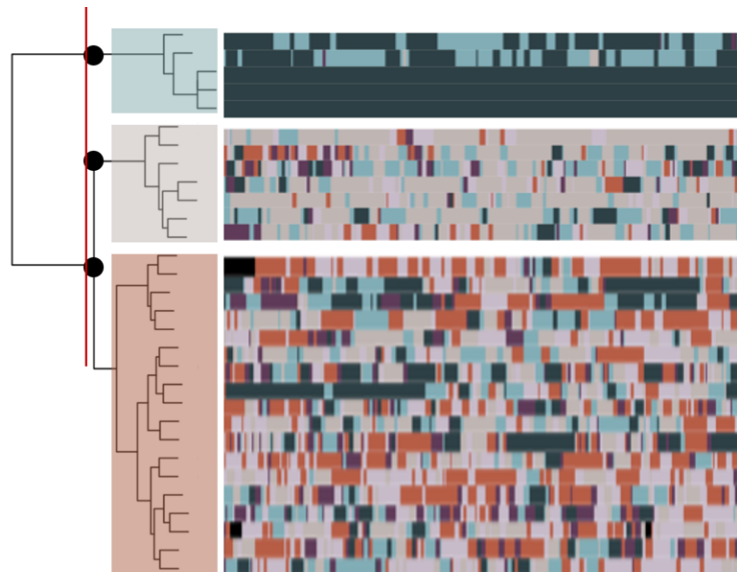


*Figure 3.* Time series plot depicting 30 dyad-level sequences extracted from the state space grids. The colors of each row show one dyad’s trajectory through the grid over time, with the color indicating the location of the grid cell in Figure 2. The colour black represents missing data.

(A)



(B)



*Figure 4.* (A) Total within-cluster sum of squares for hierarchical cluster solutions ranging from 1 to 10 clusters. (B) Dendrogram depicting the results of the hierarchical cluster analysis. The red line depicts the cut points for the three-cluster solution.

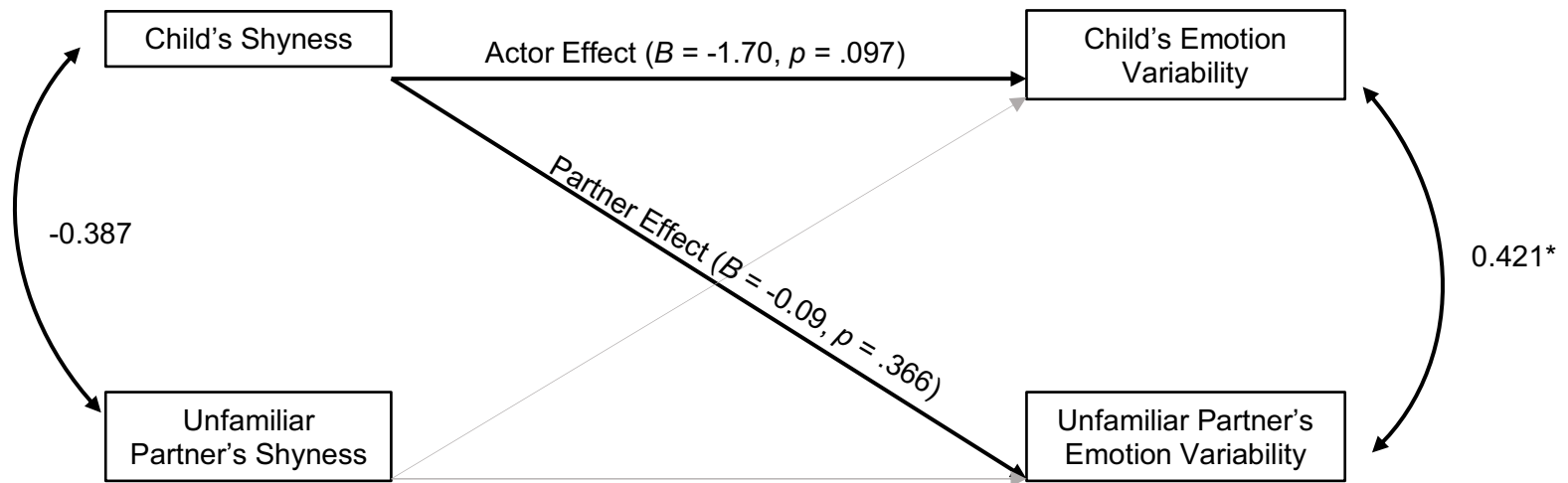


Figure 5. Actor-Partner Interdependence Models (APIM) depicting dyadic associations between child's own (actor effect) and their unfamiliar partner's (partner effect) shyness on their emotional variability during the Get to Know You Task, while controlling for the dissimilarity between dyad member's shyness. Shyness was measured using an aggregate of parent and child reported shyness.



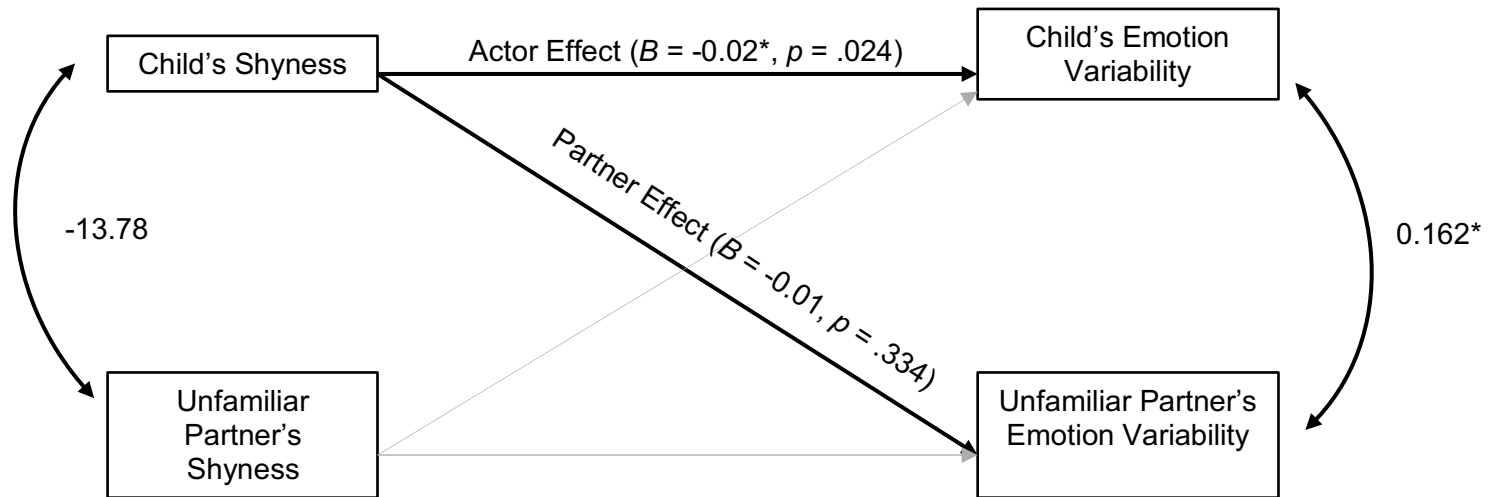


Figure 6. Actor-Partner Interdependence Models (APIM) depicting dyadic associations between child's own (actor effect) and their unfamiliar partner's (partner effect) self-reported shyness on their emotional variability during the Get to Know You Task, while controlling for the dissimilarity between dyad member's shyness. *B*s represent the standardized coefficients.

Table 1

*Five Most Frequent Subsequences by Dyadic Emotion Pattern*

Order of frequency	Cluster 1: Negative Dyadic Pattern		Cluster 2: Shared and Variable Neutral Affect		Cluster 3: Shared and Flexible Positive Affect	
	Subsequence	Number of dyads	Subsequence	Number of dyads	Subsequence	Number of dyads
1	C	3	(B>E)	7	(D>G)	19
2	(B>C)	2	(B>E)-(B>E)	7	(D>E)	17
3	(B>C)-(B>C)	2	(B>E)-(D>E)	7	(G>D)	18
4	(B>C)-(B>C)-(C>B)	2	(B>E)-(D>E)-(B>E)	7	(D>G)-(D>G)	17
5	(B>C)-(B>C)-(B>B)	2	(B>E)-(E>G)	7	(E>D)	17
N of cluster		5		7		18

*Note.* “>” indicates a transition between two states demarked by parentheses, whereas “-” indicates remaining in the same state for some duration of time. A= positive-negative, B = neutral-negative, C= shared negative, D = positive-neutral, E = shared neutral, G = shared positive affect.

## Appendix B

### Modified Specific Affect Coding System for Unfamiliar Peer Dyads

**Positive Affect:** The child is in a general happy emotional state. It includes expressions of enthusiasm, humor, and/or interest/curiosity.

Facial Cues	Vocal/Verbal Cues	Body Posture
Raised cheeks	Warm and high/excited pitch	Leaning in towards partner
Genuine smile (e.g., lips apart or together turned up)	Making jokes (shared)	Open body posture
Happy eyes	Warm and questioning tone	Head nodding
Laughter (only if shared)	Natural pauses between utterances	Head tilt
Maintaining eye contact	Validating	

**Neutral Affect:** The child is exchanging un-valenced information (e.g., content and voice tone is non-emotional). Neutral is the dividing line between negative and positive codes. Be familiar with the children's resting face (people may naturally have turned down lips or other permanent features).

Facial Cues	Vocal Tone Cues	Body Posture
Become familiar participant's resting facial features	Relaxed and calm tone	Relaxed shoulders
Absence of positive and negative affect	No variability in pitch and volume	

**Negative Affect:** The child shows withdrawal behaviors that indicate avoidance or turning inwards, or behaviors designed to question or "get a rise" out of their partner. It includes displays of anxiety/tension, frustration/annoyance and dominance.

Facial Cues	Vocal Tone Cues	Body/Posture Cues
Lower/raise up/scrunch up brows	Low/or aggressive volume	Avoiding eye contact
Cheek/lip biting	Nervous laugh (not shared)	Fidgeting/Restlessness
Eyes wide open	Slow sighing or fast/irregular	Head down
Poor eye contact	Exhalations/breathing	
Clenched jaw/teeth	Invalidation/patronizing (rude comments)	Tense/slouching posture
Wrinkling nose	Slowness or quaver of speech	Hand over mouth
Eye rolls		Head or body aversion
Uncomfortable/smirk smile		