Emotions and Communication as a Dynamic Developmental System

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Resumen
Este artículo presenta un caso cualitativo de desarrollo emocional en el contexto de la comunicación temprana madre-infante. Emociones y comunicación son conceptualizadas como una parte integral del sistema dinámico de desarrollo. El principio fundamental de diseño empleado es aislar una transición del desarrollo clave y luego examinar muy de cerca los micro y macro-cambios a lo largo de la transición. En este estudio, la transición clave del desarrollo es la ampliamente reportada transición de un foco primario en la comunicación directa cara a cara entre la madre y el infante, hacia una enfocada primariamente en la comunicación del objeto. La díada madre-infante analizada visitó un cuarto de juegos en el laboratorio tres veces a la semana por un periodo de cuatro meses, empezando cuando el niño tenía 10 semanas. Nuestro análisis microgenético indicó que los elementos de emociones positivas auto-organizadas en patrones recurrentes a través de rutinas de comunicación, llamadas *marcos*, co-creados por la madre y su infante y las emociones infantiles se desarrollaron en el tiempo como parte de este sistema de comunicación.

Palabras clave: emociones positivas, auto-organización, comunicación madre-infante, investigación microgenética, teoría de sistemas dinámicos.

Abstract
This paper presents a qualitative case study of emotional development in the context of early mother-infant communication. Emotions and communication are conceptualized as an integral part of a dynamic developmental system. The fundamental design principle employed is to isolate a key developmental transition and then to closely examine micro- and macro-changes across that transition. In this study, the key developmental transition is the well-reported transition from a primary focus on direct, face-to-face communication between mother and infant to a primary focused on object communication. The mother-infant dyad analyzed herein visited a laboratory playroom three times a week for a period of four months, starting when the infant was 10 weeks old. Our microgenetic analysis indicated that elements of positive emotions self-organized into recurring patterns through communication routines, called *frames*, co-created by the mother and her infant and the infant emotions developed over time as part of this communication system.

Keywords: Positive emotions, self-organization, mother-infant communication, microgenetic research, dynamic systems theory.

INTRODUCTION

This paper examines emotions as emerging through communication processes. Emotions are viewed as relational experiences lived in bodies, bodies that co-regulate their movements with the movements of others. The theoretical underpinnings of the work presented are predominantly influenced by dynamic systems theory and microgenetic research (e.g., de Weerth, van Geert, & Hoijtink, 1999; Lavelli, Pantoja, Hsu, Messinger, & Fogel, 2005; Pantoja, Nelson-Goens & Fogel, 2001). We start by discussing dynamic systems principles relevant to our understanding of emotions as developing over time in communication contexts. We then present a case study of a mother–infant dyad in the first months of life to demonstrate how a microgenetic analysis of communication can add to our understanding of emotional development in infancy.

EMOTIONS AS DEVELOPING THROUGH COMMUNICATION

The study of emotions in infancy has followed two dominant traditions: the detailed analysis of facial actions (e.g., Ekman, 1995; Ekman & Friesen, 1975; Izard, 1997; Tomkins & McCarter, 1995) and the analysis of the relationship between communication contexts and emotions (e.g., Camras, 1991; Fogel, Dickson, Hsu, Messinger, Nelson-Goens, & Nwokah, 1997; Fogel, Nwokah, Dedo, Messinger, Dickson, Matusov, & Holt, 1992; Messinger, Fogel & Dickson, 1997, 1999; Pantoja, Nelson-Goens & Fogel, 2001; Weinberg & Tronick, 1994; Wolff, 1987). Along with the latter tradition, dynamic systems theory inspires us to study emotions as self-organizing through communication processes. This approach to emotions emphasizes the importance of examining how the various constituents of communication (such as facial actions, gaze, body movements, vocalizations, and gestures) coalesce into coherent emotion patterns that support infants' meaningful relationships with others.

Despite the advances in dynamic systems emotion research, the linguistic connotation of the term emotion continues to be deeply rooted in the tradition of studying emotions through the face and conceptualizing emotions as internal, discrete states to be expressed outwardly (e.g., Ekman & Friesen, 1975; Izard, 1997). While detailed analyses of the face have advanced our understanding of the complexity involved in studying emotions; in everyday life, emotions dynamically involve the face, the body and the interpersonal context in which they emerge (Demos, 1988).

As de Rivera (1992) suggests, "emotions may be conceived as existing **between** people, as various sorts of attractions and repulsions . . . which transform their bodies and perceptions" (p. 200, emphasis in original). We recently discussed elsewhere (Fogel & Garvey, in press) that emotions are alive experiences dynamically lived and developed over time through co-regulated communication processes with others. From this perspective, emotions are defined as experiences of *harm* or *benefit*, perceived as personally meaningful with respect to the individual's changing relationship with the environment (Barrett, 1993, 1998; Campos, Mumme, Kermoian, and Campos, 1994; Frijda, 1986; Lazarus, 1991). Functionalist theorist, Frijda (1993), describes emotions in the following manner:

> It is in part a perception and in part a felt interaction with the environment, or felt inclination or disinclination thereto. It is something between him and me, or between her and me, or it and me. ... Most emotions, being interactions, are events over time and are felt as events over time (p. 249).

Similar to the functionalist perspective, we conceptualize emotions as relational experiences of feeling inclined to (or disinclined from) others and/or the relational contexts they occur. It is our contention that emotions not only emerge through communication, but they also help punctuate the dynamic flow of communication by opening (or closing) opportunities for individuals to experience themselves in relation to others (Fogel, 2001, Pantoja, 2001; Pantoja, Nelson-Goens, Fogel, 2001). The unique contribution of dynamic systems theory for the study of emotions is its emphasis on the emergent and malleable properties of emotions. Emotions are examined as dynamic patterns of relational experiences embodying changes in an individual's heart rate, blood flow, hormones, brain chemistry, body movements, appraisal processes, and so on. Viewing emotions as dynamically emerging through communication is a fruitful approach to circumvent the inclination toward fragmenting emotions into discrete units contained by the body, especially the face (e.g., Camras, 1991; Fogel et al., 1992; Fogel et al., 1997; Lewis, 1995, 2004; Lewis & Todd, 2005; Messinger, Fogel, & Dickson, 1997, 1999; Weinberg & Tronick, 1994; Wolff, 1987).

Emphasis on self-organization

Dynamic systems theory strongly relies on the principle of self-organization (Fogel et al., 1992; Granic, 2000; Lewis, 1995, 2004; Lewis & Todd, 2005; Liable & Thompson, 2000; Messinger, Dickson, & Fogel, 1997, 1999; Pantoja, Nelson-Goens, & Fogel, 2001, van Geert, 2003). Self-organization refers to the continuous process of interaction among the system's constituents that cooperatively and spontaneously gives form to dynamically stable patterns of co-activity. In other words, self-organization is a spontaneous process of mutual influence among the system's components through which order emerges. To self-organize is "to form intricate patterns from interactions among simpler parts, without prespecified blueprints" (Liable & Thompson, 2000, p. 299). For instance, the various muscles of the face carefully examined by differential emotions theorists are conceptualized as constituents of the system that self-organize into various emotion patterns, thereby allowing for the observable distinction between facial expressions of sadness and joy. The face is thus considered one among many constituents of the self-organization of emotions. Other constituents include body postures and positions, gestures, vocalizations, activities of the brain, and the relational contexts in which human beings are engaged (Fogel, 1993). In other words, emotions are lived dynamically vis-à-vis the actions, postures, gestures, vocalizations, movements and biological flows within the body which emerge through communication with others. As stated by Lewis and Todd (2005) in a recent discussion of emotions and cognition:

> Emotion theorists who have taken a dynamic systems approach (Fogel, 1993; Lewis, 1995, 1996; Scherer, 2000) view

> emotions as evolving wholes, rather than end-points in a cognitive computation or starting points in the production of a cognitive bias. Emotional wholes are seen as cohering in real time through the interaction of many constituent processes, and it is the synchronization of these processes, as well as the properties of the whole, that becomes the focus of investigation (p. 215).

The concept of self-organization implicates a dynamic process of change that occurs **over time**. Thus, the notion of historical understanding becomes at the core of dynamic systems thinking (Kellert, 1993; Prigogine & Stengers, 1984). Specifically, developmental psychologists influenced by dynamic systems theory argue that an appreciation of a particular moment in time implicates an historical understanding of that moment. Therefore, the concept of self-organization underscores the importance of incorporating an historical understanding for the study of emotions. What follows then is that the self-organization of emotions needs to be examined at two distinct time scales: real-time and developmental-time.

There is the self-organizing process of emotions that occur at the level of the moment-by-moment change (referred to herein as real-time change). Examples are the minute transformations in an individual's emotions observed second after second as individuals interact with one another. During a conversation, for instance, two individuals may gradually lean toward each other, relaxing their bodies, slightly tilting their heads and turning their gazes to one another, forming a smile on their faces, and gently raising the intonation of their voices to produce melodic sounds, thereby contributing to the self-organization of the individuals' positive emotions toward one another.

At the same time, individuals organize and transform their emotions at the developmental level (referred to herein as developmental-time changes). For example, in the multiple encounters described above, these two individuals may co-create a positively meaningful relationship characterized by a pleasant inclination toward one another, a desire to be together, a feeling of benefit and joy in the presence of the other. This positive emotional inclination in turn facilitates the participants' future engagement in mutually gratifying and creative experiences. At this point, not only a developmental-time change emerges from the details that constitute the participants' day-to-day life, but the real-time encounters also become transformed by those developmental changes. Through this dynamics involving both real-time and developmental-time changes, each moment can be conceived of as historical moments that require an historical understanding (for a more detailed account on time-scales, see Fogel & Lyra, 1997; Lewis, 1995; Lyra, 2000; Thelen & Ulrich, 1991)

Therefore, based on the principle of self-organization, descriptions of the microgenetic details of humans' day-to-day experiences and over time are at the core of an analysis of emotional development. But how do these self-organizing emotion patterns emerge over time, punctuating, maintaining and/or changing the quality of an individual's emotional life and his/her relationships with others? We further address this question later on through our case study analysis of a mother-infant dyad.

Where is the individual in this relational model of emotions?

This view of emotions as dynamically self-organizing patterns that emerge through communication does not deny that individuals experience emotions as their own. Quite the contrary, within this framework, emotions are uniquely experienced by each individual whose body is situated in different locations in relation to others. As stated previously, emotions are lived in bodies as forms of approach and avoidance with respect to the environment or in a co-creative interpersonal relationship, but they are not "contained" by the body. As an individual's body reaches out, leans into, and connects to another body, that individual may experience openness and relatedness with the other as long as the other is also open to connect and relate to him/her. Through communication, the body will tune into various emotional experiences such as openness or closeness toward others, connection or disconnection from others, and so on, a process called affective resonance (Schore, 2001).

This paper is thus based on the idea that emotions can be thought of as self-organizing experiences of connection or disconnection that emerge through communication with others as participants develop patterns of relating with (or avoiding) one

another. We refer to these patterns of communication *frames* and these constitute our main unit of emotion analysis. In interpersonal contexts, frames are segments of co-action that have a coherent theme, that take place in a specific location, and that involve particular forms of mutual co-orientation between participants (for a more detailed discussion on frames, see Fogel, 1993; Pantoja, 2001). In the case of infants, the co-creation of frames with their mothers are particularly relevant because it is with those significant others infants spend a great deal of their waking time developing primary relationships. We now turn our attention to the microgenetic analysis of infant emotional development in communication contexts co-created with mothers during the first months of life.

CASE STUDY OF EMOTIONS AND COMMUNICATION AS A DYNAMIC SYSTEM

The infant in our case study is referred to as Nathan and the mother is referred to as Patricia. Nathan was the youngest child of three of a middle-class Anglo-Saxon family residing in the western mountain region of the United States. Nathan and Patricia visited the laboratory playroom three times a week for a period of four months, starting when Nathan was 10 weeks old and ending when he was 26 weeks old for a total of 48 visits. This time frame was selected because the communication development literature reports that a key developmental transition from a primary focus on social frames to a primary focus on social-object frames transition occurs around the fourth month of life (Adamson, 1995; Fogel et al., 2000; Lyra & Rossetti-Ferreira, 1995 Pantoja, 1997; Stern, 1990). At their first visit to the laboratory, Patricia was asked to "do what you would normally do at home". No other instructions were provided. Patricia was allowed to play with Nathan in the sofa and on the floor, to freely talk to Nathan, to change Nathan's diapers, or to feed him, thereby allowing the information-richness of the dyad's everyday life be part of the videotaped sessions.

After systematically watching the 48 visits of free-flowing communication between Nathan and Patricia, multiple patterns of emotion were identified in the ways Nathan and Patricia related to one another. These emotions self-organized as frames were co-created by Nathan and Patricia (Pantoja, 2000). For the purpose of illustrating the contributions of examining emotions as dynamically evolving over time through frames, we will focus our analyses on a few frames observed from visit 1 through 20 as Nathan and Patricia gradually shifted their focus from direct-playful frames to frames characterized by Nathan's concentrated interest in toys while Patricia quietly observed him. The distinct emotion patterns identified were viewed as self-organizing through the process of frame co-creation.

Specifically, in the first five visits, frames involving the direct connection between Nathan and Patricia without the consistent use of objects were observed: these frames ranged from playful moments involving positive emotions composed of large smiles, vocalizations, and tactile games to more mellow moments between Nathan and Patricia involving mutual gazing, subtle smiles, and soft touches. In these frames, both Nathan and Patricia were predominantly co-oriented to one another, continually co-regulating their movements with respect to one another. Between sessions 5 and 9, Nathan and Patricia began to more consistently introduce novel activities to their existing frames, including the use of objects and new patterns of positive emotions. As novelty was introduced, familiar routines (as reflected in previously observed emotions and frames) were also reinstated in the flow of their communication.

Lastly, between visits 10 and 20, a phase shift in the dyad's playful routines was observed: Nathan began to consistently engage in a form of absorbed interest by persistent exploring his hands and/or toys through mouthing, while Patricia quietly observed her infant, often times providing postural support to his explorations.

But how does the development of Nathan's positive emotions emerge through the changes in frames? With the goal of addressing this question, we will focus our microgenetic analysis on three frames co-created by Nathan and Patricia over the course of the first 20 visits: social playful frames, social-object playful frames, and interest in toy frames (defined below). These frames are emphasized herein as they represent some of the predominant patterns of communication between Nathan

and Patricia observed across the 20 visits analyzed and they served as relational contexts from which some of Nathan's positive emotions self-organized over time. Throughout the microgenetic analysis presented below, Nathan's positive emotions and the relevant communication frames are highlighted in **bold**.

Tuesday, June 9, 1998. This is Nathan and Patricia's first visit. Nathan is 10 weeks old. Patricia places him on the floor in a supine position while he is crying loudly. His arms and legs are stiff, his mouth open and downward, his gaze directed to the ceiling as Patricia changes Nathan's diapers, talking with a neutral tone of voice, looking at him and gently soothing him. As Nathan calms down, Nathan and Patricia gradually establish a sense of **contentment** with each other's company. They look at one another, quietly and gently. Sometimes, Patricia talks to Nathan, touching his body, changing his posture, and/or forming a subtle smile on her face. These **content social frames** are becoming, often preceding and following moments of fussiness. Moments of positive playful connection between Nathan and Patricia also emerge, referred to here as **social playful frames** due to the absence of toys. In these social playful frames, Nathan and Patricia appear to immensely enjoy one another as Patricia plays with Nathan's body, talking with a melodic tone of voice, smiling and brightening her face. Nathan also smiles, looking at Patricia, protruding his lips and vocalizing. These sequences of co-actions that constitute the dyad's playful connection and the self-organization of Nathan's positive emotion of **joy** are illustrated in the following segment. Nathan's bodily changes are underlined and *italicized*.

> *Visit 1, Segment 1. 04:52 Patricia looks at Nathan's eyes, raising her eyebrows, softly talking to him and rubbing her right hand on Nathan's stomach. 04:56 As Patricia continues rubbing her right hand on Nathan's stomach, Nathan jerks his body, abruptly moving his left arm and relaxing his eyebrows. At this point, Patricia makes a mock surprise face saying: "Oh!" and slightly raising her lip corners while Nathan continues staring at Patricia. 05:01 Patricia then begins to gently tickle Nathan, whispering, and raising her lip corners, while Nathan begins vocalizing and grabbing his shirt as they look at one another. 05:16 Patricia removes Nathan's pacifier from his mouth, raising her lip corners even more, opening her eyes wide, and whispering. Nathan begins making cooing mouth movements, at times vocalizing, keeping his mouth open, moving his head up and down, waving his left arm and stretching his trunk, while Patricia raises her lip corners, whispering and gently tickling Nathan. 05:20 Nathan briefly raises his lip corners, keeping his mouth open, while Patricia continues tickling Nathan with her lip corners raised. 05:26 Nathan briefly raises his lip corners again as Patricia continues tickling Nathan with her lip corners raised.*

As illustrated above, Nathan's positive emotions self-organize and become amplified as the social playful frame emerges over real-time: he maintains his gaze toward Patricia, vocalizing, smiling, moving his head up and down, and opening up his body to this flow of positive inclination toward his mother. In other words, Nathan's positive emotion of **joy** and relatedness with his mother gradually emerges as the **social playful frame** is co-created with her. Over real-time, Nathan and Patricia jointly create a convergent emotional inclination to one another by mutually amplifying each other's contributions to the flow of their communication.

Two days pass. It is now Thursday, June 11, 1998. Patricia and Nathan start their morning visit to the laboratory playroom welcoming a toy into their communication. With the introduction of the toy, both Patricia and Nathan begin to direct their attention to the toy and a new positive emotion not observed during the first visit is now taking shape: Nathan's **concentrated interest** in toys. Specifically, Patricia holds a toy while Nathan looks at it intently, at times moving his arm toward the toy in a jerky manner, thereby forming the **interest in toy frame**. The inclusion of toys in the flow of their communication is emphasized for two reasons: (a) it is pertinent for the investigation of the key developmental transition targeted in this study; and, most importantly, (b) it participates in the changes in Nathan's emotional repertoire observed through the changes in the interest in toy frame. The **interest in toy frame** is illustrated in the segment below. Note how Nathan welcomes the toy by gazing at it and moving his arm while vocalizing (underlined and *italicized*), becoming increasingly more concentrated on the toy and magnifying Patricia's initial effort to introduce the mirror to him.

> *Visit 2, Segment 2. 00:00 Patricia is sitting on the sofa with Nathan sitting on her lap facing the room. As Patricia puts the Sesame Street mirror in front of Nathan's eyes, Nathan looks at it, moving his left arm toward the toy in a jerky manner, vocalizing. Patricia continues holding the mirror in front of Nathan's eyes, saying with a neutral tone of voice "Can you stop it?", pressing the bottom located on the top corner of the mirror. As Nathan moves his left arm to-*

wards the toy, looking at it, he burps, spitting up. 00:21 At this point, Patricia says "Oooooh!," immediately putting the mirror on the floor, reaching out for the tissue box and starting to clean off Nathan's face.

During this moment of **concentrated interest** in the mirror toy, Nathan maintains a sense of relational connection with his mother as interest in toys gradually self-organizes. As briefly illustrated in the above segments, Nathan and Patricia have been co-creating a variety of opportunities for Nathan to experience and develop his repertoire of positive emotions (from a serene sense of **contentment**, to intense, playful **joy** to concentrated **interest**) by co-regulating changes in their bodies and face in relation to one another. In the examples provided, these emotions are lived through moments of positive and convergent emotional co-orientation as embodied through the **content social frames**, **playful social frames** and **interest in toy frames**. We argue that through these real-time changes observed in the flow of Nathan and Patricia's communication, Nathan's repertoire of positive emotions is formed and expanded over time.

Friday and Tuesday, June 12 and 16, 1998. As Nathan and Patricia's first week visiting the laboratory comes to a close, a similar emotions and frames continues to recur, thereby dynamically stabilizing Nathan's emotional repertoire. Specifically, Nathan and Patricia continue to engage in moments of **content social frames** as they merely look at one another with neutral faces and relaxed bodies, keeping a serene pace. They also continue **enjoying** and **amusing** one another in **social playful frames** as they re-establish and maintain their games involving Nathan's body while looking at one another, smiling, vocalizing and laughing. The main difference is that these moments begin to occur in longer durations as Nathan and Patricia become more playful during these frames of positive, intense connection. The segment below illustrates how Nathan and Patricia continue to closely co-regulate their bodily and facial changes in relation to each other's contributions, thereby participating in the increasing emotional intensity of the social playful frame.

Visit 3, Segment 3. 03:14 Patricia begins rubbing Nathan's feet against each other more roughly, making a synchronized sound "tsch tsch tsch" with her movements and looking at Nathan. Meanwhile, Nathan continues looking at Patricia with a relaxed face and body, sucking on his pacifier. While Patricia continues rubbing Nathan's feet, vocalizing in a synchronized way, Nathan (03:16) produces a long, positive vocalization, looking at Patricia with a relaxed face and body. At this point, Patricia begins moving Nathan's legs up and down, saying "tsch tsch tsch", raising her lip corners and showing her teeth while pressing them together. 03:17 Nathan begins to gradually become more engaged in this face-to-face feet-rubbing game to the point of dropping his pacifier as he vocalizes (03:27). As Nathan vocalizes, Patricia continues rubbing his feet together, keeping her lip corners raised and talking to him softly. 03:29 Nathan begins raising his lip corners, vocalizing and protruding his tongue while looking at Patricia rubbing his feet together with her lip corners raised and talking to him. This goes on until 04:14. At this point, Nathan brings his face and body to a neutral position as Patricia also brings her face to a neutral position with Nathan.

The recurrence of these positive joyous moments in its previous form combined with its increased vigor and duration may be indicators of the increasing prevalence of **joy** in Nathan's emotional life. The next example, extracted from visit 4, also demonstrates the emotional prevalence of **joy** and significance of these playful moments as it highlights similarities across segments. In the example below, their playful games revolve around Nathan's foot, which is carefully observed by Nathan.

Visit 4, Segment 4. 07:41 As Patricia approaches Nathan's left foot again, opening her mouth and looking at Nathan, Nathan vocalizes, tonguing his lips, raising his lip corners even more, and shifting his gaze towards his left foot. 07:43 Patricia stops kissing Nathan's left foot, looking straight into his eyes, keeping her lip corners raised and her teeth showing. At the same time, Nathan begins opening his mouth while keeping his lip corners raised and his gaze towards his left foot, touching Patricia's hand with his right hand and resting his left hand on his left thigh. 07:44 As Nathan shifts his gaze toward Patricia's face with his lip corners raised, he also begins opening his mouth even more, vocalizing a long sound. At the same time, Patricia opens her mouth, wrinkles her nose, maintaining her lip corners raised, looking at Nathan. 07:44:26 Nathan slightly closes his mouth, producing another long sound (a bit louder than the previous one), maintaining his lip corners raised, his right hand touching Patricia's hand, his left hand touching his left thigh, and looking at Patricia. Meanwhile Patricia maintains her lip corners raised, her teeth showing and she stops wrinkling her nose. 07:45 Patricia begins approaching Nathan's foot again, opening her mouth and looking at Nathan's foot, while Nathan continues looking at Patricia with his lip corners raised, his right hand touching Patricia's hand and his left hand resting on his thigh.

As illustrated above, an intense sense of **joy** and **the social playful frame** self-organize as Nathan and Patricia mutually amplify each other's actions by producing big smiles, vocalizing, and alternating their gaze between Nathan's foot and each other's eyes.

Furthermore, Nathan's serene **contentment** and concentrated **interest** in toys also continue to recur during visits 3 and 4 in the **content social frames** and the **interest in toy frames**, respectively. As previously observed, Patricia gently touches Nathan or quietly presents a toy within Nathan's sight, maintaining a neutral face and a relaxed body while Nathan looks at Patricia or the toy held by her, attentively.

During visit 4, however, new emotional qualities are also observed within this **interest in toy frame**. Specifically, a form of **excited interest** is introduced by Nathan, as illustrated in the real-time changes described in the segment below. Of particular note, movements of **excitement** become incorporated into this frame as well as other frames in later visits, thereby suggesting the later prevalence of excitement in Nathan's emotional repertoire.

> *Visit 4, Segment 5. 00:00 Nathan is in a supine position, lying on the floor, while Patricia sits next to Nathan on his right side, holding the Sesame Street mirror in front of Nathan's eyes and softly saying "Do you see yourself in there? Do you see yourself in there?" Meanwhile Nathan looks at the mirror, protruding his lips, kicking his legs and resting his hands on his stomach. 00:04 Nathan begins to get more vigorous, kicking his legs more intensely, waving his arms, and vocalizing short sounds, briefly raising his eyebrows while looking at the mirror. Patricia continues holding the mirror in front of Nathan's eyes, finishing her sentence "... yourself in there?"*

This relational pattern of communication in which Nathan **excitedly** kicks his legs, waves his arms, protrudes his lips, and vocalizes while intently looking at the mirror continues for the next six minutes. Throughout these six minutes, Patricia gradually becomes quieter, holding the mirror in front of Nathan's eyes, at times gently touching his arm, his stomach or briefly raising the intonation of her voice as Nathan's actions become more vigorous. Not only the **interest in toy frame** begins to include the additional emotional quality of **excited interest**, thereby potentially contributing to the expansion of Nathan's emotional repertoire, but Nathan is also able to further explore his cross-modal experiences of seeing and feeling his movements (in this case, through the mirror toy), while being touched and talked to by his mother.

Almost one week and half have passed. Nathan and Patricia have visited the laboratory playroom four times. Up until now, Nathan's experiences of **contentment**, **joy** and variations of **interest** self-organized as communication frames were co-created and maintained by Nathan and Patricia. Although these emotions and frames recur in somewhat recognizable ways across the first four visits, the ways they recurred are not always the same. Specifically, in the last four visits, toys were first introduced during visit 2 and a new emotion (**concentrated interest**) involving toys emerges. As this novel emotional connection with toys becomes mutually recognized and maintained by the dyad, a new form of dynamic stability is also co-created. Specifically, on visit 4, Nathan becomes more vigorously oriented to the toy (**excited interest**) while Patricia participates in this change in their emotional orientation by continuously showing the toy to Nathan.

What might happen next? Will these real-time innovations observed during visit 4 remain as mere potentials and not become amplified? Or will some of these innovations further self-organize into new paths of emotional connection between Nathan and Patricia, thereby contributing to a developmental change in Nathan's emotional repertoire? The unfolding of Nathan's emotional development and his relationship with his mother continues to be described in the next pages.

Thursday, June 18, 1998. This is their fifth visit to the laboratory playroom. Between this session and session 9, Nathan and Patricia start to consistently integrate toys as part of the flow of their communication, as reflected in their use of object toys in many of the previously observed frames. With this reorganization of their communication patterns, new emotional variations self-organize and further expand Nathan's repertoire of positive emotions. For instance, positive playful moments between Nathan and Patricia now predominantly emerge through toys.

This innovated form of playful connection is now referred to as **social/object playful frame** and Nathan's **excited interest in toys** is also accompanied by elements of **joy** and **interest in Patricia**, as indicated by the presence of gaze alternation between toys and one other and/or subtle smiles. Although brief in duration (shorter than one second), while Nathan and Patricia's emotional orientation is becoming predominantly directed toward the toy,

they simultaneously maintain their serene social connection through their brief gaze alternations and/or subtle smiles. The following segment illustrates the inclusion of gaze alternation within the **interest in toy frame**.

> *Visit 5, Segment 9. 04:31 Patricia starts shaking the rattle in front of Nathan's eyes and whispering something. Nathan, at this point, looks at the toy held by Patricia, bringing his right hand to his chest and jerking his left arm. 04:35 Patricia stops shaking the rattle, bringing it towards Nathan's left hand quietly. Nathan continues looking at the toy intently, tonguing his lips. 04:42 As Patricia adjusts the rattle into Nathan's left hand, she begins talking to Nathan with a neutral tone of voice. 04:42:19 Nathan briefly looks at Patricia, looking back at the toy (04:43:03) as Patricia continues adjusting the rattle in Nathan's hand.*

Furthermore, Nathan's **excited interest** in toys also begins to pervade the **interest in toy frames**. Although **excitement** was first introduced as an innovation by Nathan in visit 4 (while he looked at the toy mirror) excitement did not constitute a consistent and predominant component of this frame at the time. At visit 5, however, in almost every instance of **interest in toy frame**, Nathan kicks his legs and waves his arms while intently looking at the toy held by his mother, thereby suggesting that **excited interest** is becoming more stable in Nathan's emotional repertoire. In sum, starting on visit 5, as Nathan and Patricia appear to begin shifting their communication from a primary focus on blissful social games to an emerging focus on interest in toys, Nathan's emotional repertoire of positive emotions becomes expanded to include **contentment**, **joy** and variations of **interest** (i.e., concentrated and excited) in toys or in social others (i.e., Patricia).

Between June 19 and 26, 1998 (visits 6 and 9). In the next four visits, Nathan and Patricia expand Nathan's opportunities for emotional connection with his surrounding through the co-creation of different forms of maintaining existing frames as well as the co-creation of new frames. Direct social contact between Nathan and Patricia continues predominates and emerges in its various emotional forms ranging from **content social frames** filled with a serene sense of **contentment** to **playful social frames** filled with intense moments of **joy**. The emotional nature of these social frames appears to remain relatively stable as they recur over time. The following segment of a **social playful frame** illustrates the similar character of this emotion frame across the six visits thus far described.

> *Visit 6, Segment 17. 00:25 Patricia briefly stops kissing Nathan's feet, saying "Uuuuh!', clicking her tongue, rubbing his feet together, looking at him and raising her lip corners. At the same time, Nathan looks at Patricia slightly raising his lip corners. Patricia continues rubbing Nathan's feet against one another, talking to Nathan with a gentle tone of voice, while Nathan continues looking at Patricia with his lip corners slightly raised. 00:26 Nathan vocalizes, waving his arms, keeping his lip corners raised and looking at Patricia. Meanwhile, Patricia continues playing with Nathan's feet, talking to Nathan and raising the intonation of her voice. 00:28 Nathan vocalizes again, waving his arms, looking at Patricia and maintaining his lip corners raised. At this point, Patricia starts making "tsch tsch tsch" sounds as she continues rubbing Nathan's feet against one another.*

While the **social playful frame** described above demonstrates a recognizable emotional dynamic permeated by **joy**, it also begins to include constituents of **excitement** (e.g., arm waving) that have previously emerged as real-time innovations within the **interest to toy frame**.

In the next five visits (i.e., visits 6 through 9), as Patricia and Nathan continue integrating Nathan's **interest** to toy and **joyous** playful connections with Patricia, a new frame is co-created: the **social/object playful frames**. This emotional integration of experiences appears to contribute to Nathan's increasing complex emotional repertoire and is illustrated in the following segment.

> *Visit 6, Segment 18. 06:11 As Nathan briefly contracts his eyebrows together, looking at the toy held by Patricia with his arms resting on his stomach, Patricia begins shaking the rattle, quietly. 06:12:22 Nathan begins raising his lip corners as he continues looking at the toy with his eyes open and his arms resting on his stomach. At the same time, Patricia continues shaking the rattle and begins raising her lip corners with Nathan. 06:13 Patricia abruptly stops shaking the rattle, putting it to the side, making a mock surprise face. 06:14 As Patricia holds the toy to the side with her lip corners raised and her mouth slightly open, she says "What are doing?", briefly touching Nathan's chin. Nathan, at this point, begins to slightly lower his lip corners while looking at Patricia. 06:15 Patricia starts shaking the rattle between their faces again, keeping her lip corners raised and her mouth slightly open. Nathan looks at the toy Patricia shakes, raising his lip corners again.*

At the same time, Nathan's serene sense of **contentment** co-created with his mother begin to merge with his **interest** to toy, as reflected in the self-organization of **content social frames** with object toys (i.e., the **content social/object frame**). The

following segment illustrates how Nathan and Patricia maintain their serene connection toward one another with the aid of a toy.

> *Visit 6, Segment 19. 06:35 Nathan continues looking at Patricia, gradually relaxing his face and body. 06:35:28 Patricia starts rubbing the spinning-rattle against Nathan's stomach, vocalizing. Nathan immediately closes his eyes, keeping his body and face relaxed while Patricia caresses Nathan's body with the toy.*

In addition to these innovations in how Nathan's positive emotions of **joy**, **interest** and **excitement** self-organize into new frames, Patricia and Nathan maintain the initial emotional character of the **interest to toy frames** (i.e., Nathan's **concentrated interest** and **excited interest** in toys held by Patricia). We propose that this increasing variability in how Nathan's emotions are self-organizing in the various frames (with or without toys) he co-created with his mother is indicative that the emotion system might be navigating across a phase shift: a period of developmental re-organization through these real-time changes.

Tuesday, June 30, 1998 (visit 10): From now on. In the next ten visits (visits 10 through 20), another variation of Nathan's **interest** in toys is observed, thereby contributing to the emergence of a new frame. Specifically, Nathan and Patricia develop a new routine characterized by their mutual participation in **social playful frames** in the first three to four minutes of their interaction followed by a gradual settling into **absorbed interest in toy frames**. This form of **absorbed interest** becomes increasingly prevalent and it is mainly characterized by Nathan's quiet and persistent concentration on a toy or his hand through mouthing while he faces back Patricia. As Patricia co-regulates her movements in relation to Nathan's absorbed interest, she quietly watches him, providing postural support or gently touching his back, legs and head. In fact, starting on visit 11, each time Patricia places Nathan in a supine position while he is mouthing a toy, Nathan begins crying, arching his back, kicking his legs and stiffening his body. As Patricia immediately repositions Nathan back in the sitting position, Nathan calms down and resumes his concentrated manipulation of the toy. From now on, this form of **absorbed interest** begins to stand out in Nathan's emotional repertoire as the **interest in toy frame** begins to predominantly emerge as Nathan sits upright, back facing his mother and manipulating a toy, and Patricia quietly watches Nathan, providing postural support. This new emotional dynamics is illustrated in the segment below extracted from visit 19 (July 21, 1998). Nathan, at the time of this visit, is 16 weeks old. Note how he asserts his focused interest in the toy by protesting to his mother's touching of his feet (screaming and kicking his legs):

> *Visit 19, Segment 25. 03:13 As Patricia continues inspecting Nathan's toes, Nathan starts screaming out loud and kicking his legs while holding a toy. 03:16 Patricia stops inspecting his toes and says "Now what?" looking at Nathan with a serious face. At the same time, Nathan stops screaming, turning his body to the side, bringing his feet together and the toy to his mouth. Patricia starts to watch Nathan quietly.*

As visit 20 approaches, Nathan and Patricia appear to have just navigated across a phase shift in Nathan's emotional life as well as a phase shift in their communication, which changed from a primary emphasis on mutually amplifying each other's joy of being engaged in blissful social games to exploring and facilitating Nathan's increasing interest in himself and his toys. Over time, Nathan and Patricia transformed the landscape of their relationship and, in the process of doing so, Nathan's positive emotions self-organized and diversified. We argue that frames constituted relational opportunities for Nathan to develop and further expand his positive emotional repertoire, which in the data presented herein ranged from mutually participating in joyous playful endeavors with his mother to persisting on absorbed forms of interest in manipulating his hands or toys.

CONCLUSION: EMOTIONS AND COMMUNICATION DEVELOP AS A DYNAMIC SYSTEM

Many theoretical approaches to emotions exist, each yielding to diverse methodologies of investigation. Strongly influenced by dynamic systems theory, we emphasized that emotions and communication are processes that flow together in the day-to-day occurrences of relational partners such as Nathan and

Patricia, thereby contributing to the development of emotions. Emotions were viewed and examined as self-organizing experiences in the context of frames. When studied through continuous real-time, microgenetic analyses of frames, we contend that the approach described herein yielded to a fruitful understanding of how emotions developed over time in relational contexts. For those developmental researchers concerned with the study of emotional development, we propose that a commitment to describing in great detail the changes in emotions as a part of the emergence of frames is helpful.

Furthermore, viewing emotions as self-organizing over time requires that emotional development is examined at two time scales: real-time and developmental-time. As illustrated in the microgenetic case study presented above, there was the self-organizing process of emotions that occurred at the level of the moment-by-moment change. Examples were the minute transformations in Nathan's emotions observed second after second as Nathan and Patricia co-created and maintaining frames. At the same time, Nathan's emotional repertoire was becoming expanded and increasingly more complex at the developmental level. Specifically, between visits 6 and 9, an increasing variety of emotions (i.e., contentment, joy, concentrated interest and excited interest, with or without toys) and frames were observed. This period of increasing emotional variability was followed by a new landscape in the way Nathan and Patricia were emotionally oriented to one another, predominantly characterized by Nathan's persistent interest in his hands or toy while Patricia quietly observed Nathan. In dynamic systems terms, periods in which a given system displays "a temporary increase in the variability of behavior" (Lewis, 2004, p. 667) and is thought to be most susceptible to qualitative reorganization of the system is referred to as phase shift (e.g., Fogel et al., 1992; Thelen & Ulrich, 1991). Were the real-time changes in the self-organization of Nathan's emotions through the frames pointing out that Nathan and Patricia were co-creating a phase shift in Nathan's emotional development and in their communication system?

We demonstrated in great detail above that as Nathan's emotions self-organized over real-time, Nathan and Patricia actively participated in the developmental transformation of the relationship and Nathan's emotional repertoire. In other words, Nathan gradually developed distinct emotion patterns through his relational moments co-created with his mother as they navigated across the target developmental transition. It is important to note once again that a relational and self-organizing view of emotions does not mean that individuals cannot feel and perceive their emotions in the flow of communication. Relationships open us up to a multiplicity of ways to experience our emotions, while at the same time fostering our sense of connection with (or disconnection from) others. We are and feel in relation and the self-organization of our emotions are a powerful testimony of that.

REFERENCES CITED

Adamson, L.B. (1995). *Communication development during infancy*. Madison, WI: Brown & Benchmark.

Barrett, K.C. (1993). The development of nonverbal communication of emotion: A functionalist perspective. *Journal of Nonverbal Behavior, 17 (3)*, 145-169.

Barrett, K.C. (1998). A functionalist approach to the development of emotion. In M.F. Mascolo and S. Griffin (Eds.), *What develops in emotional development?* (pp. 109-133). New York: Plenum.

Campos, J.J.; Mumme, D.L.; Kermoian, R. and Campos, R.G. (1994). A functionalist perspective on the nature of emotion. Commentary on The development of emotion regulation: Biological and behavioral considerations. *Monographs of the Society for Research in Child Development 59(2-3),* 284-303.

Camras, L.A. (1991). Conceptualizing early infant affect. In K. Strongman (Ed.), *International review of studies on emotion* (pp. 16-28). New York: Wiley.

Demos, E.V. (1988). Affect and the development of the self: A new frontier. In A. Goldberg (Ed.), *Frontiers in self psychology progress in self psychology, vol. 3* (pp. 27-53). Hillsdale, NJ: The Analytic Press.

de Rivera, J. (1992). Emotional climate: Social structure and emotional dynamics. In K. T. Storngman (Ed.), *International review of studies of emotion, Vol 2*. John Wiley & Sons.

de Weerth, C., van Geert, P., & Hoijtink, H. (1999). Intra-individual variability in infant behavior. *Developmental Psychology, 35,* 1102-1112.

Ekman, P. (1995). Silvan Tomkins and facial expression. In V. Demos (Ed.), *Exploring affect: The selected writings of*

Silvan S. Tomkins (pp. 209-214). New York: Cambridge University Press.

Ekman, P. and Friesen, W. (1975). *Unmasking the face.* Englewood Cliffs, NJ: Prentice-Hall.

_____(1978). *Manual for the facial affect coding system*. Palo Alto, CA: Consulting Psychologist Press.

Fogel, A. (1993). *Developing through relationships.* Chicago: University of Chicago.

_____ (2001). A relational perspective on the development of self and emotion. In H. A. Bosma & E. S. Kunnen (Eds.), *Identity and emotions: Development through self-organization*. New York: Cambridge University Press.

Fogel, A.; Dickson, L.; Hsu, H.; Messinger, D.; Nelson-Goens, C.; & Nwokah, E. (1997). Communicative dynamics of emotion. In K.C. Barrett (Ed.), *The communication of emotion: Current research from diverse perspectives* (pp. 5-24). San Francisco, CA: Jossey-Bass Inc.

Fogel, A., Garvey, A., Hsu, H., & West-Stroming, D. (2006). *Change processes in relationships: A relational-historical research approach*. New York: Cambridge University Press.

Fogel, A., & Lyra, M. (1997). Dynamics of development in relationships. In I. Masterpasqua & P. Perna (Eds.), *The psychological meaning of chaos*. Washington DC: APA Press.

Fogel, A.; Nwokah, E.; Dedo, J.Y.; Messinger, D.; Dickson, K.L.; Matusov, E.; and Holt, S.A. (1992). Social process theory of emotion: A dynamic systems approach. *Social Development,* 1(2), 122-142.

Fogel, A. & Garvey, A. (in press). Alive communication. Manuscript in press to compose the special issue on communication of *Infant Behavior and Development*.

Frijda, N. H. (1986). *The emotions*. Cambridge University Press.

Granic, I. (2000). The self-organization of parent-child relations: Beyond bidirectional models. In M. Lewis & I. Granic (Eds.), *Emotion, Development and Self-Organization: Dynamic Systems Approaches to Emotional Development* (pp. 267-348). New York: Cambridge University Press.

Izard, C. E. (1997). Emotions and facial expressions: A perspective from Differential Emotions Theory. In J.A. Russel and J.M. Fernandez-Dols (Eds.), *The psychology of facial expression* (pp. 57-77). New York: Cambridge University Press.

Lavelli, M., Pantoja, A.P.F., Hsu, H., Messinger, D., & Fogel, A. (2005). Using microgenetic desings to study change processes. In D. M. Teti (Ed.), *Handbook of research methods in developmental science* (pp. 40-65). Baltimore, MD: Blackwell Publishers.

Lazarus, R. S. (1991). Cognition and motivation in emotion. *American Psychologist, 46*, 352-367.

Lewis, M. D. (1995). Cognition-emotion feedback and the self-organization of developmental paths. *Human Development*, *38*, 71-102.

Lewis, M.D. (2004). Trouble ahead: Predicting antisocial trajectories with dynamic systems concepts and methods. *Journal of Abnormal Child Psychology, 32* (6), 665-671.

Lewis, M. D. & Todd, R. M. (2005). Getting emotional: A neural perspective on emotion, intention, and consciousness. *Journal of Consciousness Studies, 12,* 210-235.

Liable, D. & Thompson, R. (2000). Attachment and self-organization. In M. Lewis & I. Granic (Eds.), *Emotion, Development and Self-Organization: Dynamic Systems Approaches to Emotional Development* (pp. 298-323). New York: Cambridge University Press.

Lyra, M.C.D.P. (2000). Desenvolvimento de um sistema de relações historicamente construído: Contribuições da comunicação no início da vida. *Reflexão e Crítica.*

Lyra, M.C.D.P and Rossetti-Ferreira, M.C. (1995). Transformation and construction in social interaction: A new perspective of analysis of the mother-infant dyad. In J. Valsiner (Ed.), *Child development within culturally structured environment: Comparative-cultural and constructivist perspectives* (pp. 51-77). Hillsdale, NJ: LEA.

Messinger, D. S., Fogel, A., and Dickson, K. L. (1997). A dynamic systems approach to infant facial action. In J. A. Russell and J. M. Fernandez-Dols (Eds.), *The psychology of facial expression* (pp. 205-226). New York: Cambridge University Press.

_____ (1999). What's in a smile? *Developmental Psychology*, 35 (3), 701-708.

Pantoja, A.P.F. (2000). *Emotional life development from a relational-historical approach: The story of one mother-infant dyad.* Unpublished doctoral dissertation, University of Utah, Salt Lake City, Utah.

_____ (1997). *Relational-historical change processes in early mother-infant communication: A qualitative investigation.* Unpublished master's thesis, University of Utah, Salt Lake City, Utah.

_____ (2001). A narrative-developmental approach to early emotions. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research* [On-line Journal], 2(3). Available at: http://www.qualitative-research.net/fqs-texte/3-01/3-01pantoja-e.htm.

Pantoja, A.P.F., Nelson-Goens, G.C. & Fogel, A. (2001). A dynamical systems approach to the study of early emotional development in the context of mother-infant com-

munication. In A.F. Kalverboer & A. Gramsbergen (Eds), *Handbook of Brain and Behaviour in Human Development* (pp. 901-920). Norwell, MA: Kluwer Academic Publishers.

Prigogine, I.; and Stengers, I. (1984). *Order out of chaos: Man's new dialogue with nature*. New York: Bantam Books.

Schore, A. (2001). Effects of a secure attachment on right brain development, affect regulation, and infant mental health. *Infant Mental Health Journal, 22*, (1-2), 7-66.

Stern, D. (1990). *Diary of a baby*. New York: Basic Books, Inc.

Tomkins, S.S. and McCarter, R. (1995). What and where are the primary affects? Some evidence for a theory. In V. Demos (Ed.), *Exploring affect: The selected writings of Silvan S. Tomkins* (pp. 217-262). New York: Cambridge University Press.

Thelen, E.; and Ulrich, B.D. (1991). Hidden skills: A dynamic systems analysis of treadmill stepping during the first year. *Monographs of the Society for Research in Child Development*, 56 (1).

Van Geert, P. (2003). Dynamic systems approaches and modeling of developmental processes. In J. Valsiner & K.J. Connolly (Eds.), *Handbook of Developmental Psychology* (pp. 640-672). Thousand Oaks, CA: Sage Publications.

Weinberg, M.K. and Tronick, E.Z. (1994). Beyond the face: An empirical study of infant affective configurations of facial, vocal, gestural, and regulatory behaviors. *Child Development*, 65, 1503-1515.

Wolff, P.H. (1987). *The Development of Behavioral States and the Expression of Emotions in Early Infancy: New proposals for investigation*. Chicago: The University of Chicago Press.