



A dynamic system analysis of dyadic flexibility and stability across the Face-to-Face Still-Face procedure: Application of the State Space Grid



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ARTICLE INFO

Article history:

Received 14 March 2014

Received in revised form 1 August 2014

Accepted 28 October 2014

Keywords:

Dynamic systems

Mother–infant interaction

Social stress

State Space Grid

Still-Face paradigm

ABSTRACT

The Face-to-Face Still-Face (FFSF) paradigm allows to study the mother–infant dyad as a dynamic system coping with social stress perturbations. The State Space Grid (SSG) method is thought to depict both flexibility and stability of the dyad across perturbations, but previous SSG evidence for the FFSF is limited. The main aims were: (1) to investigate mother–infant dyadic flexibility and stability across the FFSF using the SSG; (2) to evaluate the influence of dyadic functioning during Play on infant Still-Face response and of infant stress response in affecting dyadic functioning during Reunion. Forty 4-month-old infants and their mothers were micro-analytically coded during a FFSF and eight SSG dyadic states were obtained. Dyadic flexibility and attractor states were assessed during Play and Reunion. Infants' stress response was coded as negative engagement during the Still-Face episode. Two dyadic states, “maternal hetero-regulation” and “affective mismatch”, showed significant changes in the number of visits from Play to Reunion. During Play “maternal positive support to infant play” emerged as attractor state, whereas during Reunion a second attractor emerged, namely “affective mismatch”. Dyadic affective mismatch during Play correlated with infants' negative engagement during Still-Face, whereas infants' response to Still-Face resulted in minor social matching during Reunion. Findings provide new insights into the flexible, yet stable, functioning of the mother–infant dyad as a dynamic system. Evidence of a reciprocal influence between dyadic functioning and infant social stress response are discussed.

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1. Introduction

According to the dynamic systems (DS) theory (Smith & Thelen, 2003), the mother–infant dyad is viewed as an open, non-linear dynamical system (Beebe, Jaffe, & Lachmann, 1992; Lewis, Lamey, & Douglas, 1999). Mothers and infants are believed to mutually and jointly contribute to the moment-by-moment ongoing dynamics of their interaction (Beebe & Lachmann, 2003; Fonagy, Gergely, & Target, 2007; Hsu & Fogel, 2003; Tronick & Beeghly, 2011). From this perspective, the

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mother–infant dyad is characterized by two inherent dynamic properties such as: dyadic flexibility and stability across contextual perturbations (Hollenstein, 2007; Smith & Thelen, 2003).

1.1. Dyadic flexibility and stability in mother–infant dyad

Dyadic flexibility is usually meant to depict the openness of the mother–infant dyad and the moment-by-moment regulation of the response to environmental perturbations, including social stress (Chow, Haltigan, & Messinger, 2010; Van Egeren, Barratt, & Roach, 2001). Thus, the interactive couple continuously keeps shifting from a dyadic state to another in order to adapt to environmental changes and challenges (Hollenstein, Granic, Stoolmiller, & Snyder, 2004). Within a DS conceptual frame, flexibility is usually operationalized as the difference in the number of “visits” to a given state from before to after an environmental perturbation (Hollenstein, 2007; Lunkenheimer, Hollenstein, Wang, & Shields, 2012). On the other hand, stability means that, despite being open and flexible, the system dynamics tend to crystalize in attractor states (Guastello, Koopmans, & Pincus, 2009; Thelen & Smith, 1998). An attractor state reflects the common behavioral patterns that recur in dyadic systems and it is generally defined as the system tendency to get stuck and absorbed in a given dyadic state (Guastello et al., 2009; Lunkenheimer & Dishion, 2009). Operationally, the mean visit duration relative to a given state is meant to be a reliable measure of an attractor state (Lewis et al., 1999). Therefore, while on one hand dynamic flexibility confers openness and adaptability in relation to environmental perturbations, on the other hand attractor states convey the stability which is needed for self-organizing and structuring processes (Cerezo, Trenado, & Pons-Salvador, 2012; Hollenstein, 2007).

1.2. Stressful perturbations in mother–infant dyads

It has been suggested that environmental perturbations are an appropriate methodological strategy to study the ongoing flexibility and stability of dynamic systems (Hollenstein et al., 2004). For what pertains early infancy, the experimental manipulation of maternal unavailability to interact is a well-known source of social stress for infants (Adamson & Frick, 2003). The Face-to-Face Still-Face (FFSF; Tronick, Als, Adamson, Wise, & Brazelton, 1978) paradigm involves an experimentally induced short period of maternal unavailability and has received adequate validation as a reliable method to elicit social stress in young infants (Mesman, van Ijzendoorn, & Bakermans-Kranenburg, 2009). When facing such stressful inducing experimental condition, the mother–infant dyad needs to disorganize and reorganize to reach better adaptation (Fogel, Hsu, Shapiro, Nelson-Goens, & Secrist, 2006; Sravish, Tronick, Hollenstein, & Beeghly, 2013). The FFSF generally comprises three two-minute lasting episodes. During the Play episode mothers are asked to engage with their infant as they usually do. During the Still-Face episode mothers are instructed to stop interacting with the infant, avoiding any verbal, gestural and touch communication. The maternal Still-Face elicits a typical social stress response in infants, with a dramatic increase of negative emotionality (Tronick et al., 1978). During the Reunion episode, mothers are asked to re-engage as they did during the Play. Previous FFSF studies aimed at depicting mother–infant dyadic functioning usually adopted dyadic measures of mother–infant interaction such as matching and synchrony (Cohn & Tronick, 1988; Crandell, Patrick, & Olson, 2003; Montiroso, Borgatti, Trojan, Zanini, & Tronick, 2010). Nonetheless, both measures have limitations, when confronting with DS theory principles (Sravish et al., 2013). In particular, measures of matching, defined as the proportion of time during which both interactive partners display a similar behavioral and/or affective state (Tronick & Cohn, 1989), have been found to be static, more similar to a photograph than to the movie-like ongoing dynamic of dyadic system functioning (Sravish et al., 2013). On the other hand, synchrony evaluates the level of dyadic coordination as a correlation between mother and infant behavior or affect over time, and is typically reported as a proportion of variance. Notwithstanding, synchrony is an overall measure that does not allow the researcher to identify the specific behaviors that contribute to the dyadic functioning (Sravish et al., 2013).

1.3. The State Space Grid

The State Space Grid (SSG; Hollenstein, 2013) is a recent method to study mother–infant dyad that appears more consistent with the DS theoretical frame (Lewis et al., 1999). The SSG is thought to account for dyadic behavioral patterns that emerge from the real-time intersection of both mothers' and infants' behavior. As a consequence, this approach helps in depict both dynamic flexibility and stability of dyadic system (Cerezo et al., 2012). The SSG graphically represents the behavior of both interactive partners on two separate orthogonal axis, defining a grid that is considered as the space of all possible dyadic states (Hollenstein, 2007). Several quantitative observational data could be obtained from the grid, assuming the dyad as the primary unit of analysis. The possibility to look at the dyad as the primary unit allows overtaking limitations of the matching measure. At the same time, looking at the intersection between specific behaviors of both the mother and the infant allows to depict the specific behaviors making up synchronous and non-synchronous dyadic state, overcoming limits of the traditional synchrony measure. The SSG has been usefully adopted in relation to children emotional and relational development (Cerezo et al., 2012; Dishion, Nelson, Winter, & Bullock, 2004; Granic & Lamey, 2002; Martin, Fabes, Hanish, & Hollenstein, 2005), but previous SSG works on early infancy are still limited. Recently, Sravish et al. (2013) used the SSG method to study dyadic functioning across the FFSF paradigm. Authors adopted a Shannon's entropy-derived unpredictability measure of dyadic flexibility as an index of dyadic unpredictability, documenting that mother–infant dyads increased their flexibility from Play to Reunion. Although this finding underlines an intrinsic regulatory function of the mother–infant

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