Research Interests
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Overview

I am engaged in a comprehensive program of research on early social communication and development. My research uses objective—automated—approaches to behavioral measurement and, increasingly, genetic information, to better understand emotional expression and social interaction. My theoretical orientation is dynamic systems theory (Messinger & Fogel, 2007; Messinger et al., 1997). That is, I am interested in identifying the emergence of basic competencies in ongoing interactions that enable later developmental achievements. This work is conducted from a developmental psychopathology perspective. I ask how typical developmental processes are disrupted in the emergence of autism and other forms of psychopathology, and address what these disruptions reveal about typical development.

My work has been well-supported with multiple grants from the National Institutes of Health, the National Science Foundation, and Autism Speaks. For example, I am currently funded by the NIH to model the role of common genetic variants in the development of emotional interaction, and funded by the NSF to investigate the development of infant attention. I am the director of the Miami Marino Autism Research Institute, which administers seed grants to junior investigators, and a past member of the Executive Committee of the NIH/Autism Speaks Baby Sibs Research Consortium, which coordinates studies of infants at risk for autism. I am an Associate Editor of *Developmental Science*, a past Associate Editor of *Emotion*, a member of the editorial board of *Infancy*, and am a frequent reviewer for the NIH, the NSF, and Autism Speaks.

I am committed to the active dissemination of behavioral data, new measurement tools, and research findings (see http://measurement.psy.miami.edu). My research findings are communicated in 89 publications, 69 of which are peer-reviewed articles in journals such as *PLoS ONE, Current Directions in Psychological Science, Developmental Psychology, Pediatrics,* and the *Journal of the American Academy of Child and Adolescent Psychiatry*. The findings have also been featured in the popular press in books, magazines, television, and the internet. My research has three interconnecting strands: 1) emotional development, 2) infant-adult interaction, and 3) developmental risk factors such as a family history of autism.

1. Emotional Development

To understand early emotional development, one of my graduate students and I investigated how infant expressive behaviors were coordinated in time using a novel bootstrapping procedure (Yale et al., 2003; Yale et al., 1999). This research indicated that infants develop an ability to regulate their own emotions (including positive emotions) by looking away from parents in the midst of facial expressions. That is, attention to the timing of individual behaviors evidenced broad developmental shifts in emotion regulation. At a more general level, the work yielded evidence for the communicative centrality of facial expressions, which provided an empirical basis for my research on the emotional meaning and development of these expressions.

How does joy develop? My colleagues and I discovered surprisingly mature smiling among sleeping neonates (Dondi et al., 2006; Messinger et al., 2002; Messinger et al., 1999). Tracing the subsequent social development of specific forms of smiling during face-to-face interaction suggested qualitative differences between different types of smiling (Messinger et al., 2001). Rating studies, however, suggested that different types of smiling (e.g., the Duchenne smile involving eye constriction) communicated a continuum of positive emotion (Bolzani-Dinehart et al., 2005; Messinger et al., 2008). These conflicting results made it unclear whether different forms of infant smiling were qualitatively distinct, or whether they varied along a continuum of affective intensity (Messinger & Fogel, 2007). Faced with this conceptual impasse, I developed and adopted novel approaches—e.g., automated measurement—that offered new insight into infant emotion and communication.

My team conducted the first automated measurements of the intensity of anatomically-based facial expression in dyadic interaction (Messinger et al., 2009). These automated measurements, in which the software 'sees' the face, predicted continuous ratings of affective valence that were made by non-experts using a novel joystick interface. This approach indicated the presence of a single dimension of positive emotional expression that was simultaneously indexed by the intensity of smiling and the intensity of eye constriction. In other words, objective measurement results challenged adult-oriented theories which dichotomize smiles as emotional or non-emotional (Duchenne smiles versus non-Duchenne smiles). Instead, my research suggested a continuum of positive emotional intensity in infants (and mothers) that incorporates Duchenne smiling at its high end.

I am utilizing these objective (automated) measurements to better understand how emotion develops. A prevailing view holds that different facial expressions are discrete sui generis entities expressing different emotions (Messinger & Fogel, 2007; Messinger et al., 1997). My research challenges this view by investigating commonalities between different emotional expressions. In this vein, I found that when smiles occur in situations more likely to elicit positive affect, they were more likely to involve eye constriction, and were perceived as more emotionally positive. When cry-faces occur in more negative situations, they too are more likely to involve eye constriction, and to be perceived as more emotionally negative (Mattson et al., 2013 [attached]; Messinger et al., 2012 [attached]). This parallel suggests a common rule—eye constriction indexes intensity—that unites early positive and negative emotional expressions (Messinger, 2002). The parallel suggests an evolutionarily parsimonious account of infant emotion expression—add eye constriction to intensify emotional valence—which informs my research on the development of interaction.

2. Infant-Adult Interaction

I employ naturalistic face-to-face interactions and procedures such as the still-face to understand the early development of communication in typical and high-risk samples. In the still-face procedure, for example, when the parent briefly stops responding to the six-month-old infant, infant engagement with the parent (e.g., gazing at the parent and smiling) declines over time. This dynamic still-face effect had been hypothesized for 30 years, but never documented. Moreover, the slope of the declines for six-month-olds was associated with later (15 month) attachment security in a theoretically meaningful fashion. Infants later classified as avoidant in the strange situation, for example, showed the steepest disengagement declines in the still-face procedure and curtailed engagement with the parent prematurely in the strange situation (Ekas et al., 2013). The research exemplifies conceptual associations between early individual differences in dynamically changing patterns of behavior and later social-emotional outcome.

My research on infant-parent interaction aims to uncover the structure of early social interaction and understand its development. For example, we were the first group to document a developmental increase in smile-based turn-taking, a basic social competency, during infant-parent interaction (Messinger, Ruvolo, et al., 2010). Likewise, our analyses of automated measurements of infant and parent facial expression revealed second-by-second changes in dyadic synchrony (Messinger et al., 2009), which led us to statistically document robust changes in infant-parent emotional influence *within* the course of interaction (Chow et al., 2010). More recently, we harnessed a mathematically rigorous inverse optimal control framework to infer infant goals during interaction. Infants timed their smiling so as to increase their net exposure to mother smiling while minimizing their own smiling, a result we validated by porting the infant strategy to a humanoid robot that engaged in smiling interactions with experimental participants (Ruvolo et al., 2015 [attached]). In sum, innovative approaches to modeling provided clues as to *how* and *why* interaction occurs, revealing patterns that may be central to the prediction of infant outcome.

By six months of age, infants exhibit stable patterns of attention to social and nonsocial foci during face-to-face interaction (Messinger et al., 2011 [attached]). Beginning at about eight months, infants begin to offer toys to their parents while smiling as if to share their experience of the object (Messinger & Fogel, 1998). My students and I identified joint attention sequences in which infants smile at an interesting toy and then gaze at an adult examiner while smiling, as if sharing the positive emotion. These "anticipatory smiles" emerge between 8 and 10 months, and suggest that the infant is aware of the relationship between the examiner and toy (Venezia et al., 2004). Early smiling in interaction with the parent is associated with later levels of anticipatory smiling with the examiner. Positive affect, then, appears to motivate the infant's referential communication both in real time and in developmental time. In fact, early anticipatory smiling indexes a pro-social orientation manifested in social competence at two and a half years of age (Parlade et al., 2009). Attention to timing in this research revealed early indices of intentional communication that may shed light on both typical development and developmental disorders.

3. Developmental Risk Factors

My research in communicative development is enriched by consideration of the variability in development associated with risk factors such as low birth weight, prenatal cocaine exposure, and a family history of autism. Findings in a low birth weight sample, for example, suggested the importance of social and emotional functioning to mental and psychomotor developmental outcome in high risk infants (Messinger, Lambert, et al., 2010). With respect to prenatal substance exposure, my colleagues and I found that the *mothers* of cocaine-exposed infants tended to be less engaged with their one-month-olds during feeding interactions and less engaged with their four-month-old infants during the still-face procedure (LaGasse et al., 2003; Tronick et al., 2005). However, *infant* social and emotional differences associated with cocaine exposure were not evident at 4 or 18 months of age (Brunner et al., 2005). Overall, we found that indices of caregiving quality associated with poverty, but not prenatal cocaine exposure, were associated with mental, motor, and behavioral functioning (Messinger et al., 2004). These results speak to the pervasive influence of socioeconomic status on development, and the potential for resilience among prenatally exposed infants.

The infant siblings of children with autism spectrum disorders (ASD) exhibit a broad range of developmental outcomes. My colleagues and I found that almost one-fifth of these high-risk siblings will themselves develop an ASD (Messinger et al., 2015) and that even high-risk siblings *without* an ASD show slight increases in symptomatology and subtle deficits in developmental functioning (Messinger et al., 2013). I view autism-related symptoms as manifestations of a continuum of impairment that is impacted by species-typical developmental processes. My colleagues and I recently found, for example, that what are thought of as autism-specific sex differences—for example, a propensity for males to engage in more repetitive behaviors—are not specific to autism but a characteristic of sex-related differences found in typically developing children as well (Messinger et al., 2015 [attached]).

Disruptions of early emotion and communication in high-risk siblings may be related to later autism symptomatology. I found that infant siblings of children with ASD exhibit lower levels of emotional fluctuation during and after the still-face (Chow et al., 2010) while those infant siblings who will themselves be diagnosed with an ASD do not show the normative decline in smiling after the still-face (Lambert-Brown et al., 2015). Later in development, we found that high-risk siblings exhibit brief, high-pitched cries when separated from the parent (Esposito et al., 2014), but are just as likely as comparison children to form secure attachments to their parents (Haltigan et al., 2010). Finally, higher levels of empathic responding at two years—a potential protective factor—predicted lower levels of autism symptomatology at outcome among the high-risk siblings of children with autism (McDonald & Messinger, 2012). The results suggest that high-risk infants as a group show subtle differences in emotional functioning from early in development.

My current work indicates that difficulties in flexibly shifting attention characterize a potential endophenotype among infant siblings of children with ASD that impacts later functioning. In initial work, infant siblings exhibited subtle difficulties shifting gaze between social and nonsocial foci in early interaction (Ibañez et al., 2008), and later difficulties requesting objects from an examiner and initiating joint attention (Cassel et al., 2007). As early as 8 months, initiating joint attention predicts 30-month levels of ASD symptoms (and ASD diagnosis) suggesting that difficulty shifting between social and nonsocial foci of attention is a pathway to communicative and social deficits for these high-risk infants (Gangi et al., 2014; Ibañez et al., 2012). This detection of early symptom predictors highlights the need to identify factors that can beneficially shift these developmental trajectories.

My developmental and intervention research is guided by constructivist models which suggest that environmental factors can ameliorate disability in the development of children affected by ASD. Among children who were later diagnosed with ASD, for example, parents' sensitivity during free-play with their 15-month-olds was associated with increases in expressive language between two and three years of age (Baker et al., 2010). My colleagues and I followed up these observations with an intervention study to assess the effects of promoting parental sensitive structuring for young children with ASD symptoms. This randomized control trial of a parent-implemented ASD intervention yielded moderated effects in which the intervention positively impacted joint attention development among low-functioning children (Carter et al., 2011). In sum, my research, which spans basic studies of socio-emotional functioning and translational implementations of intervention research, is united by an emphasis on associations between interactive process and developmental outcome.

Future Directions

Immediate future work involves leveraging temporal dynamics to understand behavior in both experimental protocols and more ecologically valid settings. Recently, for example, we found that patterns of attention to mother's face during interaction stimuli—the duration of one look predicts the duration of the next—also predict discrimination, the recovery of attention to a novel test stimulus in habituation paradigms. In more naturalistic settings, I am harnessing objective measurements of children's movement to model the social dynamics of kindergarten students. The overall aim of this research is to harness what I term "big behavioral data" to uncover rule-governed patterns in interaction and development.

My overall aim is to rigorously explore the legacy of early interaction by combining objective measurement of behavior, predictive modeling, and integration of genetic factors influencing development, with attention to the neural underpinnings of behavior. My current NIH award, for example, investigates associations between genetic indices of dopaminergic and serotonergic functioning and automated measurements of interactive behavior in high-risk infant siblings. Recent results suggest differential influence of common dopaminergic variants on attention-related behaviors in infants at risk for autism. Potential neural correlates to such behaviors involved probing resting state connectivity, which we are contrasting in young children with and without autism. In these endeavors, the integration of neural and genetic strands of research with systematic investigations of communicative process will be used to provide a more complete understanding of how social development occurs, how it is disrupted, and how these disruptions can be rectified.