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# Stabilities of infant behaviours and maternal responses to them

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Abstract

Consistency in the order of individuals in a group across substantial lengths of time—*stability*—is a central concept in developmental science for several reasons. Stability underscores the meaningfulness of individual differences in psychological phenomena; stability informs about the origins, nature, and overall developmental course of psycho- logical phenomena; stability signals individual status and so affects the environment, experience, and development; stability has both theoretical and clinical implications for individual functioning; and stability helps to establish that a measure constitutes a consequential individual-differences metric. In this three-wave prospective longitudinal study (*N*s = 40 infants and mothers), we examined stabilities of individual variation in multiple infant behaviors and maternal responses to them across infant ages 10, 14, and 21 months. Medium to large effect size stabilities in infant behaviors and maternal responses emerged, but both betray substantial amounts of unshared variance. Documenting the ontogenetic trajectories of infant behaviors and maternal responses helps to elucidate the nature and structure of early human development.

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# Introduction

A central and recurring issue in developmental science is *stability*, that is individual-order consistency through time (see Baltes & Nesselroade, 1979; Bornstein, Putnick, & Esposito, 2017; Cairns, 1979; Hartman, Abbott, & Pelzel, 2015; McCall, 1981; Wohlwill, 1973). Operationally, a stable characteristic is one that some individuals display at relatively high levels at one point in time and again display at relatively high levels at later points in time, where other individuals display consistently lower levels at all times; an unstable characteristic is one where individuals do not maintain relative order in their group through time. This 3-wave prospective longitudinal study is concerned with stability and instability in infant behaviors and maternal responses to them across the first-to-second years of life. This study attempts to address several gaps and shortcomings in the extant infancy literature by including several infant behaviors and maternal responses in a single omnibus design; assessing stability across 3 developmental waves; evaluating stabilities in infants and mothers jointly; controlling one for the other as well as sociodemographic characteristics; and attending to shared and unshared variance interpretations of stability.

## 1.1. Meaningfulness and characteristics of developmental stability

The study of stability of psychological characteristics (constructs, structures, functions, or processes) in individuals through time is important and relevant to developmental science for several reasons. First, many systems in humans require certain consistencies—physical, chemical, psychological, and environmental homeostasis—to survive (Cannon, 1932). Stable systems allow for the maintenance of consistencies even in the face of changing circumstances; living organisms generally exist in, and strive to maintain, states of “adaptive” consistency. Stability also provides basic information about overall ontogenesis. Describing a characteristic as stable or not is developmentally informative, with a major predictor of a characteristic at a given age being that characteristic at an earlier age (Sternberg, Grigorenko, & Bundy, 2001). Stability thereby provides insights into a practical understanding of individuals when younger and older. From the perspective of evocative interactions, stable characteristics in individuals at one time can be expected to differentially shape responses from the environment that

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contribute to later outcomes in those individuals (Lerner, 2018). Stability is also a cornerstone of developmental theorizing. Theoretical views that hold that child development and child-rearing are invariant are appealing because they provide parsimonious models (Holden & Miller, 1999). For example, stability is a tenet of attachment theory, which claims consistency in neurobiological systems that underpin, and relational behaviors that express, affiliative bonds (Bowlby, 1973; Sroufe, Egeland, Carlson, & Collins, 2005; Stern et al., 2018). As Maccoby (1984, p. 326) observed, "the family system, like any system, has self-stabilizing properties ... families tend to stabilize around habitual patterns of interaction; thus, there is continuity over time in ... familial forces ...". Persistent child-rearing practices are credited with influencing the course of child development (Bornstein, 2015; Collins, Maccoby, Steinberg, Hetherington, & Bornstein, 2000). Stability has additional value clinically. To evaluate concurrent characteristics or predict future characteristics accurately, for indicators to merit incorporation into diagnostic batteries, performance at a given time needs to be stable in the individual (DeVellis, 2016). Finally, stability has multiple implications for measurement. To be psychometrically meaningful, a characteristic should be stable (at least across short time spans), and stability is a gateway to prediction because stability of a characteristic sets a statistical limit on that characteristic's predictive validity (Hartmann, Abbott, & Pelzel, 2015). In brief, stability has many central applications and implications in developmental science.

The most common model of stability describes *homotypic* stability, the maintenance of order among individuals on the same characteristic through time. That said, even homotypic stabilities can be expected to vary, and variation in stability can reflect many factors, including the characteristic (some characteristics are more stable than others); the age(s) of individuals when stability of the characteristic is assessed (a characteristic may not be stable at one age in the life course, but stabilize at other ages, and people are thought to become increasingly stable in relation to one another as they age); the temporal interval between assessments of the characteristic (the shorter the inter-assessment interval normally the greater the stability estimate of the characteristic); whether assessments are made across consistent or inconsistent contexts (the former enhance stability, and the latter attenuate stability); and the source or reporter (observed vs. reported characteristics are differentially stable).

More specifically, the developmental literature is unsettled with respect to the stability of infant behaviors and maternal responses to them for three principal reasons. The first reason is empirical. One the one hand, infancy is normally a period of developmental flux associated with relatively rapid growth and change in motor, exploratory, cognitive, and communicative skills as well as socioemotional expressiveness (Bornstein, Arterberry, & Lamb, 2014), so one might not expect much stability in different infant behaviors or in parenting rapidly developing infants. On the other hand, the empirical literature (reviewed below) gives evidence of some stability in infant behaviors and maternal responses to them. The second reason for the unresolved nature of the extant developmental literature is statistical. Stability is (typically) indexed by correlation ($r$), but correlation requires a second look and careful interpretation. For estimates of population correlation effect sizes, Cohen’s (1988, pp. 79–80) widely accepted rule of thumb is to interpret $r$ = .10 as a small effect size, $r$ = .30 as a medium effect size, $r$ = .50 as a large effect size, and $r$ = .70 as a very large effect size (see also Landis & Koch, 1977; Weir, 2005). However, a “large effect” of .50 means that only 25% of common variance is actually *shared* between two measurements of the same characteristic, and 75% of variance is *unshared*. The third reason is that the infancy literature especially is undermined by typically small-sample studies lacking adequate power to detect “significant” stabilities. For example, a “large” Kendall's $W$ rank stability correlation of .53 for infant-initiated directed social behaviors in Green, Gustafson, and West (1980 reviewed below) was nonsignificant, due to its $N$ = 14.

**1.2 Stability and instability in infants and mothers**

In the current study, we investigated stabilities of age-appropriate behaviors that are principal gauges of cognitive, communicative, and social functioning in typically developing infants. We also examined stabilities of mothers’ responses to those behaviors in infants. We did so at three times: 10, 14, and 21 months. Therefore, we limit this review to studies like this one of longer-term stability across the first-to-second years of life, to reports about term infants, and to the behaviors we observed.

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#### *1.2.1 Stability of Infant Behaviors*

We measured stabilities of four infant behaviors: exploration, play, bids to mother, and vocalizations. Many studies have examined features of these four behaviors (their character, their development, their manifestation in different infants), and several studies have examined stability of other infant behaviors in this age range (notably, temperament and language); by contrast, few studies have explored stability of the four specific and fundamental behaviors examined here. Indeed, to glean any stability data on these behaviors from the extant literature requires broadening construals of each somewhat.

**Exploration.** Infants learn about the features and properties of objects in their environment and what they can do with those objects through exploration: visually examining, manually rotating, fingering, and banging, and mouthing (Bornstein, Hahn, Putnick, & Suwalsky, 2014; Tamis-LeMonda & Lockman, 2020). Infant exploratory behaviors offer a window onto cognitive and motor development: Infants display what they know about objects when they manipulate them, learn to distinguish boundaries among objects, and adapt their fine motor skills to specific object features (Bushnell & Boudreau, 1993, 1998; Lederman & Klatzky, 1987; Mash, Bornstein, & Banerjee, 2014; Needham, 2000). Infant exploratory behaviors lead to later enhanced exploration and attention (Libertus, Joh, & Needham, 2016). With respect to past research on the stability of infant exploration, we found no studies of the stability of motor exploration, but a few of visual exploration across the first 3 years in sample sizes of 30–256 resulting in medium effect size stabilities, *r*s = .27 to .53 (Carnicero, Pérez-López, Salinas, & Martínez-Fuentes, 2000; Colombo, Mitchell, O'Brien, & Horowitz, 1986; Gaertner, Spinrad, & Eisenberg, 2008; Lawson & Ruff, 2004; McCall, 1979; Rose & Feldman, 1987).

**Play.** From the first to the second year of life, infants begin to engage with objects in functional ways—that is, in the ways that objects were designed—for example, by pressing buttons on toy phones and inserting shapes into shape sorters (non-symbolic play). With age, infants increasingly engage in symbolic play, as they use objects in pretend scenarios, such as feeding a teddy bear and putting the bear to sleep. Non-symbolic play and symbolic play provide a valuable lens onto children's cognitive development, by revealing what children know about the functions of objects and their skills at mentally representing past experiences (Bornstein, 2007; Tamis-LeMonda, Kuchirko, Escobar, & Bornstein, 2019). Evidence connects children's play with later verbal and cognitive skills (Orr & Geva, 2015; Rakoczy, 2006). With respect to past research on the stability of infant spontaneous, elicited, rela- tional, and pretend play across the first 3 years, we found sample sizes of 19–202 resulting in small to large effect size stabilities, *r*s = .01 to .76 (Bornstein, Vibbert, Tal, & O'Donnell, 1992; Else-Quest, Clark, & Tresch Owen, 2011; Gaertner et al., 2008; Power, Chapieski, & McGrath, 1985).

**Bids to mother.** As they approach their first birthdays, children turn outward from the dyad, and more and more initiate interactions with important others. Children do this in myriad ways, by pointing, by handing, by approaching, and by maintaining proximity with mother. All importantly, children's bids for attention, recognition, and language involve significant others in dialogue and interaction. With respect to past research on the stability of infants' bids to their mother across the first 3 years, we found sample sizes of 14–220 resulting in small to large effect size stabilities, *r*s = −.15 to .69 (Bornstein et al., 2010; Coates, Anderson, & Hartup, 1972; Green et al., 1980; Stayton & Ainsworth, 1973; Waters, 1978).

**Vocalization.** Infants' vocalizations are important for establishing connections with others as well as in language development per se. Infants' vocalizations attract speech and language from others and provide sounds that infants themselves hear and so help to shape infants' own future language. In the language do- main, many studies have documented relations between infants' vocalizations and their later language and cognitive development (Putnick, Bornstein, Eryigit-Madzwamuse, & Wolke, 2017). Indeed, verbal development and language development are relatively stable across the first 15 years of life and that stability is robust across gender, birth order, term status, SES, and language (Bornstein, Hahn, & Putnick, 2016; Bornstein, Hahn, Putnick, & Pearson, 2018; Bornstein, Hahn, et al., 2014; Bornstein & Putnick, 2012; Bornstein, Putnick, & De Houwer, 2006; Longobardi, Spataro, Putnick, & Bornstein, 2016, 2017). With respect to past research on the stability of infants' vocalization (considered in the current study are positive vocalizations only, close to, but not the same as, language formally) across the first 3 years, we found sample sizes of 22–77 resulting in medium to large effect size stabilities, *r*s = .25

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to .71 (Carnicero et al., 2000; Clarke-Stewart & Hevey, 1981; Coates et al., 1972; Rome- Flanders & Cronk, 1995; Waters, 1978).

### *1.2.2 Stability in maternal responses*

Many individual maternal parenting practices reportedly show temporal stability (Bornstein, Gini, et al., 2006; Dallaire & Weinraub, 2005; Haltigan, Roisman, & Fraley, 2013; Maas, Vreeswijk, & van Bakel, 2013; McNally, Eisenberg, & Harris, 1991; Roberts, Block, & Block, 1984; Stern et al., 2018). In the current study, we examined stability of maternal responsiveness, mothers' prompt, con- tingent, appropriate reactions to their children (Ainsworth, Bell, & Stayton, 1974; Bornstein 1989; Bornstein, Tamis-LeMonda, et al., 1992; De Wolff & van IJzendoorn, 1997; Landry, Smith, Swank, Assel, & Vellet, 2001; Tamis-LeMonda & Bornstein, 2002; Tamis-LeMonda, Kuchirko, & Song, 2014). Maternal responsiveness reflects the keystone parent component of the recurring and significant three-term mutual event sequence in everyday exchanges between infant and parent that involve infant act, parent reaction, and effect in infant. Responsiveness is a common characteristic of parenting around the world (e.g., Bornstein, Tamis-LeMonda, et al., 1992; Paavola, Kunnari, Moilanen, & Lehtihalmes, 2005; van IJzendoorn, Bakermans-Kranenburg, & Sagi-Schwartz, 2006), and parental responsiveness generalizes across contexts (e.g., from laboratory to home; Crockenberg & Litman, 1990; Rothbaum & Crockenberg, 1995). Parenting that is responsive to infants also fosters a variety of highly valued developmental outcomes, including emotional security, behavioural independence, social facility, symbolic competence, verbal ability, and intellectual achievement (see, e.g., Ainsworth et al., 1974; Bornstein, 1989a; Bradley, 1989; Feldman & Greenbaum, 1997; Landry, Smith, Miller- Loncar, & Swank, 1997; Mahoney, Boyce, Fewell, Spiker, & Wheeden, 1998; Paavola et al., 2005; Pomerleau, Scuccimarri, & Malcuit, 2003; van IJzendoorn, Dijkstra, & Bus, 1995).

As responsiveness occupies pride of place in the pantheon of parenting practices, several researchers have examined its psychometric characteristics, including stability. In 1999, Holden and Miller published a meta-analysis of stability correlations of a wide variety of maternal parenting constructs. Responsiveness (which subsumed behavioural variables of sensitivity and responsivity) was

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one construct investigated. Across 17 studies with *N* = 1,281 mothers, the stability correlation reported was a medium effect size of .38. However, Holden and Miller's accounting did not uniformly take into con- sideration that responsiveness is fundamentally tied to child behaviour (as we do in the current study), and so the meta-analysis consumer has no idea when their accounting takes child behaviour base rates into consideration. Additionally, like infant behaviors noted above, responsiveness requires some liberality of definition. Responsiveness is typically conflated in the literature with (at least) sensitivity, sensitive responsiveness, and contingent responsivity. Parenting researchers since Holden and Miller have continued to investigate the stability of (maternal) responsiveness to infants across the first 3 years in sample sizes of 20–1,306 resulting in small to large effect size stabilities, *r*s = .04 to .80 (Behrens, Hart, & Parker, 2012; Behrens, Parker, & Kulkofsky, 2014; Bigelow et al., 2010; Biringen, Matheny, Bretherton, Renouf, & Sherman, 2000; Bornstein et al., 2010; Dallaire & Weinraub, 2005; Else-Quest, Clark, & Owen, 2011; Hall et al., 2015; Haltigan et al., 2013; Knafo, Jaffee, Haltigan, Roisman, & Fraley, 2013; Kochanska & Aksan, 2004; Landry et al., 2001; Lohaus, Keller, Ball, Voelker, & Elben, 2004; Madigan, Plamondon, Browne, & Jenkins, 2016; Murray, Halligan, Goodyer, & Herbert, 2010; NICHD Early Child Care Research Network, 1999; Riksen-Walraven, 1978; Vereijken, Riksen-Walraven, & Kondo-Ikemura, 1997).

### 1.3 Problems in the extant infancy and parenting literatures and motives for this 3-wave prospective longitudinal study

The extant literature points to stability as well as instability in infant behaviors and maternal responses to them. However, four noteworthy limitations of the extant literature motivate this study. First, most studies examine and report about individual infant behaviors or just maternal responsiveness and so fail to provide a complete picture of either. Thus, the specificity versus generalizability of stability across infant behaviors or maternal responses is in question. What is needed is an omnibus multi- variate approach in the same infants and mothers so that we know *which* infant behaviors and *which* maternal responses are stable and *to what degree*. As we see, the range of reported stabilities for any one infant behaviour or maternal response is wide (e.g., play *r*s = .01–.76). Does this range mean that these infant behaviors and maternal responses vary so in their true stabilities? Or does it mean that different samples of infants and mothers in different studies under different conditions vary in stability? In the absence of a single omnibus design, we do not know. In the current study, we included multiple infant behaviors and maternal responses to them in the same dyads. Concomitant to this historically fragmented approach, second, most studies of stability of infant behaviors and maternal responses assess each independent of the other. In the current study, we evaluated stabilities of both infants and mothers independently and taking the dyad partner into consideration. Controlling the partner's behaviour allows stability to be assigned more precisely to the individual rather than being driven by the partner's corresponding behaviour. Third, most stability studies are confined to two time points. In the current study, we evaluated stability over three time points in infancy. By including three ages, we are able to distinguish and compare shorter- from longer-term stabilities of infant behaviors and maternal responses, a distinction that eludes assessments confined to only two ages and provides a more complete developmental picture. It is possible, for example, for a large or for a small effect size stability between any two time points to mask a pattern of increasing or decreasing stability. Fourth, stability is (typically) indexed by correlation. However, as noted, correlation calls for careful interpretation of shared versus unshared variance between two measurements of the same characteristic which we do here. With these basic issues about stability in mind, we undertook a 3-wave longitudinal study of stability of multiple infant behaviors and maternal responses to them.

## Method

### Participants

Altogether, 40 infant–mother dyads (23 mother–daughter and 17 mother–son dyads) participated in three home observations. At the first visit, infants averaged 10.1 months (*SD* = 0.1), at the second visit 14.0 months (*SD* = 0.2), and at the third visit 21.5 months (*SD* = 0.3). At birth, infants weighed an average of 3.5 kg (*SD* = 0.5). Infants were all firstborn, term, of normal birthweight, free of any known neurological and sensory abnormalities, and healthy at the times of the home visits. Mothers averaged

33.3 years (*SD* = 3.4) at the time of the study, and mothers had completed and average of 17.6 years of schooling (*SD* = 2.1).

The three times of measurement represent relatively distinct developmental periods in infancy (Bornstein, Hahn, et al., 2014). At 10 months, infants' rapidly advancing motor skills and social-cognitive abilities render them competent to explore the functions of objects and to share intentions with others. Most still do not produce language, but articulate consistent sounds (e.g., "dadada") and use symbolic gestures (e.g., waving bye-bye) to communicate and are beginning to understand language. At 14 months, most infants are walking and display an amount of psychomotor independence; most are able to understand phrases and simple commands, speak their first words, and engage in rudimentary play (e.g., pretending to drink from an empty cup). At 21 months, infants are experienced walkers and display enhanced fine motor skills; most command an amount of expressive vocabulary, and have produced their first word combinations; use language to express a range of semantic meanings, including possession, location, and action; and many engage in extended bouts of pretense play in which acts are sequenced into logical "stories" (e.g., bathing, drying, and then putting a doll to sleep). This increased autonomy in locomotion, emotion, communication, and symbolism offers parents clearly changing targets to which to respond.

Participant families were European American from intact English-speaking households, recruited through mass mailings, newspaper advertisements, and private obstetric and paediatric groups, from a large East Coast metropolitan area. Families ranged from upper-middle to high socioeconomic status (SES; Hollingshead, 1975 Index, *M* = 59.1, *SD* = 5.80). Child development and parenting are known to vary with SES and ethnicity (Bornstein & Lansford, 2010; Halgunseth, 2019; Hoff & Laursen, 2019; Magnuson & Duncan 2019; McLlyod, Hardaway, & Jocson, 2019; Murry, Hill, Witherspoon, Berkel, & Bartz, 2015; Ng & Wang, 2019). We therefore recruited a sociodemographically and ethnically homogenous community sample as a first step in understanding stabilities of infant behaviors and maternal responses. By including only European American infants and mothers, we intentionally avoided SES and ethnicity confounds that might cloud findings with respect to infant behaviour, maternal

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parenting, and stability (Bornstein, Jager, & Putnick, 2013; Jager, Putnick, & Bornstein, 2017). The present study was conducted according to guidelines laid down in the Declaration of Helsinki, with written informed consent obtained from a parent for each child before any assessment or data collec- tion. All procedures involving human subjects in this study were approved by the Institutional Review Board at the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development.

**Home observation procedures, behaviors and practices, and coding**

In assessing the stabilities of infant behaviors and maternal responses to them, we attempted to remain faithful to a principle of ecological validity by video recording and coding naturalistic interactions between infants and mothers at home (Bronfenbrenner, 1979; Connors & Glenn, 1996). Visits were scheduled when infants were awake and alert and no other family members were present. Audio/video recording commenced only after a standard period of acclimation to the recording equipment and the presence of the observer (McCune-Nicolich & Fenson, 1984; Stevenson, Leavitt, Roach, Chapman, & Miller, 1986). Mothers were asked to behave in their usual manner and to disregard the observer's presence insofar as possible, and the observer refrained from talking to, making eye contact or inter- acting with, or otherwise reacting to the infant or the mother during recording.

At each age, mothers were asked to play on the floor with their infant for 10 min using a standard set of toys provided by the observer. Infant–mother dyads could play with any or all the toys, and infants and mothers used only those toys during the observation. Toys allowed for a variety of different play behaviors (Bornstein, 2007). The observer sat on the floor at eye level with infant and mother and video-recorded the session.

Event-based coding of infant behaviors and maternal responses was conducted on the video re- cords of mother–infant interaction. An event was recorded when the infant exhibited a change in his/ her ongoing behaviour which fell into one of four categories: (a) exploring an object (i.e., looking and/or manipulating an object); (b) playing with an object (i.e., engaging in functional or pretense levels of play with an object, such as nesting a block in a shape sorter or pretending to drink from a cup); (c) nonvocal bidding to or looking at mother; or (d) vocalizing. The categories of infant behaviors were coded as mutually exclusive. If infants displayed overlapping categories of behaviors (e.g., play or exploring and vocalizing), vocalization was coded; because bids typically contained vocalizations, bids were given precedence in coding. This forced-choice approach was implemented for analytic purposes. We distinguished exploration of objects from play based on documentation in the literature that infants in this age range transition from primarily exploring objects (i.e., through mouthing and manipulation) to increasingly engaging in functional and then symbolic play with objects (see, e.g., Belsky, Goode, & Most, 1980; Bornstein, 2007; McCune, 1995; Tamis-LeMonda, Katz, & Bornstein, 2002).

After noting the infant's behaviour, the coder recorded whether or not the mother responded. Therefore, maternal responses take infant behaviors and their base rates into account. A maternal response was defined by the coordination of three factors with respect to an infant's target behaviour: promptness (occurs within a 5-s window of the onset of the infant behaviour); contingency (depends conceptually on the preceding infant behaviour; e.g., if the infant picks up the spoon, the mother makes a statement that refers to a spoon, rather than talks about a block); and appropriateness (mother changes her behaviour in a positive and meaningful way; e.g., saying “That's a spoon.”). As an example, if the infant looked at a cup (target behaviour = exploring) and the mother said "The blue cup," the mother was credited with a response. The 5-s window represented the upper end of coding a maternal response. If mothers responded to more than one infant behaviour in succession within 5 s, each different response to each different infant behaviour was coded.

Frequencies of behaviors and responses were calculated. For maternal responses, we analysed proportions, *viz*. the number of maternal responses to each infant behaviour divided by the number of occurrences of that infant behaviour (e.g., if an infant engaged in 8 episodes of play, and the mother responded to 4 of those episodes, she was credited with .50 responding). Four random reliability checks at each age for each of 3 coders were conducted to ensure coding reliability; infant behaviour and maternal responses were crossed and scored by the different coders so that coders would be blind to different data sets. Coders randomly and independently scored approximately 10% of the records: Coders’ averaged *kappa* ($\kappa$; Cohen, 1960, 1968) was .77 for infant behaviors and .73 for maternal responses.

### Analytic Plan

Prior to analyses, univariate distributions for all variables were checked for normality and outliers (Tabachnick & Fidell, 2012), and pairs of repeated measures were examined for influential bivariate outliers by scatter plot inspection and numeric statistics (the studentized deleted residual and Cook's D). All variables approximated normal distributions.

Post hoc power analysis (Faul, Erdfelder, Lang, & Buchner, 2007) indicated a 95.92% chance of detecting a large effect size ($r$ = .50) and a 60.46% chance of detecting a medium effect size ($r$ = .30) for a one-tailed test significant at the .05 level.

Stability correlations for each of the four target infant behaviors and maternal responses to each of the four target infant behaviors were calculated between 10, 14, and 21 months by Pearson's coefficients. We also computed corrected correlations, where appropriate, to account for corresponding partner behaviors and potential covariates (maternal age and education, family socioeconomic status, and infant gender) at each age. When a statistically significant correlation was found with a partner variable and/or covariate, the residual from a linear regression of the infant behaviour or mother response on the corresponding behaviour and/or covariate was computed and used in the corrected correlation analysis.

## Results

### Stability of infant behaviors

Table 1A displays zero-order and corrected correlations between frequencies at each of the three pairs of ages (10 and 14 months, 14 and 21 months, and 10 and 21 months) for each of four infant behaviors. Stabilities varied from small to large in effect size, with all coefficients being positive. For infant exploration and bids to mother, there were significant medium effect size correlations between each pair of ages, indicating stability across all ages. Stabilities of infant play were positive, but small, across time at the zero-order level and when controlling for covariates. Finally, infant vocalizations appeared stable at medium to large effect sizes only at older ages (from 14 to 21 months). In overview, infant behaviors were stable at medium effect sizes over the shorter term, $Mr$ = .30, $p$ = .03 (one-tailed test), and at somewhat smaller effect sizes over the longer term, $Mr$ = .23, $p$ = .08 (one-tailed test). By themselves

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and absent differential maternal responsiveness, infant behaviors were relatively stable; however, some infant behaviors were slightly more stable when maternal responses and covariates were partialled than not. Finally, although the average shorter-term stability of infant behaviors is statistically significant, the average *un*shared variance in the correlations is a noteworthy 91%.

**TABLE 1** Stabilities across infant ages for infant behaviors and maternal responses

| | 10–14 months | | 14–21 months | | 10–21 months | |
|---|---|---|---|---|---|---|
| **Variable** | ***r*** | **Corrected *r*** | ***r*** | **Corrected *r*** | ***r*** | **Corrected *r*** |
| A. Infant behaviors: frequencies | | | | | | |
| Exploration | .35* | .35*ac | .27* | .32*c | .23 | .27*a |
| Play | .22 | – | .15 | .21[d] | .19 | .13[d] |
| Bids to mother | .44** | – | .48*** | – | .32* | – |
| Vocalization | .13 | – | .38** | .42** [d] | .18 | .15[d] |
| B. Maternal responses: proportions | | | | | | |
| Exploration | .56*** | – | .33* | – | .42** | – |
| Play | .45** | – | .28* | .25[c] | .27* | .29*c |
| Bids to mother | .36* | – | .40** | – | .08 | – |
| Vocalization | .45** | .45**b | .26* | – | .09 | .10[b] |

*Note:* –, no significant covariates or partner variables.
[a]Controlling for mother responses to exploration at 10 months.
[b]Controlling for family SES.
[c]Controlling for maternal education.
[d]Controlling for maternal age.
*$p \le .05$;
**$p \le .01$;
***$p \le .001$; all one-tailed tests.

## Stability of Maternal Responses

Table 1B shows zero-order correlations between proportions of maternal responses to infant behaviors at each of the three ages (the number of maternal responses to each infant behaviour divided by the number of occurrences of that infant behaviour). Maternal responses to infant exploration and play, as proportions of corresponding infant exploration and play, displayed medium to large effect size stabilities across all 3 ages. Maternal responses to infant bids and vocalizations, as proportions of corresponding infant bids and vocalizations, displayed medium effect size stabilities between 10 and 14 months and between 14 and 21 months, but not between 10 and 21 months. In overview, mater- nal responses to infant behaviors were stable at a medium average effect size over the shorter term, $Mr = .39$, $p = .007$ (one-tailed test), and at a somewhat smaller average effect size over the longer term, $Mr = .22$, $p = .09$ (one-tailed test). Again, although statistically significant, the average shorter- term *un*shared variance in the correlations of maternal responses is a noteworthy 85%.

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## Discussion

Developmental science is broadly interested in individual variation in children's and parents' behaviors and practices and in ascertaining the degree to which children and parents are consistent (or not) in their behaviors and practices. There are fundamental practical, theoretical, substantive, clinical, and methodological reasons to evaluate stability of infant behaviors and maternal responses to them: Each is descriptive, explanatory, and predictive in its own way. In this three-wave prospective longitudinal investigation, we examined stability in a variety of important infant behaviors and maternal responses to them. Taken together, the results reveal across the first-to-second years of life: (a) medium effect size shorter-term stabilities in younger infants' behaviors and somewhat larger effect size stabilities in older infants' behaviors, (b) medium to large effect size stabilities in maternal responses to younger and older infants, (c) partialling maternal responses from infants' behaviors has differential attenuating effects on stability in infancy depending on the age of the infants, however (d) even statistically significant stability correlations leave considerable amounts of autoregressive shared variance unaccounted for. Future reports that employ these variables will need to take these levels of stability *and* non-shared variances into account.

### Stability and instability of infant behaviors and maternal responses

Infants' behaviors tended to be stable over shorter terms (5 of 8 behaviors were stable between 10–14 and 14–21 months) and (predictably) somewhat less stable over the longer term (1 of 4 behaviors were stable between 10 and 21 months). By and large, infants' exploration and bids to mother were stable, but their play and vocalizations were unstable (except at older ages). Infancy is often thought of as a highly variable phase of the life course with behaviors fluctuating from moment to moment; however, our data indicate some common ordering.

Mothers' proportions of responses to their infants' behaviors were stable at medium to large effect sizes over shorter terms, but their responses (especially to their infants' bids and vocalizations) were less stable over the longer term. Notably, our findings of stability in maternal responses accord well with levels described in Holden and Miller's (1999) meta-analysis.

These findings prompt three general points meritorious of discussion. One concerns measurement; a second, design; and a third, personological. On the first, the four infant behaviors and maternal response types we measured showed considerable variability in stability. Likely, then, other infant behaviors (emotional displays) and maternal responses (punishment) not measured in the current study would also follow diverse paths of stability. Furthermore, each “stable” infant behaviour and maternal response betrayed large degrees of instability. In this sense, our findings echo Shirley’s (1933, p. 56) conclusions that “Both constancy and change characterize the personality of the baby,” as they do Holden and Miller’s (1999, p. 243) conclusion that “the nature of child rearing is simultaneously enduring and different.”

On the second point, concerned with design, “infancy” extends over a somewhat lengthy time frame and encompasses a range of fast-developing systems. Our data apply to the 10- to 21-month age period and likely would not apply earlier to, say, the first year of life when infants may be even more variable and state-dependent. Our findings also highlight the importance of looking at multiple assessment points rather than just two (Forehand & Jones, 2002). Analysing stabilities across multiple assessments over time revealed, for example, the greater somewhat consistency in shorter- than longer-term stability comparisons no matter when they were scheduled (e.g., from 10–14 and 14–21 months vs. 10–21 months in maternal responses) and that stability can be specific to an age range (e.g., infant vocalization is stable from 14–21 months, but not 10–14 or 10–21 months). Furthermore, as predicted (and previously observed; Holden & Miller, 1999), stabilities over shorter interassessment intervals (10–14 and 14–21 months) somewhat exceeded stabilities over a longer interassessment interval (10–21 months).

On the last discussion point, whether their infants were stable or not mothers’ responses were uniformly stable (at least over shorter intervals), so maternal parenting practices are unlikely a reflection of (stability in) their children's behaviour and characteristics despite the fact that parent development theory suggests that parents’ practices change over time in response to their developing child (Mowder, 2005). As predicted, we also found greater stability in maternal responses than in child behaviors (see also

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Kochanska & Aksan, 2004; NICHD Early Child Care Research Network, 1999, 2003; Weinfield, Ogawa, & Egeland, 2002). Last, we measured behavioural responses in mothers. The literature suggests that verbal reports and cognitions (attitudes, etc.) enjoy larger effect size stabilities than do observed behaviors (e.g., Holden & Miller, 1999), and macroanalytic global perspectives enjoy larger effect size stabilities than do microanalytic discrete behaviors (Waters, 1978), so our obtained levels of parenting stability might underestimate stability in parenting generally.

**Causes and consequences of stability and instability**

Development (stability included) is governed by genetic and biological factors intertwined with environmental and experiential influences. These twin factors are indissociable, and therefore, stability of any characteristic is likely attributable to these transacting forces. Thus, stable genetic and biological characteristics of infants and mothers could underpin consistencies in their behaviors and responsive- ness (Broderick & Neiderhiser, 2019; Pérusse, Neale, Heath, & Eaves, 1994; Saudino, 2012), just as stable environments and experiences could promote consistencies in infants' and mothers' behaviors and responsiveness (Belsky & Isabella, 1988; Bradley, 2019).

Complementarily, if a characteristic is not stable there are two possible explanations: Either the characteristic has not been assessed adequately or the characteristic is genuinely not stable. Our coding ensured psychometrically adequate (but, of course, not perfect) measurement, and coding reliability itself is a limiting factor on stability. Also, we used relatively brief observation periods of uncontrolled free play, and longer observations in controlled situations might ensure larger stabilities. We note, however, that several infant behaviors and maternal responses reached statistically significant levels of stability even under the circumstances we measured. Unstable infant behaviors might also reflect fluctuations in state as well as the changing availability of people or objects in infants' environs. To localize stability to the dyad more precisely, we held constant over these assessments people (only mother present), objects (use of a standard toy set), and infant state (times of the day for observations were selected to provide for favourable assessment conditions, infants were observed to be in states of alertness throughout the course of the observations, and mothers were in the visual presence of their infants), and we controlled partner corresponding behaviors and general sociodemographic characteristics as potential confounders.

**Strengths and limitations**

First, our participants were all firstborn infants of primiparous mothers in European American families. This sampling is by no means invalid—it is clear to whom the findings generalize—but may have implications for any broader generalizability of the findings. Different patterns of stability could emerge in laterborns or in adolescent, multiparous, or single mothers, in at-risk samples, in fathers, alloparents, or for that matter in caregivers from other SES, ethnic, or cultural groups. For example, responsive parenting is moderated by mothers' adolescent versus adult status (Lounds, Borkowski, Whitman, Maxwell, & Weed, 2005), their SES (Jenkins, Rasbash, & O'Connor, 2003), as well as their culture (Bornstein, Tamis-LeMonda, et al., 1992). A related implication of our sampling is that the stabilities we found may underestimate "true" stabilities of these behaviors and responses because more homogeneous samples likely reduce between-subject variance and attenuate stability. We concentrated on selected infant behaviors and maternal responses occurring in open interactions based on fixed procedures. As noted, whether other infant behaviors or maternal responses would yield different degrees of stability over longer observations in more constrained circumstances is open to question. Nonetheless, the characteristics we studied are universal, important, and prominent to infants and mothers across the first-to-second years of life. Finally, the modest sample size is a limitation because effects were likely estimated with poor precision. In addition, the study lacked sufficient power to statistically compare effect sizes or genders.

**Future directions and conclusions**

We studied only a homotypic model of developmental stability; that is, order maintenance in the same characteristic over time (A→A; in the current study, e.g., vocalization to vocalization). But *developmental* science is concerned to characterize two other significant temporal models of ontogeny. One complementary model describes *heterotypic stability*, the maintenance of order among individuals on different manifest, but conceptually related, characteristics through time (A→A'; e.g., vocalization to vocabulary); another complementary model describes *predictive validity*, the maintenance of order among individuals on different characteristics through time (A→X; e.g., vocalization to internalizing behavioural adjustment). Models of heterotypic stability and predictive validity typically postulate that some shared characteristic α in the individual underlies stability between characteristic A and characteristic A' or X. Likely, homotypic stabilities enjoy larger effect sizes than heterotypic stabilities and predictive validities, but homotypic stabilities place a statistical limit on both, as heterotypic stabilities and predictive validities cannot exceed homotypic stabilities in magnitude (Alder & Scher, 1994; Hartmann et al., 2015; Nunnally, 2017).

Analyses were directed at the stabilities of behaviors in infants and responses in mothers, and not how one might influence the other over time (a different question with a different focus, although we do control partner behaviour within time). In addition, there is at present debate in the literature about the value and validity of cross-lagged approaches (see Berry & Willoughby, 2017; Hamaker, Kuiper, & Grasman, 2015).

The present study is concerned with understanding the nature and scope of stabilities in infants and mothers. Stability speaks to core theory in developmental science and to its most practical and clinical implications. On the one, persistent and systematic child-rearing practices are often credited with affording experiences that influence the course and outcome of child development (e.g., Bornstein, 2019; Collins et al., 2000; Maccoby, 2000; Vandell, 2000). As Radke-Yarrow, Zahn-Waxler, and Chapman (1983, pp. 501–502) posited, "in theories of childrearing, parental behaviour is assumed to have effects on infants through a history of experiences. There is faith that, over time, parental influences lead to generalized behavioural tendencies that have some durability." Submitted to empirical test, we found a diversity of stabilities, but relatively small amounts of shared variance. Effects that explain small quantities of variance in particular situations, but that recur, can still account for large proportions of variance in later outcomes (Abelson, 1985; Bornstein, 2014). This observation in the developmental realm implies that infants who are consistent in their behaviors or who engender or experience consistent responses likely follow consistent developmental paths, whereas infants who are inconsistent in their behaviors or who engender or experience inconsistent responses likely follow divergent ontogenetic paths. A principal charge of developmental science is to document these onto- genetic trajectories.

On the second concerning practical and clinical implications, stability provides basic information about development as it is developmentally informative to describe an individual or a characteristic as stable or not over time. Only relatively stable characteristics would be expected to quantify differences between people. Whether infants or parents maintain their order in a group across time therefore not only informs about individual variation, but also contributes to understanding possible origins, nature, and future of those characteristics. Moreover, to be incorporated into diagnostic batteries to measure concurrent characteristics or predict future ones, performance at a given time needs to be a stable indicator of the individual (DeVellis, 2016). Finally, these data have clinical implications. Interventions ought to be timed to developmental windows when stability is low, and conversely, flex- ibility is high. So, for example, promoting infant vocalization would be better geared to 10–14 months than 14–21 months.

That said, we want to conclude by underscoring the large instabilities—degrees of unshared variance—we recorded in infants' behaviors and maternal responses, 91% and 85%, respectively, on aver- age. Taking these numbers seriously, we advocate that developmental science move beyond an almost exclusive focus on the psychometric and ontogenetic returns of stability, as both the stability and in- stability of infant behaviors and maternal parenting practices are likely informative for understanding human development and family process. The life-span perspective in developmental science specifies that human beings are open systems, and the plastic nature of psychological functioning ensures that people can exhibit instability in many characteristics throughout the life course. Flexibility and plasticity may be especially adaptive early in the life cycle and likely explain why infants and mothers produce small to medium effect size stabilities overall. One could imagine, therefore, advantages to instability in infants and mothers that reflect flexibility and openness to adapting to new environmental demands and experiences.

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