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Consistency in maternal affect and positive vocalization over the first year of life

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ABSTRACT

Consistency in parenting infants has positive developmental outcomes. Yet, the role of socioeconomic status (SES) in consistency of maternal behaviors is not well understood. We investigated individual-order continuity of maternal smile and laughter and positive vocalization from 6 to 12 months of age in 82 mother-infant dyads. Overall, individual differences in maternal smile and laughter, and positive vocalization were consistent across time. A multidimensional measure of SES moderated the association of maternal smile and laughter from 6 to 12 months, such that infants from lower SES families were vulnerable to unpredictable parenting - experiencing a lack of consistency in maternal smiles and laughter.

Early quality parenting is vital for positive infant development across multiple domains including physiological, cognitive, language, and socioemotional development (e.g. Jahromi, Putnum, & Stifter, 2004; Landry, Smith, & Swank, 2006; Propper & Moore, 2006; Saint-Georges et al., 2013). Maternal sensitivity, a key characteristic of quality parenting, indexes how warm, appropriately responsive and well-attuned the mother is to her infant (Ainsworth, 1978). Mothers are relatively consistent with maternal sensitivity throughout early development (Belsky, Gilstrap, & Rovine, 1984; Bornstein and Tamis-LeMonda, 1990; Dallaire & Weinraub, 2005; Else-Quest, Clark, & Owen, 2011; Madigan, Plamondon, Browne, & Jenkins, 2016). Consistency, also called relative or individual-order stability, in parenting refers to the degree to which parents maintain their positions relative to other parents over time on measures of parenting (Forehand & Jones, 2002). Although the link between early parenting and infant development has been widely studied, minimal research has examined the role of parenting consistency on infant development.

Emerging evidence suggests that not only the quality of parenting but also consistency in parenting during infancy has concurrent and lasting positive developmental outcomes. When parents are consistent with the level of parenting sensitivity they engage in, infants are known to have better social and cognitive outcomes (Landry, Smith, Swank, Assel, & Vellet, 2001) that last through middle childhood irrespective of later parenting (Landry, Smith, & Swank, 2003). Consistency in parenting sensitivity is crucial during infancy as it instills a sense of predictability. Infancy is a period of rapid development when caregivers play a foundational role in molding many aspects of their present and later development (e.g. Ainsworth, Blehar, Waters, & Wall, 1978; Bornstein, 1985; Hostinar, Sullivan, & Gunnar, 2014). Typically, mothers are the first primary caregivers whom infants bond with and heavily depend on (Hostinar et al., 2014). Unpredictability of maternal behaviors during such a time is an early stressor leading to adverse health outcomes (Lupien, Maheu, Tu, Fiocco, & Schramek, 2007). Hence, inconsistent parenting during infancy could be detrimental for behavioral and physiological health. Predictable parenting can facilitate proper development of processes such as attachment formation, social referencing, joint attention and self-regulation which emerge during the first year of life. These processes are precursors of socioemotional and cognitive development. Perhaps consistency in parenting infants is essential for these areas of

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development. It is then important to examine contributors of variability in consistency in early parenting to help identify infants at risk for poor developmental outcomes.

Children living in poverty are at risk for insensitive caregiving (Bornstein, Hahn, Suwalsky, & Haynes, 2014) and are likely experiencing inconsistent parenting. Parenting infants, especially in the first year of life, is a turbulent time for mothers who are vulnerable to financial strain (Bornstein et al., 2014; Feldman, 2007) rendering it difficult for them to consistently display certain parenting behaviors. This has not been well explored during infancy. A study on toddlerhood through preschool age found that SES, indexed by family finances did not moderate consistency of maternal sensitivity during toddlerhood and preschool years (Madigan et al., 2016). Whether the same holds true during infancy is not clear. SES could matter more for consistency in maternal sensitivity during infancy as mothers may still be adjusting to the added demands of caring for a new infant. Moreover, in addition to family finances, parental education and occupational prestige should also be included when assessing SES in the context of parenting (Hoff, Laursen, & Tardif, 2002). The link between higher education levels and better parenting is well documented (Richman, Miller, & LeVine, 1992; Suizzo & Stapleton, 2007; Tamis-LeMonda, Briggs, McClowry, & Snow, 2009). Likewise, higher occupational prestige is also linked to better parenting (Raver, 2003). Both of these factors could also influence consistency in maternal sensitivity. To better understand the role SES plays in the consistency with which mothers engage in maternal sensitivity when parenting infants, research using a multidimensional assessment of SES is warranted.

Maternal sensitivity, a broad multimodal parenting construct, is a conglomerate of various discrete maternal behaviors (Mesman & Emmen, 2013). Two such building blocks of maternal sensitivity that are known to facilitate physiological, socioemotional and language development are maternal positive affect (Gunnar & Stone, 1984; Hanley, Brain, & Oberlander, 2013) and infant-directed speech (Bigelow et al., 2010; Saint-Georges et al., 2013). Maternal positive affect typically refers to maternal smiling, positive tone of voice, and often also to physical affection like caressing (see Mesman & Emmen, 2013). It is known to facilitate better infant physiological regulation (Martinez-Torteya et al., 2014; Moore et al., 2009), social referencing in infants (Gunnar & Stone, 1984), and socioemotional development (Hanley et al., 2013). Infant-directed speech (IDS) refers to the way in which adults speak to infants involving overall higher and variable pitch, intonation contours, and exaggerated vowels conveying positive affect. Additionally, it is characterized by slower repetitive speech, long pauses, shorter utterances and use of syntactically and semantically simple language (e.g. Cristia, 2013; Fernarld, Taeschner, Dunn, & Papousek, 1989; Singh, Morgan, & Best, 2002; Soderstrom, 2007; Spinelli, Fasolo, & Mesman, 2017). IDS is linked with affect, attention, physiological regulation and language learning in infants and predicts formation of secure attachment (Bigelow et al., 2010; Filippa et al., 2017; Jahromi et al., 2004; Saint-Georges et al., 2013). Although maternal positive affect and IDS are evidently associated with better infant developmental outcomes, the consistency in how much infants are exposed to these maternal behaviors is not fully understood.

There are indications that mothers engage in these behaviors consistently across infancy (Belsky et al., 1984; Bornstein & Tamis-LeMonda, 1990), but whether SES has a role on such consistency is not well understood. For example, early research by Belsky et al. (1984) found that positive maternal affect is consistent across the first nine months of infancy. However, the participants were predominantly middle-income families and whether consistency of maternal affect differed by SES was not reported. Longitudinal studies on IDS have assessed whether specific characteristics of IDS, such as prosodic modifications in pitch, exaggerated vowels and vocal affect, change in development and whether consistencies in those characteristics have implications for language development (see Burnham et al., 2015; Cristia & Seidl, 2014; Kalashnikova & Burnham, 2018; Kitamura, Thanavishuth, Burnham, & Luksaneeyanawin, 2002). However, it is important to note that mothers do not always speak to their infants using positive vocalizations, prosodic modifications associated with IDS. The extent to which positive vocalizations are a part of the infant environment can make a difference in infant language and socioemotional development. There is limited research assessing whether there is consistency in the extent to which infants hear maternal positive vocalizations. An early study found that exposure to IDS, characterized by extreme or fluctuating pitch, is consistent across the first 5 months of infancy (Bornstein & Tamis-LeMonda, 1990). This study also included middle to higher SES families, and it is not clear if consistency in the use of IDS varies by SES. Given that minimal research has been done on consistency of maternal affect and IDS in the context of SES, there is a need to better understand the role of SES on consistency of these behaviors.

The present study investigated whether there is consistency in the use of maternal smiling and laughter and maternal positive vocalization in the context of SES from 6 to 12 months of infancy. Maternal smiling and laughter are components of maternal positive affect, and maternal positive vocalization refers to prosodic components of IDS such as higher and variable pitch, intonation contours and exaggerated vowels. SES was indexed by family income, parental education and parental occupational prestige. Based on previous literature, we hypothesized that maternal smiling and laughter, and positive vocalization at 6 and 12 months would be consistent. We predicted that SES would moderate consistency of maternal smiling and laughter and positive vocalization, such that mothers from higher SES would display more consistency in these behaviors.

Participants were 82 mothers (M = 33.37 years, SD = 3.70) and their healthy, singleton infants with no known hearing, visual, neurological or developmental disorders. Families were recruited from the greater Boston area using public birth records and a departmental database of families who had expressed interest in participating in research. The dyads were assessed at home when infants were 6 months old (M = 6.69 months; SD = 0.43; 38 females) and then in the laboratory when their infants were 12 months old (M = 12.18 months; SD = 0.73). Table 1 summarizes demographic characteristics of all the participants.

Home visits at six months were conducted during the day at a convenient time for the mothers and when the infants were well rested. Following informed consent, mothers engaged with their infants in a freeplay session after which they provided demographic information and filled out a questionnaire on depressive symtomatology. Six months after the initial visit, the dyads participated in a follow-up freeplay session at the laboratory.

Maternal parenting behaviors were assessed at both time points by micro-coding videotapes of 6-minute mother-infant freeplay

Table 1
Demographic characteristics of participating families.

Variables	
Infant Ethnicity	
White	70.4 %
Black	2.5 %
Asian	3.7 %
Hispanic	1.2 %
Native American	0.0 %
Multiracial/Other	22.2 %
Maternal Ethnicity	
White	77.5 %
Black	5.0 %
Asian	11.3 %
Hispanic	2.5 %
Native American	1.3 %
Multiracial/Other	2.5 %
Income to Needs Ratio (ITN)	
M (SD)	5.79 (3.18)
Economically Strained Participants (ITN = < 3)	21.2 %
Maternal Education percent with at least a 4 yr college degree	90.30 %
Paternal Education percent with at least a 4 yr college degree	81.70 %
Maternal Job Prestige (ranged from 1 to 5; 1 requiring less to no preparation)	
M (SD)	3.99 (0.94)
Paternal Job Prestige (ranged from 1 to 5; 1 required less to no preparation)	
M (SD)	3.92 (1.03)
CES-D (above the clinical cutoff score, 16)	18.30 %

sessions designed to elicit maternal behaviors that occur naturally during mother-infant interactions (Feldman & Eidelman, 2004; Feldman, Gordon, & Zagoory-Sharon, 2011). The dyads sat on the floor with five age-appropriate toys laid before them and were left by themselves in a room with the instructions to play as they normally would. A bumbo floor seat was provided and parents were free to place the infants in the seat or allow them to move around the room. Coders were trained to a kappa of 0.80. They assessed maternal behaviors every 33.33 ms, frame by frame (Feldman & Eidelman, 2004) using the software Observer XT – Noldus 11.0 (Wageningen, the Netherlands). One minute of each video was double-coded for reliability. Interrater reliability kappa ranged from 0.84 to 0.97. At every 30th of a second, the software paused the video so that the coders could code for presence of maternal smiles or laughter and positive vocalization to obtain the exact duration of the behaviors. When the mothers smiled or laughed looking at the baby, it was coded as engaging in maternal smiles and laughter. Maternal smile and laughter was calculated as the proportion of time mothers displayed smile or laughter during freeplay. Positive vocalization was calculated as the proportion of time mothers used higher and variable pitch, intonation contours, and exaggerated vowels directed at the infant during the freeplay. These variables were corrected for the time when mothers' could not be coded either because their faces were out of the camera view or because their voices were inaudible.

Mothers reported on family income, maternal and paternal occupation, and highest level of maternal and paternal education. An income-to-needs ratio (ITN) was calculated using total household size, household income and federal poverty guidelines. For example, an ITN of 2 indicates the household income is twice the federal poverty line for that household size. Highest education level was coded from 1 to 5 where a score of 1 represented elementary, middle and junior high school, 2 represented high school and general educational development (GED) certificate, 3 represented vocational school and community college, 4 represented college (4-year degree) and 5 represented graduate school. Occupational prestige of both parents was coded using the Job Zone coding scheme from the Occupational Information Network (O*NET, http://www.onetonline.org/help/online/zones), which ranks U. S. Census-based occupational categories on a 5-point scale based on the education, experience, and training required (1 = *requiring the least preparation* and 5 = *requiring the most extensive preparation*). A composite SES was calculated by averaging the standardized scores of ITN, total parental education level and total parental occupational prestige.

As some mothers are prone to depressive symptomatology when parenting infants in the first year of life (Feldman, 2007), maternal depressive status was tested as a potential covariate. Mothers' depressive symptomatology was assessed using the Center for Epidemiologic Studies - Depression Scale (CES-D). It is a 20-item ($\alpha = 0.84$) self-report questionnaire designed to measure depressive symptoms in the general population (Radloff, 1977).

Preliminary analyses indicated that all the variables, except maternal positive vocalization, were normally distributed. Maternal positive vocalization at both time points was winsorized to ensure normal distribution of the data. Descriptive statistics of maternal behaviors at both time points are presented in Table 2. ITN, parental job prestige and education were significantly correlated with each other (see Table 3) and a composite SES was calculated. An independent sample *t*-test revealed that SES did not significantly differ based on White ($M = 6.05$, $SD = 2.78$) or non-White participants ($M = 5.17$, $SD = 3.97$), $t(78) = 1.14$, $p > 0.05$.

To explore whether there was developmental mean-group level change in maternal smile and laughter and positive vocalization, we ran two separate repeated-measures analyses of covariance (ANCOVAs) with time as a within-subjects factor. To assess whether SES also had a main effect on developmental changes in maternal smile and laughter, and positive vocalization, it was entered as a

Table 2
Descriptive Statistics of Maternal Behaviors.

Variables	*M* (*SD*)
At 6 months	
Maternal Smiling and Laughter	0.153 (0.145)
Maternal Positive Vocalization	0.221 (0.204)
At 12 months	
Maternal Smiling and Laughter	0.273 (0.239)
Maternal Positive Vocalization	0.162 (0.169)

Table 3
Correlations among Individual Components of SES.

Measure	1	2	3
1. ITN	–		
2. Parental education	0.405**	–	
3. Parental job prestige	0.435**	0.631**	–

Note. $^{**}p < 0.001$.

predictor in both the models. Statistically, SES was entered as a covariate because it was a continuous measure (Hoffman, 2015; Sweet & Grace-Martin, 2011). There was a main effect of infant age on maternal smile and laughter ($F(1, 77) = 23.58$, $p < 0.001$, $\eta_p = 0.234$), such that proportion of maternal smile and laughter increased from 6 months to 12 months of infant age at the mean level. There was also a main effect of age on maternal positive vocalization ($F(1, 78) = 10.51$, $p < 0.01$, $\eta_p = 0.119$), such that proportion of maternal positive vocalization decreased from 6 to 12 months of age at the mean level. However, SES did not have a significant main nor interaction effect on either of the models. That is, neither smile and laughter nor maternal vocalization varied by SES, and age-related shifts in the prevalence of these maternal behaviors were observed independent of SES.

For the main regression analyses assessing individual-order continuity in maternal behaviors and the role of SES, we examined maternal depressive symptomatology at 6 months as a potential covariate. Associations of maternal depressive symptomatology at 6 months with maternal smile and laughter, and positive vocalization concurrently as well as at 12 months were examined. Maternal depressive status at 6 months was not significantly associated with maternal smile and laughter concurrently nor at 12 months, and thus was not included as a covariate in the main regression analysis assessing the role of SES on consistency of maternal smile and laughter. Depressive symptomatology was not correlated with maternal positive vocalization concurrently, but did correlate with maternal positive vocalization at 12 months ($r(77) = -.264$, $p < 0.021$) and therefore was included as a covariate in the regression analysis examining the role of SES on consistency of positive vocalization. In our sample, maternal depressive symptomatology and SES were not related.

For the main analysis examining individual-order consistency in maternal smile and laughter, and positive vocalization, both maternal behaviors were standardized at each age (6 and 12 months) to control for mean-level developmental changes. Pearson's correlation analyses revealed individual-order continuity in the use of maternal smile and laughter ($r(80) = 0.33$, $p = .003$) and positive vocalization ($r(81) = 0.50$, $p < 0.001$) from 6 months to 12 months. Next, we examined whether SES moderated consistency of maternal smile and laughter from 6–12 months. In an ordinary least squares (OLS) regression analyses conducted using the PROCESS macro in SPSS (Hayes, 2013), maternal smile and laughter at 12 months was regressed on maternal smile and laughter at 6 months, SES and their interaction term. This was a single model in which all independent variables were entered simultaneously. Results presented in Table 4 show that the overall model was statistically significant and revealed a significant main effect of maternal smile and laughter at 6 months, but not of SES. However, there was a significant interaction between maternal smile and laughter at 6 months and SES in predicting 12-month maternal smile and laughter, with bias corrected bootstrapped confidence

Table 4
OLS Regression Model Examining the Moderation of the Effect of Maternal Smile and Laughter at 6 Months on Maternal Smile and Laughter at 12 Months by SES.

						95 % confidence interval for coeff.	
		Coeff.	*SE*	*t*	*p*	Lower bound	Upper bound
Constant	i^1	0.022	0.117	0.192	0.8483	−0.209	0.255
Maternal Smile and Laughter (6 months)	b^1	0.322	0.127	2.533	0.0134	0.069	0.574
SES	b^2	0.059	0.178	0.330	0.7425	−0.295	0.412
Maternal Smile and Laughter (6 months) X SES	b^3	0.379	0.189	1.995	0.0497	0.001	0.757
		$R^2 = 0.385$, $MSE = 1.004$					
		$F(3, 75) = 4.347$, $p = 0.007$					

Note. Coeff. = unstandardized coefficient.

Table 5
Conditional Effect of Focal Predictor at Values of the Moderator Variable for the OLS Regression Model Examining the Moderation of the Effect of Maternal Smile and Laughter at 6 Months on Maternal Smile and Laughter at 12 Months by SES.

					95 % confidence interval for effect	
SES	Effect	*SE*	*t*	*p*	Lower bound	Upper bound
−0.707	0.054	0.202	0.266	0.7911	−0.349	0.456
0.167	0.385	0.125	3.086	0.0028	0.136	0.633
0.702	0.587	0.165	3.559	0.0007	0.259	0.916

Note. Effect = estimated effect of maternal smile and laughter at 6 months on maternal smile and laughter at 12 for the given value of SES.

intervals at 95 % level based on 5000 samples, CI: 0.006–0.7573. Inclusion of this interaction effect significantly improved the model (R^2 change = 0.045, $F(1, 75) = 3.98$, $p < 0.05$) indicating that SES moderated consistency of maternal smile and laughter from 6 months to 12 months, with follow-up analyses revealing that only mothers who had higher SES showed significant consistency in maternal smile and laughter (Table 5). In the another OLS regression model examining the role of SES on consistency of maternal positive vocalization, with maternal depressive symptomatology included as a covariate, we regressed maternal positive vocalization at 12 months on maternal positive vocalization at 6 months, SES, maternal depressive symptomatology and the interaction term between positive vocalization at 6 months and SES. This was a single model in which we entered maternal positive vocalization at 6 months as a predictor, SES as a moderator and maternal depressive symptomatology as covariate simultaneously. As presented in Table 6, this model was statistically significant but, only maternal positive vocalization at 6 months had a significant main effect on maternal positive vocalization at 12 months. Thus, maternal positive vocalization at 6 months uniquely predicted maternal positive vocalization at 12 months above and beyond SES and maternal depressive symptomatology. Moreover, SES did not moderate consistency of maternal positive vocalization when controlled for maternal depressive symptomatology.

The present study investigated the associations of maternal smile and laughter and positive vocalizations from 6 to 12 months during infancy. Additionally, we examined the role of SES in the consistency of use of these maternal behaviors. Overall, infants were exposed to maternal smile and laughter and positive vocalizations consistently across the first year of life. However, infants from lower SES families were vulnerable to inconsistent parenting, experiencing no stability in the level of maternal smile and laughter they received from 6 to 12 months of age. This implies that while privileged infants experience more predictability in terms of their mothers' facial affective responses, less privileged infants are more likely to be challenged with uncertainty about their mothers' facial affective responses. Unpredictable reactions from mothers when infants depend on them for facilitation of processes like attachment formation and social referencing can be detrimental to their socioemotional development. Moreover, such unpredictability is an additional stressor for infants already facing other adversities which place them at a greater risk for maladaptive physiological development.

Given that consistency in maternal smiling and laughing, but not positive vocalization, varied by SES, the results emphasize how factors contributing to parenting consistency may differ by the parenting behavior in question. SES may not have played a role in consistency of positive vocalization in our sample because most of our participants were highly educated despite some variability in their household incomes. Higher SES measured by income and education is a predictor of greater use of IDS when parenting toddlers. Rowe (2008) found that mothers who have higher levels of education are more knowledgeable about child development and those who are more knowledgeable about child development use more IDS. It is possible that maternal education is crucial for consistency of maternal positive vocalization as well. It is likely that the majority of the mothers in our sample, who are well educated, were also knowledgeable about child development and engaged in positive vocalizations consistently. Future studies examining the role of SES on consistency of parenting should also consider parental knowledge on child development.

Previous literature has not found that SES was important for consistency of maternal sensitivity when parenting toddlers (Madigan et al., 2016). However, they relied only on financial indices of SES whereas we employed a multidimensional measure of

Table 6
OLS Regression Model Examining the Moderation of the Effect of Maternal Positive Vocalization at 6 Months on Maternal Positive Vocalization at 12 Months by SES, Controlling for Maternal Depressive Symptomatology at 6 Months.

						95 % confidence interval for coeff.	
		Coeff.	*SE*	*t*	*p*	Lower bound	Upper bound
Constant	i^1	0.189	0.152	1.241	0.2179	−0.114	0.493
Maternal Positive Vocalization (6 mo.)	b^1	0.482	0.101	4.785	0.0000	0.281	0.682
SES	b^2	0.119	0.131	0.906	0.3681	−0.142	0.379
Maternal Positive Vocalization (6 mo.) X SES	b^3	0.085	0.151	0.565	0.5738	−0.216	0.386
Maternal Depressive Symptomatology	b^4	−1.143	0.735	−1.555	0.1242	−2.607	0.322
		$R^2 = 0.310$, $MSE = 0.691$					
		$F(4, 72) = 8.090$, $p < 0.001$					

Note. Coeff. = unstandardized coefficient.

SES including parental education and occupational prestige. Our finding that SES mattered in order for mothers to consistently display similar levels of positive facial affect to their infants underscores the importance of including parental education and occupational prestige as measures of SES when exploring its role in consistency of parenting. There is a possibility that the role of SES on consistency of parenting varies by child age, and the measure of parenting. We indexed maternal sensitivity by specific parenting behaviors which likely overlap with global measures of maternal sensitivity. SES was associated with consistency of only maternal smile and laughter and not positive vocalization in this study. This finding, considered in concert with previous literature on consistency of the broader construct of maternal sensitivity (Madigan et al., 2016), raises a question regarding whether the role of SES in consistency of parenting is specific to particular parenting behaviors or if it is also applicable to broader measures of maternal sensitivity. It is yet to be fully understood to what extent these specific parenting behaviors index broader measures of maternal sensitivity and how SES influences consistency of these constructs. To address this question, future studies should assess the role of SES in consistency of both broad as well as discrete parenting measures of maternal sensitivity in various child age groups.

When interpreting the findings, it is important to take into consideration that we assessed maternal behaviors in different settings at two time points: in the home at 6 months and in the laboratory at 12 months. We cannot tease apart whether mothers with low SES were generally inconsistent with their smiles and laughter over time, or if they appeared inconsistent because they were uncomfortable in a laboratory setting at 12 months. Mothers of low SES or from racial or ethnic minority groups may have responded differently to the laboratory setting, with differential effects on observed parenting in this context. While it is important to note that racial and ethnic minority status did not relate to SES in our sample, we did not have a large enough sample to allow for analysis of subgroups of specific racial and ethnic minorities. Future studies of maternal consistency and SES should assess these behaviors in the same environment across time, ideally the home, and should include larger numbers of individuals of specific racial and ethnic minority groups to allow for examination of the interplay of SES and racial and ethnic identity in consistency of parenting.

The finding that SES moderated consistency of maternal smile and laughter from 6 to 12 months even in a sample facing relatively low adversity highlights how consistency of maternal smile and laughter is sensitive to SES. Thus, this study demonstrates the role that SES has in consistency of an aspect of parenting. This study establishes that while individual differences in discrete maternal behaviors are consistent across the second half year of infancy overall, lower multidimensional SES contributes to infants' risk for experiencing inconsistent parenting.

CRediT authorship contribution statement

Charu T. Tuladhar: Conceptualization, Methodology, Data curation, Formal analysis, Writing - original draft, Writing - review & editing. **Amanda R. Tarullo:** Methodology, Resources, Writing - review & editing, Project administration, Supervision, Funding acquisition.

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