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Previous research has linked higher levels of household chaos to parenting problems, but it is not clear whether household chaos actually *causes* parenting problems. In this study, we used an experimental design in which levels of household chaos were manipulated to test the effect of household chaos on caregiver sensitivity. As sensory-processing sensitivity has been linked to the perception of household chaos, we also tested whether household chaos has a stronger effect on participants with higher sensory-processing sensitivity. Ninety-six young adults (nonparents) visited our lab twice and took care of an infant simulator in a lab furnished like a living room. In the neutral condition the room was orderly and calm, and in the chaos condition it was cluttered, noisy and smaller (order counterbalanced). Caregiver sensitivity was observed, and sensory-processing sensitivity was measured through questionnaires and observational data. Multilevel modeling showed caregiver sensitivity decreased over time in both conditions and that condition had a small effect on caregiver sensitivity, with sensitivity being lower in the chaos condition. We found that participants with higher sensory sensitivity decreased faster in the chaos condition than in the neutral condition. According to our findings, household chaos leads to less positive caregiving behavior and parents with higher sensory sensitivity may be more affected by household chaos. Thus, reducing household chaos may be effective in promoting positive parenting.

Keywords: household chaos, parenting, sensitivity, sensory-processing sensitivity, experiment

Supplemental materials: http://dx.doi.org/10.1037/fam0000766.supp

Always running late, not being able to find your keys and not being able to hear yourself think in your own home—these are examples of chaotic moments in the household. A lack of family and week routines, high noise levels, material disorganization, and crowding are all aspects of household chaos (Evans & Wachs, 2010; Matheny, Wachs, Ludwig, & Phillips, 1995). Higher levels of household chaos are known to be related to more negative parenting (e.g., Coldwell, Pike, & Dunn, 2006; Deater-Deckard, Wang, Chen, & Bell, 2012; Dumas et al., 2005), however, there is no clear evidence of a *causal* effect of household chaos on parenting. In addition, the relation between household chaos and negative parenting may not be the same for everyone, as the perception of household chaos is related to sensory-processing sensitivity (Wachs, 2013). In this study, we used an experimental design to test whether household chaos has a causal effect on caregiving behavior and whether this relation is stronger for people with higher sensory-processing sensitivity.

Household Chaos, Parenting, and Child Outcomes

Ample research has linked household chaos to various negative child outcomes. Higher levels of household chaos have been related to more child conduct problems and lower IQ (Coldwell et al., 2006; Deater-Deckard et al., 2009; Mills-Koonce et al., 2016). There is also evidence for a relation between household chaos and child language development: more household chaos during the first three years of life was related to less child expressive and receptive language at 36 months (Vernon-Feagans, Garrett-Peters, Willoughby, Mills-Koonce, & The Family Life Project Key Investigators, 2012). In another longitudinal study, more household chaos measured when the child was two years old was related to lower receptive vocabulary of children at age five (Martin, Razza, & Brooks-Gunn, 2012). In the same study, higher levels of household chaos were also related to lower delayed gratification and to more aggression and attention problems.

Household chaos has also been related to negative parenting outcomes. Using self-report measures, household chaos was correlated with maternal harsh parenting-negativity (Deater-Deckard,

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Chen, Wang, & Bell, 2012) and dysfunctional discipline (Dumas et al., 2005). In line with this, Coldwell et al. (2006) found that higher self-reported household chaos was related to less parental warmth and joy and to more parental anger and hostility measured with child puppet interviews, and to more self-reported maternal and paternal negativity. Furthermore, there is evidence that the association between household chaos and child outcomes is (partially) mediated by parenting. A large longitudinal study showed that more harsh parenting and less parental sensitivity mediated the relation between more household chaos and less favorable child outcomes in conduct problems, callous-unemotional behavior, and expressive language development (Mills-Koonce et al., 2016; Vernon-Feagans et al., 2012).

Causal Effect of Household Chaos

Previous research mostly used correlational designs and suggested that household chaos is related to sensitive and to negative parenting. Although previous research has suggested that household chaos is the predictor in this relation (e.g., Mills-Koonce et al., 2016), the directionality of this relation is not known. Therefore, it is not known whether more household chaos results in more negative parenting, whether negative parenting results in more household chaos, possibly through an effect on child problem behavior, or whether household chaos may be a byproduct of more negative parenting or of a latent variable related to both household chaos and parenting. An answer to this question is needed to better understand the role of household chaos in parenting. This knowledge can be used to inform prevention and intervention programs. If a causal relation between household chaos and negative parenting exists, then reducing household chaos may indeed lead to an improvement in parenting. To address the causal effect of chaos on parenting, an experimental research design is needed, which we employed in the current study.

Sensory-Processing Sensitivity

Although previous research has established a clear relation between household chaos and negative parenting, this relation may not be equal for all parents. Sensory-processing sensitivity seems to be an important factor in the perception of the level of household chaos (Wachs, 2013). Sensory-processing sensitivity is defined as the awareness of stimuli and arousal by stimuli (Aron & Aron, 1997; Evans & Rothbart, 2008). People with more sensory-processing sensitivity may notice the higher number of stimuli in chaotic households more readily and be more affected by these stimuli than participants with low sensory-processing sensitivity, and thus be more susceptible to the effects of household chaos. Wachs (2013) found that higher levels of observed household chaos were only related to self-reported household chaos for mothers with high levels of sensory-processing sensitivity, but not for mothers with lower sensory-processing sensitivity. Other studies, although not (directly) related to household chaos, also underline the importance of sensory-processing sensitivity. Aron, Aron, and Davies (2005) found in an experimental study that students with high sensory-processing sensitivity reported more negative affect after a stress-inducing task than students with low sensory-processing sensitivity. In the work context, more sensory-processing sensitivity was related to experiencing more work stress (Evers, Rasche, & Schabracq, 2008). These findings imply that the negative effects of household chaos on parenting may be stronger for parents with higher sensory-processing sensitivity. Knowing who is most affected by household chaos, could help improve prevention and intervention efforts.

Previous research is mixed on whether sensory-processing sensitivity should be seen as a unidimensional or two- or three-dimensional construct. Aron and Aron (1997) - who were the first to state that sensory-processing sensitivity is a separate personality trait and is not part of other traits, such as neuroticism - considered sensory-processing sensitivity to be a unidimensional construct. Smolewska, McCabe, and Woody (2006) found sensory-processing sensitivity to be a three-dimensional construct, reflecting awareness for aesthetics, negative arousal by external stimuli, and the extent to which a person is overwhelmed by external and internal demands. Evans and Rothbart (2008) found a two-dimensional construct, and named the two dimensions sensory sensitivity (reflecting the threshold for awareness of stimuli) and sensory discomfort (reflecting to what extent someone is negatively affected due to stimuli). More research is needed to answer whether the construct of sensory-processing sensitivity is unidimensional or multidimensional, and if so, whether different components of sensory-processing sensitivity have different effects on, for instance, the relation between household chaos and negative parenting.

Current Study

In the current study we addressed the question of whether there is a causal effect of household chaos on caregiving behavior, specifically caregiver sensitivity, and whether sensory-processing sensitivity moderates this relation. Caregiver sensitivity is defined as the caregiver's ability to observe and interpret child signals and respond promptly and appropriately (Ainsworth, Bell, & Stayton, 1974). We used an experimental design in which we manipulated a lab room to look like either an orderly, neat living room (the neutral condition), or a cluttered, noisy and crowded living room (the chaos condition). We controlled for variation in child behavior by using an infant simulator, which can be programmed to cry at certain times, so the demands on the caregiver were equal for all participants. We controlled for previous child rearing experiences by including nonparents.

Our first hypothesis was that caregiver sensitivity toward the infant simulator would be lower in the chaos condition than in the neutral condition. Our second hypothesis was that the effect of chaos on caregiver sensitivity would be stronger for participants with high sensory-processing sensitivity. Next to exploring the dimensionality of the construct sensory-processing sensitivity, we investigated whether different components of sensory-processing sensitivity played a different role in the relation between household chaos and caregiver sensitivity. Lastly, we tested both our hypotheses exploratively for an interaction with the duration of caring for the infant simulator.

Method

Participants

Participants were 96 Dutch, female students enrolled at schools for vocational education (in Dutch: MBO; $N = 21$) or colleges (in

Dutch: HBO; $N = 75$). The mean age of the participants was 20.31 years ($SD = 1.93$). Of the participants, 96% were born in the Netherlands. Vocational students ($M = 19.19$, $SD = 1.50$) were significantly younger than college students ($M = 20.64$, $SD = 1.93$; $t(94) = -3.15$, $p = .002$), which follows from the average age of entry into each of the levels within the Dutch education system. College students mostly came from intact families (84%), whereas only 38% of vocational students came from intact families. There was no difference in self-reported household chaos in the current living situation between vocational and college students, $t(88) = -0.04$, $p = .967$, respectively $M = 2.42$, $SD = 0.39$ and $M = 2.43$, $SD = 0.55$ as measured by the Confusion, Hubbub, And Order Scale (Matheny et al., 1995). No differences in birth country, current living situation or social status were observed between vocational and college students. The first lab visit was completed by 96 participants, of whom 90 (94%) also completed the second lab visit. There were no differences between participants who completed one or two visits on education ($\chi^2(1) = 2.96$, $p = .116$). Participants who only completed one lab visit were younger ($M = 19.00$, $SD = 1.10$) than the participants who completed both lab visits ($M = 20.40$, $SD = 1.95$; $t(94) = 2.85$, $p = .024$). Of the participants who did complete both visits, 4% reported a country other than the Netherlands as their birth country, against none of the participants who completed one lab visit. No significant differences in caregiver sensitivity and in sensory-processing sensitivity were found between participants who completed only one lab visit and participants who completed both lab visits.

Participants were recruited between December 2015 and August 2017 through messages on their school's digital learning environment, presentations during classes, and advertisements on Facebook targeting women between 18 and 25 years old living in cities nearby the lab. People interested in participation filled out an online questionnaire and were then contacted by the researchers to further inform them about the study and to confirm whether they met the inclusion criteria (female, age between 18 and 25 years, and vocational or college student). Participants were excluded if they had a child, had been or were pregnant at the time of recruitment, or had mental (e.g., depression, autism) or physical problems (e.g., hearing problems, paralysis). Students from educational programs in which child rearing was an important part of the curriculum, such as vocational education for childcare practitioner, were excluded. Participants reported whether they had experience with taking care of children below the age of two years. Most participants indicated they had experience with this (58%), which included experience through relatives and babysitting. Vocational students had significantly less experience than college students, with 62% of vocational students indicating no experience versus only 32% of college students indicating no experience ($\chi^2[1] = 5.60$, $p = .018$).

Procedure

The research project was approved by the ethics committee of the Institute of Education and Child Studies of Leiden University and preregistered in the Open Science Framework (Prevoo, Alink, Bodrij, & IJzendoorn, 2015). Participants attended two lab visits of two hours each at the university, separated by two months. At the start of the first lab visit participants gave informed consent. During both visits participants took care of an infant simulator to elicit caregiving behavior from participants (Voorthuis et al., 2013) in a lab room furnished as a living room. The infant simulator is a lifelike baby doll, which can be programmed to make sounds on certain moments, such as crying, burping, fussing and laughing (Realityworks, Eau Claire, WI, U.S.A.). During the first phase no other tasks were given (12 min). During the second and third phase participants were asked to fill out a questionnaire and play a game and were instructed to progress as far as possible (12 min and 13 min, respectively). The infant simulator was programmed to cry for 5 min during each phase and to not respond to caregiving behavior.

The living room had two conditions, namely the neutral condition and the chaos condition. The order of conditions was counterbalanced and assignment to condition of the first phase was randomized. In the neutral condition (see online supplemental materials Figure A1) the living room looked neat and orderly, with calm music playing (average level of 43.4 dB). In the chaos condition, the living room was very unorganized, with baby clothes, magazines, letters, notes and toys scattered around the room, the TV playing loud music videos and commercials (average level of 58.1 dB), and there were a lot of colorful and bold prints in the room. To increase crowding, the room was made smaller in the chaos condition by pulling a see-through curtain to close off part of the room (see online supplemental materials Figure A2). This chaos manipulation tapped into multiple aspects of household chaos, namely material disorganization, high noise levels, and crowding, or person-to-square meter ratio (Evans & Wachs, 2010; Matheny et al., 1995). In both conditions, participants were asked to not make changes to the room. Our manipulation was successful: participants rated the chaos condition as less spacious, noisier, busier and dirtier than the neutral condition (with *t*s (89) between 9.62 and 49.07, *p*s $< .001$).

Before and after taking care of the infant simulator, participants came to a different lab room where they completed multiple questionnaires and computer tasks. In addition, saliva was collected during both visits to measure salivary alpha-amylase. Data from the computer tasks and salivary alpha-amylase were not used in the current report. Participants' responses to the sound of a squeaky door and a high-pitched tone were filmed before the start of the neutral condition to code for responsivity to noise as part of the sensory-processing sensitivity measure. At the end of the second visit participants received €40 as a reward for their participation and participants were debriefed about the goal of the study.

Measures

Caregiver sensitivity. The Ainsworth Sensitivity Scale (Ainsworth et al., 1974) was slightly adapted to the use of the infant simulator and was used to code caregiver sensitivity (Voorthuis et al., 2013). This scale considers the caretaker's awareness and interpretation of signals and the appropriateness and promptness of the response. A score on a scale of 1 to 9 was given, with 1 = *highly insensitive* and 9 = *highly sensitive*. Each phase was scored separately. Five coders were trained and reached good intercoder reliability with a mean intraclass coefficient of all different pairs (single measure, absolute agreement) of .79 (range .74–.83, $N = 15$). Coders met regularly to prevent coder drift. The two lab visits were coded by two different coders who had not met the participant.

Sensory-processing sensitivity. Sensory-processing sensitivity was measured using self-report questionnaires, informant-reported questionnaires, and an observational measure of responsivity to noise. The Orienting Sensitivity scale of the Adult Temperament Questionnaire Short form (ATQ-OS) measures awareness of and affect associated with stimuli (Evans & Rothbart, 2007). The original version consisted of 15 items, but for the current study some items were separated to make these items easier to interpret for the participants (e.g., the original item "I dream of lively, detailed situations that do not resemble anything I have experienced in real life" was split into "I dream about lively situations" and "I dream of situations that resemble what I have experienced in real life"). This resulted in a version with 22 items. The items were answered on a five-point Likert scale, ranging from "never" to "always"; an additional answering option was available to indicate that one had never been in that situation, in which case the item was treated as missing. The ATQ-OS was administered during both lab visits. The average scores did not differ significantly between the two lab visits, $t(79) = 0.55$, $p = .585$ and were highly correlated, $r = .79$, $p < .001$. Scores were thus averaged across lab visits. Cronbach's alphas were .84 in the first visit and .83 in the second visit. Higher scores indicated higher orienting sensitivity.

The Noise Sensitivity Scale (NSS) measures sensitivity to noise (Weinstein, 1978). The original version consists of 21 items, but some items were split so that they were easier to interpret. The modified version consisted of 24 items. An example of an item is "I find whispering at the cinema annoying." A six-point Likert scale was used, ranging from "totally disagree" to "totally agree", and with an additional option to indicate that one had never been in that situation. Cronbach's alpha was .84. Higher scores indicated more sensitivity to noise.

The Highly Sensitive Person Scale (HSPS) measures sensory-processing sensitivity as thresholds for processing and excitability by sensory stimuli (Aron & Aron, 1997). The original version consisted of 27 items. Again, some items were split, resulting in a version of the HSPS with 38 items. An example of an item is "I notice subtle sounds." A five-point Likert scale was used, ranging from "not at all applicable" to "completely applicable." Cronbach's alpha was .89. Higher scores indicated more sensory-processing sensitivity.

Informant-report versions were used for the ATQ-OS and the NSS (Evans & Rothbart, 2007; Weinstein, 1978). These were filled out after the first lab visit about the participant by someone who knew them well. Informants were mostly relatives (71%) or friends (27%), or roommates or partners. Cronbach's alphas were .83 and .81, respectively. The informant reports were significantly correlated with the self-reports (NSS: $r = .31$, $p = .005$; ATQ: $r = .39$, $p < .001$) and no differences between relative versus nonrelative informants were observed, $t(76) = -1.69$, p .094, $t(76 = -0.48$, $p = .63$, respectively). Higher scores indicated more orienting sensitivity and more noise sensitivity.

In addition, an observational coding system was used to code responsivity to noise from the observations of responses to the sounds of a squeaking door and a high-pitched bleep. This coding system was based on the emotional intensity scale and the body movement scale of the behavioral coding system developed by Gross and Levenson (1993). Emotional expression, intensity of body movement and latency in seconds between the onset of the sound and the most intense behavioral response were coded. For both sounds combined, intercoder reliability between the two coders was .68 for emotional intensity, .86 for body movement, and .46 for latency in seconds (intraclass correlations, single measure, absolute agreement, $N = 15$). Because of the low intercoder reliability for latency and the fact that it was not significantly correlated with emotional intensity and body movement, latency was not included in the score for observed responsivity to noise. Emotional intensity for the high tone correlated significantly with emotional intensity for the squeaking door and body movement for both sounds (correlations between .22 and .33, ps between .001 and .033). The emotional intensity and body movement scales were averaged for both sounds to compute a score for responsivity to noise.

To explore how measures could be combined into a sensory-processing sensitivity construct, a principal component analysis (PCA) was executed with the self-reported ATQ-OS, NSS, and HSPS, the informant-reported ATQ-OS and NSS and observed responsivity to noise. The scree criterion indicated two components. A second PCA was conducted with the number of components set to two using oblique rotation. The pattern matrix indicated that the ATQ-OS, the NSS, the HSPS and observed responsivity to noise loaded high on component 1, explaining 37% of the variance, whereas the informant ATQ-OS and NSS loaded high on component 2, explaining 23% of the variance (see online supplemental materials Table B1). Thus, component 2 seemed to reflect a measurement type (namely informant reports) rather than a salient aspect of sensory-processing sensitivity. Therefore, the informant measures were not used in the final construct. Z-Scores of the self-reported ATQ-OS, NSS, and HSPS and observed responsivity to noise were averaged and this mean was standardized. Cronbach's alpha was sufficient at .64. Higher scores indicated more sensory-processing sensitivity.

Previous research has suggested that sensory-processing sensitivity is a multidimensional construct (e.g., Smolewska et al., 2006). We conducted PCAs using the predefined subscales of the ATQ-OS (Evans & Rothbart, 2007) and the subscales defined by Smolewska et al. (2006) for the HSPS. For the NSS, no subscales have been described (Weinstein, 1978). Based on the scree criterion a PCA was conducted with a three-component solution with direct oblimin rotation (see online supplemental materials Table B2 for pattern matrix). The first component explained 48% of the variance and reflected arousal by stimuli in general and the threshold for perception of stimuli. This component was named sensory sensitivity (Cronbach's alpha = .84). The second component explained 14% of the variance and reflected being overwhelmed or negatively aroused by stimuli and was named sensory discomfort (Cronbach's alpha = .74). Observed responsivity to noise did not load on either component 1 or 2 and seemed to reflect a measurement type in component 3 rather than a different component, so we decided to leave observed responsivity to noise out of additional analyses with components of sensory-processing sensitivity. The standardized means of the subscales were averaged, and this mean was standardized. Higher scores on sensory sensitivity and sensory discomfort reflected more sensitivity. Cronbach's alpha was .84 for sensory sensitivity and .74 for sensory discomfort.

Analyses

Preliminary analyses were performed to compute correlations between caregiver sensitivity for the separate phases, condition, sensory-processing sensitivity, caregiving experience, and demographic variables. As our data was nested (i.e., three measurements per condition and two conditions per participant), observations were not independent within these levels, and therefore multilevel modeling was used. First, we fitted the unconditional means model, unconditional growth Model 1, and unconditional growth Model 2. Next, covariates were added to the model along with a main effect for condition to test our first hypothesis. In the next model, we added an interaction between condition and sensory-processing sensitivity to test our second hypothesis. Exploratively, we tested a model with a three-way interaction between condition, sensory-processing sensitivity, and phase. The latter two models were also tested for both components of sensory-processing sensitivity separately. See Table B3 for an overview of the tested multilevel models. To predict power, we used G*power 3.1.9.4 and the repeated measures ANOVA with within-between interaction, and entered an expected power of .80, alpha level of .05, effect size of .40, with two groups and three repetitions. The required sample size was 62, indicating our sample was large enough to detect significant interactions.

For the multilevel modeling we used a dataset in which all missing values were multiply imputed. As five out of six participants who did not complete the second lab visit started with the chaos condition, drop out may not be random. According to Van Ginkel, Linting, Rippe, and Van der Voort (2019), multiple imputation is also a fitting solution when data are not missing at random, and equivalent or better compared to complete cases analysis. Therefore, this method was used in this study. To correct for an effect of the order of conditions in the lab visits on caregiver sensitivity and its development over time, we controlled for the main effect of order of condition and the interaction between order of condition and phase.

All analyses were performed in R Version 3.5.1, on a Dell XPS 9370 with an i7 8550U processor overclocked at 2.0Ghz, with 16GB of RAM. Stability of multilevel imputations was evaluated by comparing four methods: the MI function in the Amelia package, with the mice function from the mice package, and the panImpute and jomoImpute functions from the mitml package. The (required) number of iterations varied per method, due to differences in implementation, but all lead to equivalently imputed data sets. A fixed starting seed was set for reproducibility. Pooling of results on 100 imputation sets was performed using the summary functions from mitml and miceadds, as well as using the summary and modelRandEffStats from the merTools package. A series of multilevel models were estimated, incrementally comparing nested models using the anova function from mitml and merTools (which yielded equivalent results). Model comparisons and effect estimates were evaluated at 5% alpha level.

Results

Preliminary Analyses

Correlations between caregiver sensitivity, sensory-processing sensitivity, caregiving experience, age and education level are shown in Table 1. All caregiver sensitivity scores were significantly correlated, apart from phase 1 of the chaos condition and phase 2 of the neutral condition. Caregiver sensitivity scores were significantly lower for consecutive phases (see Table 1), for both the neutral and the chaos condition (with a range of $t(89)$ between 2.62 and 9.78, p values between $<.001$ and $<.010$). Sensory-processing sensitivity was significantly correlated with caregiver sensitivity in the third phase of the neutral condition, with higher rates of sensory-processing sensitivity being related to higher scores on caregiver sensitivity. Age correlated significantly with caregiver sensitivity in the first phase. Education level showed this pattern as well. Caregiving experience was only related to education level. As education level and age were related to caregiver sensitivity scores, we included both as covariates, alongside the interaction between condition of the first lab visit and phase.

Table 1
Descriptive Statistics and Correlations Between Caregiver Sensitivity, Sensory-Processing Sensitivity, Caregiving Experience, and Demographic Variables (N Between 80 and 96)

	M (*SD*)	1	2	3	4	5	6	7	8	9	10	11	12
Neutral condition													
1. CS phase 1	6.03 (1.55)	—											
2. CS phase 2	4.74 (1.92)	.54***	—										
3. CS phase 3	4.09 (1.92)	.43***	.83***	—									
Chaos condition													
4. CS phase 1	5.75 (1.54)	.43***	.18	.22*	—								
5. CS phase 2	4.37 (1.96)	.25*	.50***	.53***	.46***	—							
6. CS phase 3	4.03 (1.89)	.25*	.50***	.58***	.41***	.81***	—						
7. Sensory-processing sensitivity	−0.003 (0.69)	.01	.09	.25*	.04	.18	.11	—					
8. Sensory sensitivity	0.01 (0.82)	−.04	.08	.22*	−.04	.00	−.05	.79**	—				
9. Sensory discomfort	−0.03 (0.88)	−.05	.08	.21*	.05	.16	.11	.79**	.54**	—			
10. Caregiving experience	—	.04	−.13	−.13	.16	−.07	.01	.03	.03	−.05	—		
11. Age	20.31 (1.93)	.19	.11	.06	.23*	.17	.17	.01	−.00	.08	.04	—	
12. Education level	—	.19	.00	.04	.21*	.19	.14	.10	.06	.07	.25*	.31**	—

Note. CS = caregiver sensitivity. Sensory-processing sensitivity, sensory sensitivity, and sensory discomfort are the standardized means of the standardized scores of the sensory-processing sensitivity measures.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Explaining Caregiver Sensitivity

All results from multilevel analyses hereafter are based on the pooled results of the imputed data sets (see Table 2), with the exception of the intraclass correlation and explained variance. The unconditional means model (Model 1) showed an intraclass correlation of .37, meaning that 37% of the variance in caregiver sensitivity was within-subject variance. This indicates sufficient dependency in the data to warrant the use of multilevel modeling. In Model 2, phase was added as a numeric predictor, since a linear functional form provided an adequate representation, which showed caregiver sensitivity scores significantly declined over time, $t = -13.05$, $p < .001$. Model 2 fit the data significantly better than Model 1 ($\chi^2(1) = 144.43$, $p < .001$) and the main effect of phase explained 28% of the within-subject variance in caregiver sensitivity. In Model 3, random intercepts and random slopes were added for phase, allowing for different slopes in caregiver sensitivity per phase. The main effect of phase remained significant, with caregiver sensitivity declining over time, $t = -11.17$, $p < .001$. Model 3 fit the data significantly better than Model 2 ($\chi^2(2) = 10.85$, $p < .001$), indicating that allowing for different slopes per phase is necessary. The main and random effect of phase explained 37% of the within-subject variance in caregiver sensitivity.

Causal effect of household chaos. To test our first hypothesis, that caregiver sensitivity was lower in the chaos than in the neutral condition, a main effect for condition was added in Model 4. Age, education level, and the interaction between order of condition and phase were added as control variables. Condition had a significant effect on caregiver sensitivity, $t = -2.18$, $p = .030$, with lower caregiver sensitivity in the chaos than in the neutral condition. Model 4 fit the data significantly better than Model 3 ($\chi^2(5) = 2.64$, $p = .022$) and explained 21% additional variance in intercepts in comparison to Model 3 and 1% additional variance in slopes.

Moderation by sensory-processing sensitivity. To test our second hypothesis, that the effect of household chaos on caregiver sensitivity was stronger for participants with higher sensory-processing sensitivity, we added the interaction between condition and sensory-processing sensitivity in Model 5. The interaction was not significant, $t = -0.07$, $p = .945$, meaning sensory-processing sensitivity did not moderate the effect of condition on caregiver sensitivity. Model 5 did not fit the data significantly better than Model 4 ($\chi^2(2) = 0.25$, $p = .780$).

Interaction with phase. Exploratively, we tested whether there was an interaction between condition and sensory-processing sensitivity over time. Thus, a three-way interaction of phase, condition and sensory-processing sensitivity was added in Model 6. The three-way interaction was not significant, $t = -1.16$, $p = .248$ and the model did not fit significantly better than Model 5 ($\chi^2(3) = 1.76$, $p = .153$) nor Model 4 ($\chi^2(5) = 1.52$, $p = .330$). This means that the decrease in caregiver sensitivity due to condition was not stronger over time for participants with higher sensory-processing sensitivity. The interaction between phase and sensory-processing sensitivity nearly reached statistical significance, $t = 1.78$, $p = .075$, with participants with higher sensory-processing sensitivity tending to have a slower decrease in caregiver sensitivity than participants with lower sensory-processing sensitivity.

Components of Sensory-Processing Sensitivity

Sensory sensitivity. Next, we tested the models discussed above for both components of sensory-processing sensitivity separately (see Table 3). In Model 5a, an interaction between condition and sensory sensitivity was added, while keeping the covariates. The interaction for condition and sensory sensitivity was not significant, meaning the effect of condition on caregiver sensitivity was not moderated by sensory sensitivity, $t = -1.24$, $p = .215$. Model 5a did not fit the data significantly better than Model 4 ($\chi^2(2) = 0.70$, $p = .499$).

In Model 6a we exploratively tested the interaction between condition, sensory sensitivity and phase. The three-way interaction reached statistical significance, $t = -2.15$, $p = .032$. In Figure 1, lines for low ($< M - 1$ *SD*), medium (between 1 *SD* $\pm$ *M*), and high ($> M + 1$ *SD*) sensory sensitivity were

Table 2
Overview of Fitted Models for Caregiver Sensitivity Moderated by Sensory-Processing Sensitivity

Parameter	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	4.84 (0.14)***	6.65 (0.19)***	6.65 (0.17)***	3.55 (1.31)**	3.60 (1.31)**	3.84 (1.36)**
Phase		−0.91 (0.07)***	−0.91 (0.08)***	−0.87 (0.12)***	−0.87 (0.12)***	−0.99 (0.23)***
Condition				−0.25 (0.11)*	−0.25 (0.11)*	−0.43 (0.28)
Sensory-processing sensitivity					0.09 (0.21)	−0.57 (0.46)
Condition × Sensory-processing Sensitivity					−0.01 (0.11)	0.30 (0.29)
Phase × Condition × Sensory-processing Sensitivity						−0.15 (0.13)
Phase × Sensory-processing Sensitivity						0.38 (0.22)
Age				0.13 (0.07)*	0.13 (0.07)*	0.13 (0.07)*
Education level				0.43 (0.31)	0.41 (0.31)	0.41 (0.31)
Phase × Condition First Visit				−0.07 (0.16)	−0.07 (0.16)	−0.11 (0.16)
σ_0^2 (ID)	1.44	1.57	0.96	0.76	0.82	0.74
σ_1^2			0.26	0.26	0.27	0.24
σ_e^2 (Resid)	2.42	1.74	1.53	1.51	1.51	1.50
$\rho_{01phase}$			−0.20	−0.18	−0.22	−0.14
LogLikelihood	−1109.8	−1034.0	−1021.0	−1014.1	−1013.4	−1010.2
Deviance	2219.5	2067.9	2042.1	2028.1	2026.9	2020.5

Note. The values for σ_0^2, σ_1^2, σ_e^2, $\rho_{01phase}$, LogLikelihood, and Deviance are based on complete cases.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 3
Overview of Fitted Models for Caregiver Sensitivity Moderated by Sensory Sensitivity and Sensory Discomfort

Parameter	Model 5a	Model 6a	Model 5b	Model 6b
Intercept	3.56 (1.31)**	3.78 (1.37)**	3.60 (1.32)**	3.86 (1.37)**
Phase	−0.87 (0.12)***	−0.98 (0.23)***	−0.87 (0.12)***	−1.00 (0.23)***
Condition	−0.25 (0.11)*	−0.41 (0.28)	−0.25 (0.11)*	−0.42 (0.28)
Age	0.13 (0.07)*	0.13 (0.07)*	0.13 (0.07)*	0.13 (0.07)*
Education level	0.43 (0.31)	0.43 (0.31)	0.42 (0.31)	0.42 (0.31)
Phase × Condition First Visit	−0.07 (0.16)	−0.09 (0.16)	−0.07 (0.16)	−0.08 (0.16)
Sensory sensitivity	0.23 (0.22)	−0.71 (0.46)		
Condition × Sensory Sensitivity	−0.15 (0.12)	0.41 (0.29)		
Phase × Condition × Sensory Sensitivity		−0.28 (0.13)*		
Phase × Sensory Sensitivity		0.50 (0.22)*		
Sensory discomfort			−0.02 (0.22)	−0.76 (0.47)
Condition × Sensory Discomfort			0.04 (0.12)	0.40 (0.29)
Phase × Condition × Sensory Discomfort				−0.18 (0.13)
Phase × Sensory Discomfort				0.42 (0.22)
σ_0^2 (ID)	0.87	0.86	0.78	0.70
σ_1^2	0.30	0.29	0.26	0.23
σ_e^2 (Resid)	1.52	1.51	1.51	1.51
$\rho_{01phase}$	−0.33	−0.31	−0.20	−0.10
LogLikelihood	−894.4	−891.7	−1013.8	−1010.9
Deviance	1788.7	1783.4	2027.7	2021.9

Note. The values for σ_0^2, σ_1^2, σ_e^2, $\rho_{01phase}$, LogLikelihood, and Deviance are based on complete cases.
* $p < .05$. ** $p < .01$. *** $p < .001$.

drawn. Next to a main effect of condition, the Figure shows that in the neutral condition, participants with higher sensory sensitivity had a slower decrease in caregiver sensitivity compared to participants with lower sensory sensitivity, whereas in the chaos condition there was no interaction between phase and sensory sensitivity. For participants with low sensory sensitivity, the decrease in caregiver sensitivity over time does not appear to differ between conditions, whereas participants with high sensory sensitivity appear to have a stronger decrease over time in the chaos condition. The model did not fit the data significantly better than Model 5a ($\chi^2(3) = 1.91$, $p = .125$) or Model 4 ($\chi^2(5) = 1.49$, $p = .191$).

Sensory discomfort. To test whether the effect of condition on caregiver sensitivity was stronger for participants with higher sensory discomfort, we entered the interaction between condition and sensory discomfort in Model 5b, while keeping the covariates in the model. The interaction for condition and sensory discomfort was not significant, $t = 0.36$, $p = .719$, meaning sensory discomfort did not moderate the effect of condition on caregiver sensitivity. Model 5b did not fit the data significantly better than Model 4 ($\chi^2(2) = 0.13$, $p = .882$).

In Model 6b we exploratively tested the interaction between condition, sensory discomfort and phase, while keeping the covariates in the model. The three-way interaction was not significant, $t = -1.34$, $p = .181$, meaning the decrease in caregiver sensitivity due to condition was not stronger over time for participants with higher sensory discomfort. The interaction between phase and sensory discomfort nearly reached statistical significance, with participants with higher sensory sensitivity tending to have a slower decrease in caregiver sensitivity than participants with lower sensory sensitivity, $t = 1.89$, $p = .059$. Model 6b did not fit the data significantly better than Model 5b ($\chi^2(3) = 1.72$, $p = .160$) or Model 4 ($\chi^2(5) = 1.09$, $p = .3625$).

Discussion

In the current study, we used an experimental design with a neutral and chaotic lab setting to test whether household chaos had a causal effect on caregiver sensitivity. In both conditions, caregiver sensitivity decreased over time. Caregiver sensitivity was significantly lower in the chaos condition than in the neutral condition, confirming our first hypothesis. Our second hypothesis was that sensory-processing sensitivity would moderate the relation between household chaos and caregiver sensitivity. We did not find support for this hypothesis in the current study. We did find a significant three-way interaction, which showed that the chaos condition led to a stronger decrease in caregiver sensitivity over time compared to the decrease in the neutral condition for participants with higher sensory sensitivity than for participants with lower sensory sensitivity.

Causal Effect of Household Chaos

Previous correlational and longitudinal research has shown a relation between higher levels of household chaos and negative parenting and caregiver sensitivity (e.g., Coldwell et al., 2006; Deater-Deckard et al., 2012; Dumas et al., 2005; Mills-Koonce et al., 2016; Vernon-Feagans et al., 2012). With our experimental design we were able to confirm a causal effect of household chaos on caregiver sensitivity: caregiver sensitivity was lower in the chaos condition than in the neutral condition. It is possible that more household chaos makes a bigger demand on parental self-regulation, which is the regulation of behavior and attention (Deater-Deckard et al., 2012; Deater-Deckard & Bell, 2017). Parents with lower self-regulation may have more trouble regulating their parenting behaviors in the face of household chaos than parents with higher self-regulation, leading to less positive and more negative parenting. A second explanation may be that stress

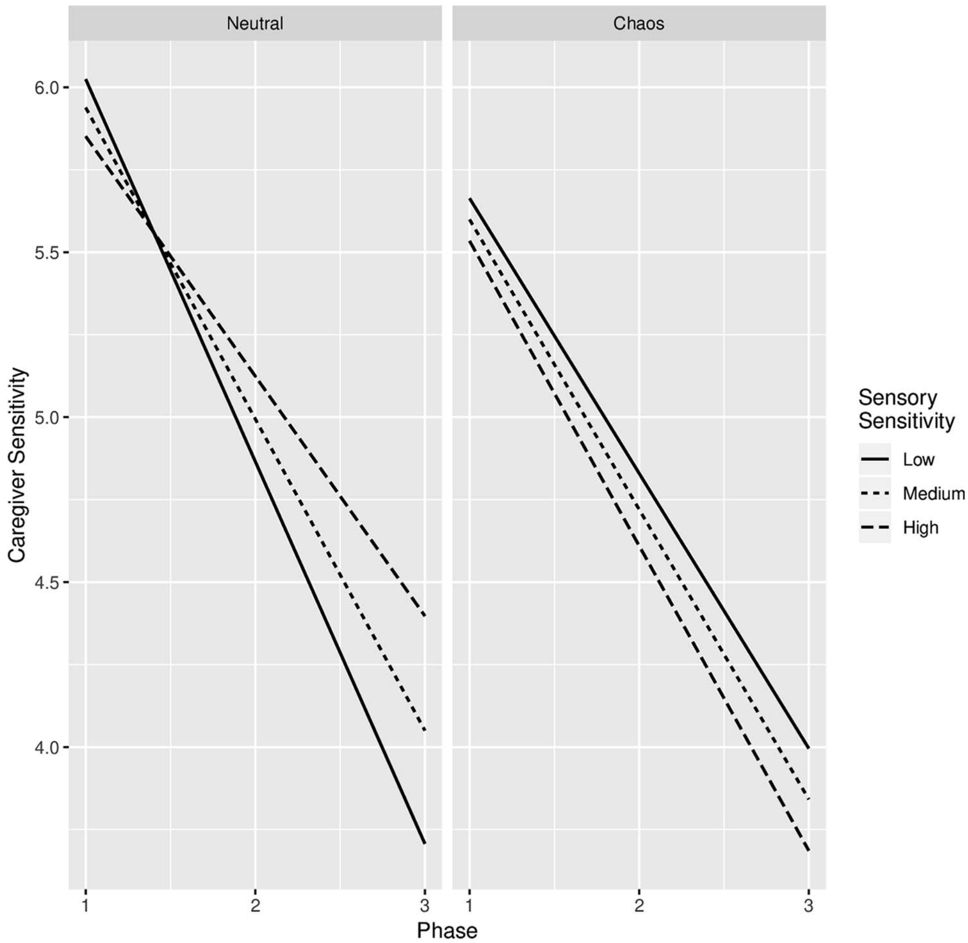

Figure 1. Three-way interaction between condition, phase, and sensory sensitivity on caregiver sensitivity.

and negative emotions mediate the causal effect of household chaos on parenting. The distracting and unpredictable nature of more chaotic households may evoke stress and negative emotions (Nelson, O'Brien, Blankson, Calkins, & Keane, 2009; Selander et al., 2009), which in turn may lead to more negative parenting (Stith et al., 2009). Third, as we asked participants not to change the chaos manipulation, the level of household chaos was uncontrollable. This may have led to a feeling of diminished control, which may lead to a feeling of less parental efficacy (Corapci & Wachs, 2002). A lower sense of parental efficacy has been linked to less positive parenting (Albanese, Russo, & Geller, 2019). Outside the lab, this uncontrollable nature can be seen as chaos caused by others in the household and as levels of crowding and exterior noise. Lastly, the increased noise levels may simply make it more difficult to notice infant signals, leading to less prompt responses as more subtle infant signals may be missed. Higher observed noise levels were related to more nonverbal responsiveness in caregivers (Corapci & Wachs, 2002), which gives less opportunity to show caregiver sensitivity than verbal responses.

Although we found that household chaos does have a causal effect on caregiving behavior, the effect of household chaos was small: condition only had an effect of 0.25 on the 9-point scale measuring caregiver sensitivity. Previous research showed moderate to large effect sizes for the relation between more household chaos and more negative parenting and less parental sensitivity (e.g., Coldwell et al., 2006; Dumas et al., 2005; Vernon-Feagans et al., 2012). The difference in magnitude of the effect was probably not due to types of measurement, as these studies also included observational measures. One possible explanation is that chronic exposure to household chaos is needed to find a larger effect on parenting. As household chaos is relatively stable over time (e.g., Deater-Deckard et al., 2009), causal effects of chronic exposure may be highly relevant and should be further investigated. It would also be interesting to investigate whether a two-way interaction is present after chronic exposure to high levels of household chaos. A second explanation is that household chaos also acts on parenting through other pathways than just through a direct effect. Future research should focus on whether there is an interplay between household chaos and parenting characteristics, leading to parenting problems. Parents with certain characteristics may have more trouble maintaining an orderly home and with choosing positive parenting strategies. The increased level of household chaos may also have a direct effect on parenting and further impede on parent characteristics. Following this line of thought, the interplay of parent characteristics with household chaos and parenting may result in a negative spiral, leading to increased parenting problems.

Sensory-Processing Sensitivity

To add to the existing body of research on the dimensionality of sensory-processing sensitivity, we used PCAs to determine whether this was a unidimensional construct or consisted of multiple components. Our data fit the notion of a two-dimensional construct, supporting previous findings by Evans and Rothbart (2008). The two components reflected how readily stimuli are noticed and if a person is in general affected by stimuli (sensory sensitivity), and how overwhelmed or negatively aroused a person is by stimuli (sensory discomfort).

We expected that the effect of household chaos on caregiver sensitivity would be stronger for participants with higher (components of) sensory-processing sensitivity. In this study, we found that participants with higher sensory sensitivity decreased faster in caregiver sensitivity in the chaos condition than in the neutral condition, whereas the decrease over time was similar in both conditions for participants with low sensory sensitivity. Due to having a lower threshold for noticing stimuli, it may be more difficult for these participants to endure chaotic environments. Interestingly, these participants showed more caregiver sensitivity in the neutral condition than participants with medium or lower sensory sensitivity. Parents who are high in sensory sensitivity may thus lose their advantage in a chaotic environment over time due to overstimulation, as child and environmental stimuli compete for attention. Future studies should test whether a loss of advantage is also true for other parenting characteristics, as Deater-Deckard et al. (2012) already showed for self-regulation. For participants with lower sensory sensitivity, no differences were found over time between conditions. Also, we did not find a three-way interaction for the overall construct of sensory-processing sensitivity or the component sensory discomfort. The amount of discomfort in response to environmental stimuli is apparently not related to caregiving behavior or may only exist when studying the effect of chronic exposure to household chaos. Another explanation is that our measure of sensory discomfort, which only explained 14% of the variance in sensory-processing sensitivity, did not adequately reflect sensory discomfort.

Strengths and Limitations

The current study had multiple strong aspects, such as its experimental design, the use of an infant simulator to ensure there was no variability in caregiver demands, and the use of multiple types of data to form a measure of sensory-processing sensitivity. There were also some limitations. First, as proof of principle, this study was executed in a highly controlled lab setting with female students and an infant simulator and participants were asked not to alter the manipulation. This impedes generalizability in multiple ways. At home, parents are able to influence levels of household chaos, such as noise levels, while participants were asked to not alter our manipulation. Parents interacting with their children already have experience and expectations regarding parenting and their child, which influence parenting. While we deliberately used the infant simulator to rule out a child effect, in real families children may respond to the chaotic environment and thus also affect parenting (e.g., Dumas et al., 2005). Also, our infant simulator was programmed not to respond to caregiver behavior, which could mean that our results are mostly generalizable to infants who are more difficult to sooth, such as infants with negative temperaments (Yoo & Reeb-Sutherland, 2013). Participants were in our manipulation for 45 min, which may not be comparable to effects of chronic exposure to household chaos. Also, we studied women, meaning results may be only generalizable to mothers. Second, we did not manipulate levels of family and week routines, thus not testing the entire definition of household chaos. Using a nontransparent movable wall or room divider instead of a see-through curtain may also increase ecological validity, although our see-though curtain was enough to affect spaciousness ratings. Last, the coders of caregiver sensitivity could not be blind to the condition of the living room, as the condition was visible in the videos, potentially leading to biased coding of caregiver sensitivity (either lower in the chaos condition in line with the study hypothesis or higher in sympathy with the participants).

Future Research and Implications

Our results imply the need for further experimental research in family home environments to test whether the causal effect of household chaos on parenting holds outside the lab. Potentially, our findings may be amplified when taking chronic exposure to household chaos into account. Future research should therefore take into account participants' chronic exposure to household chaos and examine whether this numbs the participant to the effect of household chaos (e.g., habituation) or makes the participant more susceptible (e.g., sensitization). If our findings are replicated outside the lab, then this may be reason to include reducing household chaos in interventions aimed at improving parenting. Future studies should further explore in light of which parental characteristics, in addition to sensory sensitivity, we should see household chaos as a particularly difficult environment for parenting, and should explore the potential negative spiral between household chaos and parent characteristics in explaining parenting. Lastly, studies on sensory-processing sensitivity should distinguish between sensory sensitivity and sensory discomfort, as these may yield different results.

Conclusion

In conclusion, our experimental lab study was the first to show that household chaos has a causal effect on caregiving behavior, although the effects were small. As correlational and longitudinal studies tend to find larger effects, it may be valuable to study the importance of chronic exposure to household chaos and whether there is a negative interplay between household chaos and parent characteristics in predicting parenting. Using an RCT in a highly chaotic sample and reducing household chaos to a lower level over a longer time period may be informative. For parents with higher sensory sensitivity household chaos may have a more pronounced effect on parenting quality. More research is needed to understand the mechanisms through which household chaos exerts an influence on parenting, particularly outside the lab, to inform prevention and intervention and to ultimately lead to improved parenting and child development.

References

Ainsworth, M. D. S., Bell, S. M., & Stayton, D. J. (1974). Infant mother attachment and social development; Socialization as a product of reciprocal responsiveness to signals. In M. P. M. Richards (Ed.), *The integration of a child into a social world* (pp. 99–135). Cambridge, England: Cambridge University Press.

Albanese, A. M., Russo, G. R., & Geller, P. A. (2019). The role of parental self-efficacy in parent and child well-being: A systematic review of associated outcomes. *Child: Care, Health and Development, 45,* 333–363. http://dx.doi.org/10.1111/cch.12661

Aron, E. N., & Aron, A. (1997). Sensory-processing sensitivity and its relation to introversion and emotionality. *Journal of Personality and Social Psychology, 73,* 345–368. http://dx.doi.org/10.1037/0022-3514.73.2.345

Aron, E. N., Aron, A., & Davies, K. M. (2005). Adult shyness: The interaction of temperamental sensitivity and an adverse childhood environment. *Personality and Social Psychology Bulletin, 31,* 181–197. http://dx.doi.org/10.1177/0146167204271419

Coldwell, J., Pike, A., & Dunn, J. (2006). Household chaos—Links with parenting and child behaviour. *Journal of Child Psychology and Psychiatry, 47,* 1116–1122. http://dx.doi.org/10.1111/j.1469-7610.2006.01655.x

Corapci, F., & Wachs, T. D. (2002). Does parental mood or efficacy mediate the influence of environmental chaos upon parenting behavior? *Merrill-Palmer Quarterly, 48,* 182–201. http://dx.doi.org/10.1353/mpq.2002.0006

Deater-Deckard, K., & Bell, M. A. (2017). Maternal executive function, heart rate, and EEG alpha reactivity interact in the prediction of harsh parenting. *Journal of Family Psychology, 31,* 41–50. http://dx.doi.org/10.1037/fam0000286

Deater-Deckard, K., Chen, N., Wang, Z., & Bell, M. A. (2012). Socioeconomic risk moderates the link between household chaos and maternal executive function. *Journal of Family Psychology, 26,* 391–399. http://dx.doi.org/10.1037/a0028331

Deater-Deckard, K., Mullineaux, P. Y., Beekman, C., Petrill, S. A., Schatschneider, C., & Thompson, L. A. (2009). Conduct problems, IQ, and household chaos: A longitudinal multi-informant study. *Journal of Child Psychology and Psychiatry, 50,* 1301–1308. http://dx.doi.org/10.1111/j.1469-7610.2009.02108.x

Deater-Deckard, K., Wang, Z., Chen, N., & Bell, M. A. (2012). Maternal executive function, harsh parenting, and child conduct problems. *Journal of Child Psychology and Psychiatry, and Allied Disciplines, 53,* 1084–1091. http://dx.doi.org/10.1111/j.1469-7610.2012.02582.x

Dumas, J. E., Nissley, J., Nordstrom, A., Smith, E. P., Prinz, R. J., & Levine, D. W. (2005). Home chaos: Sociodemographic, parenting, interactional, and child correlates. *Journal of Clinical and Adult Psychology, 34,* 93–104. http://dx.doi.org/10.1207/s15374424jccp3401_9

Evans, D. E., & Rothbart, M. K. (2007). Developing a model for adult temperament. *Journal of Research in Personality, 41,* 868–888. http://dx.doi.org/10.1016/j.jrp.2006.11.002

Evans, D. E., & Rothbart, M. K. (2008). Temperamental sensitivity: Two constructs or one? *Personality and Individual Differences, 44,* 108–118. http://dx.doi.org/10.1016/j.paid.2007.07.016

Evans, G. W., & Wachs, T. D. (2010). *Chaos and its influence on children's development*. Washington, DC: American Psychological Association.

Evers, A., Rasche, J., & Schabracq, M. J. (2008). High sensory-processing sensitivity at work. *International Journal of Stress Management, 15,* 189–198. http://dx.doi.org/10.1037/1072-5245.15.2.189

Gross, J. J., & Levenson, R. W. (1993). Emotional suppression: Physiology, self-report, and expressive behavior. *Journal of Personality and Social Psychology, 64,* 970–986. http://dx.doi.org/10.1037/0022-3514.64.6.970

Martin, A., Razza, R., & Brooks-Gunn, J. (2012). Specifying the links between household chaos and preschool children's development. *Early Child Development and Care, 182,* 1247–1263. http://dx.doi.org/10.1080/03004430.2011.605522

Matheny, A. P., Jr., Wachs, T. D., Ludwig, J. L., & Phillips, K. (1995). Bringing order out of chaos: Psychometric characteristics of the Confusion, Hubbub, and Order Scale. *Journal of Applied Developmental Psychology, 16,* 429–444. http://dx.doi.org/10.1016/0193-3973(95)90028-4

Mills-Koonce, W. R., Willoughby, M. T., Garrett-Peters, P., Wagner, N., Vernon-Feagans, L., & the Family Life Project Key Investigators. (2016). The interplay among socioeconomic status, household chaos, and parenting in the prediction of child conduct problems and callous-unemotional behaviors. *Development and Psychopathology, 28,* 757–771. http://dx.doi.org/10.1017/S0954579416000298

Nelson, J. A., O'Brien, M., Blankson, A. N., Calkins, S. D., & Keane, S. P. (2009). Family stress and parental responses to children's negative emotions: Tests of the spillover, crossover, and compensatory hypotheses. *Journal of Family Psychology, 23,* 671–679. http://dx.doi.org/10.1037/a0015977

Prevoo, M. J. L., Alink, L. R. A., Bodrij, F. F., & IJzendoorn, M. H. van (2015). *Changing chaos: The causal role of household chaos in child maltreatment—Study 1*. http://dx.doi.org/10.17605/OSF.IO/VA8WM

Selander, J., Bluhm, G., Theorell, T., Pershagen, G., Babisch, W., Seiffert, I., . . . Jarup, L. (2009). Saliva cortisol and exposure to aircraft noise in six European countries. *Environmental Health Perspectives, 117,* 1713–1717. http://dx.doi.org/10.1289/ehp.0900933

Smolewska, K. A., McCabe, S. B., & Woody, E. Z. (2006). A psychometric evaluation of the Highly Sensitive Person Scale: The components of sensory-processing sensitivity and their relation to the BIS/BAS and "Big Five." *Personality and Individual Differences, 40,* 1269–1279. http://dx.doi.org/10.1016/j.paid.2005.09.022

Stith, S. M., Liu, T., Davies, L. C., Boykin, E. L., Alder, M. C., Harris, J. M., . . . Dees, J. E. M. E. G. (2009). Risk factors in child maltreatment: A meta-analytic review of the literature. *Aggression and Violent Behavior, 14,* 13–29. http://dx.doi.org/10.1016/j.avb.2006.03.006

Van Ginkel, J. R., Linting, M., Rippe, R. C. A., & Van der Voort, A. (2019). Rebutting existing misconceptions about multiple imputation as a method for handling missing data. *Journal of Personality Assessment, 18,* 1–12. http://dx.doi.org/10.1080/00223891.2018.1530680

Vernon-Feagans, L., Garrett-Peters, P., Willoughby, M., Mills-Koonce, R., & The Family Life Project Key Investigators. (2012). Chaos, poverty, and parenting: Predictors of early language development. *Early Childhood Research Quarterly, 27,* 339–351. http://dx.doi.org/10.1016/j.ecresq.2011.11.001

Voorthuis, A., Out, D., van der Veen, R., Bhandari, R., van IJzendoorn, M. H., & Bakermans-Kranenburg, M. J. (2013). One doll fits all: Validation of the Leiden Infant Simulator Sensitivity Assessment (LISSA). *Attachment & Human Development, 15*(5–6), 603–617. http://dx.doi.org/10.1080/14616734.2013.820897

Wachs, T. D. (2013). Relation of maternal personality to perceptions of environmental chaos in the home. *Journal of Environmental Psychology, 34,* 1–9. http://dx.doi.org/10.1016/j.jenvp.2012.11.003

Weinstein, N. D. (1978). Individual differences in reactions to noise: A longitudinal study in a college dormitory. *Journal of Applied Psychology, 63,* 458–466. http://dx.doi.org/10.1037/0021-9010.63.4.458

Yoo, K., & Reeb-Sutherland, B. C. (2013). Effects of negative temperament on 5-month-old infants' behavior during the still-face paradigm. *Infant Behavior & Development, 36,* 344–348. http://dx.doi.org/10.1016/j.infbeh.2013.03.002

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