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Unravelling the effect of household chaos on parenting

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Self-regulation and impulsivity: Moderators of the effect of household chaos on parenting?

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Abstract

Previous studies have shown that higher levels of household chaos are related to more parenting problems. This relation may be particularly strong for some parents. Self-regulation and impulsivity have been related to household chaos, parenting, and negative responses to stressful environments. Thus, we expected that an effect of household chaos on parenting would be stronger for participants with lower self-regulation and more impulsivity. Using an experimental design, we manipulated levels of household chaos by asking participants to take care of an infant simulator in a neutral and in a chaotic living room (order counterbalanced). Participants were 96 young adults (all female, non-parents). Self-regulation was measured using a self-report questionnaire and computer task on inhibition. Impulsivity was measured by a computer task on delay of gratification. We found a causal effect of household chaos on caregiver sensitivity and not on harsh caregiving. No moderation by self-regulation and impulsivity was found. Furthermore, effects of household chaos on parenting did not depend on self-regulation and impulsivity. Directions for future research concerning moderation of the effect of household chaos on parenting by self-regulation and impulsivity are discussed.

Key words: household chaos, sensitivity, harsh caregiving, self-regulation, experiment, impulsivity

Introduction

More household chaos has been related to parenting problems, including harsh discipline and less parental warmth (e.g., Coldwell, Pike & Dunn, 2006; Deater-Deckard, Wang, Chen & Bell, 2012b). Household chaos is defined as a lack of family routines and week structure, high noise levels, material disorganization, and crowding (Evans & Wachs, 2010; Matheny, Wachs, Ludwig & Phillips, 1995). While there clearly is a relation between more household chaos and lower parenting quality, this may not be present in all parents: parents with lower self-regulation and more impulsivity may be more susceptible to the effects of household chaos on parenting, whereas parents with higher self-regulation and less impulsivity may be better able to cope with household chaos and thus not experience its negative effect on parenting. Previous studies have shown that the effects of stressful environments on behavior were moderated by self-regulation and parent temperament (e.g., Chen, Deater-Deckard & Bell, 2014; Karreman, Van Tuijl, Van Aken & Deković, 2008; Sprague, Verona, Kalkhoff & Kilmer, 2011). Therefore, in the current study we examine whether self-regulation and impulsivity moderate the relation between household chaos and parenting.

Household chaos and parenting

Household chaos has been related to many negative outcomes among parents and children. Higher levels of household chaos have been related to lower child cognitive development, including language development and IQ, more stress, and more behavior and attention problems (e.g., Coldwell et al., 2006; Deater-Deckard et al., 2009; Martin, Razza & Brooks-Gunn, 2011; Mills-Koonce et al., 2016; Vernon-Feagans, Garrett-Peters, Willoughby, Mills-Koonce & The Family Life Project Key Investigators, 2012; Wang, Deater-Deckard, Petrill & Thompson, 2012). Also, parents living in more chaotic households experience more physiological and self-reported stress and report a lower sense of parental efficacy (e.g., Blair, Berry, Mills-Koonce, Granger, & The FLP Investigors, 2013; Corpaci & Wachs, 2002; Deater-Deckard et al., 2009; Selander et al., 2009).

Ample research has related household chaos to parenting problems. Higher levels of household chaos have been related to maternal harsh parenting and negativity, dysfunctional discipline, including overreactivity and laxness, and parental anger and hostility towards the child (Coldwel et al., 2006; Deater-Deckard et al., 2012b; Dumas et al., 2005). Household chaos is also related to less parental warmth and joy, less parental responsiveness and acceptance of the child, and less stimulating parenting (Coldwel et al., 2006; Corapci & Wachs, 2002; Vernon-Feagans, Willoughby, Garrett-Peters & The FLP Investigators, 2016). Moreover, in our previous report on the current experimental study, we found that chaos negatively influenced caregiver sensitivity (Andeweg, Bodrij, Prevoo, Rippe &

Alink, 2020). Lastly, results of another experimental study showed that parents who received an intervention to reduce household chaos showed less harsh discipline post intervention compared to the control group (Chapter 4).

The moderating role of self-regulation and impulsivity

Self-regulation, effortful control (EC), and executive functioning (EF) have been subject to different conceptualizations, operationalizations, and terminologies throughout developmental research (e.g., Bridgett, Oddi, Laake, Murdock & Bachmann, 2013; Crandall et al., 2015; Rothbart & Rueda, 2005). Self-regulation reflects attentional and inhibitory control, and both EC and EF are seen as aspects of self-regulation. EC is mostly viewed as a temperamental construct, encompassing the activation and inhibition of behavior and attention focusing, and EF is mostly viewed as referring to cognitive capacities, including working memory, attention shifting, and inhibition (Bridgett et al., 2013). As EC and EF largely overlap and have very similar developmental trajectories, neurobiological bases and common correlates, researchers are increasingly calling to integrate these constructs under the term self-regulation (Bridgett et al., 2013; Zhou, Chen & Main, 2012). Therefore, in this study we use the integrative term self-regulation. Related to self-regulation is impulsivity, with more impulsivity relating to less self-regulation (e.g., Fino et al., 2014; MacKillop et al., 2016; Rothbart & Rueda, 2005). This temperamental construct refers to how fast a response is initiated and to urgency in approach behavior (Eisenberg et al., 2007). Although impulsivity is related to self-regulation, it predicts different behavioral outcomes, indicating that these are different constructs (e.g., Eisenberg et al., 2004; Eisenberg et al., 2007).

Based on previous research, it is possible that self-regulation and impulsivity are both moderators of the effect of household chaos on parenting. Lower inhibition and attention shifting skills and a faster response initiation may make it more difficult to cope with a chaotic environment and to choose positive parenting practices over harsh parenting practices. A recent study found that the relation between household chaos and harsh parenting was attenuated in parents with higher self-regulation (Park & Johnston, 2020). Also, stress was related to more aggressive behavior in low-income adult community members with low self-regulation but not with high self-regulation (Sprague et al., 2011). Chaotic environments may be more challenging for individuals with low self-regulation and high levels of impulsivity and as such can be more stressful (e.g., Nelson, O'Brien, Blankson, Calkins, & Keane, 2009; Selander et al., 2009). More parental extraversion, which predicts impulsivity (Helmers, Young & Pihl, 1997), was related to lower parenting quality in high-demand parenting situations (Karreman et al., 2008). Deater-Deckard et al. (2012b), however, found that parents with high self-regulation used less harsh discipline in non-chaotic households, but found no difference between high and low self-regulation on harsh discipline in chaotic households. This suggests that more chaotic households may be challenging regardless of self-regulation and impulsivity. It is important to know whether low self-regulation and more impulsivity make parents more susceptible to the effects of household chaos on parenting so that (preventive) parenting interventions can be tailored to these characteristics.

Current study

Using an experimental design, we studied whether the negative effect of household chaos on parenting was stronger for participants with lower self-regulation and higher impulsivity. Studying whether the effect of household chaos on parenting is especially detrimental for parents with lower self-regulation and more impulsivity could serve as an indicator to determine the subgroup of parents that could particularly benefit from reducing household chaos. The experimental design included a lab setting resembling a living room, and the creation of a chaotic and neutral condition in this lab setting (see Andeweg et al., 2020). Participants were asked to care for an infant simulator, which was programmed to cry inconsolably at specific times during the lab sessions (e.g., Voorthuis et al., 2013). Caregiver sensitivity and harsh caregiving behavior were measured. Caregiver sensitivity was defined as the caregiver's ability to observe and interpret child signals and respond in a prompt and appropriate manner (Ainsworth, Bell & Stayton, 1974). Harsh caregiving was defined as physically harsh behavior, verbal and non-verbal overreactivity, and lack of physical support of the infant simulator. We expected that participants would show lower caregiver sensitivity and more harsh caregiving in the chaos condition compared to the neutral condition, and that this effect would be stronger in participants with lower self-regulation or more impulsivity. We also explored the effect of duration of taking care of the infant simulator on the development of caregiver sensitivity and harsh caregiving over time.

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Method

Participants

Ninety-six Dutch, female students participated in this study, of whom 21 were enrolled in vocational education (in Dutch: MBO) and 75 in college (in Dutch: HBO). Participants were 20.31 years old (SD = 1.93) on average and vocational students (M = 19.19, SD = 1.50) were significantly younger than college students (M = 20.63, SD = 1.93; t (94) = -3.15, p = .002), which follows from the structure of the Dutch education system. The study included two lab visits. Participants who only completed the first lab visit (N = 6; M = 19.00, SD = 1.10) were significantly younger than participants who finished both lab visits (N = 90; M = 20.40, SD = 1.95; t (94) = 2.85, p = .024) but did not differ in education level (X^2 (1) = 2.96, p = .116). Participants were mostly born in The Netherlands (96%). None of the participants who only completed the first lab visit reported a country other than the Netherlands as their birth country against 4% of the participants who completed both lab visits. Scores on caregiver sensitivity did not differ between participants who completed only one or both lab visits. Five out of six participants who dropped out started with a lab visit with the chaos condition. Data of all participants were used and missing data were imputed using multiple imputation.

Participants were recruited through public messages on their school's digital learning environment, through classroom presentations and Facebook advertisements targeted at women living near the lab between the ages of 18 and 25 years. Students indicated their interest in participating by answering an online questionnaire about demographics. They were then asked additional questions concerning inclusion criteria and were further informed about the study. Exclusion criteria were mental (e.g. depression, autism) or physical problems (e.g. hearing problems, paralysis) and being pregnant at or having been pregnant prior to time of inclusion. Educational programs with attention to child rearing, such as vocational education for childcare practitioner, were also excluded.

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, & Van IJzendoorn, 2015). The study consisted of two lab visits at Leiden University of two hours each, with two months in between visits. During both visits participants took care of an infant simulator in a lab setting that was designed as a living room. The living room was neat and orderly during the neutral condition, and unorganized and chaotic during the chaos condition (see Andeweg et al., 2020). The order of these conditions was counterbalanced over the two lab visits. Participants rated the chaos condition as more busy, noisy and dirty and less spacious than the neutral condition (with *t*s (89) between 9.62 and 49.07, *p*s $< .001$), but not as less inviting ($t(89) = -1.45$, $p = .150$). Participants were asked not to make changes in the room during both lab visits.

At the start of the first lab visit participants gave informed consent. Prior to taking care of the infant simulator participants filled out questionnaires in a regular lab room that did not look like a living room. Afterwards participants entered the living room setting and were asked to take care of the infant simulator as they would take care of a real infant. This was divided into three phases. During phase 1 (12 min) participants were asked to take care of the infant simulator. During phase 2 (12 min) they were asked to fill out a questionnaire and finish as far as possible. During phase 3 (13 min) participants were asked to play a game and finish as far as possible. The three participants with the highest score would receive a prize at the end of the study, which was rewarded after data collection was completed. All three phases included a pre-scheduled 5 min crying episode of the infant simulator. The crying episodes were the same during both lab visits and the infant simulator was programmed not to respond to participant caregiving, ensuring there was no variability in child demands between conditions.

After taking care of the infant simulator participants went back to the regular lab room and filled out additional questionnaires. They also completed computer tasks during the visits. Saliva was collected during both lab visits, but these data were not used in the current report. Participants were asked to fill out additional questionnaires between the two visits. At the end of the second lab visit participants were debriefed about the goal of the study and asked not to discuss this with classmates, who might participate as well. They received €40 as a reward for their participation.

Measures

Caregiver sensitivity

Observations of the participant with the infant simulator were coded for caregiver sensitivity using the Ainsworth Sensitivity Scale (Ainsworth et al., 1974), which was slightly adapted to the use of the infant simulator (Voorthuis et al., 2013). This 9-point scale measures the awareness and interpretation of infant signals and assesses whether the response is appropriate and prompt. A score of 1 indicates poor caregiver sensitivity and a score of 9 indicates excellent caregiver sensitivity. Caregiver sensitivity scores were assigned to each phase. Five coders were trained and reached good inter-coder reliability with a mean intra-class coefficient of all different pairs (single measure, absolute agreement) of .79 (range .74 - .83, N = 15). To prevent coder drift regular meetings were scheduled. The two lab visits per participant were coded by different coders who had not met the participant.

Harsh caregiving

Harsh caregiving was coded from the same observations with the infant simulator. An adapted version of the discipline rating scales by Joosen, Mesman, Bakermans-Kranenburg and van IJzendoorn (2012) was used. This included a five-point rating scale for the use of physical harsh caregiving (e.g., pulling an arm or leg too hard, shaking the infant simulator) and a five-point rating scale for the use of verbal or non-verbal over-reactivity (e.g., angry or impatient tone, rolling with eyes). A three-point scale for the lack of physical support (e.g., not supporting the head, holding the infant simulator by its arm or leg) was added. Per phase, a score was given for each scale of harsh caregiving, with higher scores indicating more harsh caregiving. The two lab visits per participant were coded by different coders who had not met the participant. Intercoder reliability was obtained using four scores for each participant (three phases) on each scale (harsh, over-reactivity, and lack of support). Good inter-rater reliability was established, with a mean intraclass coefficient of all different pairs (single measure, absolute agreement) of .77 (range .71 - .87, N = 15). The lack of physical support scale was rescaled to a 5-point scale. All scales were then log-transformed to reduce skewness and kurtosis. In the neutral condition, lack of physical support was significantly and positively correlated to overreactivity and to physical harsh caregiving in phase 3, and in the chaos condition physical harsh caregiving was significantly and positively correlated to lack of support and overreactivity in phase 3. The log-transformed scales were summed, resulting in a score for harsh caregiving per phase with higher scores indicating more harsh caregiving.

Self-regulation

To measure self-regulation, we used a self-report questionnaire and a computer task and examined these separately. The Effortful Control subscale from the Adult Temperament Questionnaire Short Form was used as the self-report measure of self-regulation and consists of three subscales: activation control (7 items), attention control (5 items), and inhibitory control (7 items; ATQ-EC; Evans & Rothbart, 2007). Examples of items are “I can keep performing a task even when I would rather not do it”, “It is often hard for me to alternate between two different tasks”, and “It is easy for me to hold back my laughter in a situation when laughter wouldn’t be appropriate”. Participants were asked to rate how often the statement was true for them on a five-point Likert scale, ranging from “never” to “always”, and with an additional option that someone had never been in that situation. The questionnaire was administered during both visits. The items were averaged per visit, with Cronbach’s alphas of .82 and .85, respectively. The means per visit were significantly correlated (r = .87, p < .001). The mean over both visits was computed and then standardized. A higher score reflected better self-regulation.

The Go/No-go task was used as the computer task to measure self-regulation, specifically inhibition (Braver, Barch, Gray, Molfese & Snyder, 2001). Participants were presented with stimuli of the letter x or k and were asked to press the space bar after x, but not after k. The time between stimuli was between 1000-3000 milliseconds and 20 of the 100 stimuli were k’s. The number of correct rejections – in other words: when participants correctly suppressed a response – was standardized and used as a measure of executive functioning. A higher score reflected better executive functioning. The scores on the ATQ-EC and the Go/No-go were not significantly correlated (r = .09, p = .400).

Impulsivity

To measure impulsivity, participants completed a computerized Monetary Choice Questionnaire (MCQ; Kirby & Marocović, 1996). Participants were asked to choose between receiving a reward now or receiving a higher reward in the future, using 27 items. Using the Monetary Choice Questionnaire Automated Scorer by Kaplan et al. (2016), the log-transformed overall *k* was calculated. A higher *k* reflects higher impulsivity (for further information see Kirby, 2009). The log-transformed overall *k* was reverse-coded and standardized so that a higher score would reflect less impulsivity.

Analyses

After preliminary analyses consisting of correlations among the predictors and parenting measures, multilevel models were used. Analyses were conducted for caregiver sensitivity and harsh caregiving separately. To test whether parenting quality was lower in the chaos condition than in the neutral condition, a fixed effect of condition was entered. In separate analyses, lower self-regulation and more impulsivity were tested as moderators for the effect of condition on parenting quality. Lastly, three-way interactions were tested exploratively with interactions between condition, phase and the separate measures for self-regulation and impulsivity. These analyses were conducted separately for both caregiver sensitivity and harsh caregiving. Using G*power 3.1.9.4 and the repeated-measures ANOVA with within-between interaction, we entered an expected power of .80, alpha level of .05, a small effect size of .40, with two groups and three repetitions and expected correlations between measures at .50. This gave a required sample size of 62, indicating our sample was large enough to detect significant interactions. For an overview of the evaluated models, see Table 1.

Table 1
Overview models of caregiver sensitivity and harsh caregiving

1.	Unconditional means model.
2.	Unconditional growth model: phase as fixed effect.
3.	Unconditional growth model: phase as fixed and random effect.
4.	Phase and condition as fixed effects, phase as random effect, covariates added.
5a.	Phase and interaction between condition and self-reported self-regulation as fixed effects, phase as random effect, covariates added.
6a.	Interaction between condition, self-reported self-regulation, and phase as fixed effects, phase as random effect, covariates added.
5b.	Phase and interaction between condition and computer-assessed self-regulation as fixed effects, phase as random effect, covariates added.
6b.	Interaction between condition, computer-assessed self-regulation, and phase as fixed effects, phase as random effect, covariates added.
5c.	Phase and interaction between condition and impulsivity as fixed effects, phase as random effect, covariates added.
6c.	Interaction between condition, impulsivity, and phase as fixed effects, phase as random effect, covariates added.

Five out of six participants who did not complete both lab visits started with a lab visit in the chaos condition. According to Van Ginkel, Linting, Rippe and Van der Voort (2019), multiple imputation is a fitting solution to data not missing at random and is equivalent or better compared to complete case analysis. Thus, we used multiple imputation in the current report (see Andeweg et al., 2020). To control for the effect of the order of conditions on caregiver sensitivity over time, we controlled for the order of condition as well as 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. To pool the results on 100 imputation sets the summary functions from mitml and miceadds, as well as the summary and modelRandEffStats from the merTools package were used. 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

Caregiver sensitivity scores were significantly correlated with *r*s between .22 and .92 (*p*s between <.001 and .041), with the exception of caregiver sensitivity in phase 1 of the chaos condition and phase 2 of the neutral condition ($r = .18$, $p = .088$; see Table 2). Harsh caregiving scores were also significantly correlated, with *r*s between .24 and .60 (*p*s between <.001 and .022), except for phases 2 and 3 of the chaos condition with phase 1 of the neutral condition (*r*s of .16 and .20, *p*s of .129 and .055, respectively). Measures of self-regulation and impulsivity were not significantly correlated with each other and were mostly uncorrelated to measures of caregiving. There were multiple significant correlations between education level and caregiving behavior. In addition, age was significantly correlated to caregiver sensitivity during phase 1 of the chaos condition (see Tables 2 and 3). Therefore, age and education level were added as covariates alongside the interaction between order of condition and phase.

Table 2
Descriptive statistics and correlations between caregiver sensitivity, harsh caregiving, self-regulation, impulsivity, and demographic variables (*N* between 85-96).

		M(*SD*) neutral	*M*(*SD*) chaos	1	2	3	4	5	6	7	8	9	10	11
1.	CS phase 1	6.03 (1.55)	5.75 (1.54)	.43**	.46**	.41**	-.21*	-.02	-.10	-.11	-.06	-.01	.24*	.21*
2.	CS phase 2	4.74 (1.92)	4.37 (1.96)	.54**	.50**	.81**	-.18	-.03	.06	-.07	-.15	.15	.17	.19
3.	CS phase 3	4.09 (1.92)	4.01 (1.89)	.43**.	.83**	.58**	-.12	-.04	.09	-.02	-.10	.17	.17	.14
4.	HC phase 1	.88 (.47)	.89 (.47)	-.135	.03	.06	.24*	.46**	.50**	-.11	-.01	-.18	-.03	-.12
5.	HC phase 2	.74 (.39)	.74 (.43)	-.01	.18	.17	.38**	.27*	.60**	-.07	.10	-.11	-.05	-.07
6.	HC phase 3	.78 (.48)	.71 (.45)	.03	.22*	.23*	.41**	.56**	.44**	-.02	.06	-.17	-.17	-.26*
7.	Self-reported self-regulation	0.00 (1.00)	-	-.01	-.02	-.11	.04	.03	-.03	-	-	-	-	-
8.	Computer-assessed self-regulation	0.00 (1.00)	-	-.04	-.02	-.01	-.13	.04	.10	-.09	-	-	-	-
9.	Impulsivity	0.00 (1.00)	-	-.03	-.04	-.01	-.10	-.22*	-.12	-.04	-.17	-	-	-
10.	Age	20.33 (1.98)	-	-.18	-.10	-.05	.00	.02	-.05	-.06	-.04	-.03	-	-
11.	Education level	-	-	-.19	-.00	-.04	-.26*	-.06	-.23*	-.14	-.03	-.16	-.31**	-

Note. CS = caregiver sensitivity, HC = harsh caregiving. Below the diagonal reflects the neutral condition, above the diagonal reflects the chaos condition. The measures for self-regulation and impulsivity are standardized. * p < .05, ** p < .01.

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Caregiver sensitivity

All results from multilevel analyses hereafter are based on the pooled results of the imputed datasets (see Table 3), except for the intra-class correlation and explained variance. The unconditional means model (Model 1) gave an intra-class correlation of .37, warranting the use of multilevel modeling. Phase was added in Model 2 as a numeric predictor, as a linear functional form was an adequate representation. Phase had a significant main effect on caregiver sensitivity, which significantly decreased over time (t = - 13.05, p < .001). Model 2 fit the data better than Model 1 (X^2 (1) = 144.43, p < .001) and explained 28% of the variance in intercepts. In Model 3, phase was added as a random effect. Phase remained significant (t = -11.17, p <.001) and this model fit better than Model 2 (X^2 (2) = 10.85, p < .001), explaining 37% of the within-subject variance in caregiver sensitivity. To test whether caregiver sensitivity was lower in the chaos condition than in the neutral condition, we added condition to Model 4 along with the covariates age, education level, and the interaction between order of condition and phase. These covariates were kept in all following models. Condition had a significant effect, with lower caregiver sensitivity in the chaos condition (t = -2.16, p = .031). Model 4 fit the data significantly better than Model 3 (X^2 (5) = 2.56, p = .025) and explained 21% more of the variance in intercepts and 1% more of the variance in slopes of caregiver sensitivity than Model 3 (see also Andeweg et al., 2020).

Self-reported self-regulation

To test whether the effect of condition on caregiver sensitivity was stronger for participants with lower self-regulation, the interaction between condition and self-reported self-regulation was added in Model 5a. The interaction between condition and self-reported self-regulation was not significant (t = 0.07, p = .945) and Model 5a did not fit the data better than Model 4 (X^2 (2) = 0.05, p = .949). This means that the effect of household chaos on caregiver sensitivity was not stronger for participants with lower self-reported self-regulation. Exploratively, we tested a three-way interaction between phase, condition, and self-reported self-regulation on caregiver sensitivity in Model 6a. The three-way interaction was not significant (t = -0.33, p = .744) and the model did not fit the data better than Model 5a (X^2 (3) = 0.89, p = .446) or Model 4 (X^2 (5) = 0.56, p = .733). Our results showed no support for moderation of self-reported self-regulation on the effect of condition over time on caregiver sensitivity.

Computer-assessed self-regulation

In Model 5b the interaction between condition and computer-assessed self-regulation were added. The interaction was not significant (t = -1.65, p =.100). Model 5b did not fit the data better than Model 4 (X^2 (2) = 1.33, p = .266). In Model 6b we exploratively added a three-way interaction between phase, condition, and computer-assessed self-regulation. The three-way interaction was not significant (*t* = -0.14, *p* = .891) and the model did not fit the data better than Model 5b (X^2(3) = 0.30, *p* = .829) or Model 4 (X^2(5) = 0.69, *p* = .631). This means there was no moderation of computer-assessed self-regulation on the effect of condition over time on caregiver sensitivity.

Impulsivity

To test whether the effect of condition on caregiver sensitivity was stronger for participants with more impulsivity, we added the interaction between condition and impulsivity in Model 5c. The interaction between condition and impulsivity was not significant (*t* = -1.61, *p* =.107). The model did not fit the data better than Model 4 (X^2(2) = 1.26, *p* =.284). These results mean that the effect of condition on caregiver sensitivity was not stronger for participants with more impulsivity. Exploratively, we added a three-way interaction between phase, condition, and impulsivity in Model 6c. The three-way interaction was not significant (*t* = -0.98, *p* = .325) and the model did not fit the data better than Model 5c (X^2(3) = 1.05, *p* < .371) or Model 4 (X^2(5) = 1.12, *p* = .349). This means that the interaction between household chaos and impulsivity on caregiver sensitivity did not change over time.

Table 3
Overview of fitted models for caregiver sensitivity with coefficients, *SE*'s and significance per parameter.

Parameter	Model 1	Model 2	Model 3	Model 4	Model 5a	Model 6a	Model 5b	Model 6b	Model 5c	Model 6c
Intercept	4.84 (0.14)***	6.67 (0.20)***	6.67 (0.17)***	3.63 (1.32)**	3.60 (1.32)**	3.93 (1.38)**	3.66 (1.32)**	3.98 (1.38)**	3.63 (1.32)**	3.95 (1.38)**
Phase		-0.92 (0.07)***	-0.92 (0.08)***	-0.87 (0.12)***	-0.87 (0.12)***	-1.04 (0.23)***	-0.87 (0.12)***	-1.03 (0.23)***	-0.87 (0.12)***	-1.03 (0.28)***
Condition				-0.24 (0.11)*	-0.24 (0.11)*	-0.46 (0.29)	-0.24 (0.11)*	-0.46 (0.28)	-0.24 (0.11)*	-0.46 (0.28)
Self-reported self-regulation					-0.02 (0.21)	0.04 (0.46)				
Condition*self-reported self-regulation					0.01 (0.11)	0.09 (0.28)				
Condition*self-reported self-regulation*phase						-0.04 (0.13)				
Computer-assessed self-regulation							0.24 (0.21)	0.24 (0.46)		
Condition*computer-assessed self-regulation							-0.19 (0.12)	-0.15 (0.29)		
Condition*computer-assessed self-regulation*phase								-0.02 (0.13)		
Impulsivity									0.29 (0.22)	0.01 (0.48)
Condition*impulsivity									-0.19 (0.17)	0.08 (0.30)

Table 3
Continued.

Parameter	Model 1	Model 2	Model 3	Model 4	Model 5a	Model 6a	Model 5b	Model 6b	Model 5c	Model 6c
Condition*impulsivity*phase										-0.14 (0.14)
Age				0.13 (0.07)	0.13 (0.07)*	0.13 (0.07)*	0.13 (0.07)	0.13 (0.07)	0.13 (0.07)	0.13 (0.07)
Education level				0.43 (0.31)	0.44 (0.31)	0.44 (0.31)	0.43 (0.31)	0.43 (0.31)	0.43 (0.31)	0.43 (0.31)
Phase*Condition first visit				-0.09 (0.17)	-0.09 (0.17)	-0.08 (0.16)	-0.09 (0.17)	-0.09 (0.16)	-0.09 (0.17)	-0.10 (0.16)
σ_0^2	1.44	1.57	1.06	0.88	0.88	0.88	0.83	0.83	0.93	0.92
σ_1^2			1.28	1.04	1.04	1.05	1.04	1.04	1.06	1.05
σ_e^2	2.42	1.69	1.35	1.38	1.38	1.37	1.38	1.38	1.37	1.36
$\rho_{01\ phase}$			-0.01	0.20	0.20	0.19	0.20	0.20	0.14	0.15
LogLikelihood	-1109.8	-1027.5	-1004.5	-947.1	-947.0	-945.3	-912.3	-910.9	-914.7	-912.3
Deviance	2219.5	2055.1	2009.0	1894.1	1894.0	1890.6	1824.6	1821.8	1829.5	1824.7

Note. * $p < .05$, ** $p < .01$, *** $p < .001$. Condition is coded as 1 = neutral and 2 = chaos. Education level is coded as 1 = vocational education and 2 = college. The values for σ_0^2, σ_1^2, σ_e^2, $\rho_{01\ phase}$, LogLikelihood, and Deviance are based on complete cases.

3

Harsh caregiving

All results from multilevel analyses hereafter are based on the pooled results of the imputed datasets (see Table 4), except for the intra-class correlation and explained variance. The unconditional means model (Model 1) gave an intra-class correlation of .02. Phase was added in Model 2 as a categorical predictor, as a linear functional form was not an adequate representation. Phase had a significant main effect on harsh caregiving (t = - 3.85, p < .001), with harsh caregiving slightly decreasing from phase 1 to phase 2 and remaining stable from phase 2 to phase 3. Model 2 fit the data better than Model 1 ($X^2(1) = 14.59$, p < .001) and explained 0.36% of the variance in intercepts. In Model 3, phase was added as a random effect. Phase remained significant (t = -3.80, p <.001). This model did not fit better than Model 2 ($X^2(2) = 0.66$, p < .515). To test whether harsh caregiving was higher in the chaos condition than in the neutral condition, we added condition to Model 4 along with the covariates age, education level, and the interaction between order of condition and phase. These covariates were kept in all following models. Condition did not significantly affect harsh caregiving (t = -0.41, p = .679). Model 4 did not fit the data significantly better than Model 3 ($X^2(5) = 1.20$, p = .305).

Self-reported self-regulation

To test whether the effect of condition on harsh caregiving was stronger for participants with lower self-regulation, the interaction between condition and self-reported self-regulation was added in Model 5a. The interaction between condition and self-reported self-regulation was not significant (t = -1.28, p = .202) and Model 5a did not fit the data better than Model 4 ($X^2(2) = 1.11$, p = .331). This means that the effect of household chaos on harsh caregiving was not dependent on self-reported self-regulation. Exploratively, we tested a three-way interaction between phase, condition, and self-reported self-regulation on harsh caregiving in Model 6a. The three-way interaction was not significant (t = 0.99, p = .324) and the model did not fit the data better than Model 5a ($X^2(3) = 0.76$, p = .518) or Model 4 ($X^2(5) = 0.90$, p = .482). Our results showed no support for moderation of self-reported self-regulation on the effect of condition over time on harsh caregiving.

Computer-assessed self-regulation

In Model 5b the interaction between condition and computer-assessed self-regulation were added. The interaction was not significant (t = 0.36, p = .723); the effect of condition on harsh caregiving was not moderated by computer-assessed self-regulation. Model 5b did not fit the data better than Model 4 ($X^2(2) = 0.04$, p = .979). In Model 6b we exploratively added a three-way interaction between phase, condition, and computer-assessed self-regulation. The three-way interaction was not significant (t = -1.08, p = .282) and the model did not fit the data better than Model 5b ($X^2(3) = 1.71$, p = .164) or Model 4 ($X^2(5) = 1.06$, p = .380). This means there was no moderation of computer-assessed self-regulation on the effect of condition over time on harsh caregiving.

Impulsivity

To test whether the effect of condition on harsh caregiving was stronger for participants with more impulsivity, we added the interaction between condition and impulsivity in Model 5c. The interaction between condition and impulsivity was not significant (t = 0.51, p = .612). The model did not fit the data better than Model 4 (X^2 (2) = 1.31, p = .269); the effect of condition on caregiver sensitivity was not stronger for participants with more impulsivity. Exploratively, we added a three-way interaction between phase, condition, and impulsivity in Model 6c. The three-way interaction was not significant (t = -0.18, p = .859) and the model did not fit the data better than Model 5c (X^2 (3) = 0.478, p < .697) or Model 4 (X^2 (5) = 0.79, p = .555). This means that the interaction between household chaos and impulsivity on harsh caregiving did not change over time.

Table 4
Overview of fitted models for harsh caregiving with coefficients, *SE*'s and significance per parameter.

Parameter	Model 1	Model 2	Model 3	Model 4	Model 5a	Model 6a	Model 5b	Model 6b	Model 5c	Model 6c
Intercept	0.79 (0.03)***	0.93 (0.05)***	0.93 (0.05)***	1.19 (0.33)***	1.21 (0.33)***	1.08 (0.35)**	1.19 (0.33)***	1.07 (0.35)**	1.17 (0.33)***	1.04 (0.34)**
Phase		-0.07 (0.02)***	-0.07 (0.02)***	-0.06 (0.03)*	-0.06 (0.03)*	0.01 (0.06)	-0.06 (0.03)*	0.01 (0.06)	-0.06 (0.03)*	0.01 (0.06)
Condition				-0.01 (0.03)	-0.01 (0.03)	0.07 (0.08)	-0.01 (0.03)	0.07 (0.08)	-0.01 (0.03)	0.07 (0.08)
Self-reported self-regulation					0.04 (0.06)	0.14 (0.13)				
Condition*self-reported self-regulation					-0.04 (0.03)	-0.11 (0.08)				
Condition*self-reported self-regulation*phase						0.04 (0.04)				
Computer-assessed self-regulation							-0.02 (0.06)	-0.20 (0.13)		
Condition*computer-assessed self-regulation							0.01 (0.03)	0.09 (0.08)		
Condition*computer-assessed self-regulation*phase								-0.04 (0.04)		
Impulsivity									0.02 (0.06)	0.00 (0.14)
Condition*impulsivity									0.02 (0.03)	0.03 (0.09)

Table 4
Continued.

Parameter	Model 1	Model 2	Model 3	Model 4	Model 5a	Model 6a	Model 5b	Model 6b	Model 5c	Model 6c
Condition*impulsivity*phase										-0.01 (0.04)
Age				0.00 (0.02)	0.00 (0.02)	0.00 (0.02)	0.00 (0.02)	0.00 (0.02)	0.00 (0.02)	0.00 (0.02)
Education level				-0.17 (0.08)*	-0.18 (0.08)*	-0.18 (0.08)*	-0.17 (0.08)*	-0.17 (0.08)*	-0.16 (0.08)*	-0.16 (0.08)*
Phase*Condition first visit				-0.03 (0.04)	-0.03 (0.04)	-0.03 (0.04)	-0.03 (0.04)	-0.03 (0.04)	-0.03 (0.04)	-0.03 (0.04)
σ_0^2	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.00
σ_1^2			0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
σ_e^2	0.20	0.20	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
$\rho_{01\ phase}$			-0.02	-0.17		-0.30	-0.21	-0.34		
LogLikelihood	-354.1	-353.3	-352.8	-332.3	-331.0	-326.4	-313.4	-309.9	-319.0	-312.5
Deviance	708.2	706.6	705.7	664.6	662.1	652.8	626.8	619.7	638.0	624.9

Note. * $p < .05$, ** $p < .01$, *** $p < .001$. Condition is coded as 1 = neutral and 2 = chaos. Education level is coded as 1 = vocational education and 2 = college. The values for σ_0^2, σ_1^2, σ_e^2, $\rho_{01\ phase}$, LogLikelihood, and Deviance are based on complete cases. Correlation between random effects could not be estimated due to negligible residual random intercept variance.

3

Discussion

Using an experimental design, we examined whether the effect of household chaos on caregiver sensitivity and harsh caregiving was stronger for participants with lower self-regulation and more impulsivity. We found that household chaos affected caregiver sensitivity (see Andeweg et al., 2020), but not harsh caregiving. No support for moderation by self-regulation or impulsivity, nor interactions with the duration of taking care for the infant simulator were found.

We hypothesized that the chaos condition would affect both measures of parenting, i.e. caregiver sensitivity and harsh caregiving, but only found that caregiver sensitivity was affected (see Andeweg et al., 2020). It is not likely that this means that household chaos only affects caregiver sensitivity and not harsh parenting, as previous correlational studies have shown that household chaos is related to sensitive and to harsh parenting (e.g., Dumas et al.). Also, a recent experimental study found that an intervention aimed at reducing household chaos led to less harsh parenting (Chapter 4). One explanation may be that our measure of harsh caregiving was not sensitive enough to reflect smaller differences in harsh caregiving or that our adaptation to the infant simulator was not successful in distinguishing between what was harsh caregiving and what was necessary force to, for instance, move the infant simulator's leg or arm during a diaper change. However, intercoder reliability was good on all scales, indicating that coders distinguished between these behaviors in similar ways and precision issues are unlikely. Another explanation is that the crying infant is successful in eliciting caregiver sensitivity, but not in eliciting harsh caregiving. In response to infant crying, soothing can be expected, which falls under caregiver sensitivity, whereas behavior that would be considered harsh caregiving is less likely to occur in response to infant crying. However, it is important to note that nearly 6% of 6-month old infants is shaken, slapped, or smothered in response to crying, especially in case of excessive crying (Reijneveld, Van der Wal, Brugman, Hira Sing, & Verloove-Vanhorick, 2004). This incidence largely increases from 3 to 6 months, which could indicate that excessive crying over a long period of time may be a precursor to harsh caregiving. Our 2 observations of 45 min may thus not be enough to observe harsh caregiving in response to infant crying.

Self-regulation

We did not find evidence that the effect of household chaos on parenting was moderated by self-regulation, neither for harsh caregiving nor caregiver sensitivity. For harsh caregiving, this could simply be due to the task with the infant simulator not eliciting sufficient variation in harsh caregiving. We expected to find moderation by self-regulation because lower self-regulation would make it more difficult to exhibit positive instead of negative parenting practices when in a challenging environment. Part of coping with a challenging environment may be altering the environment to your needs, e.g., cleaning up clutter or turning off the loud, annoying tv. We asked our participants not to change the lab setting to keep the level of chaos constant, thereby potentially limiting the exhibition of self-regulatory behavior in challenging environments. Another explanation is that self-regulation only acts as a moderator under prolonged exposure to a chaotic environment. Our design used two 45 min episodes in a simulated environment, whereas other studies assessed self-regulation, household chaos and parenting in the home, where parents spend most of their time (e.g., Valiente, Lemery-Chalfant, & Reiser, 2007). Longer exposure than 45 min may be needed to approximate prolonged exposure of the home environment and for moderation by self-regulation to become visible. A third interpretation is that self-regulation may need to be considered in a different role in the effect of household chaos on parenting. We used the same measure for self-reported self-regulation as Valiente et al. (2007), who found that lower levels of self-reported household chaos were related to higher levels of self-reported self-regulation. As this was a correlational study, this could mean that parents with more self-regulation are better able to cope with household chaos and therefore experience lower levels of household chaos than parents with less self-regulation. This suggests that self-regulation moderates the effect of household chaos on parenting, but our results do not support this. Thus, other interpretations of this finding should be considered. For example, higher levels of household chaos may impede on self-regulation, or parents with more self-regulation may maintain lower levels of household chaos. To test these interpretations, measuring state self-regulation, reflecting self-regulation in a specific situation (Hong, 1998), in a neutral and a chaotic situation would be necessary. This would allow for testing whether household chaos impedes on self-regulation, as previously suggested by Crandall et al. (2015) and Deater-Deckard, Chen, Wang and Bell (2012a). Lastly, it may be key to investigate child behavior. It is possible that parents with more self-regulation are better armed to deal with more difficult child behavior, especially in difficult environments, such as a more chaotic household. Following this reasoning, household chaos would affect parenting and child behavior, and more challenging child behavior would in turn affect parenting (as suggested by Dumas et al., 2005), which is especially difficult to manage for parents with lower self-regulation, who in turn may show lower sensitivity and more harsh parenting. Using an infant simulator, thus keeping child behavior stable, we were not able to find moderation by self-regulation. Future research should study whether self-regulation moderates the effect of household chaos on parenting in response to different levels of challenging child behavior. To this end, adding an extra manipulation to our current design would be necessary, in which the infant simulator is programmed to be easily soothed or difficult to sooth.

Impulsivity

We did not find that the effect of household chaos on parenting was stronger for more impulsive participants. One explanation for not finding moderation is that it may be necessary to test the comorbidity of impulsivity and neuroticism. More neurotic people are more easily aroused (e.g., Brown & Rosellini, 2008; Helmers et al., 1997), and Karreman et al. (2008) found that parenting quality was lower in demanding situations for more neurotic and extraverted fathers. Thus, household chaos may affect parenting more strongly in parents with more impulsivity as well as higher neuroticism. However, it is also possible that impulsivity is not relevant regarding how people respond to their environment. Karreman et al. (2008) found that extraversion moderated parenting in response to high-demand parenting situations. In that study, the parenting situation was considered high-demand because of a difficult child temperament. Impulsivity may be more relevant to how a person responds to other people's behavior, and not relevant for how a person responds to their environment. Lastly, it is also possible that participants were able to control their response urgency and approach behavior in response to the crying infant simulator, and that our design was not taxing enough to allow for moderation in impulsivity to arise. Eisenberg et al. (2004) suggested that control over these reactive behaviors tends to improve with age. For our young-adult sample, the current design may have fallen within the ability to regulate their impulsive behavior. Testing whether impulsivity moderates caregiving in response to a more challenging environment is necessary to evaluate this assumption.

Strengths and limitations

Strengths of this study include the experimental design in which we manipulated household chaos, the use of an infant simulator to control for child effects, and the use of multiple measures for self-regulation. A limitation to the current study is that we did not measure fluid intelligence and thus could not control for this, which was recommended by Crandall et al. (2015). Furthermore, as the current study used a highly controlled lab setting with an all-female student population, results may not be generalizable to families, and to fathers. Lastly, the infant simulator was unsoothable as it was programmed not to respond to caregiving behavior. This means that our results may only be generalizable to less soothable infants, such as infants with negative temperaments (Yoo & Reeb-Sutherland, 2013).

Future research and implications

Future research should experimentally study whether household chaos affects positive and negative parenting practices by including situations in which both can be expected. Also, identifying the mechanism through which household chaos affects parenting is crucial for knowing which parents may be most affected by household chaos. Furthermore, future research should include both state and trait measures of self-regulation and extend research on the moderating role of impulsivity by combining this with neuroticism. Based on our findings, efforts to improve parenting through reducing household chaos may be effective and should not solely target parents with low self-regulation or more impulsivity. However, this implication should be taken with caution as our findings need to be replicated with real parents and children outside a highly controlled lab setting. Lastly, the effect of household chaos on parenting should be studied with an infant simulator as well as parent-child interactions to disentangle potential effects of child behavior.

Conclusion

In situations in which an infant is inconsolable, household chaos appears to affect caregiver sensitivity but not harsh caregiving. Our results indicate that the effect of household chaos on parenting did not depend on self-regulation or impulsivity. Future research should test the combined effect of impulsivity and neuroticism and should study whether child behavior partly explains how household chaos affects parenting. Ultimately, understanding how and in which parents household chaos affects parenting could inform parenting intervention and prevention programs.

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