Corrigendum: Childhood Adversity, Self-Esteem, and Diurnal Cortisol Profiles Across the Life Span

Original article: Zilioli, S., Slatcher, R. B., Chi, P., Li, X., Zhao, J., & Zhao, G. (2016). Childhood adversity, self-esteem, and diurnal cortisol profiles across the life span. *Psychological Science*, *27*, 1249–1265. doi:10.1177/0956797616658287

It has come to the authors' attention that the two neuroticism items in Study 2 were *negatively* correlated with each other ($r = -.202$, $p < .001$) instead of positively correlated, as originally reported. For this reason, the authors reran the Study 2 analyses treating the two items as separate covariates instead of combining them into a single scale. The article is now being corrected to reflect the results of this reanalysis. In addition, some corrections and clarifications are being made in the sections presenting the method and results for Study 1.

The authors note that, apart from some minor fluctuations in regression estimates and p values, the new pattern of results for Study 2 did not change from the pattern of results observed in the original analyses. Thus, the scientific conclusions presented in the original article remain unchanged.

Corrected Results for Study 2

Tables 4, 5, and 6 (and Table S2 in the Supplemental Material) are being corrected to show the values obtained in the reanalysis. Several paragraphs in the main text are also affected. The first complete paragraph on page 1255 should read as follows:

The psychological covariates consisted of measures of neuroticism, depression, daily positive affect, and daily negative affect. Neuroticism was assessed via two personality descriptors (i.e., "anxious, easily upset" and "calm, emotionally stable"), which were rated on a 4-point Likert scale (1 = *strongly disagree*, 4 = *strongly agree*; Gosling, Rentfrow, & Swann, 2003). Responses to the second neuroticism item were reverse-scored. Because the two items were negatively correlated ($r = -.202$, $p < .001$), we treated them as separate covariates in the analyses. Scores for "anxious, easily upset" ranged from 1 to 4 ($M = 2.40$, $SD =$

0.96), and scores for "calm, emotionally stable" also ranged from 1 to 4 ($M = 2.17$, $SD = 0.89$).

In the concluding sentence of the immediately following paragraph, the average depression score should be 20.17 instead of 20.16.

The first sentence of the Data Analysis section for Study 2 (p. 1255) should read as follows:

At the daily level, the incidence of missing data among the variables was 9.8%, and at the person level, the incidence of missing data was 3.1%.

The second paragraph of the results for Study 2 (p. 1258) should read as follows:

In Model 1 and Model 4, childhood adversity was a significant predictor of morning cortisol, such that individuals who reported more adverse childhood conditions had lower levels of cortisol at awakening (Model 1: $\gamma_{001} = -0.011$, $p = .009$; Model 4: $\gamma_{001} = -0.011$, $p = .017$). However, childhood adversity was not associated with the cortisol slope (Model 1: $\gamma_{201} = 0.000$, $p = .553$; Model 4: $\gamma_{201} = 0.000$, $p = .730$) or CAR (Model 1: $\gamma_{101} = 0.006$, $p = .193$; Model 4: $\gamma_{101} = 0.007$, $p = .182$). Next, self-esteem was introduced as a predictor in the analyses. Corroborating the findings from Study 1, results showed that individuals with higher self-esteem had higher morning cortisol (Model 2: $\gamma_{002} = 0.044$, $p = .003$; Model 5: $\gamma_{002} = 0.042$, $p = .008$) and a steeper cortisol slope (Model 2: $\gamma_{202} = -0.003$, $p = .025$; Model 5: $\gamma_{202} = -0.003$, $p = .044$). In other words, individuals who reported higher self-esteem had higher cortisol at awakening and a steeper cortisol decline through the day. Self-esteem was not a significant predictor of CAR (Model 2: $\gamma_{102} =$

Table 4. Bivariate Correlations Between Person-Level Variables in Study 2

Variable	2	3	4	5	6	7	8	9	10	11	12
1. Female	−.087*	.004	.023	−.038	−.037	−.054	−.006	−.059	−.109**	.100*	.067†
2. Age	—	−.025	−.074†	.085*	.057	.101*	−.002	−.011	−.026	.050	.049
3. Caregiver education (high school)		—	−.021	.059	.099*	.113**	−.018	.004	.050	−.022	−.121**
4. Health status			—	−.183**	−.106**	−.205**	.054	−.045	−.066†	.007	.131**
5. CA-SE				—	−.011	.703**	.025	−.039	.212**	−.056	−.035
6. CA-RP					—	.703**	−.027	.183**	.153**	−.247**	−.218**
7. Childhood adversity						—	−.001	.102**	.260**	−.216**	−.180**
8. Neuroticism: "anxious, easily upset"							—	−.202**	.243**	−.021	−.021
9. Neuroticism: "calm, emotionally stable" (R)								—	.083*	−.299**	−.123**
10. Depression									—	−.400**	−.139**
11. Youth self-esteem										—	.100*
12. Caregiver self-esteem											—

Note: CA-SE = Childhood Adversity Stressful Events scale; CA-RP = Childhood Adversity Relationship With Parents scale; R = reverse-scored.
$^\dagger p < .10$. *$p < .05$. **$p < .01$.

−0.018, $p = .259$; Model 5: $\gamma_{102} = -0.024$, $p = .182$). Effect sizes in Study 2 were comparable with the effect sizes in Study 1.[1]

The first four sentences of the immediately following paragraph (p. 1259) should read as follows:

We next tested whether the associations between childhood adversity and the cortisol parameters were partially explained by self-esteem. Further, because indirect effects can exist in the absence of a significant total effect (Zhao, Lynch, & Chen, 2010), we also tested the significance of a potential indirect effect of childhood adversity on cortisol slope through self-esteem. Regression analyses showed that childhood adversity negatively predicted self-esteem (without controlling for covariates: $b = -0.067$, $SE = 0.012$, $p < .001$; controlling for covariates: $b = -0.032$, $SE = 0.011$, $p = .005$). Monte Carlo analyses showed a significant indirect effect of childhood adversity on morning cortisol via self-esteem (without controlling for covariates: 95% CI = [−0.005319, −0.000950]; controlling for covariates: 95% CI = [−0.003004, −0.000199]), as well as a significant indirect effect of childhood adversity on diurnal cortisol slope via self-esteem (without controlling for covariates: 95% CI = [0.000025, 0.000413]; controlling for covariates: 95% CI = [0.000006, 0.000231]), which indicates that high childhood adversity was linked to low morning cortisol and a flatter cortisol slope via low self-esteem.

In the next paragraph, the third sentence (p. 1261) should read as follows:

Although no association emerged with CAR (Model 3: $\gamma_{103} = -0.026$, $p = .110$; Model 6: $\gamma_{103} = -0.024$, $p = .150$) or morning cortisol (Model 3: $\gamma_{003} = 0.028$, $p = .087$; Model 6: $\gamma_{003} = 0.031$, $p = .061$), higher caregiver self-esteem predicted a steeper diurnal cortisol slope (Model 3: $\gamma_{203} = -0.003$, $p = .030$; Model 6: $\gamma_{203} = -0.003$, $p = .048$).

The second sentence of the final paragraph presenting results for Study 2 (p. 1261) should read as follows:

As shown in Table 6, we found indirect effects between CA-RP scores and morning cortisol via self-esteem, 95% CI = [−0.002334, −0.000268], and between CA-RP scores and the cortisol slope via self-esteem, 95% CI = [0.000008, 0.000189].

Corrections and Clarifications for Study 1

In the first paragraph of the Method section (p. 1250), the average age for MIDUS II participants should be 55.43 years, rather than 56.62 years. The next sentence should read, "The first wave of data collection for MIDUS (MIDUS I), a large panel survey of adults between the ages of 20 and 75 years (average age = 46.39 years), occurred from 1995 to 1996." The fourth through sixth sentences in the same paragraph should read as follows:

For the current study, inclusion criteria required that participants provided data about parents' education, childhood adversity, self-esteem, neuroticism, depressed affect, and demographics

Table 5. Results of Selected Hierarchical Linear Models of Diurnal Cortisol Parameters in Study 2

Fixed effect	Model 4			Model 5			Model 6		
	Estimate	SE	p	Estimate	SE	p	Estimate	SE	p
Morning cortisol, π_0									
Average morning cortisol, β_{00}, γ_{000}	0.6934	0.0121	< .001	0.6943	0.0121	< .001	0.6987	0.0129	< .001
Childhood adversity, γ_{001}	−0.0109	0.0045	.017	−0.0094	0.0045	.038	−0.0079	0.0045	.079
Youth self-esteem, γ_{002}	—	—	—	0.0423	0.0160	.008	0.0405	0.0160	.012
Caregiver self-esteem, γ_{003}	—	—	—	—	—	—	0.0309	0.0165	.061
Female, γ_{004}	−0.0042	0.0130	.746	−0.0058	0.0130	.657	−0.0057	0.0130	.662
Age, γ_{005}	0.0066	0.0037	.077	0.0061	0.0037	.100	0.0052	0.0037	.164
Caregiver education, γ_{006}	0.0029	0.0132	.825	0.0027	0.0131	.840	0.0080	0.0135	.557
Health status, γ_{007}	−0.0030	0.0087	.727	−0.0017	0.0086	.841	−0.0034	0.0088	.701
Neuroticism: "anxious, easily upset," γ_{008}	0.0019	0.0069	.782	0.0016	0.0070	.818	0.0024	0.0070	.738
Neuroticism: "calm, emotionally stable" (R), γ_{009}	−0.0032	0.0073	.659	0.0021	0.0075	.777	0.0025	0.0075	.736
Depression, γ_{0010}	−0.0020	0.0016	.215	−0.0004	0.0017	.801	−0.0004	0.0017	.833
Caregiver sex: female, γ_{0011}	—	—	—	—	—	—	−0.0138	0.0132	.296
Caregiver age, γ_{0012}	—	—	—	—	—	—	−0.0001	0.0007	.824
Weekend, β_{01}, γ_{010}	−0.1018	0.0103	< .001	−0.1021	0.0103	< .001	−0.1019	0.0103	< .001
Wake-up time, β_{02}, γ_{020}	−0.0132	0.0066	.045	−0.0126	0.0066	.057	−0.0129	0.0066	.052
Daily negative affect, β_{03}, γ_{030}	−0.0197	0.0148	.181	−0.0201	0.0147	.170	−0.0205	0.0147	.163
Daily positive affect, β_{04}, γ_{040}	−0.0075	0.0142	.600	−0.0073	0.0141	.606	−0.0102	0.0141	.469
Cortisol awakening response (CAR), π_1									
Average CAR, β_{10}, γ_{100}	0.0069	0.0118	.558	0.0065	0.0118	.582	0.0028	0.0135	.834
Childhood adversity, γ_{101}	0.0065	0.0048	.182	0.0056	0.0049	.247	0.0048	0.0049	.326
Youth self-esteem, γ_{102}	—	—	—	−0.0235	0.0176	.182	−0.0227	0.0179	.204
Caregiver self-esteem, γ_{103}	—	—	—	—	—	—	−0.0237	0.0165	.150
Female, γ_{104}	−0.0315	0.0129	.015	−0.0307	0.0129	.017	−0.0307	0.0129	.018
Age, γ_{105}	0.0060	0.0037	.104	0.0063	0.0037	.090	0.0069	0.0037	.065
Caregiver education, γ_{106}	0.0222	0.0132	.094	0.0222	0.0132	.094	0.0196	0.0138	.156
Health status, γ_{107}	0.0071	0.0095	.453	0.0063	0.0095	.505	0.0071	0.0096	.460
Neuroticism: "anxious, easily upset," γ_{108}	0.0042	0.0077	.590	0.0044	0.0078	.570	0.0040	0.0077	.610
Neuroticism: "calm, emotionally stable" (R), γ_{109}	−0.0008	0.0077	.913	−0.0038	0.0081	.638	−0.0040	0.0082	.628
Depression, γ_{1010}	−0.0005	0.0016	.738	−0.0014	0.0017	.400	−0.0016	0.0017	.359
Caregiver sex: female, γ_{1011}	—	—	—	—	—	—	0.0097	0.0143	.499
Caregiver age, γ_{1012}	—	—	—	—	—	—	−0.0004	0.0006	.523
Weekend, β_{11}, γ_{110}	−0.0294	0.0132	.026	−0.0291	0.0132	.027	−0.0293	0.0132	.027
Wake-up time, β_{12}, γ_{120}	−0.0192	0.0075	.010	−0.0196	0.0075	.009	−0.0194	0.0075	.010
Daily negative affect, β_{13}, γ_{130}	0.0003	0.0175	.985	0.0004	0.0175	.981	0.0012	0.0175	.947
Daily positive affect, β_{14}, γ_{140}	−0.0103	0.0127	.418	−0.0105	0.0126	.404	−0.0079	0.0129	.541
Time since waking, π_2									
Average linear slope, β_{20}, γ_{200}	−0.0385	0.0022	< .001	−0.0386	0.0022	< .001	−0.0391	0.0023	< .001
Childhood adversity, γ_{201}	0.0001	0.0004	.730	0.0000	0.0004	.934	−0.0001	0.0004	.841
Child self-esteem, γ_{202}	—	—	—	−0.0030	0.0015	.044	−0.0028	0.0015	.055
Caregiver self-esteem, γ_{203}	—	—	—	—	—	—	−0.0029	0.0014	.048
Female, γ_{204}	−0.0012	0.0011	.306	−0.0011	0.0011	.350	−0.0010	0.0011	.356
Age, γ_{205}	−0.0006	0.0003	.087	−0.0005	0.0003	.110	−0.0005	0.0003	.177
Caregiver education, γ_{206}	0.0000	0.0011	.981	0.0000	0.0011	.992	−0.0004	0.0012	.723
Health status, γ_{207}	−0.0002	0.0007	.761	−0.0003	0.0007	.668	−0.0002	0.0007	.809
Neuroticism: "anxious, easily upset," γ_{208}	0.0006	0.0006	.333	0.0006	0.0006	.316	0.0006	0.0006	.369
Neuroticism: "calm, emotionally stable" (R), γ_{209}	0.0001	0.0007	.855	−0.0003	0.0007	.703	−0.0003	0.0007	.667
Depression, γ_{2010}	0.0001	0.0001	.413	0.0000	0.0001	.966	0.0000	0.0002	.981

(continued)

Table 5. *(continued)*

Fixed effect	Model 4			Model 5			Model 6		
	Estimate	SE	p	Estimate	SE	p	Estimate	SE	p
Caregiver sex: female, γ_{2011}	—	—	—	—	—	—	0.0012	0.0012	.298
Caregiver age, γ_{2012}	—	—	—	—	—	—	0.0000	0.0001	.887
Weekend, β_{21}, γ_{210}	0.0076	0.0010	< .001	0.0076	0.0010	< .001	0.0076	0.0010	< .001
Wake-up time, β_{22}, γ_{220}	−0.0007	0.0006	.216	−0.0008	0.0006	.194	−0.0008	0.0006	.206
Daily negative affect, β_{23}, γ_{230}	0.0024	0.0013	.062	0.0024	0.0013	.058	0.0025	0.0013	.053
Daily positive affect, β_{24}, γ_{240}	−0.0002	0.0012	.883	−0.0002	0.0012	.874	0.0001	0.0012	.957
Time since waking^2, π_3									
Average curvature, β_{30}, γ_{300}	0.0008	0.0001	< .001	0.0008	0.0001	< .001	0.0008	0.0001	< .001
Smoking, π_4									
Intercept, β_{40}, γ_{400}	0.1462	0.0473	.002	0.1461	0.0474	.002	0.1460	0.0477	.002
Exercise, π_5									
Intercept, β_{50}, γ_{500}	0.0187	0.0082	.023	0.0191	0.0082	.020	0.0190	0.0082	.021

Note: Intercepts indicate average cortisol values at awakening; average slopes of time since waking indicate change in cortisol per 1-hr change in time; average slopes of time since waking^2 indicate change in cortisol per 1-hr change in time^2. R = reverse-scored. Thirty-three cortisol values were more than 3 *SD* above the mean; when analyses were run after Winsorizing these values, the magnitude of the main results remained approximately the same as reported here, despite minor changes in the *p* values (highest *p* value = .057).

(age, gender, ethnicity, education, and physical health), as well as cortisol data. Information about childhood adversity and parents' education was collected during MIDUS I, and information about self-esteem and psychological covariates was collected during MIDUS II. Data for age, education, and physical health were taken from MIDUS II, and data for ethnicity and gender were taken from MIDUS I.

In the first complete paragraph on page 1251, the second and third sentences are being replaced by the following:

Participants had to answer 7 questions about their relationship with their mother and the same 7 questions about their relationship with their father (14 total items). Twelve of these questions (6 for the mother and 6 for the father) were answered on a 4-point Likert scale (1 = *a lot*, 4 = *not at all*). Two of the questions (1 for the mother and 1 for the father) were answered on a 5-point Likert scale (1 = *excellent*, 5 = *poor*); these ratings were multiplied by 0.75 factorial to maintain continuity with the other items. Averaging these two scales (one for the mother and one for the father) yielded a measure of overall parental affection (higher

Table 6. Results of Analyses on the Effects of Childhood-Adversity Measures on Cortisol Parameters Controlling for Covariates in Study 2

Measure	Morning cortisol	Cortisol awakening response	Cortisol slope
Without controlling for self-esteem			
Childhood Adversity Stressful Events score	−0.0044† (0.0026)	0.0008 (0.0030)	0.0003 (0.0002)
Childhood Adversity Relationship With Parents score	−0.0044 (0.0027)	0.0042 (0.0027)	−0.0001 (0.0002)
Controlling for self-esteem			
Childhood Adversity Stressful Events score	−0.0045† (0.0026), [−0.000581, 0.000837]	0.0009 (0.0030), [−0.000557, 0.000374]	0.0003 (0.0002), [−0.000058, 0.000039]
Childhood Adversity Relationship With Parents score	−0.0031 (0.0027), [−0.002334, −0.000268]	0.0035 (0.0028), [−0.000365, 0.001709]	−0.0002 (0.0002), [0.000008, 0.000189]

Note: The table shows unstandardized regression coefficients, followed by robust standard errors in parentheses. For indirect effects, 95% confidence intervals are given in brackets.
$^†p < .10.$

scores indicated higher parental affection), which was reverse-scored (so that higher scores indicated lower parental affection) and showed high internal consistency ($\alpha = .92$).

The first sentence of the following paragraph originally reported that we used nine items from the Conflict Tactics Inventory. This sentence is being corrected to say that we used 12 items (i.e., 3 referring to the mother, 3 referring to the father, 3 referring to brothers, and 3 referring to sisters).

On page 1252, the last sentence of the second paragraph should read as follows:

Values greater than 3 standard deviations above the mean were treated as missing cases, and this variable was included as a covariate at the daily level ($M = 0.6839$, $SD = 1.37$; $M = 0.5193$, $SD = 0.82$, after removing values more than 3 SD above the mean).

In the first complete paragraph on page 1253, the fourth sentence should read as follows:

Specifically, we first ran a multiple regression analysis in which self-esteem was regressed on childhood adversity while we controlled for appropriate (i.e., nonspecific to cortisol) person-level demographic covariates (age, gender, education, race-ethnicity, childhood SES) and person-level psychological covariates (neuroticism and depressive symptoms).

The multiple regression coefficients reported on page 1258 are unstandardized coefficients and should be labeled as "b" rather than "β." The footnote in Table S1 in the Supplemental Material is also being corrected for this error.

Finally, two errors in the tables presenting results for Study 1 are being corrected. In Table 2, the correct p value for the effect of non-White race on morning cortisol (γ_{004}) in Model 4 is .005 (instead of $< .001$). In Table 3, the correct 95% confidence interval for the indirect effect linking Childhood Adversity Physical/Emotional Abuse score to cortisol slope controlling for self-esteem is [−0.000068, 0.000670] (instead of [−0.002716, 0.001604]).