

**Supplementary materials for:**

**Neither environmental unpredictability nor harshness predict reliance on  
alloparental care among families in Cebu, Philippines**

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## Description of 2014 alloparental care measurement

In 2014, household mothers were asked to name all of the people who participated in the 12 direct caregiving tasks identified in Table S1, up to a maximum of five individuals (including herself). The questions were worded as across children generally, and not within a specific time frame. Mothers had the option of stating that a given task was not done in the household, or that the child(ren) take care of the task themselves. While the tasks overlapped significantly with the tasks asked about in the 1983-86 survey, it was impossible to quantify them identically, since the 2014 survey did not include information about the amount of time alloparents devoted to these tasks.

Following the categorizations used in a recent publication (Rosenbaum et al. 2021), the tasks were divided into three categories: 'routine' caregiving tasks (e.g. helping with grooming or toilet needs, putting to bed), recreational caregiving tasks (e.g. playing, going for walks or outings), and educational caregiving tasks (e.g. reading to children, helping them with homework; see Table S1, column 3). We focused on seven types of potential alloparental helpers: grandmothers, grandfathers, aunts, uncles, siblings, cousins, and unrelated (paid) household help. Mothers very rarely reported that people who fell outside of these categories participated in childcare (Rosenbaum et al. 2021). Grandparents, aunts, and uncles were further subdivided into maternal and paternal relatives, bringing the total number of types of alloparental helpers to 11.

To quantify how much alloparental help families were receiving, we tallied the number of task categories in which at least one of a given type of alloparent participated in at least one of the relevant tasks. This meant that each type of caregiver could in theory have a maximum count of three; for example, if a sibling was reported to help with at least one routine caregiving task, one recreational task, and one educational task, then the count for sibling help would be  $n=3$ . If in that same family, a maternal grandmother helped with routine and educational caregiving but not recreational, then that family's total count of alloparental help would be  $n=5$ . The maximum possible count would be 33 ( $n=11$  categories of potential caregivers,  $\times 3$  categories of caregiving tasks), though in reality, no family exceeded an alloparental caregiver count of 12. This alloparental help count was used as the outcome variable in Models 3-5 (located in Tables 3-5) in the main text.

**Table S1 Caregiving tasks included in alloparental caregiving measures**

Caregiving task	Task grouping
Bathing	Routine caregiving
Grooming	Routine caregiving
Helping with toilet	Routine caregiving
Feeding	Routine caregiving
Putting to bed	Routine caregiving
Playing	Recreational caregiving
Going for walks/outings	Recreational caregiving
Singing or dancing	Recreational caregiving
Exchanging stories	Recreational caregiving
Taking to/from school	Educational caregiving
Helping with homework	Educational caregiving
Reading to child(ren)	Educational caregiving

## Description of environmental hygiene scores

In all three data collection periods, environmental hygiene scores were a composite measure that integrates information about potential pathogen exposure. Specifically, the measure included information about the type of toilet facility used by the household, the amount of feces in the surrounding area, the method of garbage disposal, and the general cleanliness of the area where the household members kept their food. Lower numbers mean less-sanitary conditions, meaning that the household is presumably at risk of increased exposure to pathogens that may cause infectious disease (e.g. diarrhea, respiratory illnesses). This follows the aggregate hygiene measurements used in Carba, Tan, & Adair (2009).

**Table S2 Descriptive statistics, by statistical models presented in the main text (models 1-5, presented in Tables 3-5)**

Variable	Obs	Mean	Std. Dev.	Min	Max	Model number (outcome year)
Hrs/week alloparental care	1327	11.92	15.23	0	114.33	1 (1983-86)
Household income <sup>1</sup>	1327	259.2	359.96	-1.37	5340.27	1 (1983-86)
Maternal education	1327	7.43	3.76	0	18	1 (1983-86)
Environmental hygiene	1327	5.4	1.92	0	9	1 (1983-86)
Crowding	1327	2.78	1.62	.4	11	1 (1983-86)
Maternal unemployment	908 <sup>2</sup>					1 (1983-86)
Paternal absence	219 <sup>2</sup>					1 (1983-86)
Household move	74 <sup>2</sup>					1 (1983-86)
Household size	1327	7.04	2.61	2.67	17.33	1 (1983-86)
Alloparental helper count	984	1.01	1.05	0	3	2 (1994)
Household income	984	536.38	1003.65	5.12	27923.79	2 (1994)
Maternal education	984	7.47	3.96	0	19	2 (1994)
Environmental hygiene	984	5.33	1.9	0	9	2 (1994)
Crowding	984	3.2	1.99	.67	15	2 (1994)
Maternal unemployment	236 <sup>2</sup>					2 (1994)
Paternal absence	99 <sup>2</sup>					2 (1994)
Household move	54 <sup>2</sup>					2 (1994)
Household size	984	7.25	2.47	2	19	2 (1994)
Alloparental helper count	428	1.63	2.05	0	12	3 (2014)
Household asset count	428	8.78	5.27	0	28	3 (2014)
Paternal education	428	10.28	3.24	1	16	3 (2014)
Environmental hygiene	428	6.55	1.68	1	9	3 (2014)
Crowding	428	18.37	3.94	2	20	3 (2014)
Paternal unemployment	43 <sup>2</sup>					3 (2014)
Household move	91 <sup>2</sup>					3 (2014)
Household size	428	5.34	2.46	3	24	3 (2014)

Alloparental helper count	404	1.65	2.06	0	12	4 (2014)
Household income (1980s)	404	239.21	278.06	-1.37	2914.11	4 (2014)
Maternal education (1980s)	404	6.98	3.5	0	15	4 (2014)
Environmental hygiene (1980s)	404	5.29	1.88	0	9	4 (2014)
Crowding (1980s)	404	2.82	1.63	.45	10.2	4 (2014)
Maternal unemployment (1980s)	277 <sup>2</sup>					4 (2014)
Paternal absence (1980s)	58 <sup>2</sup>					4 (2014)
Household move (1980s)	27 <sup>2</sup>					4 (2014)
Household asset count (2014)	404	8.83	5.31	0	28	4 (2014)
Paternal education (2014)	404	10.24	3.24	1	16	4 (2014)
Environmental hygiene (2014)	404	6.56	1.67	1	9	4 (2014)
Crowding (2014)	404	18.39	3.94	2	20	4 (2014)
Paternal unemployment (2014)	36 <sup>2</sup>					4 (2014)
Household move (2014)	81 <sup>2</sup>					4 (2014)
Household size (2014)	404	5.33	2.45	3	24	4 (2014)
Alloparental helper count	359	1.73	2.11	0	12	5 (2014)
Household income (1994)	359	476.66	414.59	5.12	4101.71	5 (2014)
Maternal education (1994)	359	6.93	3.66	0	18	5 (2014)
Environmental hygiene (1994)	359	5.2	1.82	0	9	5 (2014)
Crowding (1994)	359	3.19	1.86	.5	12	5 (2014)
Maternal unemployment (1980s & 90s)	272 <sup>3</sup>					5 (2014)
Paternal absence (1980s & 90s)	60 <sup>3</sup>					5 (2014)
Household moves (1980s & 90s)	29 <sup>2</sup>					5 (2014)
Household asset count (2014)	359	9	5.29	0	28	5 (2014)
Paternal education (2014)	359	10.36	3.19	1	16	5 (2014)
Environmental hygiene (2014)	359	6.58	1.68	1	9	5 (2014)
Crowding (2014)	359	18.43	3.86	2	20	5 (2014)
Paternal unemployment (2014)	35 <sup>2</sup>					5 (2014)
Household move (2014)	72 <sup>2</sup>					5 (2014)
Household size (2014)	359	5.38	2.5	3	24	5 (2014)

<sup>1</sup>Minimum value of household income can be <0 due to adjustment for currency deflation.

<sup>2</sup>For binary variables, the “Obs” column refers to the number of households in the sample where the relevant parent was unemployed, where the father was not co-resident, or where the household moved, respectively.

<sup>3</sup>The maternal employment and paternal absence variables that aggregate across 1980s and 1990s data were four-category variables, where 0=mother always employed and father always present, respectively. The numbers given here are the sum of the people in the other (i.e., non-reference) categories. For sample sizes of specific cells, see Table 2 in the main text.

### Tables S3a-c: SES summary statistics by availability of live-in, paid help

Tables (a-c) present socioeconomic status-related information (wealth and education) for families that did and did not have live-in, paid help available. Both variables were z-scored within survey wave. Differences between wealth and education in families that did versus did not have live-in, paid help were statistically significant at the  $p < 0.01$  level, for all three survey waves.

#### (a) 1980s data

Live in help?	Variable	Obs	Mean (SD units)	Std.Dev.	Min	Max
No	Wealth (income)	1,204	-0.129	0.582	-0.696	8.347
Yes	Wealth (income)	123	1.015	2.201	-0.504	13.091
No	Maternal education	1,204	-0.173	0.908	-2.011	2.750
Yes	Maternal education	123	1.210	0.945	-1.747	2.485

#### (b) 1994 data

Live in help?	Variable	Obs	Mean (SD units)	Std.Dev.	Min	Max
No	Wealth (income)	947	-0.036	1.039	-0.562	29.101
Yes	Wealth (income)	37	0.975	1.286	-0.558	4.548
No	Maternal education	947	-0.154	0.959	-1.979	2.805
Yes	Maternal education	37	1.355	0.819	-1.476	2.301

#### (c) 2014 data

Live in help?	Variable	Obs	Mean (SD units)	Std.Dev.	Min	Max
No	Wealth (asset count)	416	-0.139	0.888	-1.685	2.721
Yes	Wealth (asset count)	12	2.216	0.889	0.334	3.455
No	Paternal education	416	-0.046	0.988	-2.871	1.750
Yes	Paternal education	12	1.159	0.579	0.210	1.750

### Tables S4a-h: Inter-variable correlation tables

Tables (a-c) provide raw correlation coefficients for the continuous variables used in models for each study year. In these tables \* = a statistically significant predictor of the dependent variable in the relevant core model, identified in the parentheses, at the  $p < 0.05$  level; \*\* = statistically significant at the  $p < 0.01$  level. Tables (d-h) provide correlations between the continuous predictor variables across the three study years.

#### (a) Pairwise correlations between predictor variables used in 1983-1986 model (Model 1, Table 3 in the main text)

Variables	(1)	(2)	(3)	(4)	(5)
(1) Wealth (income)	1.000				
(2) Maternal education	0.320	1.000			
(3) Environmental hygiene	0.207	0.454	1.000		
(4) Crowding**	-0.039	-0.261	-0.285	1.000	
(5) Household size**	0.220	-0.039	-0.073	0.602	1.000

**(b) Pairwise correlations between predictor variables used in 1994 model (Model 2, Table 3 in the main text)**

Variables	(1)	(2)	(3)	(4)	(5)
(1) Wealth (income)	1.000				
(2) Maternal education	0.225	1.000			
(3) Environmental hygiene*	0.191	0.480	1.000		
(4) Crowding	-0.132	-0.266	-0.234	1.000	
(5) Household size**	0.076	-0.108	-0.083	0.419	1.000

**(c) Pairwise correlations between predictor variables used in 2014 models (Model 3, Table 3 in the main text)**

Variables	(1)	(2)	(3)	(4)	(5)
(1) Wealth (asset count)	1.000				
(2) Paternal education*	0.545	1.000			
(3) Environmental hygiene	0.434	0.395	1.000		
(4) Crowding	0.150	0.200	0.223	1.000	
(5) Household size**	0.265	0.087	0.045	0.073	1.000

**(d) Pairwise correlations between wealth variables, across time**

Variables	(1)	(2)	(3)
(1) 1983-1986	1.000		
(2) 1994	0.354	1.000	
(3) 2014	0.307	0.290	1.000

**(e) Pairwise correlations between education variables, across time**

Variables	(1)	(2)	(3)
(1) 1983-1986	1.000		
(2) 1994	0.970	1.000	
(3) 2014	0.407	0.410	1.000

**(f) Pairwise correlations between environmental hygiene variables, across time**

Variables	(1)	(2)	(3)
(1) 1983-1986	1.000		
(2) 1994	0.367	1.000	
(3) 2014	0.328	0.322	1.000

**(g) Pairwise correlations between crowding variables, across time**

Variables	(1)	(2)	(3)
(1) 1983-1986	1.000		
(2) 1994	0.197	1.000	
(3) 2014	0.010	-0.035	1.000

**(h) Pairwise correlations between household size variables, across time**

Variables	(1)	(2)	(3)
(1) 1983-1986	1.000		
(2) 1994	0.323	1.000	
(3) 2014	0.018	0.066	1.000

**Table S5 1983-1986 model limited to families that had at least one potential alloparental caregiver<sup>1</sup> co-resident (compare to Model 1, Table 3 in main text)**

1983-86	
Hours of alloparental care	
	Beta coefficient (Standard error)
Wealth <sup>2</sup>	0.012 (0.054)
Maternal education <sup>2</sup>	-0.004 (0.032)
Environmental hygiene <sup>2</sup>	0.017 (0.032)
Crowding <sup>2</sup>	-0.076* (0.033)
Maternal unemployment	-0.473** (0.065)
Paternal absence	0.380** (0.079)
Household move	0.030 (0.116)
Household size <sup>2</sup>	0.435** (0.039)
Constant	0.304** (0.059)
Observations	1095
R-squared	0.220

Robust standard errors are in parentheses

\*\* p<.01, \* p<.05

<sup>1</sup>Potential alloparental caregivers were defined as any non-parent household members over the age of 6.

<sup>2</sup>Predictors were standardized within the 1983-86 survey wave

**Table S6 Relationship between harshness and unpredictability measures and alloparental care in 1983-86, 1994, and 2014, excluding families who had live-in, paid help (compare to Models 1-3, Table 3 in the main text)**

	1983-86 Hours of alloparental care	1994 Count of alloparent participation	2014 Count of alloparent participation
	Beta coefficient (Standard error)	Incidence rate ratio <sup>1</sup> (Standard error)	Incidence rate ratio <sup>1</sup> (Standard error)
Wealth <sup>2</sup>	0.005 (0.042)	0.090 (0.073)	1.134 (0.094)
Parental education <sup>2</sup>	0.012 (0.028)	1.001 (0.042)	1.222* (0.104)
Environmental hygiene	0.024 (0.026)	0.924* (0.036)	1.037 (0.079)
Crowding <sup>2</sup>	-0.096** (0.031)	0.996 (0.033)	1.058 (0.089)
Parental unemployment	-0.426** (0.062)	1.136 (0.084)	0.804 (0.205)
Paternal absence	0.409** (0.081)	0.977 (0.116)	n/a n/a
Household move	0.034 (0.105)	0.813 (0.168)	1.126 (0.194)
Household size	0.513** (0.034)	1.221** (0.043)	1.224** (0.093)
Constant	0.218*** (0.059)	0.941 (0.042)	1.514** (0.110)
Observations	1,204	947	416
R <sup>2</sup>	0.307	n/a	n/a
Pseudo R <sup>2</sup>	n/a	0.020	0.021

Robust standard errors are in parentheses

\*\* p<.01, \* p<.05

<sup>1</sup>Negative binomial regression model; coefficients are reported as incidence rate ratios.

<sup>2</sup>See Table 1 in the main text for further information on how predictor variables were quantified in a given outcome year; all predictors were standardized within survey wave.



**Table S7 Relationship between harshness and unpredictability measures in 1983-1986 and alloparental care use in 2014, excluding families who had live-in, paid help in 2014 (compare to Table 4 in the main text)**

1980s predicting 2014		
Count of alloparent participation		
	Incidence rate ratio <sup>1</sup>	Standard error
Early wealth <sup>2</sup>	0.947	0.084
Early maternal education <sup>2</sup>	1.026	0.085
Early environmental hygiene	0.994	0.077
Early crowding <sup>2</sup>	0.860*	0.058
Early maternal unemployment	0.939	0.136
Early paternal absence	0.777	0.142
Early household move	1.399	0.359
Current wealth <sup>2</sup>	1.123	0.098
Current paternal education <sup>2</sup>	1.212*	0.105
Current environmental hygiene	1.069	0.081
Current crowding <sup>2</sup>	1.118	0.093
Current paternal unemployment	0.842	0.258
Current household move	1.272	0.225
Current household size	1.218*	0.106
Constant	1.544**	0.198
Observations	393	
Pseudo R <sup>2</sup>	0.030	

Robust standard errors are in parentheses

\*\* p<.01, \* p<.05

<sup>1</sup>Negative binomial regression model; coefficients are reported as incidence rate ratios.

<sup>2</sup>See Table 1 in the main text for further information on how predictor variables were quantified in a given outcome year; all predictors were standardized within survey wave.

**Table S8 Relationship between harshness experienced in 1994, unpredictability experienced across childhood through 1994<sup>1</sup>, and alloparental care use in 2014, excluding families who had live-in, paid help in 2014 (compare to Table 5 in the main text)**

1994 <sup>1</sup> predicting 2014		
Count of alloparent participation		
	Incidence ratio ratio <sup>2</sup>	Standard error
Middle childhood wealth <sup>3</sup>	0.801	0.136
Middle childhood maternal education <sup>3</sup>	1.121	0.092
Middle childhood environmental hygiene	0.958	0.076
Middle childhood crowding <sup>3</sup>	0.915	0.072
Childhood maternal unemployment <sup>3,4</sup>		
Always unemployed	0.912	0.340
Sometimes employed in 1980s/1991, employed in 1994	0.946	0.171
Sometimes/always employed in 1980s/1991, unemployed in 1994	0.982	0.215
Childhood paternal absence <sup>4</sup>		
Always absent	0.369	0.193
Sometimes/always absent in 1980s/1991, present in 1994	0.833	0.163
Sometimes absent in 1980s/1991, absent in 1994	0.635	0.186
Childhood household move <sup>4</sup>	1.262	0.332
Current wealth <sup>3</sup>	1.141	0.107
Current paternal education <sup>3</sup>	1.185	0.105
Current environmental hygiene	1.066	0.085
Current crowding <sup>3</sup>	1.126	0.098
Current paternal unemployment	0.731	0.219
Current household move	1.280	0.228
Current household size	1.167	0.094
Constant	1.681**	0.247
Observations	350	
Pseudo R <sup>2</sup>	0.028	

\*\* p<.01, \* p<.05

<sup>1</sup>Unpredictability variables (unemployment, paternal absence, moving) in this model aggregate information across childhood, by integrating survey information from the 1980s and 1990s. See Tables 1 and 2 and 'Defining environmental harshness and unpredictability' in the main text for more details.

<sup>2</sup>Negative binomial regression model; coefficients are reported as incidence rate ratios (IRR).

<sup>3</sup>See Table 1 in the main text for further information on how predictor variables were quantified in a given outcome year

<sup>4</sup>Reference category is mother employed in all surveys/father present in all surveys/no household moves in any surveys.

<sup>5</sup>Sample size shrinks due to families who did not have complete information available in all three time periods (i.e. the 1980s, 1994, and 2014).

## References

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