Supplementary Information for:

Accelerated reproduction is not an adaptive response to early-life adversity in wild baboons

Chelsea J. Weibel[a], Jenny Tung[b,c,d,e], Susan C. Alberts[b,c,d,e], Elizabeth A. Archie[a,d]

[a]Department of Biological Sciences, University of Notre Dame, Notre Dame, IN 46556, USA; [b]Department of Biology, Duke University, Durham, NC 27708, USA; [c]Department of Evolutionary Anthropology, Duke University, Durham, NC 27708, USA; [d]Institute of Primate Research, National Museums of Kenya, Nairobi 00502, Kenya; [e]Duke Population Research Institute, Duke University, Durham, NC 27708, USA

Corresponding authors: Chelsea J. Weibel (cweibel2@gmail.com; 574-631-3455) or Elizabeth A. Archie (earchie@nd.edu; 574-631-0178)

Address: Department of Biological Sciences, University of Notre Dame, 100 Galvin Life Sciences Center, Notre Dame, IN 46556, USA

Contents:

www.pnas.org/cgi/doi/10.1073/pnas.2004018117

Supplementary Information Text

Methods

Measuring early-life adversity

We measured the same six sources of early-life adversity used in Tung *et al.* (1). The data underlying these measures were collected as follows.

Maternal death. Maternal death occurred if the focal female's mother died before the focal female reached 4 years of age. Four years represents the earliest age when females attain menarche and become sexually mature (2).

Presence of a competing younger sibling. The presence of a competing younger sibling occurred if the focal female's mother gave birth to another live offspring before the focal female reached 1.5 years of age, which represents the lower quartile of surviving interbirth intervals in this population.

Drought. Drought occurred if the total rainfall during the focal female's first year of life did not exceed 200 mm (median annual rainfall is 344 mm). Rainfall is measured daily at the field site using a rain gauge.

Maternal social isolation. We calculated maternal social isolation by determining the relative social connectedness of a focal female's mother to other adult females during the first two years of the focal female's life. Social connectedness measures were based on a metric of social connectedness (SCI-F) used in previous studies in this population (1, 3). SCI-F measures the mother's frequency of grooming interactions (both as the actor or recipient) with other adult females in the social group in the same year and is then normalized relative to these rates for all other females alive in the population during the same year. The value was standardized and adjusted for observer effort (1, 3). To transform this measure of social connectedness into a measure of social isolation, we multiplied these values by -1. For the final maternal social isolation variable, negative measures thus represented females with relatively high frequencies of grooming during the designated time period, while positive measures represented females with relatively low frequencies of grooming (i.e. females with socially isolated mothers).

Maternal dominance rank. Maternal dominance rank was defined as the ordinal dominance rank of the female's mother during the month that the focal female was born. Dominance ranks in Amboseli are determined based on the observed outcomes of dyadic aggressive interactions, on a monthly basis (4). Win and loss records are compiled into a pairwise interaction matrix and rank orderings are then assigned to

minimize the number of interactions in which lower ranking females won interactions with higher ranking females (1, 5).

Social density. Social density was determined based on the total number of adult social group members in the focal female's social group on the day of her birth. Membership in a social group is determined via census data that are collected during regular field observations. Individuals are considered adults if the females have attained menarche and the males have enlarged testes.

Measuring pace of reproduction and lifespan

Calculating age at first live birth. Age at first birth was defined as the focal female's age when she gave birth to her first live offspring. For the majority of individuals in the data set, the subject's birthdate and the date when she gave birth to her first live offspring are known to within a few days (birthdate=91.4%, *N*=255; date of first birth=90.3%, *N*=252); for the rest of the individuals, the dates are accurate within three months (birthdate=8.6%, *N*=24; date of first birth=9.7%, *N*=27).

Calculating lifespan. For all lifespan measurements, individuals' birthdates and death dates are known within a few days. In our survival models, we also included censored individuals—individuals who are either still alive or for whom we stopped following while they were still living. For these individuals (*N*=132; 57.4%), birthdates and censored dates are also known to within a few days.

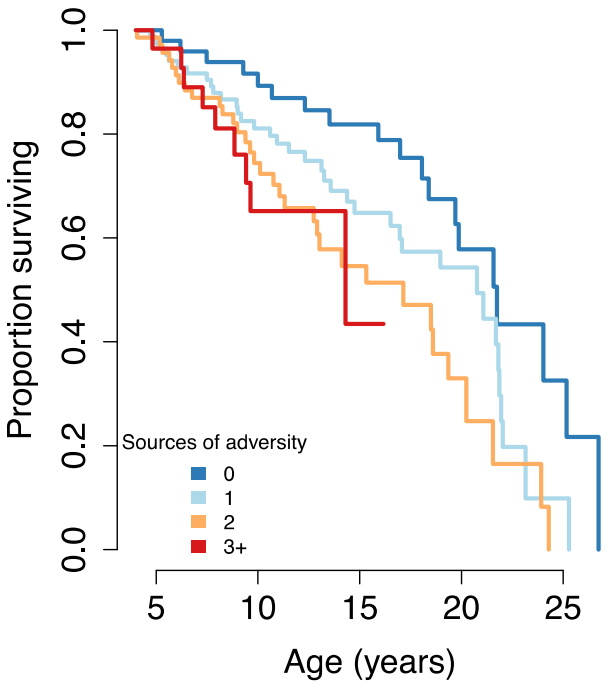

Fig. S1. Cumulative early-life adversity predicted lifespan in female baboons. Survival curves show that the number of experienced sources of early-life adversity predicted adult lifespan. Lifespan was significantly reduced for individuals who experienced more sources of adversity (r^2=0.052, Wald Test *P*=4.67 x 10^{-4}, *N*=230). Colors indicate the number of adverse conditions occurring in early life.

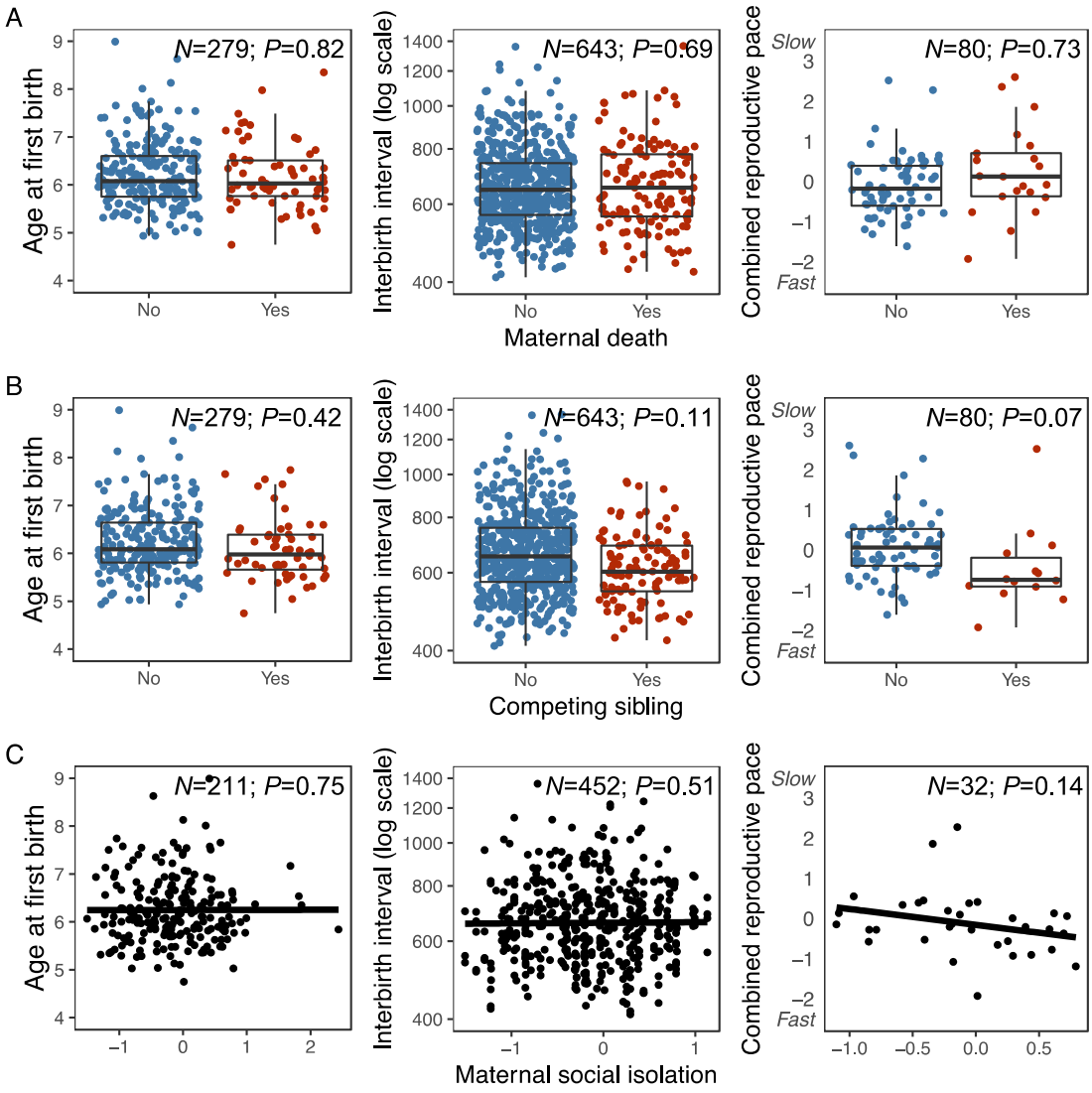

Fig. S2. Individual sources of early-life adversity did not predict the timing or pace of reproduction in female baboons. Plots depict the relationship between all pairwise combinations of the three individual sources of early-life adversity that predict survival (maternal death [row A]; competing sibling [row B]; maternal social isolation [row C]), and the three measures of reproductive pace (age at first birth [left column]; interbirth interval [middle column]; combined reproductive pace [right column]). None of the sources of early-life adversity significantly predicted any of the pace of reproduction measures. Data points in plots A and B are jittered along the x-axis to increase readability.

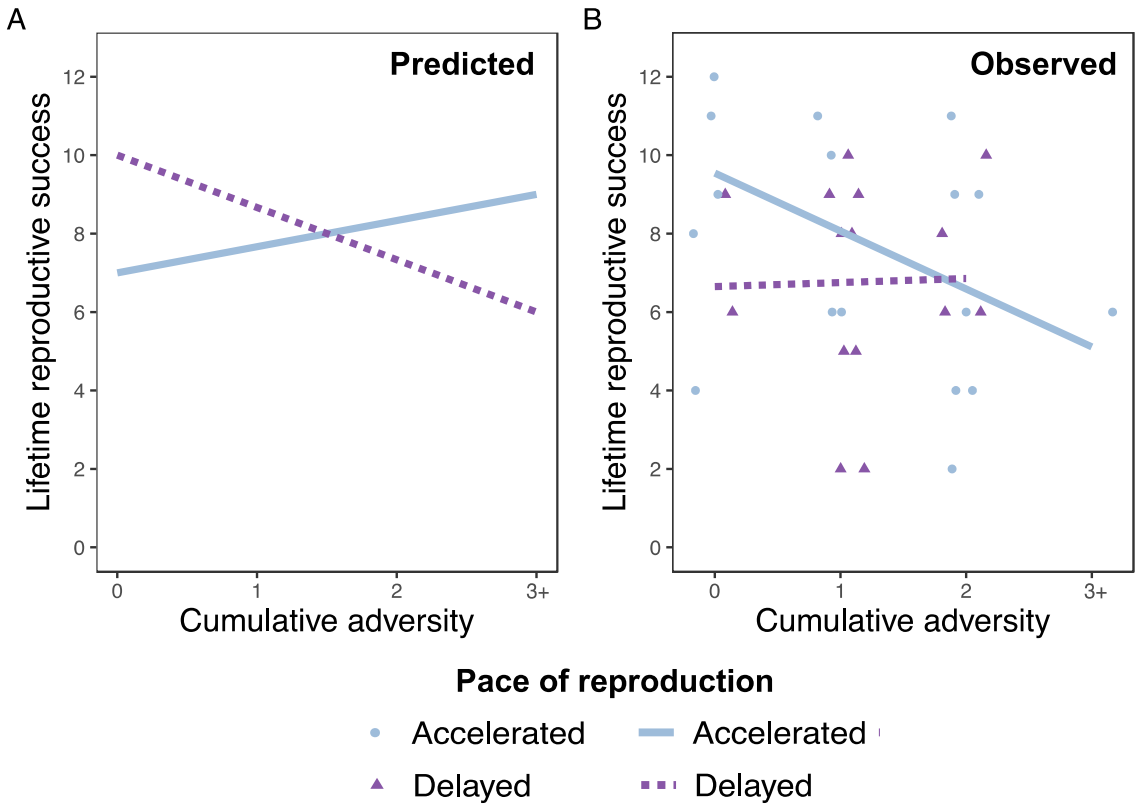

Fig. S3. Accelerated combined reproductive pace offered fitness benefits, but only for individuals who experienced little early-life adversity. (A) Predicted relationships between cumulative adversity, pace of reproduction, and lifetime reproductive success (LRS) under the iPAR model. **(B)** The observed relationships between cumulative adversity, combined reproductive pace, and LRS in this study. The points in B represent the raw data and are colored and shaped based on whether the combined reproductive pace was above (accelerated=blue circles) or below (delayed=purple triangles) the median value. The lines represent the predicted values from the linear model that best fit the data, holding combined reproductive pace at the bottom 25th percentile (delayed=purple dashed) or the top 25th percentile (accelerated=blue solid). The model with the interaction was nearly a better fit for the data compared to the model without the interaction, based on our model selection criterion (ΔAIC=1.999; *N*=32); however, the interaction was in the opposite direction of the iPAR's prediction (plot A). Specifically, plot B shows that accelerated reproduction predicted greater LRS for individuals who *did not* experience early-life adversity, but not for females who *did* experience early-life adversity. Data points in plot B are jittered along the x-axis to increase readability.

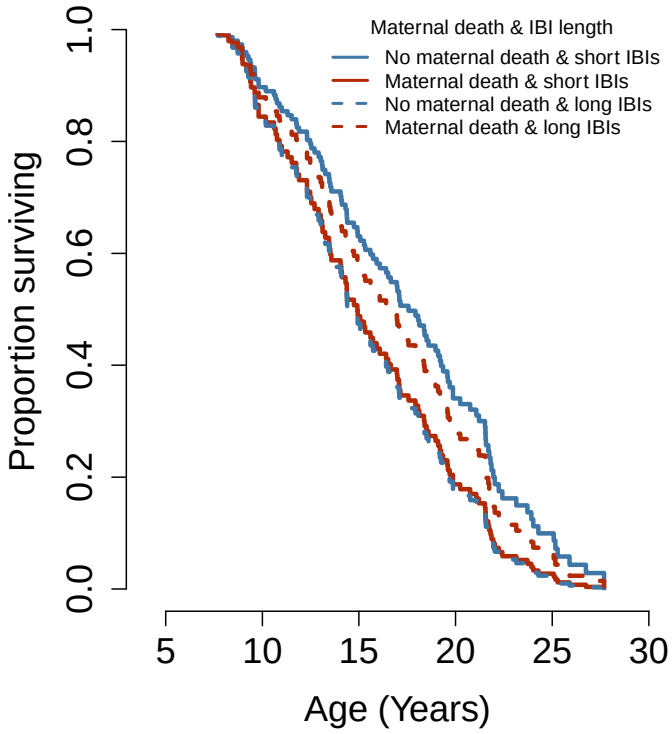

Fig. S4. Short interbirth intervals predicted shorter lifespans for individuals who experienced maternal death. Survival curves showing the interaction effect between maternal death and average interbirth interval ($P_{interaction}$=0.035; P_{IBI}=0.014; $P_{maternal\ death}$=0.034; N=110). Colors represent exposure to maternal death in the first four years of life (blue=no maternal death; red=maternal death) and line types represent average length of interbirth intervals (solid=shorter than the median; dashed=longer than the median). The pattern reveals that individuals who experienced maternal death led shorter lives if they accelerated their reproduction as adults.

Table S1. Sample sizes for all statistical analyses. Analyses focus on the four measures of early-life adversity that most strongly predict lifespan (see Results).

Analysis		Maternal death	Competing sibling	Maternal social isolation	Cumulative adversity
Nettle & Bateson's 1st prediction: Does early adversity predict survival?		230 females			
Initial analysis 1: Does accelerated pace of reproduction increase fitness?	Age at first birth & average IBI	110 females			
	Combined reproductive pace	81 females			
Initial analysis 2: Does early-life adversity predict accelerated pace of reproduction?	Age at first birth	279 females	279 females	211 females	211 females
	IBI	643 intervals in 189 females	643 intervals in 189 females	452 intervals in 138 females	452 intervals in 138 females
	Combined reproductive pace	80 females	80 females	32 females	32 females
Nettle & Bateson's 2nd prediction: Does accelerated pace of reproduction predict increased fitness specifically for females who experienced early-life adversity?	Age at first birth	145 females	145 females	85 females	85 females
	Average IBI	110 females	110 females	61 females	61 females
	Combined reproductive pace	81 females	81 females	32 females	32 females
Nettle & Bateson's 3rd prediction: Does accelerated pace of reproduction predict increased fitness specifically for females with short lifespan?	Age at first birth	145 females			
	Average IBI	110 females			
	Combined reproductive pace	81 females			

Table S2. Results of a multivariate Cox proportional hazards model testing the relationship between each source of early-life adversity and lifespan in female baboons (whole model r^2=0.08, *P*=2.36 x 10^{-3}; *N*=230). Maternal death, maternal social isolation, and competing sibling were the strongest predictors of lifespan in this population.

Source of early-life adversity	Coefficient	Hazard ratio (± 95% CI)	P	Interpretation
Maternal rank	0.024	1.024 (0.980 – 1.070)	0.288	
Competing sibling	0.532	1.702 (0.968 – 2.994)	0.065	Competing younger sibling predicts earlier mortality
Maternal social isolation	0.378	1.459 (1.042 – 2.043)	0.028	Maternal social isolation predicts earlier mortality
Rainfall	0.081	1.084 (0.603 – 1.948)	0.787	
Maternal death	0.866	2.377 (1.507 – 3.748)	1.96 x 10^{-4}	Maternal death predicts earlier mortality
Social density	-0.005	0.995 (0.968 – 1.023)	0.720	

Table S3. Effects of lifespan and pace of reproduction on female lifetime reproductive success (LRS), where LRS is defined as the total number of offspring born to each female that survived to 70 weeks†.

Predictor variable*	Coefficient	SE	z	P	% variance explained
Model 1: Do lifespan, age at first birth, and average IBI predict LRS?					
Lifespan	0.407	0.021	19.518	7.00×10^{-37}	71.8%
Age at first birth	-0.608	0.174	-3.503	6.74×10^{-4}	6.7%
Average IBI	-3.043	0.700	-4.347	3.18×10^{-5}	3.3%
Model 2: Do lifespan and combined reproductive pace predict LRS?					
Lifespan	0.422	0.025	16.591	2.65×10^{-27}	70.5%
Combined reproductive pace	-0.884	0.154	-5.755	1.63×10^{-7}	`8.8%

† Results using the original definition of lifetime reproductive success (the total number of live offspring born to each female) are found in Table 2 in the main text.

* Lifespan and age at first birth are measured in years, while average interbirth interval (IBI) is the natural log transformed length of the mean IBI measured in days.

Table S4. The effects of early-life adversity on pace of reproduction. For initial analysis 2, we used multivariate linear models to test all pairwise combinations of different measures of early-life adversity and different measures of reproductive acceleration. Our measures of early adversity included cumulative adversity (all adverse events combined), maternal death, competing sibling, and maternal social isolation; our measures of reproductive acceleration included age at first birth, surviving interbirth intervals, and combined reproductive pace. Covariates include social/environmental factors shown in prior studies to explain variation in female reproduction in our population (6, 7). None of the sources of early-life adversity significantly predicted female reproductive timing or pace (p-values > 0.05).

Predictor variables	Coefficient	SE	P	Interpretation
Effects of cumulative adversity				
Response variable: Age at first birth (N = 211 females)				
Cumulative early adversity	0.021	0.047	0.66	Cumulative adversity does not predict age at first birth
Group size at first birth	-0.003	0.007	0.67	Group size does not predict age at first birth
Response variable: Interbirth interval (IBI) (N = 452 intervals in 138 females)				
Cumulative early adversity	0.006	0.014	0.69	Cumulative adversity does not predict IBI duration
Rank at the start of the IBI	0.009	0.002	<0.001	Low ranking females have longer IBIs
Parity at the start of the IBI	0.024	0.032	0.46	Parity does not predict IBI duration
Age at the start of the IBI	-0.063	0.019	<0.001	Middle-aged females have shorter IBIs
Age^2 at the start of the IBI	0.003	0.001	<0.001	
Response variable: Combined reproductive pace (CRP) (N = 32 females)				
Cumulative early adversity	-0.046	0.133	0.73	Cumulative adversity does not predict CRP
Group size at first birth	-0.014	0.017	0.39	Group size does not predict CRP
Average rank at the start of the IBIs	0.089	0.022	<0.001	Low ranking females have slower CRP
Effects of maternal death				
Response variable: Age at first birth (N = 279 females)				
Maternal death	-0.020	0.087	0.82	Maternal death does not predict age at first birth
Group size at first birth	0.001	0.006	0.90	Group size does not predict age at first birth
Response variable: Interbirth interval (N = 643 intervals in 189 females)				
Maternal death	-0.010	0.025	0.69	Maternal death does not predict IBI duration
Rank at the start of the IBI	0.009	0.002	<0.001	Low ranking females have longer IBIs
Parity at the start of the IBI	0.038	0.027	0.16	Parity does not predict IBI duration
Age at the start of the IBI	-0.045	0.015	0.003	Middle-aged females have shorter IBIs
Age^2 at the start of the IBI	0.002	0.001	0.002	
Response variable: Combined reproductive pace (N = 80 females)				
Maternal death	0.055	0.160	0.73	Maternal death does not predict CRP

Group size at first birth	0.009	0.015	0.55	Group size does not predict CRP
Average rank at the start of the IBIs	0.089	0.016	<0.001	Low ranking females have slower CRP
Effects of competing sibling				
Response variable: Age at first birth (N = 279 females)				
Competing sibling	-0.074	0.091	0.42	The presence of a competing sibling does not predict age at first birth
Group size at first birth	0.001	0.006	0.82	Group size does not predict age at first birth
Response variable: Interbirth interval (N = 643 intervals in 189 females)				
Competing sibling	-0.041	0.026	0.11	The presence of a competing sibling does not predict IBI duration
Rank at the start of the IBI	0.009	0.002	<0.001	Low ranking females have longer IBIs
Parity at the start of the IBI	0.037	0.027	0.17	Parity does not predict IBI duration
Age at the start of the IBI	-0.046	0.015	0.002	Middle-aged females have shorter IBIs
Age^2 at the start of the IBI	0.002	0.001	0.002	
Response variable: Combined reproductive pace (N = 80 females)				
Competing sibling	-0.373	0.206	0.07	The presence of a competing sibling does not predict CRP
Group size at first birth	0.013	0.016	0.41	Group size does not predict CRP
Average rank at the start of the IBIs	0.078	0.016	<0.001	Low ranking females have slower CRP
Effects of maternal social isolation				
Response variable: Age at first birth (N = 211 females)				
Maternal social isolation	-0.020	0.064	0.75	Maternal social isolation does not predict age at first birth
Group size at first birth	-0.003	0.007	0.66	Group size does not predict age at first birth
Response variable: Interbirth interval (N = 452 intervals in 138 females)				
Maternal social isolation	-0.014	0.020	0.51	Maternal social isolation does not predict IBI duration
Rank at the start of the IBI	0.009	0.002	<0.001	Low ranking females have longer IBIs
Parity at the start of the IBI	0.024	0.032	0.46	Parity does not predict IBI duration
Age at the start of the IBI	-0.063	0.019	<0.001	Middle-aged females have shorter IBIs
Age^2 at the start of the IBI	0.003	0.001	<0.001	
Response variable: Combined reproductive pace (N = 32 females)				
Maternal social isolation	-0.285	0.195	0.14	Maternal social isolation does not predict CRP
Group size at first birth	-0.017	0.016	0.30	Group size does not predict CRP
Average rank at the start of the IBIs	0.083	0.022	<0.001	Low ranking females have slower CRP

Table S5. **Testing Nettle and Bateson's 2nd prediction (8): interaction effects between early-life adversity and pace of reproduction predicting lifetime reproductive success, defined as the total number of live offspring born to each female.** Results using the alternative definition of lifetime reproductive success, which includes offspring survival to weaning, are found in Table S6. We tested for an interaction effect between all pairwise combinations of early-life adversity (cumulative early-life adversity, maternal death, competing sibling, and maternal social isolation) and all three measures of reproductive acceleration (age at first birth, surviving interbirth intervals, and combined reproductive pace). For each early-life adversity and pace of reproduction combination, the best-fitting model for predicting lifetime reproductive success was determined via a difference in Akaike information criteria (AIC) greater than 2; if the difference in AICs was less than 2, we chose the simpler model (the model without the interaction effect). ΔAIC values greater than 2 represent comparisons where the model with the interaction was a better fit for the data. The asterisk (*) marks a model where the interaction was a better fit for the data. For all of the adversity and pace of reproduction pairings, the model with the interaction was only a better fit under one condition: maternal death and combined reproductive pace. However, this interaction was in the opposite direction of the iPAR's prediction.

Model	Predictor variable	Coefficient	SE	P	ΔAIC (>2 supports the presence of an interaction effect)	Interpretation
Adversity metric: Cumulative adversity						
Pace of reproduction metric: Age at first birth (N = 85 females)						
Interaction	Age at first birth	-1.888	0.861	0.031	-1.318	The interaction effect does not significantly improve model fit
	Cumulative adversity	-4.084	3.475	0.243		
	Interaction	0.453	0.560	0.422		
No interaction	Age at first birth	-1.310	0.478	0.008		
	Cumulative adversity	-1.293	0.371	0.001		
Pace of reproduction metric: Interbirth interval (N = 61 females)						
Interaction	Interbirth interval	-6.598	4.309	0.131	-1.976	The interaction effect does not significantly improve model fit
	Cumulative adversity	-3.533	18.048	0.846		
	Interaction	0.418	2.769	0.881		
No interaction	Interbirth interval	-6.020	1.953	0.003		
	Cumulative adversity	-0.811	0.414	0.055		
Pace of reproduction metric: Combined reproductive pace (N = 32 females)						
Interaction	Combined reproductive pace	-3.260	1.568	0.047	1.999	The interaction effect does not significantly improve model fit
	Cumulative adversity	-0.433	0.612	0.485		
	Interaction	1.780	0.922	0.064		

No interaction	Combined reproductive pace	-0.493	0.665	0.465		
	Cumulative adversity	-0.761	0.615	0.226		
Adversity metric: Maternal death						
Pace of reproduction metric: Age at first birth (N = 145 females)						
Interaction	Age at first birth	-1.597	0.468	0.001	0.153	The interaction effect does not significantly improve model fit
	Maternal death	-7.761	4.895	0.115		
	Interaction	1.147	0.789	0.149		
No interaction	Age at first birth	-1.194	0.378	0.002		
	Maternal death	-0.701	0.572	0.223		
Pace of reproduction metric: Interbirth interval (N = 110 females)						
Interaction	Interbirth interval	-8.364	1.875	<0.001	1.870	The interaction effect does not significantly improve model fit
	Maternal death	-42.391	21.401	0.050		
	Interaction	6.408	3.289	0.054		
No interaction	Interbirth interval	-6.282	1.560	<0.001		
	Maternal death	-0.713	0.583	0.224		
Pace of reproduction metric: Combined reproductive pace (N = 81 females)						
Interaction	Combined reproductive pace	-1.598	0.489	0.002	4.001*	The interaction effect significantly improves the model, but the interaction is in the direction opposite to the iPAR's prediction; females who *do not* experience maternal death and accelerate their reproduction accrue fitness benefits
	Maternal death	-0.762	0.696	0.277		
	Interaction	1.794	0.737	0.017		
No interaction	Combined reproductive pace	-0.810	0.377	0.035		
	Maternal death	-0.634	0.716	0.379		
Adversity metric: Competing sibling						
Pace of reproduction metric: Age at first birth (N = 145 females)						
Interaction	Age at first birth	-1.240	0.416	0.003	-1.881	The interaction effect does not significantly improve model fit
	Competing sibling	0.389	5.877	0.947		
	Interaction	-0.330	0.968	0.734		
No interaction	Age at first birth	-1.301	0.375	0.001		
	Competing sibling	-1.599	0.650	0.015		
Pace of reproduction metric: Interbirth interval (N = 110 females)						
Interaction	Interbirth interval	-6.617	1.776	<0.001	-1.779	The interaction effect does not significantly
	Competing sibling	10.202	25.377	0.688		

	Interaction	-1.819	3.939	0.645		improve model fit
No interaction	Interbirth interval	-6.987	1.580	<0.001		
	Competing sibling	-1.512	0.727	0.040		
Pace of reproduction metric: Combined reproductive pace (N = 81 females)						
Interaction	Combined reproductive pace	-1.110	0.426	0.011	-1.490	The interaction effect does not significantly improve model fit
	Competing sibling	-0.324	1.177	0.784		
	Interaction	0.868	1.245	0.488		
No interaction	Combined reproductive pace	-1.009	0.399	0.013		
	Competing sibling	-0.861	0.888	0.335		
Adversity metric: Maternal social isolation						
Pace of reproduction metric: Age at first birth (N = 85 females)						
Interaction	Age at first birth	-1.405	0.542	0.011	-1.155	The interaction effect does not significantly improve model fit
	Maternal isolation	4.920	6.094	0.422		
	Interaction	-0.873	0.970	0.371		
No interaction	Age at first birth	-1.273	0.521	0.017		
	Maternal isolation	-0.537	0.598	0.372		
Pace of reproduction metric: Interbirth interval (N = 61 females)						
Interaction	Interbirth interval	-7.630	2.162	<0.001	0.488	The interaction effect does not significantly improve model fit
	Maternal isolation	45.700	29.548	0.127		
	Interaction	-6.988	4.536	0.129		
No interaction	Interbirth interval	-6.312	2.008	0.003		
	Maternal isolation	0.194	0.638	0.762		
Pace of reproduction metric: Combined reproductive pace (N = 32 females)						
Interaction	Combined reproductive pace	-0.869	0.716	0.235	0.809	The interaction effect does not significantly improve model fit
	Maternal isolation	-1.066	0.990	0.290		
	Interaction	-2.836	1.770	0.120		
No interaction	Combined reproductive pace	-0.568	0.709	0.429		
	Maternal isolation	-0.575	0.966	0.556		

Table S6. **Testing Nettle and Bateson's 2nd prediction (8): interaction effects between early-life adversity and pace of reproduction predicting lifetime reproductive success, defined as the total number of offspring born to each female that survived to 70 weeks.** Results using the original definition of lifetime reproductive success, which does not consider offspring survival, are found in Table S5. We tested for an interaction effect between all pairwise combinations of early-life adversity (cumulative early-life adversity, maternal death, competing sibling, and maternal social isolation) and all three measures of reproductive acceleration (age at first birth, surviving interbirth intervals, and combined reproductive pace). For each early-life adversity and pace of reproduction combination, the best-fitting model for predicting lifetime reproductive success was determined via a difference in Akaike information criteria (AIC) greater than 2; if the difference in AICs was less than 2, we chose the simpler model (the model without the interaction effect). ΔAIC values greater than 2 represent comparisons where the model with the interaction was a better fit for the data. The asterisk (*) marks a model where the interaction was a better fit for the data. For all of the adversity and pace of reproduction pairings, the model with the interaction was only a better fit under two conditions: maternal death and interbirth intervals, and maternal death and combined reproductive pace. However, these interactions were in the opposite direction of the iPAR's prediction.

Model	Predictor variable	Coefficient	SE	P	ΔAIC (>2 supports the presence of an interaction effect)	Interpretation
Adversity metric: Cumulative adversity						
Pace of reproduction metric: Age at first birth (N = 85 females)						
Interaction	Age at first birth	-1.729	0.736	0.021	-1.314	The interaction effect does not significantly improve model fit
	Cumulative adversity	-3.642	2.971	0.224		
	Interaction	0.388	0.479	0.421		
No interaction	Age at first birth	-1.233	0.409	0.003		
	Cumulative adversity	-1.249	0.317	<0.001		
Pace of reproduction metric: Interbirth interval (N = 61 females)						
Interaction	Interbirth interval	-10.792	3.647	0.004	0.227	The interaction effect does not significantly improve model fit
	Cumulative adversity	-23.032	15.275	0.137		
	Interaction	3.411	2.343	0.151		
No interaction	Interbirth interval	-6.070	1.683	<0.001		
	Cumulative adversity	-0.801	0.357	0.029		
Pace of reproduction metric: Combined reproductive pace (N = 32 females)						
Interaction	Combined reproductive pace	-2.638	1.436	0.077	1.390	The interaction effect does not significantly improve model fit
	Cumulative adversity	-0.937	0.560	0.106		
	Interaction	1.495	0.845	0.088		
No interaction	Combined reproductive pace	-0.315	0.603	0.605		

	Cumulative adversity	-1.212	0.558	0.038		
Adversity metric: Maternal death						
Pace of reproduction metric: Age at first birth (N = 145 females)						
Interaction	Age at first birth	-1.567	0.387	<0.001	1.160	The interaction effect does not significantly improve model fit
	Maternal death	-7.994	4.043	0.050		
	Interaction	1.149	0.652	0.080		
No interaction	Age at first birth	-1.162	0.314	<0.001		
	Maternal death	-0.916	0.474	0.055		
Pace of reproduction metric: Interbirth interval (N = 110 females)						
Interaction	Interbirth interval	-8.183	1.532	<0.001	6.198*	The interaction effect significantly improves the model, but the interaction is in the direction opposite to the iPAR's prediction; females who *do not* experience maternal death and have short IBIs accrue fitness benefits
	Maternal death	-51.064	17.491	0.004		
	Interaction	7.699	2.688	0.005		
No interaction	Interbirth interval	-5.683	1.301	<0.001		
	Maternal death	-0.989	0.486	0.044		
Pace of reproduction metric: Combined reproductive pace (N = 81 females)						
Interaction	Combined reproductive pace	-1.253	0.422	0.004	3.031*	The interaction effect significantly improves the model, but the interaction is in the direction opposite to the iPAR's prediction; females who *do not* experience maternal death and accelerate their reproduction accrue fitness benefits
	Maternal death	-1.287	0.601	0.035		
	Interaction	1.414	0.637	0.029		
No interaction	Combined reproductive pace	-0.632	0.324	0.055		
	Maternal death	-1.187	0.614	0.057		
Adversity metric: Competing sibling						
Pace of reproduction metric: Age at first birth (N = 145 females)						
Interaction	Age at first birth	-1.307	0.341	<0.001	-1.982	The interaction effect does not significantly improve model fit
	Competing sibling	-2.485	4.815	0.607		
	Interaction	0.106	0.793	0.894		
No interaction	Age at first birth	-1.288	0.307	<0.001		
	Competing sibling	-1.844	0.533	<0.001		
Pace of reproduction metric: Interbirth interval (N = 110 females)						
Interaction	Interbirth interval	-7.329	1.454	<0.001	-0.575	The interaction effect does not significantly improve model fit
	Competing sibling	-26.301	20.775	0.208		
	Interaction	3.791	3.224	0.242		

No interaction	Interbirth interval	-6.558	1.300	<0.001		
	Competing sibling	-1.887	0.598	0.002		
Pace of reproduction metric: Combined reproductive pace (N = 81 females)						
Interaction	Combined reproductive pace	-1.243	0.355	<0.001	0.614	The interaction effect does not significantly improve model fit
	Competing sibling	-0.872	0.982	0.378		
	Interaction	1.651	1.039	0.116		
No interaction	Combined reproductive pace	-1.050	0.337	0.003		
	Competing sibling	-1.892	0.751	0.138		
Adversity metric: Maternal social isolation						
Pace of reproduction metric: Age at first birth (N = 85 females)						
Interaction	Age at first birth	-1.205	0.474	0.013	-1.993	The interaction effect does not significantly improve model fit
	Maternal isolation	-0.064	5.325	0.990		
	Interaction	-0.070	0.848	0.934		
No interaction	Age at first birth	-1.194	0.453	0.010		
	Maternal isolation	-0.509	0.520	0.335		
Pace of reproduction metric: Interbirth interval (N = 61 females)						
Interaction	Interbirth interval	-7.189	1.899	<0.001	-0.714	The interaction effect does not significantly improve model fit
	Maternal isolation	28.785	25.965	0.272		
	Interaction	-4.394	3.986	0.275		
No interaction	Interbirth interval	-6.360	1.747	<0.001		
	Maternal isolation	0.173	0.555	0.756		
Pace of reproduction metric: Combined reproductive pace (N = 32 females)						
Interaction	Combined reproductive pace	-0.580	0.698	0.413	-0.985	The interaction effect does not significantly improve model fit
	Maternal isolation	-1.065	0.964	0.279		
	Interaction	-1.638	1.725	0.350		
No interaction	Combined reproductive pace	-0.407	0.672	0.550		
	Maternal isolation	-0.781	0.915	0.400		

Table S7. Model results for the three Cox proportional hazards models that include maternal death, the three pace of reproduction metrics, and their interactions as predictors of lifespan. The only significant interaction effect was between interbirth interval and maternal death. The direction of the interaction suggests that accelerating reproduction was costly (i.e. lead to shorter lifespans) for individuals who experienced maternal death.

Predictor variable	Coefficient	Hazard ratio (± 95% CI)	P	N (# events)	Interpretation
Pace of reproduction metric: Age at first birth					
Age at first birth	0.136	1.146 (0.848 – 1.547)	0.375	280 (145)	The interaction effect is not significant
Maternal death	1.189	3.285 (0.106 – 102.143)	0.498		
Interaction	-0.129	0.879 (0.505 – 1.531)	0.650		
Pace of reproduction metric: Interbirth interval					
Interbirth interval	1.995	7.356 (1.487 – 36.380)	0.014	110 (110)	The interaction effect is significant; individuals who lose their mother and have short IBIs live shorter lives
Maternal death	20.300	6.551×10^{8} $4.544 – 9.445 \times 10^{16}$	0.034		
Interaction	-3.113	0.044 (0.002 – 0.801)	0.035		
Pace of reproduction metric: Combined reproductive pace					
Combined reproductive pace	0.177	1.193 (0.816 – 1.745)	0.362	81 (81)	The interaction effect is not significant
Maternal death	0.092	1.097 (0.644 – 1.868)	0.735		
Interaction	-0.619	0.539 (0.260 – 1.115)	0.096		

Table S8. **Testing Nettle and Bateson's 3rd prediction (8): interaction effects between lifespan and pace of reproduction predicting lifetime reproductive success, defined as the total number of live offspring born to each female.** Results using the alternative definition of lifetime reproductive success, which includes offspring survival to weaning, are found in Table S9. For each early-life adversity and pace of reproduction combination, the best-fitting model for predicting lifetime reproductive success was determined via a difference in Akaike information criteria (AIC) greater than 2; if the difference in AICs was less than 2, we chose the simpler model (the model without the interaction effect). ΔAIC values greater than 2 represent comparisons where the model with the interaction was a better fit for the data (represented with an asterisk (*)). For each pace of reproduction measure, the model with the interaction was a better fit for the data; however, the interaction was in the incorrect direction. For all of these circumstances, individuals who accelerated their reproduction only accrued greater lifetime reproductive success if they led long lives.

Model	Response variable	Coefficient	SE	P	ΔAIC (>2 supports the presence of an interaction effect)	Interpretation
Pace of reproduction metric: Age at first birth (N = 145 females)						
Interaction	Age at first birth	-0.062	0.381	0.870	4.064*	The interaction effect significantly improves the model, but the interaction is in the direction opposite the iPAR's prediction; females who experience an early age at first birth and live long lives accrue fitness benefits
	Lifespan	0.910	0.153	<0.001		
	Interaction	-0.062	0.025	0.015		
No interaction	Age at first birth	-0.955	0.114	<0.001		
	Lifespan	0.537	0.014	<0.001		
Pace of reproduction metric: Interbirth interval (N = 110 females)						
Interaction	Interbirth interval	3.436	1.569	0.031	23.553*	The interaction effect significantly improves the model, but the interaction is in the direction opposite to the iPAR's prediction; females who have short IBIs and live long lives accrue fitness benefits
	Lifespan	4.027	0.668	<0.001		
	Interaction	-0.542	0.103	<0.001		
No interaction	Interbirth interval	-4.390	0.560	<0.001		
	Lifespan	0.514	0.019	<0.001		
Pace of reproduction metric: Combined reproductive pace (N = 81 females)						
Interaction	Combined reproductive pace	0.746	0.408	0.071	17.381*	The interaction effect significantly improves the model, but the interaction is in the direction opposite the iPAR's prediction; females who have a fast combined reproductive pace and live long lives accrue fitness benefits
	Lifespan	0.495	0.019	<0.001		
	Interaction	-0.109	0.024	<0.001		
No interaction	Combined reproductive pace	-1.043	0.126	<0.001		
	Lifespan	0.515	0.021	<0.001		

Table S9. **Testing Nettle and Bateson's 3rd prediction (8): interaction effects between lifespan and pace of reproduction predicting lifetime reproductive success, defined as the total number of offspring born to each female that survived to 70 weeks.** Results using the original definition of lifetime reproductive success, which does not consider offspring survival, are found in Table S8. For each early-life adversity and pace of reproduction combination, the best-fitting model for predicting lifetime reproductive success was determined via a difference in Akaike information criteria (AIC) greater than 2; if the difference in AICs was less than 2, we chose the simpler model (the model without the interaction effect). ΔAIC values greater than 2 represent comparisons where the model with the interaction was a better fit for the data (represented with an asterisk (*)). For two of the pace of reproduction measures (interbirth intervals and combined reproductive pace), the model with the interaction was a better fit for the data; however, the interaction was in the incorrect direction. For these circumstances, individuals who accelerated their reproduction only accrued greater lifetime reproductive success if they led long lives.

Model	Response variable	Coefficient	SE	P	ΔAIC (>2 supports the presence of an interaction effect)	Interpretation
Pace of reproduction metric: Age at first birth (N = 145 females)						
Interaction	Age at first birth	-0.213	0.428	0.620	1.538	The interaction effect does not significantly improve model fit
	Lifespan	0.750	0.172	<0.001		
	Interaction	-0.053	0.029	0.064		
No interaction	Age at first birth	-0.977	0.128	<0.001		
	Lifespan	0.431	0.016	<0.001		
Pace of reproduction metric: Interbirth interval (N = 110 females)						
Interaction	Interbirth interval	3.653	1.890	0.056	16.250*	The interaction effect significantly improves the model, but the interaction is in the direction opposite to the iPAR's prediction; females who have short IBIs and live long lives accrue fitness benefits
	Lifespan	3.921	0.804	<0.001		
	Interaction	-0.542	0.124	<0.001		
No interaction	Interbirth interval	-4.179	0.652	<0.001		
	Lifespan	0.404	0.022	<0.001		
Pace of reproduction metric: Combined reproductive pace (N = 81 females)						
Interaction	Combined reproductive pace	0.667	0.529	0.211	7.254*	The interaction effect significantly improves the model, but the interaction is in the direction opposite the iPAR's prediction; females who have a fast combined reproductive pace and live long lives accrue fitness benefits
	Lifespan	0.405	0.025	<0.001		
	Interaction	-0.095	0.031	0.003		
No interaction	Combined reproductive pace	-0.884	0.154	<0.001		
	Lifespan	0.422	0.025	<0.001		

Supplementary Information References

1. J. Tung, E. A. Archie, J. Altmann, S. C. Alberts, Cumulative early life adversity predicts longevity in wild baboons. *Nat Commun* **7**, 11181 (2016).

2. P. O. Onyango, L. R. Gesquiere, J. Altmann, S. C. Alberts, Puberty and dispersal in a wild primate population. *Horm. Behav.* **64**, 240–249 (2013).

3. E. A. Archie, J. Tung, M. Clark, J. Altmann, S. C. Alberts, Social affiliation matters: both same-sex and opposite-sex relationships predict survival in wild female baboons. *Proc. R. Soc. B* **281**, 1–9 (2014).

4. J. Altmann, Observational study of behavior: Sampling methods. *Behaviour* **49**, 227–267 (1974).

5. A. J. Lea, N. K. Learn, M. J. Theus, J. Altmann, S. C. Alberts, Complex sources of variance in female dominance rank in nepotistic society. *Anim. Behav.* **94**, 87–99 (2014).

6. M. J. Charpentier, J. Tung, J. Altmann, S. C. Alberts, Age at maturity in wild baboons: genetic, environmental and demographic influences. *Mol Ecol* **17**, 2026–40 (2008).

7. L. R. Gesquiere, J. Altmann, E. A. Archie, S. C. Alberts, Interbirth intervals in wild baboons: Environmental predictors and hormonal correlates. *Am J Phys Anthr.* (2018).

8. D. Nettle, M. Bateson, Adaptive developmental plasticity: what is it, how can we recognize it and when can it evolve? *Proc Biol Sci* **282**, 20151005 (2015).