Supplementary information
Family structure transitions and educational outcomes:
Explaining heterogeneity by parental education in Germany

Table S1. Entropy balancing for single-mother families: reweighted control group

	Treatment group		Control group	
	mean	variance	mean	variance
M highly educated	.2068	.1646	.2077	.1646
F highly educated	.188	.1532	.1888	.1532
M or F: highest parental occupational position (ISEI)	5.46	208.8	5.44	208.7
Household income decile	5.44	6.537	5.439	6.535
F unemployed	.04887	.04666	.04899	.0466
M or F born outside Germany	.2143	.169	.2152	.1689
M's age at childbirth	29.59	27.77	29.58	27.77
M and F married	.8947	.09454	.8943	.09456
Number of children	2.184	1.079	2.184	1.079
Living in rural area	.2556	.191	.2567	.1908
Girl	.4962	.2509	.4963	.2501
Birth order: 2nd	.3271	.2209	.3281	.2205
Birth order: 3rd or later	.1391	.1202	.1398	.1203
Birth year 1981	.03008	.02928	.03015	.02925
Birth year 1982	.00751	.00749	.00754	.00749
Birth year 1983	.01504	.01487	.01508	.01485
Birth year 1984	.03383	.03281	.03392	.03278
Birth year 1985	.01128	.01119	.01131	.01118
Birth year 1986	.0188	.01851	.01884	.01849
Birth year 1987	.03759	.03632	.03769	.03628
Birth year 1988	.05263	.05005	.05276	.04999
Birth year 1989	.02632	.02572	.02638	.02569
Birth year 1990	.05639	.05341	.05652	.05334
Birth year 1991	.02632	.02572	.02638	.02569
Birth year 1992	.04887	.04666	.04899	.0466
Birth year 1993	.04511	.04324	.04522	.04319
Birth year 1994	.02632	.02572	.02638	.02569
Birth year 1995	.03759	.03632	.03769	.03628
Birth year 1996	.04511	.04324	.04522	.04319
Birth year 1997	.03008	.02928	.03015	.02925
Birth year 1998	.04887	.04666	.04899	.0466
Birth year 1999	.0188	.01851	.01888	.01853
Birth year 2000	.1278	.1119	.1284	.112
Birth year 2001	.1203	.1062	.1209	.1063
Birth year 2002	.04135	.03979	.04145	.03975
Birth year 2003	.04135	.03979	.04145	.03975
Birth year 2004	.03383	.03281	.03392	.03278

Notes: Balancing variables included also the federal state of residence, but the results are not presented due to data protection issues. This analysis step proceeded the estimation of the treatment effect in Table 2.

Table S2. Entropy balancing for stepfamilies: reweighted control group

	Treatment group		Control group	
	mean	variance	mean	variance
M highly educated	.2134	.1689	.215	.1688
F highly educated	.1768	.1465	.1782	.1465
M or F: highest parental occupational position (ISEI)	47.22	241.9	47.19	241.8
Household income decile	5.136	5.555	5.134	5.552
F unemployed	.04268	.04111	.04284	.04102
M or F born outside Germany	.1524	.13	.1536	.1301
M's age at childbirth	26.77	22.83	26.76	22.82
M and F married	.9207	.07343	.9202	.07346
Number of children	2.183	1.132	2.182	1.132
Living in rural area	.3537	.23	.3552	.2291
Girl	.5305	.2506	.53	.2492
Birth order: 2nd	.3415	.2262	.3431	.2255
Birth order: 3rd or later	.1159	.1031	.1168	.1032
Birth year 1981	.00609	.00609	.00612	.00608
Birth year 1982	.03049	.02974	.0306	.02967
Birth year 1983	.02439	.02394	.02448	.02389
Birth year 1984	.02439	.02394	.02448	.02389
Birth year 1985	.04268	.04111	.04283	.04101
Birth year 1986	.03659	.03546	.03672	.03538
Birth year 1987	.02439	.02394	.02448	.02389
Birth year 1988	.05488	.05218	.05507	.05205
Birth year 1989	.04878	.04669	.04895	.04657
Birth year 1990	.07927	.07343	.07953	.07322
Birth year 1991	.1159	.1031	.1167	.1031
Birth year 1992	.04878	.04669	.04895	.04657
Birth year 1993	.04268	.04111	.04283	.04101
Birth year 1994	.06098	.05761	.06118	.05746
Birth year 1995	.04268	.04111	.04283	.04101
Birth year 1996	.03049	.02974	.0306	.02967
Birth year 1997	.03049	.02974	.0306	.02967
Birth year 1998	.03659	.03546	.03672	.03538
Birth year 1999	.04878	.04669	.04895	.04657
Birth year 2000	.04878	.04669	.04895	.04657
Birth year 2001	.07927	.07343	.07953	.07322
Birth year 2002	0	0	.00047	.00047
Birth year 2003	.0122	.01212	.01224	.01209
Birth year 2004	.01829	.01807	.01836	.01803

Notes: Balancing variables included also the federal state of residence, but the results are not presented due to data protection issues. This analysis step proceeded the estimation of the treatment effect in Table 2.

Table S3. The effect of trajectory of family structure transitions on the likelihood to attend the academic track, by gender

	A) Sample only for girls		B) Sample only for boys	
	M1a	M2a	M1b	M2b
Control group: stable two-parent (bio.)				
Single-mother family	-.109*** (.035)		-.094** (.035)	
Stepfamily		-.094** (.037)		-.100** (.036)
N (children)	2,020	1,975	2,057	1,941

Notes: Coefficients from linear probability models with entropy balancing weighting. Standard errors in parentheses. Models balance for child's gender, birth order and birth year, federal state of residence, mother's and father's education, migration status, maternal age at childbirth and following pre-separation controls: highest parental occupation, paternal unemployment, household income decile, marital status, living in rural area and the number of children.
* p<0.05, ** p<0.01, *** p<0.001

Table S4. The cumulative effect of transition to stepfamily compared to single-parent family, the likelihood to attend academic track

	Sample for stepfamilies and single-parent families		Sample for stepfamilies (control sibling single-mother)	Sample for children of lower-educated stepfathers and children of lower-educated fathers in single-parent family
	LPM	**LPM with EB**	**Siblings FE**	**LPM with EB**
	M1	M2	M3	M4
Control group: single-parent family / sibling experienced only transition to single-parent family before age 11)				
Stepfamily	-.021	.027	.089	-.043
	(.043)	(.041)	(.093)	(.044)
N (children)	430	430	221	344
N (families)			100	

Notes: Coefficients from simple linear probability models (LPM) and from LPM models with entropy balancing weighting (EB) and from siblings fixed effects models (Siblings FE). Standard errors are in parentheses. Simple LPM and LPM with EB control/are balanced for child's gender, birth order and birth year, federal state of residence, mother's and father's education, migration status, maternal age at childbirth and following pre-separation controls: highest parental occupation, paternal unemployment, household income decile, marital status, living in rural area and the number of children. Siblings FE model controls for child's gender, birth order and birth year.

Table S5. Interacting effects of trajectory of family structure transitions and parental education on the likelihood to attend the academic track

	Linear probability models [a]				Siblings fixed effects models [b]			
	M1a		M2a		M1b		M2b	
Instability (ref. stable two-parent)								
Single-mother family	-.101**	(.031)			-.050	(.063)		
Stepfamily	-.139***	(.038)	-.161***	(.039)	.020	(.071)	.006	(.070)
Mother: highly educated (HE)	.190***	(.019)	.191***	(.019)	-		-	
Father: highly educated (HE)	.190***	(.020)			-		-	
Stepfather/father: HE			.192***	(.020)			.208*	(.103)
Interactions								
Single-mother ^{x} mother HE	.162*	(.070)			.253†	(.143)		
Stepfamily ^{x} mother HE	.075	(.098)	.083	(.090)	.041	(.127)	.071	(.132)
Single-mother ^{x} father HE	-.171*	(.073)			-.277*	(.113)		
Stepfamily ^{x} father HE	.110	(.105)			-.024	(.119)		
Stepfamily ^{x} (step)father HE			.145†	(.089)			.029	(.127)
N (children)	4,241		3,975		3,180		3,003	
N (families)					1,379		1,311	
R-squared (within for siblings FE)	.319		.320		.048		.047	

*Note*s: Standard errors are in parentheses.

[a] Models control for child's gender, birth order and birth year, federal state of residence, mother's and father's education, migration status, maternal age at childbirth and following pre-separation controls: highest parental occupation, paternal unemployment, household income decile, marital status, living in rural area and the number of children.

[b] Models control for child's gender, birth order and birth year.

† p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Table S6. Sample of children who had <u>at least one highly educated parent</u> and lived in a single-mother family after parental separation or in a stable two-parent family: combined educational level of both parents and the likelihood to attend the academic track

	M1	
Instability (ref. stable two-parent)		
Single-mother family	-.014	(.082)
Parental education (ref. mother HE and father LE)		
Both mother and father highly educated (HE)	.163***	(.033)
Mother lower-educated (LE) and father HE	-.012	(.032)
Interactions (ref. mother HE and father LE)		
Single-mother ^{x} both mother and father HE	-.030	(.116)
Single-mother ^{x} mother LE and father HE	-.322**	(.120)
N (children)	1,546	
R-squared	.198	

Notes: Coefficients from linear probability models. Standard errors are in parentheses. Models control for child's gender, birth order and birth year, federal state of residence, migration status, maternal age at childbirth and following pre-separation controls: highest parental occupation, paternal unemployment, household income decile, marital status, living in rural area and the number of children.
* $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table S7. The sample for children of <u>highly educated fathers</u>: the effect of trajectory of family structure transitions on the mediators

	Dependent variable:							
	Household income decile	Working fulltime vs. other	Hours spent on childcare	Maternal life satisfaction	Maternal health	Moving	Poverty experience	Poverty with moving
Ref. stable two-parent								
Single-mother family	-2.776***	.177***	-.478	-1.050***	-.762**	.236***	.467***	.215***
	(.202)	(.052)	(.643)	(.210)	(.260)	(.058)	(.041)	(.028)
Stepfamily	-.321	.166*	.496	.286	.265	.567***	.229***	.266***
	(.266)	(.068)	(.846)	(.277)	(.341)	(.076)	(.054)	(.037)
N (children)	1,259	1,259	1,259	1,259	1,259	1,259	1,259	1,259

Notes: Coefficients from linear regression and linear probability models. Standard errors are in parentheses. Models control for child's gender, birth order and birth year, federal state of residence, mother's education, migration status, maternal age at childbirth and following pre-separation controls: highest parental occupation, paternal unemployment, household income decile, marital status, living in rural area and the number of children.
* $p<0.05$, ** $p<0.01$, *** $p<0.001$

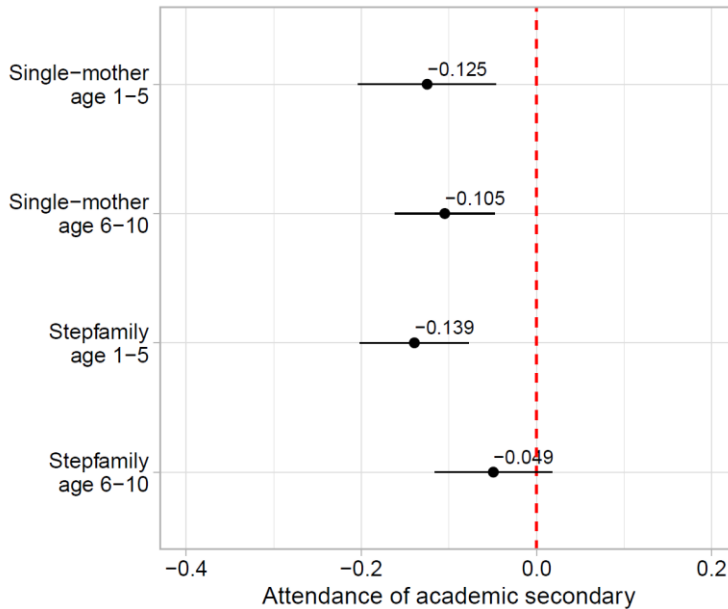**Table S8**. The sample for children of <u>whose both parents have lower education</u>: the effect of trajectory of family structure transitions on the mediators

	Potential mediator as dependent variable:							
	Household income decile	Working fulltime vs. other	Hours spent on childcare	Maternal life satisfaction	Maternal health	Moving	Poverty experience	Poverty with moving
Ref. stable two-parent								
Single-mother family	-1.312***	0.091***	0.985**	-0.684***	-0.435**	0.417***	0.556***	0.403***
	(0.128)	(0.027)	(0.380)	(0.131)	(0.156)	(0.032)	(0.029)	(0.022)
Stepfamily	-0.389*	0.098**	1.773***	-0.489**	-0.496**	0.567***	0.327***	0.365***
	(0.157)	(0.033)	(0.466)	(0.161)	(0.192)	(0.039)	(0.036)	(0.027)
N (children)	2,652	2,652	2,652	2,652	2,652	2,652	2,652	2,652

Notes: Coefficients from linear regression and linear probability models. Standard errors are in parentheses. Models control for child's gender, birth order and birth year, federal state of residence, migration status, maternal age at childbirth and following pre-separation controls: highest parental occupation, paternal unemployment, household income decile, marital status, living in rural area and the number of children.
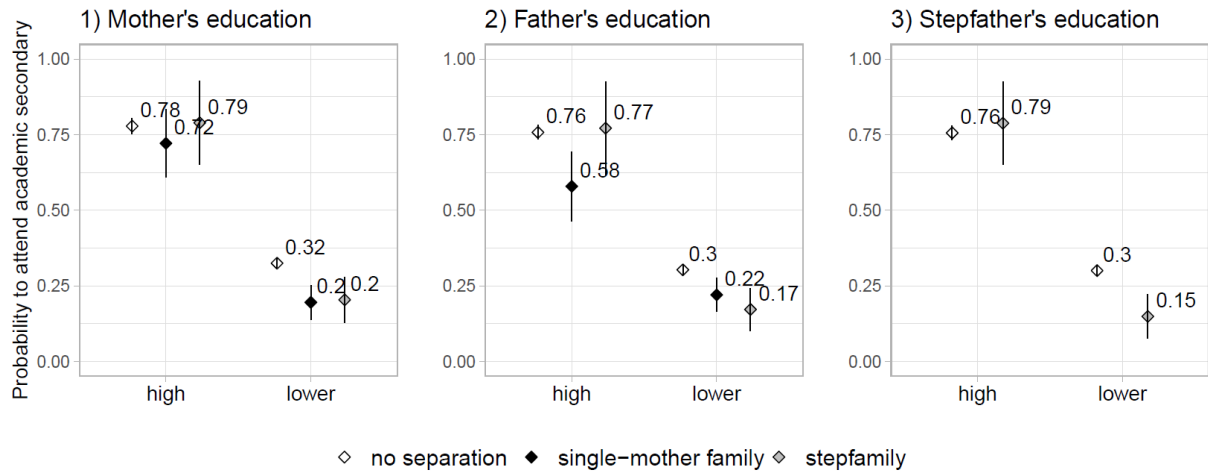
* $p<0.05$, ** $p<0.01$, *** $p<0.001$

Figure S1. The effect of trajectory of family structure transitions on the likelihood to attend the academic track, by age at separation
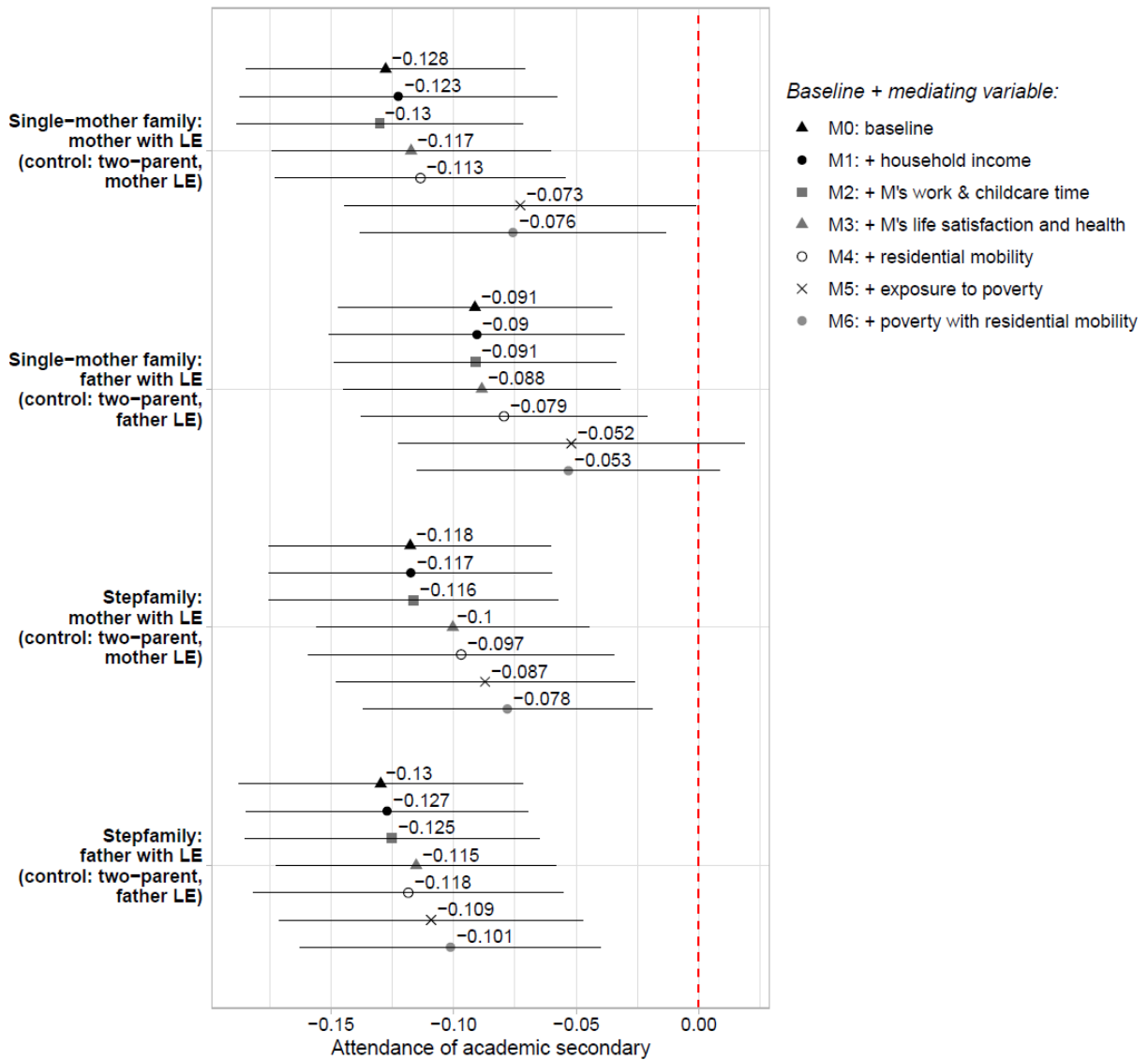

Notes: Coefficients from linear probability models with entropy balancing weighting. Models are balanced for child's gender, birth order and birth year, federal state of residence, mother's and father's education, migration status, maternal age at childbirth and following pre-separation controls: highest parental occupation, paternal unemployment, household income decile, marital status, living in rural area and the number of children.

Figure S2. Predicted probabilities for attending the academic secondary school track by parental education and trajectory of family structure transitions, based on linear probability models presented in Table S6
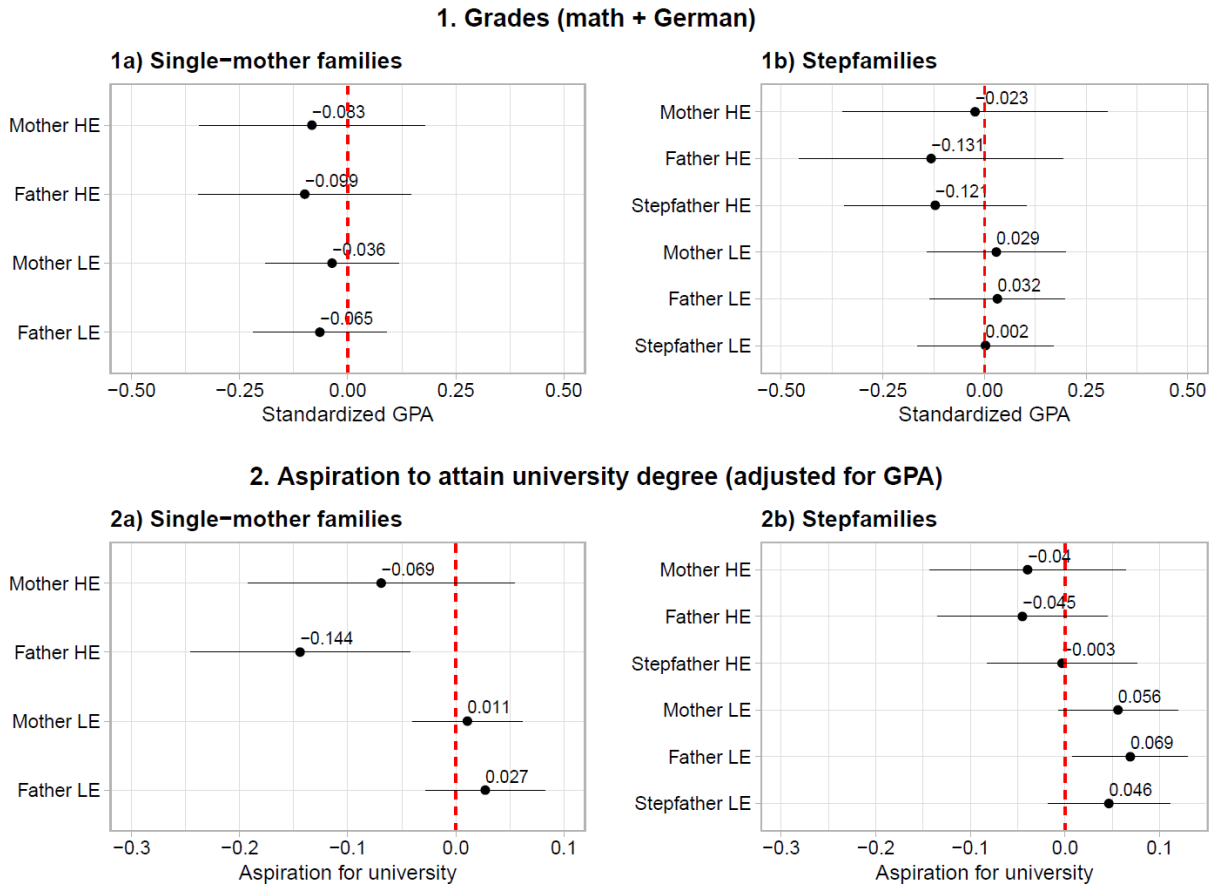

Notes: Predicted probabilities with 95% confidence intervals from linear probability models without entropy balancing weighting.

Figure S3. Mediation analysis for the effect of trajectory of family structure transitions on the likelihood to attend the academic track among lower-educated mothers and fathers

Attendance of academic secondary

Notes: LE – lower education. Coefficients with 95% confidence intervals from models with entropy balancing weighting, separate models for subgroups.

Figure S4. Subgroup analysis for heterogeneous treatment effect of trajectory of family structure transitions at age 1-10 on educational outcomes at age 16/17, by parental education

1. Grades (math + German)

1a) Single-mother families   **1b) Stepfamilies**

2. Aspiration to attain university degree (adjusted for GPA)

2a) Single-mother families   **2b) Stepfamilies**

*Note*s: HE – high education, LE – lower education. Coefficients with 95% confidence intervals from linear probability models with entropy balancing weighting, separate models for each subgroup. The control group consists of stable two-parent families with respective educational level, presented by the line crossing the horizontal axes at 0.