The Heterogeneity of Partnership Trajectories to Childlessness in Germany

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Abstract

In recent decades, childlessness has increased across many European countries. In addition to socioeconomic characteristics, having a partner is considered a prerequisite in most fertility studies. Yet, still little is known about the partnership biographies of childless women and men. We assess the heterogeneity in the partnership trajectories of childless persons in Germany and explore compositional differences of partnership trajectories by gender and education. We use data from the German Family Panel to reconstruct partnership biographies reflecting the occurrence and frequency of different partnership states (singleness, living apart together, cohabitation, marriage). The sample comprises women and men born 1971–1973 whose life courses are observed from age 18–40. Applying sequence and cluster analysis, we identify five patterns of partnership trajectories: (1) ‘Marriage’ (14.6%); (2) ‘Long-term cohabitation’ (11.8%) with one partner; (3) ‘Serial cohabitation’ (15.6%); (4) ‘LAT’ (18.8%), long-term/multiple living-apart-together relationships; and (5) ‘Single’ (39.3%), long-term singleness. Men are overrepresented in the ‘Single’ cluster, especially if highly educated. Women are more often married and more likely to experience long-lasting singleness or multiple LAT episodes when being highly educated. We speculate that theories predicting high levels of childlessness in contexts where gender norms and work-family policies do not account for the increasing gender equality in education and labor force participation might also explain differences in the pathways leading to childlessness. Generally, our findings point at a more elaborate conceptualization of childlessness that moves away from a binary cross-sectional indicator and set the ground for future cross-national comparisons.

Keywords Childlessness · Gender · Education · Partnership histories · Sequence analysis

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1 Introduction

In recent decades, childlessness has increased across many European countries. This has spurred research on the determinants and consequences of childlessness. Much of the previous research, however, has utilized cross-sectional data or has considered only women. Only recently empirical studies started to address these shortcomings (Berrington and Pattaro 2014; Kreyenfeld and Konietzka 2017a; Tocchioni 2018).

As shown by both quantitative and qualitative studies, having a partner is a strong predictor for the transition to parenthood (Hart 2018; Mynarska et al. 2015; Philipov et al. 2015; Tanturri et al. 2015)—in addition to fertility preferences and socioeconomic characteristics (Bernardi et al. 2015; Hart 2018; Trimarichi and Bavel 2017; Wood et al. 2014). Yet, still little is known about the partnership trajectories of childless persons. Examining entire union biographies instead of the partnership status at a certain age acknowledges that childlessness results from a process that unfolds over individual life courses and which is accompanied by changes in preferences for parenthood and in the structure of opportunities and constraints to realize those preferences (Buhr and Huinink 2017; Fiori et al. 2017). From this vantage point, we argue that childlessness should be conceptualized as a complex ‘process outcome’ (Abbott 2016) rather than a distinct cross-sectional state.

To our knowledge, such a process perspective was applied to partnership biographies only in one study using Finnish register data (Jalovaara and Fasang 2017). Building on this study, the present research explores, for the first time, partnership trajectories of childless people in Germany. In applying a research design similar to the Finnish study, our results facilitate cross-national comparisons on the life courses of the childless within Europe. Our analysis draws on very rich data from the German Family Panel (pairfam). Unlike less detailed general surveys or register data, pairfam aims at providing a more comprehensive account of changes in norms and behavior in family life-courses and therefore allows for distinguishing between living apart together (LAT) relationships and being single. This is crucial because experiencing (repeated) partnership dissolutions is associated with a higher probability of childlessness (Keizer et al. 2008; Thomson et al. 2012). Disregarding LAT relationships would underestimate the true scale of partnership dissolutions and therefore one important reason for childlessness. Accordingly, our detailed data provide a more accurate estimate of the actual prevalence of singleness and partnership dynamics among childless persons. In addition, our study contributes to the emerging understanding of the heterogeneity in the (partnership) life courses of childless adults (Albertini and Arpino 2018). Rather than conceptualizing childlessness and parenthood as a simple dichotomy, our results reveal a considerable amount of heterogeneity among the childless.

In what follows, we reconstruct and describe the typical union partnership among the childless. Like most other European countries, Germany witnessed a postponement of union formation and of the transition to parenthood during the recent decades (Huinink et al. 2012; Schneider 2015). Changes in union

formation, particularly the decline in long-term stable relationships, the increase in partnerships of short duration, the rising share of single person households (Eckhard et al. 2015), as well as the corresponding ideational change (Merz and Liefbroer 2012) are considered important determinants of the (German) increase in childlessness after the ‘Golden Age of Marriage.’ Although the ideational and behavioral changes regarding union and family formation are widely recognized markers of a general secular trend commonly described as ‘Second Demographic Transition’ (Lesthaeghe 2010), they do not affect all persons and societies to the same degree. Most importantly, they have been shown to be clearly stratified by education and gender (McLanahan and Percheski 2008; Struffolino et al. 2016).

Accordingly, we explore the compositional differences between different partnership trajectories along these two dimensions. Previous studies on Germany and other European countries have demonstrated marked gender differences in the attitudes and intentions toward childlessness: men become parents at a later age, more often report that they do not want to have children, and less often give up on their desire to have a child when they age (Buhr and Huinink 2017; Sobotka and Testa 2008). Even though some of these findings are biologically determined, sociodemographic circumstances play a crucial role as well.

Among these factors, we focus on education, which was also considered in Jalovaara and Fasang (2017). Whereas the positive associations between education and fertility postponement or childlessness are well-established for women, education seems to be of less relevance for predicting childlessness among men (González and Jurado-Guerrero 2006; Keizer et al. 2008; Köppen et al. 2017; Kreyenfeld and Konietzka 2017a; Waren and Pals 2013). Previous research has argued that the educational gradient for women is most pronounced in contexts—such as Germany—with a low degree of gender equity that make it challenging to reconcile work and family (Esping-Andersen and Billari 2015; McDonald 2000a, b). Accordingly, we expect to observe a clear educational gradient in the selection into childlessness among women, whereas we expect no educational stratification among men.

In terms of union formation, previous research also indicates gender-specific effects of education. Trimarchi and Van Bavel (2017), for instance, show that the positive educational gradient in the transition to fatherhood is mainly mediated by the positive effect of education on union formation. In contrast, women’s chances of forming stable unions—particularly marital unions—seem to be reduced with increasing education and labor force attachment (Eckhard 2014; Lengerer 2012). Explanations of these differences typically refer to gender-specific benefits and (opportunity) costs of family and union formation (Oppenheimer 1988). The strongest effects are expected under the conditions of the traditional male-breadwinner model, as present in (West) Germany. In such a context, the opportunity costs of the gender-specific division of labor are particularly high for better-educated women, because cultural and structural factors impose a choice between work or family after childbirth (Carmichael and Whittaker 2007; Esping-Andersen and Billari 2015; González and Jurado-Guerrero 2006).

Based on evidence on the general German population, we further expect that highly educated persons are more often engaged in LAT relationships, cohabit later, and marry later and less often than their lower-educated counterparts. Regarding

gender, differences in partnership trajectories should mainly pertain to timing, with women cohabiting and marrying at a younger age (Fulda 2016). Finally, previous findings on union histories to childlessness suggest that we will observe a high share of never partnered persons. This phenomenon should be particularly pronounced among men (Jalovaara and Fasang 2017; Keizer et al. 2008).

2 Data and Methods

The analyses are based on data from the first nine waves of the German Family Panel (Pairfam), release 9.0 (Brüderl et al. 2018). A detailed description of the study can be found in (Huinink et al. 2011). The data were collected between 2008 and 2017 and include detailed retrospective information on partnership and fertility biographies as well as living arrangements. We restrict our analysis to the oldest study-cohort (born between 1971 and 1973) for which we reconstructed the partnership trajectories from age 18–40. Our sample comprises 2,241 respondents, 403 of whom were childless at age 40, i.e., those who did not have biological children. All analyses are weighted using attrition-adjusted post-stratification weights (Brüderl et al. 2017). We censored the observation period at age 40 although some respondents were a few years older at the time of the last interview. We censored the observation period at age 40 for three reasons: (1) increasing the cutoff age would either decrease sample size due to panel attrition or produce sequences of unequal length; (2) sequence and cluster analysis yield more robust results when the sequences are of equal length; (3) it results in a very modest overestimation of childlessness for women and a moderate overestimation for men while it ensures a sufficient sample size for a detailed analysis of the life courses of childless individuals.¹

Pairfam provides exceptionally rich monthly information on partnership status. Based on these data, we reconstructed partnership trajectories distinguishing between seven partnership states: (1) single, (2) first LAT relationship, (3) second- or higher-order LAT, (4) first co-residential union, (5) second- or higher-order co-residential union, (6) first marriage, and (7) second- or higher-order marriage. This specification of the state space is more nuanced compared to previous applications (for example by identifying LAT episodes) but does not differentiate between partnership states which only occur very rarely (for example by differentiating third-order co-residential unions). Given the low prevalence of additional partnership states, more fine-grained specifications of the state space yielded substantively very similar results.

¹ In 2016, for instance, less than two percent of all first births were to mothers older than age 40 (Destatis 2018). Unfortunately, official data do not allow for parity specific analysis of father's age at birth: the only available information refers to the fact that 13% births of paternal birth events were experienced by men who were older than 40 years. Based on the data on women, we assume that only a small share of these events refers to first births. Among women only 29% of the births to mothers older than 40 years are first births. If the data on men would reveal a similar pattern, around 4% of the childless men in our data would become fathers after age 40.

We use sequence and cluster analysis to identify regularities in the partnership trajectories of the subsample of individuals who are childless at age 40. First, we apply sequence analysis with optimal matching (OM) to determine the pairwise dissimilarity between partnership trajectories. OM is based on two transformation operations—substitution and insertion/deletion (*indel*) of a state—necessary to turn one sequence into another. These transformations are assigned specific costs, and the distance between two sequences is given by the sum of these costs for each pairwise comparison. Similarly to previous studies on partnership trajectories, we employed constant substitution costs of 2 and *indel* costs of 1, which is a robust choice for identifying similarities in terms of the order and the timing of partnership states (Studer and Ritschard 2016).²

In a second step, we used cluster analysis on the distance matrix resulting from OM. We first applied Ward clustering to identify the initial clustering solution for optimizing the algorithm of the Partitioning Around Medoids (PAM) clustering technique (Reynolds et al. 2006). Well-established cutoff criteria (e.g., Average Silhouette Width and Point Biserial Correlation) consistently supported five clusters as the best grouping (Studer 2013).

Subsequently, we examined differences between the five patterns using descriptive tables and multinomial logistic regression. The descriptive exploration of the sequences considers the time persons spend in different relationship states, the number of events in the partnership trajectories, as well as the complexity of the sequences. Complexity is measured by the turbulence index proposed by Elzinga and Liefbroer (2007). The turbulence increases as the number of distinct states and state changes occur along the sequence. We predicted cluster membership by gender and education and their interaction to examine the compositional differences between patterns of partnership trajectories of the childless as identified by the cluster analysis. Education is operationalized as the highest educational qualification attained (upper secondary education³ or higher: yes/no).

Based on results from previous research (Kreyenfeld and Konietzka 2014), we also considered differences between East and West Germany measured by country of birth ('East Germany (Former GDR)', 'West Germany (FRG)', and 'other'). Table 1 provides a bivariate view on partnership trajectories and country of birth. Despite the East–West differences displayed in Table 1, we did not include this indicator in the final regression-based results presented in Table 2 because it neither improved model fit, nor did it yield significant or substantively meaningful effects once we account for gender and education. Similarly, we abstained from including other covariates which have been identified as determinants in the process leading to childlessness (e.g., work/family orientation or personality traits). These variables were collected in the yearly panel interviews when the respondents were already

² Different OM cost specifications and distance measures mostly produced substantively similar results, but less homogenous patterns of relationship histories.

³ In the German education system, this corresponds to the *Abitur* or equivalent diploma.

in their thirties: including such covariates in the regression would result in endogeneity bias. Note, however, that we are considering one indicator pertinent to the biological dimension of childlessness although it was measured at age 40, i.e., self-reported infertility/sterility (either of the respondent or the respondent's partner).⁴ Pairfam is one of very few surveys collecting information on infertility: we utilized this information to provide a more detailed descriptive account of the circumstances of childlessness.

Sequence and cluster analyses were conducted using the TraMineR (Gabadinho et al. 2011) and WeightedCluster (Studer 2013) packages in R. Regression analyses, and marginal effects were estimated in Stata using commands from the SPost13 package (Long and Freese 2014).

3 Results

Figure 1 shows the distribution of relationship states for the parents and childless respondents between age 18 and 40. Not surprisingly, the most marked difference between the two groups is the prevalence of the two states 'marriage' and 'single.' At age 40, around 78% of parents are married, whereas this applies to only around 28% of the childless. Among the parents, being married becomes the modal state from age 25 onwards, while the modal relationship state for the childless is 'single' across the entire observation period. That said, most childless respondents (66%) tend to be in a partnership at age 40, with 50% being either in a marital or a co-residential relationship.

Table 1 provides further information on notable group differences: the childless spend 19 months more in LAT relationships than parents, but approximately the same amount of time in co-residential unions (around four years). The trajectories of childless persons include slightly more sub-episodes (6.25 vs. 5.55), i.e., they more often experience changes in their partnership trajectories. This is in line with findings showing that the childless tend to have higher re-partnering probabilities than parents (e.g., Ivanova et al. 2013). Moreover, childlessness is more common among 40-year-old men (29%) than among women (22%), respondents with higher educational attainment (29% among persons with Abitur or equivalent certificate vs 22% for the lower educated) and those who were born in West Germany (28%) as compared to East Germany (22%) and abroad (17%). All these results are in line with previous findings—using different data sources—on childlessness in Germany (Kreyenfeld and Konietzka 2014), other European countries, and the USA (Baudin et al. 2015; Kreyenfeld and Konietzka 2017a; Osiewalska 2017). A further descriptive inspection of the partnership information of the childless (results not shown) revealed that the highly educated spend more time without having a partner and less time in cohabitation and marriage. In addition, there were no substantial differences

⁴ Note that respondents/couples are also considered to be infertile if they or their current partner use sterilization for contraception.

Data: pairfam, release 9.0; results are weighted by attrition-adjusted post-stratification weights

Fig. 1 State distribution plots of partnership trajectories (age 18–40) for the childless and parents

in the partnership trajectories of East and West German childless—contrary to what is usually found for the general population (Fulda 2016).

Figure 2 captures the heterogeneity in the partnership trajectories of the childless by displaying the individual sequences within the five groups identified by the cluster analysis. The clusters are loosely named after their most prevalent partnership states: (1) ‘Marriage’ (15%), (2) ‘Long-term cohabitation’ (12%), (3) ‘Serial cohabitation’ (16%), (4) ‘LAT’ (19%), and (5) ‘Single’ (39%). The sequence-index plots in Fig. 2 provide an accurate account of the respondents’ life courses and illustrate the timing and duration of events and transitions between states that follow each other. Figure 2 reveals marked differences in the timing of partnership transitions. At age 20, for example, more than two-thirds of the persons in the ‘Marriage,’ ‘LAT,’ and ‘Serial cohabitation’ clusters reported at least one LAT episode, whereas respondents classified as ‘Singles’ or ‘Long-term cohabitators’ tend to experience this transition later. Further, our results reveal that the cluster label ‘Serial cohabitation’—used in accordance with Jalovaara and Fasang (2017)—could be considered an exaggeration because only a few respondents in this group (20%) experience more than two cohabitation spells. Table 1 further substantiates this assertion: the average number of cohabitation episodes for the serial cohabitators adds up to a modest 2.13 (with a modal value of 2 cohabitation episodes for 77% of the persons in this cluster).

Contrary to most previous research on partnership histories, our definition of the partnership states distinguishes between single and LAT. This allowed us to identify distinct partnership patterns experienced by those who never cohabited or got

Table 1 Descriptive information by cluster membership

	Total		By cluster (childless only)			
	Childless	Parents	Marriage	Long-term cohabitation	Serial cohabitation	LAT Single
<i>Average time in each state</i>						
Single	122.27 (76.36)	55.44 (53.69)	43.29 (42.79)	73.03 (47.90)	77.79 (41.96)	88.91 (39.32)
1st LAT	22.31 (26.92)	20.95 (25.53)	21.90 (24.61)	25.42 (37.94)	19.73 (21.47)	24.13 (23.80)
2nd LAT	41.58 (48.74)	23.30 (33.36)	16.48 (26.41)	17.43 (23.59)	38.38 (28.22)	20.07 (23.83)
1st cohabitation	36.18 (47.98)	39.40 (44.38)	31.87 (23.09)	137.56 (56.78)	44.57 (24.41)	13.35 (21.62)
2nd cohabitation	13.02 (29.07)	12.23 (30.73)	7.98 (17.06)	0.89 (5.50)	63.24 (40.03)	1.88 (10.00)
1st marriage	28.22 (52.22)	109.11 (74.12)	140.91 (38.48)	9.43 (16.71)	19.68 (25.77)	4.57 (15.25)
2nd marriage	0.41 (4.80)	3.57 (18.94)	1.58 (10.85)	0.24 (2.27)	0.60 (4.60)	0.00 (0.00)
<i>Number of episodes</i>						
Total	6.25 (3.08)	5.55 (2.71)	5.22 (1.67)	4.93 (1.90)	8.43 (2.51)	5.24 (3.06)
Single	2.39 (1.44)	1.56 (1.13)	1.22 (0.61)	1.73 (1.07)	2.54 (1.48)	2.53 (1.44)
LAT	2.44 (1.53)	1.87 (1.29)	1.67 (0.84)	1.78 (1.00)	3.05 (1.29)	2.09 (1.52)
Cohabitation	0.98	1.14	1.19	1.04	2.13	0.47

Table 1 (continued)

	Total		By cluster (childless only)				
	Childless	Parents	Marriage	Long-term cohabitation	Serial cohabitation	LAT	Single
Marriage	(0.86) 0.37	(0.75) 0.92	(0.65) 1.05	(0.20) 0.32	(0.60) 0.55	(0.85) 0.24	(0.67) 0.12
<i>Sequence differentiation Turbulence*</i>	(0.51) 0.18	(0.42) -0.06	(0.23) -0.15	(0.50) -0.31	(0.54) 1.10	(0.46) 0.91	(0.33) -0.26
<i>Gender: Women</i>	(1.05) 0.43	(0.97) 0.53	(0.56) 0.68	(0.73) 0.43	(0.78) 0.44	(0.91) 0.49	(1.02) 0.31
<i>Education: High school</i>	0.53	0.44	0.37	0.50	0.51	0.53	0.61
<i>Place of birth:</i>							
West Germany	0.74	0.64	0.64	0.71	0.64	0.80	0.78
East Germany	0.18	0.22	0.14	0.19	0.27	0.17	0.16
Other	0.08	0.14	0.22	0.09	0.09	0.03	0.05
<i>Respondent or partner infertile</i>							
No	0.70	0.79	0.48	0.68	0.78	0.69	0.75
Yes	0.19	0.18	0.46	0.28	0.19	0.22	0.05
Missing	0.11	0.04	0.06	0.04	0.04	0.08	0.20
Relative frequency	0.25	0.75	0.15	0.12	0.16	0.19	0.39
<i>N (unweighted)</i>	403	1838	59	47	63	76	158

Data: pairfam, release 9.0; results are weighted by attrition-adjusted post-stratification weights

*z-scores; Note: Standard deviation in parentheses

Data: pairfam, release 9.0; results are weighted by attrition-adjusted post-stratification weights

Fig. 2 Sequence-index plots of partnership trajectories (age 18–40) of childless individuals by cluster membership

married but who either were mostly single (cluster 5) or were in one or more LAT relationships (cluster 4). The average individual in the 'LAT' cluster had engaged in at least two LAT relationships, while the average 'Single' trajectory can be characterized by one short LAT spell surrounded by long-lasting episodes of singleness.

In line with the results on serial cohabitation, the modest average of 2.44 LAT episodes among the childless suggest that also 'serial' LAT relationships seem not to be a common phenomenon, with the notable exception of the 'LAT' cluster (average of 3.68) and to a smaller extent the 'Serial cohabitators' (3.05).

The results presented so far illustrate the heterogeneity in the union trajectories between different sub-groups of the childless. The turbulence measure displayed in Table 1 further allows us to evaluate the complexity of the partnership histories within these groups. The comparison between parents' and childless people's sequences shows that the latter are considerably more turbulent. A closer examination of the cluster-specific turbulence values reveals that this difference is caused by those 35% of the childless who are either in the 'Serial cohabitation' or the 'LAT' cluster. Both groups stand out with turbulence scores which are approximately one standard deviation above the total sample average. Together with their very stable counterpart, i.e., the 'Single' cluster (turbulence z -score = $-.26$), these two clusters comprise a majority of three-quarters of the childless. This corroborates previous research stating that next to the absence of a partner, a high amount of instability in the partnership trajectories is a strong determinant of childlessness (Keizer et al. 2008).

In addition to detailed information on the actual sequences, Table 1 shows compositional differences in terms of sociodemographic indicators. Women are clearly overrepresented in the 'Marriage' cluster (68%) and underrepresented in the 'Single' cluster (31%). These two groups also stand out regarding education, with the lowest educational attainment in the 'Marriage' cluster and the highest in the 'Single' group (37% and 61% with high school degree, respectively).

Table 1 includes two additional indicators that will not be included in the regression model predicting cluster membership (Table 2), but that convey additional descriptive information on country of birth and self-reported infertility. Country of birth captures differences in the life courses of East and West Germans. The results indicate regional differences in union trajectories among the childless, which mirror the well-established regional pattern found within the general German population: East Germans are less likely to end up in 'Marriage' and more likely to sort into one of the two cohabitation clusters. Moreover, the very small subgroup of foreign-born respondents ($N=25$)—mainly from rather religious countries (Turkey, Italy, Poland)—are overrepresented in the marital cluster. In sum, however, these differences are modest in size and vanish once we account for compositional differences in terms of education and gender. In addition, Table 1 displays notable differences in the levels of self-reported infertility and sterility at age 40.⁵ The rather traditional

⁵ In general, the level of infertility and sterility is comparatively high in pairfam because of the inclusive measurement approach which is based on self-reported assessment of their own and their partner's fertility and contraception behavior (sterilization). When available, pairfam used the direct accounts of the partners. Among the parents in our sample 39% are infertile due to their own or their partner's sterilization. Among the childless the respective figure is much lower (10%).

union histories in the 'Marriage' and 'Long-term cohabitation' clusters are associated with high shares of infertility (46% and 28%). At the same time, both groups are below the childless average in terms of missing values. This likely indicates a high awareness of the capability to reproduce and suggests that involuntary childlessness might be a concern among individuals in these two groups, particularly so in the marriage cluster. This is further corroborated by comparing group-specific average sequence distances (results not shown): among the childless, the partnership trajectories of respondents in the 'Marriage' cluster are the only ones that are more similar to the sequences of the parents than to those of the (other) childless. Taken together, this similarity in life courses could indicate an initial similarity in life goals, including the desire to become a parent. Unfortunately, the retrospective pairfam data do not allow for an empirical test of this assertion.

Given these and related limitations of retrospectively collected data, such as the ex-post rationalization of choices and the potential endogeneity bias, our final multivariate assessment of the union trajectories of the childless pertains to differences by gender and education. Table 2 shows the resulting adjusted predictions and marginal effects at group-specific means derived from a multinomial logistic regression model that includes these two variables, as well as the interaction effect between them. The predictions reflect the probability of being in each cluster for 'average profiles,' e.g., for an average low educated woman or man. They complement the bivariate results from Table 1 by illustrating gender-specific educational effects.

The most striking finding in Table 2 concerns childless men's significantly higher likelihood of ending up in the 'Single' cluster (47.7% for the average man) compared to women. Irrespective of educational attainment, this is the men's modal cluster. This finding mirrors the results from Keizer et al. (2008) showing that the absence of partnerships is a stronger determinant of childlessness among men compared to women. That said, the 'single' pattern is also the most prevalent for women (29.2%), but for them it is closely followed by 'Marriage' (21.8%), which rarely occurs among men (8.2%).

We further observe a differential educational effect when examining the probabilities of sorting into the 'Marriage' and 'LAT' clusters. Whereas higher education strongly decreases women's likelihood of experiencing the 'Marriage' pattern, the same effect is much smaller for men (for similar results see Diekmann 2016). Highly educated childless men have the highest probability of any group of ending up as long-term 'Single' (55.6%). Their female counterparts are more diverse: they are highly likely to experience either long-lasting singleness (31.7%) or unstable partnership trajectories characterized by multiple LAT episodes (27.9%).

In sum, more than 60% of the highly educated men and women end up in the 'LAT' or the 'Single' cluster. Interestingly, both clusters are compatible with the notion of the postponement of family formation among the highly educated. In contrast, persons in the stable union clusters of 'Marriage' and 'Long-Term cohabitation' are more unlikely to postpone the transition to parenthood into their forties. Indeed, a tentative analysis of the fertility behavior after the censoring age of 40 reveals that almost 70% of the 34 births observed up to age 45 can be attributed to respondents in the 'LAT' and 'Single' clusters.

Table 2 Adjusted predictions and marginal effects at group-specific means

	Marriage				Long-term cohabitation				Serial cohabitation				LAT				Single			
	Female	Male	Δ gender		Female	Male	Δ gender		Female	Male	Δ gender		Female	Male	Δ gender		Female	Male	Δ gender	
Overall	.218	.082	.136***		.122	.119	.002		.163	.157	.006		.205	.165	.041		.292	.477	-.185***	
Education																				
No Abitur	.326	.100	.226***		.117	.132	-.015		.176	.153	.023		.133	.230	-.096†		.247	.385	-.138*	
Abitur	.144	.067	.077†		.117	.105	.013		.143	.154	-.012		.279	.118	.162***		.317	.556	-.240***	
Δ education	-.183**	-.034	.149*		.000	-.027	-.028		-.033	.002	.035		.146*	-.112**	-.258***		.069	.171**	.102	

Data: pairfam, release 9.0; results are weighted by attrition-adjusted post-stratification weights

*** $p \leq 0.001$; ** $p \leq 0.01$; * $p \leq 0.05$; † $p \leq 0.10$

Finally, the predictions show that the standard sociodemographic indicators gender and education are not well suited to identifying who sorts into the two different cohabitation clusters.

4 Conclusions

This study adds to the growing body of literature shedding light on the complexity of childlessness by presenting evidence on the within-group heterogeneity in partnership trajectories. For the first time, our study demonstrates the considerable variation in the partnership biographies of the childless in Germany, setting the stage for future systematic cross-national comparisons. In view of the long-lasting differences in family-demographic behavior between East and West Germany, we expected to find within-country variation. This expectation was met: there is a lower probability of childlessness in East Germany, which also has been shown in previous research (Goldstein and Kreyenfeld 2011; Kreyenfeld and Konietzka 2017b). However, our results do not indicate statistically and substantively meaningful differences in the union trajectories of East and West Germans once we account for the selection into childlessness.

We identified five distinct patterns of union trajectories, which clearly highlight the heterogeneity in pathways leading to childlessness. In line with recent evidence from Finland (Jalovaara and Fasang 2017), the ‘Single’ cluster was the most prevalent group, particularly among men. In contrast to the Finnish study, the pairfam data allowed us to distinguish between actual singleness and LAT relationships: we could, therefore, identify a distinct group of persons with (multiple) LAT relationships who otherwise would have been classified as being permanently single. The patterns identified by the two clusters suggest different reasons for childlessness. The ‘Single’ cluster points to the relevance of having a partner (or a stable relationship in general). Persons in this group simply might be (involuntarily) childless because they did not find a suitable partner (Berrington 2017; Jalovaara and Fasang 2017; Miettinen 2010). The respondents in the ‘LAT’ cluster, on the other hand, often report long-lasting LAT relationships. This suggests that they or/and their partners are not willing to commit themselves to a more institutionalized form of their relationship (cohabitation or marriage) or to parenthood. Thus, childlessness (or the postponement of parenthood) in the ‘LAT’ group arguably is more likely to be the result of a deliberate choice as compared to childlessness in the ‘Single’ group. This assertion is further substantiated by the overrepresentation of highly educated women in the LAT group. In fact, in the traditional male-breadwinner German context (Aisenbrey and Fasang 2017) where it is still rather difficult to reconcile work and family, these women face the highest costs of making long-term commitments. As a result, highly educated women are not only concentrated in the ‘LAT’ group but also underrepresented in the ‘marriage’ cluster. These findings clearly differ from those found for the more gender-egalitarian Finnish society in Jalovaara and Fasang (2017) and thus support the growing literature highlighting the context-dependency of gender-specific associations between education and family formation (Esping-Andersen and Billari 2015; Kalmijn 2013; Kravdal and Rindfuss

2008). According to this literature, societal norms and institutions that do not dovetail with the decrease in gender gaps in education and labor force participation will produce higher rates of childlessness. This assertion is clearly supported for the case of Germany, where the share of childlessness is high (Kreyenfeld and Konietzka 2017a, b), work-family policies are rather incoherent (Fleckenstein 2011), and variation in gender role attitudes is marked (Hudde 2018). Our results further indicate that this argument does not only apply to the level of childlessness but might also help to explain differences in the pathways leading to childlessness.

Data limitations restricted the possibility of further analyses on the individual and societal reasons for childlessness and prevented a thorough cross-national comparison of the partnership trajectories of the childless. However, the juxtaposition of the Finnish and the German results indicates that cross-national comparative research might yield valuable insights on the circumstances of childlessness and the complexity of the respective life courses.

In sum, the heterogeneity in the partnership trajectories of the childless shown here casts doubt on studies on the antecedents and consequences of childlessness that conceptualize childlessness as a binary indicator as opposed to being a parent. This is substantiated not just by the existence of five distinct partnership trajectories but also by the gender-specific educational effect we could identify. More generally, our approach highlighted that adopting a holistic analytical perspective that values the partnership trajectories as ‘process outcomes’ uncovers longitudinal dynamics that generate heterogeneity within a seemingly homogenous population.

Compliance with Ethical Standards

Conflict of interest The authors declare the present work to be compliant with the Ethical Standards of the European Journal of Population. They also declare no conflicts of interest. Ethics approval is not required for this paper.

References

- Abbott, A. (2016). *Processual sociology*. Chicago: Chicago University Press.
- Aisenbrey, S., & Fasang, A. E. (2017). The interplay of work and family trajectories over the life course: Germany and the United States in comparison. *American Journal of Sociology*, 122(5), 1448–1484. <https://doi.org/10.1086/691128>.
- Albertini, M., & Arpino, B. (2018). Childlessness, parenthood and subjective well-being. The relevance of conceptualizing parenthood and childlessness as a continuum. In *European population conference 2018*, Brussels.
- Baudin, T., de la Croix, D., & Gobbi, P. E. (2015). Fertility and childlessness in the United States. *American Economic Review*, 105(6), 1852–1882. <https://doi.org/10.1257/aer.20120926>.
- Bernardi, L., Mynarska, M., & Rossier, C. (2015). Uncertain, changing and situated fertility intentions: A qualitative analysis. In D. Philipov, A. C. Liefbroer, & J. E. Klobas (Eds.), *Reproductive decision-making in a macro-micro perspective* (pp. 113–139). New York: Springer.
- Berrington, A. (2017). Childlessness in the UK. In M. Kreyenfeld, & D. Konietzka (Eds.), *Childlessness in Europe: Contexts, causes, and consequences* (pp. 57–76). Cham: Springer. https://doi.org/10.1007/978-3-319-44667-7_3.

- Berrington, A., & Pattaro, S. (2014). Educational differences in fertility desires, intentions and behaviour: A life course perspective. *Advances in Life Course Research*, 21, 10–27.
- Brüderl, J., Drobnic, S., Karsten, H., Huinink, J., Nauck, B., Neyer, F. J., et al. (2018). The German family panel (pairfam). *Cologne, ZA5678 Dat.* <https://doi.org/10.4232/pairfam.5678.9.0.0>.
- Brüderl, J., Garrett, M., Hajek, K., Herzig, M., Huyer-May, B., Lenke, R., et al. (2017). *Pairfam data manual*. Munich: LMU Munich.
- Buhr, P., & Huinink, J. (2017). Why childless men and women give up on having children. *European Journal of Population*, 33(4), 585–606. <https://doi.org/10.1007/s10680-017-9429-1>.
- Carmichael, G. A., & Whittaker, A. (2007). Choice and circumstance: Qualitative insights into contemporary childlessness in Australia. *European Journal of Population/Revue européenne de Démographie*, 23(2), 111–143. <https://doi.org/10.1007/s10680-006-9112-4>.
- Destatis. (2018). Statistik der Geburten.
- Diekmann, A. (2016). Der Einfluß schulischer Bildung und die Auswirkungen der Bildungsexpansion auf das Heiratsverhalten. *Zeitschrift für Soziologie*, 19(4), 265–277. <https://doi.org/10.1515/zfsoz-1990-0403>.
- Eckhard, J. (2014). Theoretical Explanations of Increasing Childlessness - Divergent Approaches and the Integrating Potential of the Frame Selection Theory. *Comparative Populations Studies*, 39(1), 49–72. <https://doi.org/10.12765/CPoS-2014-01en>.
- Eckhard, J., Stauder, J., & Wiese, D. (2015). Die Entwicklung des Partnermarkts im Längsschnitt—Alters- und Kohortenunterschiede. *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie*, 67(S1), 81–109. <https://doi.org/10.1007/s11577-015-0316-7>.
- Elzinga, C. H., & Liefbroer, A. C. (2007). De-standardization of family-life trajectories of young adults: a cross-national comparison using sequence analysis. *European Journal of Population/Revue européenne de Démographie*, 23(3–4), 225–250. <https://doi.org/10.1007/s10680-007-9133-7>.
- Esping-Andersen, G., & Billari, F. C. (2015). Re-theorizing family demographics. *Population and Development Review*, 41(1), 1–31. <https://doi.org/10.1111/j.1728-4457.2015.00024.x>.
- Fiori, F., Rinesi, F., & Graham, E. (2017). Choosing to remain childless? A comparative study of fertility intentions among women and men in Italy and Britain. *European Journal of Population*, 33(3), 319–350. <https://doi.org/10.1007/s10680-016-9404-2>.
- Fleckenstein, T. (2011). The politics of ideas in welfare state transformation: Christian democracy and the reform of family policy in Germany. *Social Politics: International Studies in Gender, State & Society*, 18(4), 543–571. <https://doi.org/10.1093/sp/jxr022>.
- Fulda, B. E. (2016). The diversity in longitudinal partnership trajectories during the transition to adulthood: How is it related to individual characteristics and regional living conditions? *Demographic Research*, 35(1), 1101–1134. <https://doi.org/10.4054/DemRes.2016.35.37>.
- Gabadinho, A., Ritschard, G., Mueller, N. S., & Studer, M. (2011). Analyzing and visualizing state sequences in R with TraMineR. *Journal of Statistical Software*, 40(4), 1–37.
- Goldstein, J. R., & Kreyenfeld, M. (2011). Has East Germany overtaken West Germany? Recent trends in order-specific fertility. *Population and Development Review*, 37(3), 453–72. <http://www.ncbi.nlm.nih.gov/pubmed/22167811>.
- González, M.-J., & Jurado-Guerrero, T. (2006). Remaining childless in affluent economies: A comparison of France, West Germany, Italy and Spain, 1994–2001 Rester sans enfant dans des sociétés d'abondances: une comparaison de la France, l'Allemagne de l'Ouest et l'Espagne, 1994–2001. *European Journal of Population/Revue européenne de Démographie*, 22(4), 317–352. <https://doi.org/10.1007/s10680-006-9000-y>.
- Hart, R. K. (2018). Union histories of dissolution: What can they say about childlessness? *European Journal of Population*. <https://doi.org/10.1007/s10680-018-9464-6>.
- Hudde, A. (2018). Societal agreement on gender role attitudes and childlessness in 38 countries. *European Journal of Population*. <https://doi.org/10.1007/s10680-017-9459-8>.
- Huinink, J., Brüderl, J., Nauck, B., Walper, S., Castiglioni, L., & Feldhaus, M. (2011). Panel analysis of intimate relationships and family dynamics (pairfam): Conceptual framework and design. *Zeitschrift für Familienforschung*, 23(1), 77–100.
- Huinink, J., Kreyenfeld, M., & Trappe, H. (2012). Familie und Partnerschaft in Ost- und Westdeutschland. Eine Bilanz. In J. Huinink, M. Kreyenfeld, & H. Trappe (Eds.), *Familie und Partnerschaft in Ost- und Westdeutschland. Ähnlich und doch immer noch anders* (Zeitschrift für Familienforschung, Sonderheft 9) (pp. 9–28). Opladen: Barbara Budrich.

- Ivanova, K., Kalmijn, M., & Uunk, W. (2013). The effect of children on men's and women's chances of re-partnering in a European context. *European Journal of Population/Revue européenne de Démographie*, 29(4), 417–444. <https://doi.org/10.1007/s10680-013-9294-5>.
- Jalovaara, M., & Fasang, A. E. (2017). From never partnered to serial cohabitators: Union trajectories to childlessness. *Demographic Research*, 36(1), 1703–1720. <https://doi.org/10.4054/DemRes.2017.36.55>.
- Kalmijn, M. (2013). The educational gradient in marriage: A comparison of 25 European countries. *Demography*, 50(4), 1499–1520. <https://doi.org/10.1007/s13524-013-0229-x>.
- Keizer, R., Dykstra, P. A., & Jansen, M. D. (2008). Pathways into childlessness: Evidence of gendered life course dynamics. *Journal of Biosocial Science*, 40(6), 863–878. <https://doi.org/10.1017/S0021932007002660>.
- Köppen, K., Mazuy, M., & Toulemon, L. (2017). Childlessness in France. In M. Kreyenfeld, & D. Konietzka (Eds.), *Childlessness in Europe: Contexts, causes, and consequences* (pp. 77–95). Cham: Springer. https://doi.org/10.1007/978-3-319-44667-7_4.
- Kravdal, Ø., & Rindfuss, R. R. (2008). Changing relationships between education and fertility: A study of women and men born 1940–1964. *American Sociological Review*, 73(5), 854–873. <https://doi.org/10.1177/000312240807300508>.
- Kreyenfeld, M., & Konietzka, D. (2014). Kinderlosigkeit in Deutschland. Theoretische Probleme und empirische Ergebnisse. In D. Konietzka, & M. Kreyenfeld (Eds.), *Ein Leben ohne Kinder. Ausmaß, Strukturen und Ursachen von Kinderlosigkeit* (pp. 11–44). Wiesbaden: Springer VS. https://doi.org/10.1007/978-3-531-94149-3_1.
- Kreyenfeld, M., & Konietzka, D. (2017a). Analyzing Childlessness. In M. Kreyenfeld, & D. Konietzka (Eds.), *Childlessness in Europe: Contexts, Causes, and Consequences* (pp. 3–15). Cham: Springer. https://doi.org/10.1007/978-3-319-44667-7_1.
- Kreyenfeld, M., & Konietzka, D. (2017b). Childlessness in East and West Germany: Long-term trends and social disparities. In M. Kreyenfeld, & D. Konietzka (Eds.), *Childlessness in Europe: Contexts, Causes, and Consequences* (pp. 97–114). Cham: Springer. https://doi.org/10.1007/978-3-319-44667-7_5.
- Lengerer, A. (2012). Die soziale Selektivität des partnerschaftlichen Zusammenlebens im Wandel. *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie*, 64(2), 247–275. <https://doi.org/10.1007/s11577-012-0168-3>.
- Lesthaeghe, R. (2010). The unfolding story of the second demographic transition. *Population and Development Review*, 36(2), 211–251. <https://doi.org/10.1111/j.1728-4457.2010.00328.x>.
- Long, J. S., & Freese, J. (2014). *Regression models for categorical dependent variables using Stata* (3rd ed.). College Station: Stata Press.
- McDonald, P. (2000a). Gender equity in theories of fertility transition. *Population and Development Review*, 26(3), 427–439. <https://doi.org/10.1111/j.1728-4457.2000.00427.x>.
- McDonald, P. (2000b). Gender equity, social institutions and the future of fertility. *Journal of the Australian Population Association*, 17(1), 1–16. <https://doi.org/10.1007/BF03029445>.
- McLanahan, S., & Percheski, C. (2008). Family structure and the reproduction of inequalities. *Annual Review of Sociology*, 34(1), 257–276. <https://doi.org/10.1146/annurev.soc.34.040507.134549>.
- Merz, E.-M., & Liefbroer, A. C. (2012). The attitude toward voluntary childlessness in Europe: Cultural and institutional explanations. *Journal of Marriage and Family*, 74(3), 587–600. <https://doi.org/10.1111/j.1741-3737.2012.00972.x>.
- Miettinen, A. (2010). Voluntary or involuntary childlessness? Socio-demographic factors and childlessness intentions among childless Finnish men and women aged 25–44. *Finnish Yearbook of Population Research*, (pp. 5–24). <https://journal.fi/fypr/article/view/45051>.
- Mynarska, M., Matysiak, A., Rybińska, A., Tocchioni, V., & Vignoli, D. (2015). Diverse paths into childlessness over the life course. *Advances in Life Course Research*, 25, 35–48. <https://doi.org/10.1016/j.alcr.2015.05.003>.
- Oppenheimer, V. K. (1988). A theory of marriage timing. *American Journal of Sociology*, 94(3), 563–591. <https://doi.org/10.1086/229030>.
- Osiewalska, B. (2017). Childlessness and fertility by couples' educational gender (in) equality in Austria, Bulgaria, and France. *Demographic Research*, 37, 325–362.
- Philipov, D., Liefbroer, A. C., & Klobas, J. E. (Eds.). (2015). *Reproductive decision-making in a macro-micro perspective*. New York: Springer.

- Reynolds, A. P., Richards, G., de la Iglesia, B., & Rayward-Smith, V. J. (2006). Clustering rules: A comparison of partitioning and hierarchical clustering algorithms. *Journal of Mathematical Modelling and Algorithms*, 5(4), 475–504.
- Schneider, N. F. (2015). Familie in Westeuropa. In P. B. Hill, & J. Kopp (Eds.), *Handbuch familiensoziologie* (pp. 21–53). Wiesbaden: Springer. https://doi.org/10.1007/978-3-658-02276-1_2.
- Sobotka, T., & Testa, M. R. (2008). Attitudes and intentions toward childlessness in Europe. In C. Höhn, D. Avramov, & I. E. Kotowska (Eds.), *People, Population Change and Policies: Vol.1: Family Change* (pp. 177–211). Dordrecht: Springer. https://doi.org/10.1007/978-1-4020-6609-2_9
- Struffolino, E., Studer, M., & Fasang, A. E. (2016). Gender, education, and family life courses in East and West Germany: Insights from new sequence analysis techniques. *Advances in Life Course Research*, 29, 66–79. <https://doi.org/10.1016/j.alcr.2015.12.001>.
- Studer, M. (2013). Weighted cluster library manual. A practical guide to creating typologies of trajectories in the social sciences with R. *LIVES Working Papers*. <https://doi.org/10.12682/lives.2296-1658.2013.24>.
- Studer, M., & Ritschard, G. (2016). What matters in differences between life trajectories: A comparative review of sequence dissimilarity measures. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, 179(2), 481–511. <https://doi.org/10.1111/rssa.12125>.
- Tanturri, M. L., Mills, M., Rotkirch, A., Sobotka, T., Takács, J., & Miettinen, A., Faludi, C., Kantsa, V. & Nasiri, D. (2015). State-of-the-art report. Childlessness in Europe. *Families and Societies Working Paper Series* (No. 32). <http://www.familiesandsocieties.eu/wp-content/uploads/2015/03/WP32TanturriEtAl2015.pdf>
- Thomson, E., Winkler-Dworak, M., Spielauer, M., & Prskawetz, A. (2012). Union instability as an engine of fertility? A microsimulation model for France. *Demography*, 49(1), 175–195.
- Tocchioni, V. (2018). Exploring the childless universe: Profiles of women and men without children in Italy. *Demographic Research*, 38(19), 451–470. <https://doi.org/10.4054/DemRes.2018.38.19>.
- Trimarchi, A., & Bavel, J. Van. (2017). Education and the transition to fatherhood: The role of selection into union. *Demography*, 54(1), 119–144. <https://doi.org/10.1007/s13524-016-0533-3>.
- Waren, W., & Pals, H. (2013). Comparing characteristics of voluntarily childless men and women. *Journal of Population Research*, 30(2), 151–170. <https://doi.org/10.1007/s12546-012-9103-8>.
- Wood, J., Neels, K., & Kil, T. (2014). The educational gradient of childlessness and cohort parity progression in 14 low fertility countries. *Demographic Research*, 31, 1365–1416.

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