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Working Paper

Life events and life satisfaction: Estimating effects of multiple life events in combined models

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SOEP papers
on Multidisciplinary Panel Data Research

Life Events and Life Satisfaction: Estimating Effects of Multiple Life Events in Combined Models

Michael D. Krämer, Julia M. Rohrer, Richard E. Lucas, David Richter

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1 **Life Events and Life Satisfaction: Estimating Effects of Multiple Life Events in**
2 **Combined Models**

3
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45

Abstract

46 How do life events affect life satisfaction? Previous studies focused on a single event or separate
47 analyses of several events. However, life events are often grouped non-randomly over the
48 lifespan, occur in close succession, and are causally linked, raising the question of how to best
49 analyze them jointly. Here, we used representative German data (SOEP; $N = 40,121$ individuals;
50 $n = 41,402$ event occurrences) to contrast three fixed-effects model specifications: First,
51 individual event models in which other events were ignored, which are thus prone to
52 undercontrol bias; second, combined event models which controlled for all events, including
53 subsequent ones, which may induce overcontrol bias; and third, our favored combined models
54 that only controlled for preceding events. In this preferred model, the events of new partner,
55 cohabitation, marriage, and childbirth had positive effects on life satisfaction, while separation,
56 unemployment, and death of partner or child had negative effects. Model specification made little
57 difference for employment- and bereavement-related events. However, for events related to
58 romantic relationships and childbearing, small but consistent differences arose between models.
59 Thus, when estimating effects of new partners, separation, cohabitation, marriage, and childbirth,
60 care should be taken to include appropriate controls (and omit inappropriate ones) to minimize
61 bias.

62 *Keywords:* life events, life satisfaction, event co-occurrence, romantic relationships,
63 childbirth

64 Life Events and Life Satisfaction: Estimating Effects of Multiple Life Events in**65 Combined Models**

66 How do life events such as marriage or childbirth affect well-being? Extensive research
67 addresses this question empirically by examining effects of events on subjective well-being. In
68 particular, studies often focus on life satisfaction, which is a global, cognitive component of
69 subjective well-being that some studies have shown to be more strongly affected than measures
70 of affective well-being (Diener et al., 1999; Luhmann, Hawkley, et al., 2012; Luhmann,
71 Hofmann, et al., 2012; Schimmack, 2008; cf. Asselmann & Specht, 2022, 2023 who have shown
72 stronger effects for some facets of affect). Studies usually investigate life events in isolation and
73 present results of separate analyses of various individual events (e.g., Anusic et al., 2014a; Clark
74 et al., 2008; Clark & Georgellis, 2013; Denissen et al., 2019) or meta-analyses of such separate
75 analyses (e.g., Luhmann, Hofmann, et al., 2012; Mangelsdorf et al., 2019). But life events are not
76 randomly spread over the life span; they often emerge as part of a common sequence (Hutteman
77 et al., 2014) and are causally connected: for example, cohabitation may lead to marriage which
78 may lead to childbirth. Thus, there have been repeated calls to consider events jointly (Hentschel
79 et al., 2017; Luhmann, Orth, et al., 2014). To date, only a few studies have heeded these calls.

80 In this study, we investigate the effects of various life events in combined models of life
81 satisfaction. Control for other events can reduce confounding bias that may have affected
82 previous results—for example, changes in life satisfaction that have been attributed to the birth of
83 a child might in fact reflect the impact of preceding events such as cohabitation or marriage. But
84 such control can also induce its own biases, and successful causal identification always rests on
85 assumptions. Thus, we contrast different model specifications and compare the resulting
86 conclusions regarding the effects of life events on life satisfaction.

87 **Influence of Life Events on Life Satisfaction**

88 Life events can be defined as “time-discrete transitions that mark the beginning or the end
89 of a specific status” (Luhmann, Hofmann, et al., 2012; p. 594). Examples include relationship
90 transitions (e.g., cohabitation, marriage, divorce), childbirth, the death of a relative or loved one
91 and changes in employment. It has previously been assumed that for the moderately time-stable
92 construct life satisfaction (Fujita & Diener, 2005; Gnambs & Buntins, 2017; Lucas & Donnellan,
93 2007), changes in response to such life events are temporary (Diener et al., 2006; Lykken &
94 Tellegen, 1996). This belief is part of set-point theory, which suggests that people return to
95 genetically determined baseline levels of well-being after the occurrence of changes in life
96 circumstances. However, more recent studies show long-term changes after particularly
97 disruptive events such as disability or unemployment (Lucas, 2007; Lucas et al., 2004; Luhmann,
98 Weiss, et al., 2014). In general (and perhaps unsurprisingly), studies report that positive life
99 events (such as marriage) increase life satisfaction whereas negative life events (such as loss of
100 loved ones or livelihood) decrease life satisfaction; although the details (such as magnitude of
101 change and its duration) vary (Luhmann, Krasko, et al., 2021; Luhmann & Intelisano, 2018).

102 ***Previous Research Based on Individual Event Models***

103 In addition to the following brief summary of central research findings on the effects of
104 individual life events, a more exhaustive overview of this vast body of literature can be found in
105 Table S1.

106 ***Relationship Transitions.*** Marriage is, on average, a positive event associated with
107 increased life satisfaction in anticipation of the event and for a few years afterwards (Clark &
108 Georgellis, 2013; Lucas et al., 2003). However, a recent analysis of four nationally representative
109 data sets found that cohabiting partners were similarly satisfied as married partners, especially
110 when controlling for selection effects and relationship satisfaction (Perelli-Harris et al., 2019; see

111 also Musick & Bumpass, 2012). Divorce, on the other hand, has been associated with life
112 satisfaction decreases in the years leading up to the event and recovery starting in the year
113 afterwards (Denissen et al., 2019; van Scheppingen & Leopold, 2020).

114 Entering a new partnership without living together with the partner was associated with
115 gains in life satisfaction compared to being single (Soons et al., 2009). Cohabitation is also
116 associated with increased life satisfaction (Kamp Dush & Amato, 2005; Perelli-Harris et al.,
117 2019). Thus, there is prior evidence for a “continuum of commitment” (Kamp Dush & Amato,
118 2005, p. 610) in that a higher level of commitment in a romantic relationship on average brings
119 about higher life satisfaction. Other researchers, however, have found only temporary differences
120 between cohabiting and married couples, and have emphasized the importance of considering
121 concurrent life events (Musick & Bumpass, 2012; Perelli-Harris et al., 2019; Zimmermann &
122 Easterlin, 2006).

123 ***Childbirth.*** Childbirth has been found to be associated with increases to life satisfaction
124 already starting before the event and continuing for several years afterwards (Dyrdal & Lucas,
125 2013; Krämer & Rodgers, 2020). However, it is unclear whether the pre-event positive effects are
126 mostly due to other life events preceding first childbirth (e.g., cohabitation, marriage), and
127 whether adaptation occurs independent of events succeeding childbirth.

128 ***Bereavement.*** The death of one’s spouse or child is characterized by a sharp decrease in life
129 satisfaction and slow adaptation afterwards (Asselmann & Specht, 2022; Doré & Bolger, 2018;
130 Infurna et al., 2017). To what extent complete adaptation occurs is debated (Anusic et al., 2014a;
131 Moor & de Graaf, 2016).

132 ***Employment-related Life Events.*** Unemployment is followed by a decrease in life
133 satisfaction (Clark & Georgellis, 2013; Lawes et al., 2022b; Lucas et al., 2004). Depending on re-
134 employment (expectations), adaptation to pre-event levels might be slow or even incomplete

135 (Lawes et al., 2022a; Lucas et al., 2004). For retirement, the picture is less clear with some
136 research supporting short-time gains in life satisfaction (Hansson et al., 2020; Henning et al.,
137 2022), and other research finding no effect (Henning et al., 2016; Sohler et al., 2021).

138 *Previous Research Based on Combined Event Models*

139 In contrast to such studies focusing on single events, prospective studies of life satisfaction
140 that model multiple events simultaneously, are sparse. For example, childbirth has been studied
141 in joint models with partnership and life stressors such as separation or illness (Dyrdal et al.,
142 2019; Dyrdal & Lucas, 2013; Rudolf & Kang, 2015). These studies show that results can vary
143 depending on whether or not related events are modeled. For example, postpartum life
144 satisfaction trajectories differed depending on which concurrent life event parents experienced
145 (Dyrdal et al., 2019). The effects of partnership formation and breakup have also been
146 investigated jointly (Soons et al., 2009; Zimmermann & Easterlin, 2006). Results indicated that a
147 new partnership, cohabitation, and union dissolution were more consequential for life satisfaction
148 than mere status changes like marriage and divorce (Soons et al., 2009). Becoming a parent did
149 not alter the effects of partnership transitions but only had beneficial effects on partnered parents.

150 To our knowledge, only one study on life satisfaction attempted to jointly model *all*
151 *events* available in a dataset. Kettlewell et al. (2020) used Australian panel data to estimate
152 effects of 22 life events on life satisfaction and affect comparing results from individual and
153 combined event models. The trajectories of life satisfaction—controlling for the occurrence of
154 other life events—differed slightly from those of the individual event models. In general, effects
155 were closer to zero in the combined event models. The largest differences between the two types
156 of models emerged for the events reconciliation with a partner (where the partly negative effect
157 from the individual model shifted towards zero) and pregnancy (where the positive effect was
158 partly reversed).

159 **Methodological Considerations**160 *Causal Inference*

161 Control for other events may reduce bias if one event confounds the effect of another one.
162 But controls are not always innocuous (Wysocki et al., 2022). From a causal inference
163 perspective, we see two potential problems in the estimation of the effects of a single event
164 conditional on all other events (i.e., including controls for events occurring *after* the focal event).
165 Both concerns can be subsumed under the term overcontrol bias. First, controlling for subsequent
166 events that are caused by the focal event will control away part of the causal effect of the event.
167 For example, people who find a new partner may start to cohabit subsequently, and this
168 cohabitation may have a direct positive effect on life satisfaction. This effect, which is mediated
169 via cohabitation, is also part of the effect of finding a new partner, since this effect contrasts
170 one's potential life satisfaction given a new partner with one's potential life satisfaction given no
171 new partner—and without a new partner, there is nobody to cohabit with. Avoiding control for
172 potential mediators helps to identify the total effect of an event, which acknowledges that
173 experiencing an event may result in a chain of subsequent events.

174 Of course, researchers may only be interested in the direct effects of life events, which
175 calls for an approach that removes any effects mediated via other events. Such a procedure leads
176 to the second problem, however, because control for subsequent events can additionally introduce
177 spurious associations via collider bias (Elwert & Winship, 2014; Rohrer, 2018; Wysocki et al.,
178 2022). For example, Kettlewell et al. (2020) reported that “the unconditional positive effect of
179 pregnancy on cognitive well-being was all but reversed once concurrent events (childbirth) were
180 accounted for” (p. 5). One should be careful not to interpret this as evidence that pregnancy had a
181 negative effect on life satisfaction. Pregnancy has a causal effect on subsequent childbirth;
182 *pregnancy* → *childbirth* (see Figure S1 for an example causal graph). However, in the

183 unfortunate event of a miscarriage, no childbirth occurs. In the causal chain, suffering a
184 miscarriage (or not) is thus a second determinant of childbirth, *miscarriage* \rightarrow *childbirth*; and it
185 is likely associated on average with large negative effects on life satisfaction, *miscarriage* \rightarrow *life*
186 *satisfaction*. Future childbirth is a so-called collider between its two causes, *pregnancy* \rightarrow
187 *childbirth* \leftarrow *miscarriage*, and statistical control for it will induce a spurious association via
188 collider bias. Thus, in a model that controls for future childbirth, the coefficient of pregnancy will
189 be confounded by opening up a non-causal path via miscarriage (*pregnancy* \leftrightarrow *miscarriage* \rightarrow
190 *life satisfaction*) that was previously blocked. To put it another way, in purely statistical terms,
191 conditional on no child being born, the pregnancy coefficient contrasts those who were not
192 pregnant (*pregnancy* == 0, *childbirth* == 0) with those who lost a pregnancy (*pregnancy* == 1,
193 *childbirth* == 0). Based on these assumptions, we describe how we addressed collider bias in the
194 Analytical Strategy section below.

195 ***Prospective Longitudinal Data, Non-Linear Trajectories, and Control for Age-Related*** 196 ***Changes***

197 In the study of life events, several recommendations have been put forward (Luhmann,
198 Orth, et al., 2014). First, using prospective longitudinal designs is critical when examining
199 selection and anticipation effects occurring before the event, as well as adaptation effects
200 occurring afterwards. Selection effects are present when the propensity to experience an event
201 depends on someone's person characteristics such as personality traits (Beck, 2019; Luhmann et
202 al., 2013); such selection can induce common-cause confounding. Using a purely retrospective
203 design would forestall the investigation of anticipation effects and, in addition, introduce biases
204 of recall and post-hoc narrative interpretation. Second, it is important to allow for non-linear and
205 discontinuous change trajectories. Modeling change in a purely linear (or polynomial) fashion
206 might mask the true form of the change trajectory. Third, event-related changes and normative or

207 age-related changes should be disentangled, which can be achieved through comparison with a
208 suitable control group that does not experience the event (Luhmann, Orth, et al., 2014). Without
209 such a group, developmental trends over the life span might be wrongly attributed to life events
210 happening around that age.

211 **Current Study**

212 In this study, we investigated the effects of a wide range of life events on life satisfaction,
213 including their repetition (e.g., second marriage, birth of a second child). We estimated models
214 for 14 life event types (see Table 1) using representative yearly panel data from Germany from
215 1984 to 2020. We strove to implement best practices with respect to modeling, and explicitly
216 took into account the potentially confounding effects of co-occurring life events. Further, we
217 allowed the effects of life events to vary by gender because effects sometimes differed between
218 men and women in the previous literature (see Table S1). Following previous recommendations,
219 we estimated non-linear pre- and post-event trajectories (Luhmann, Orth, et al., 2014), and we
220 specified models of within-person change so that time-invariant background characteristics could
221 not confound findings (Allison, 2019; McNeish & Kelley, 2019; Rohrer & Murayama, 2023).
222 Our research was exploratory in the sense that we did not formulate substantive hypotheses for
223 each event but the methodology was preregistered (<https://osf.io/kajrd>).

224 To gauge the extent to which the effects of life events confound each other, and whether
225 overcontrol bias could cause issues depending on the model specification, we contrasted models
226 in which each event is considered individually with models that control for either all other life
227 events, or only the preceding life events. In the first combined event model, we adopted a total
228 control strategy and included other life events as control variables regardless of when they
229 occurred (similar to Kettlewell et al., 2020). In the second combined event model, we adopted a

Table 1

Life Event Occurrence in the Full Sample (After Exclusion Step 1) and Final Sample (After Exclusion Step 4)

Event type	Available since wave	Analysis Sample	Total occurrence	1st occur.	2nd occur.	3rd occur.	4th occur.	5th occur.
<i>Count based on biographical information:</i>								
New partnership	1984	Full	16,292	<u>8,625</u>	<u>4,289</u>	<u>2,062</u>	<u>916</u>	319
		Final	7,086	2,283	2,233	1,479	750	276
Cohabitation	1984	Full	10,666	<u>7,749</u>	<u>2,053</u>	<u>686</u>	143	35
		Final	4,373	2,353	1,296	567	123	34
Separation	1984	Full	13,476	<u>8,465</u>	<u>3,154</u>	<u>1,248</u>	455	116
		Final	5,801	2,862	1,690	809	334	81
Marriage	1984	Full	11,230	<u>8,135</u>	<u>2,543</u>	<u>489</u>	60	3
		Final	3,407	2,532	752	117	6	
Divorce	1984	Full	4,079	<u>2,831</u>	<u>1,079</u>	153	15	1
		Final	1,256	868	339	44	4	1
Childbirth	1985	Full	20,064	<u>8,125</u>	<u>7,264</u>	<u>3,012</u>	<u>1,056</u>	370
		Final	5,755	1,853	2,165	1,045	431	147
<i>Count based on occurrence during panel participation:</i>								
First job	1985	Full	9,980	<u>8,463</u>	1,320	171	22	4
		Final	4,296	3,542	643	95	13	3
Retirement	1985	Full	4,508	<u>4,169</u>	329	10		
		Final	642	602	40			
Unemployment	1985	Full	13,071	<u>10,859</u>	<u>1,807</u>	346	55	3
		Final	3,665	3,134	418	88	23	2
Child moved out	1985	Full	16,514	<u>11,198</u>	<u>3,770</u>	<u>1,121</u>	313	83
		Final	3,788	2,920	662	159	35	9
Death of partner	1985	Full	2,413	<u>2,360</u>	51	1	1	
		Final	333	325	8			
Death of father	2003	Full	3,852	<u>3,719</u>	128	5		
		Final	1,712	1,667	44	1		
Death of mother	2003	Full	3,886	<u>3,745</u>	137	4		
		Final	1,494	1,446	48			
Death of child	2007	Full	288	<u>279</u>	9			
		Final	103	103				

Note. For the first six event types shown here, biographical information allowed us to determine the biographically first, second, etc. occurrence of an event. For the remaining event types, the first, second, etc. occurrence of an event refers to the first, second, etc. observed occurrence while a respondent is a panel member. 6th and higher occurrences were observed for some events but are not depicted here. For all underlined occurrences, we considered these events separately in the coding of event dummies and in analyses.

230

231 control strategy that aimed to strike a balance between two types of confounding: first, to reduce

232 undercontrol bias, we controlled for preceding life events, and second, to reduce the risk of

233 overcontrol bias, we refrained from controlling for events occurring in the future (including their
234 anticipation effects).

235 **Method**

236 **Sample and Procedure**

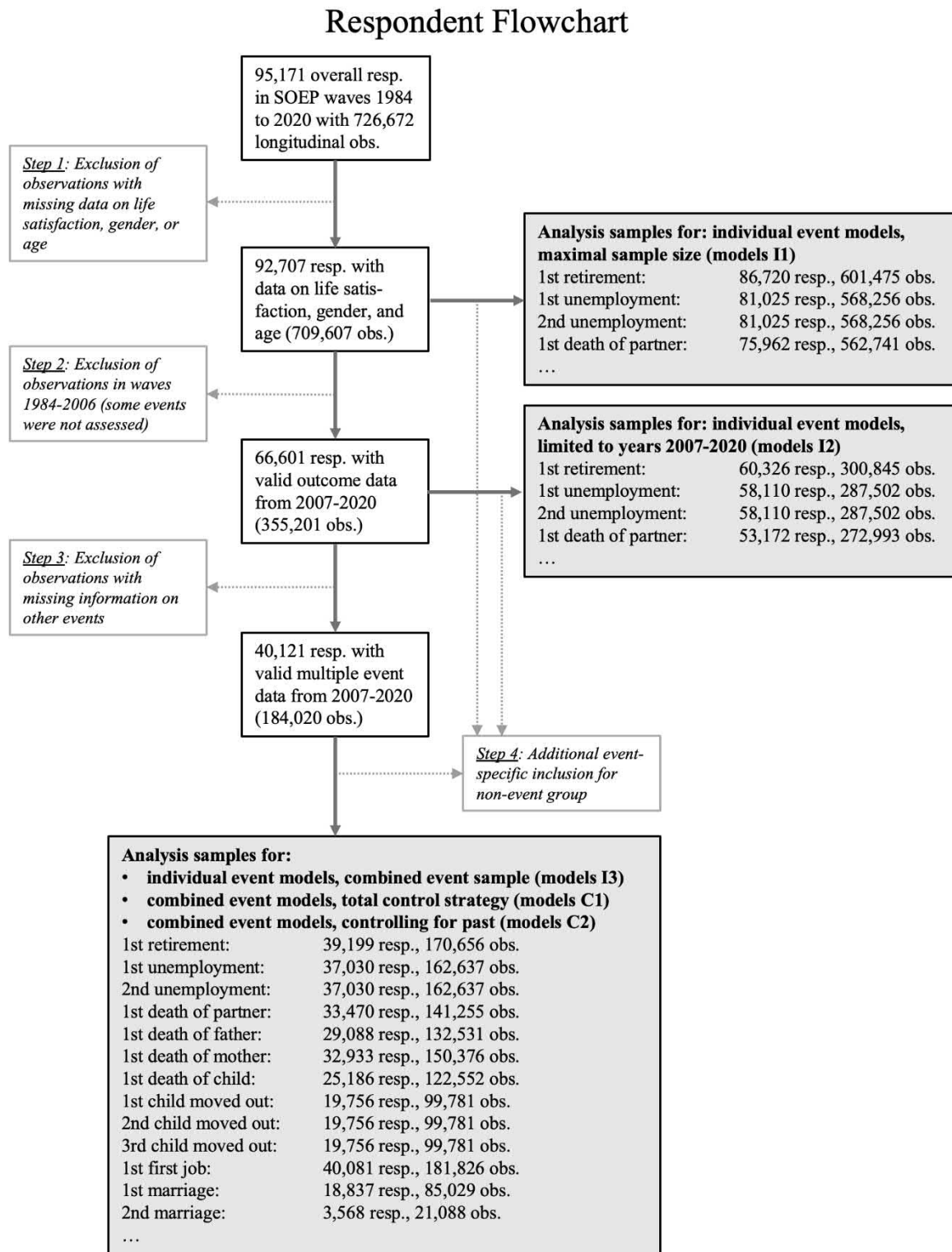
237 We used data from the German Socio-Economic Panel (SOEP; Version 37¹). The SOEP is
238 an ongoing household panel study initiated in 1984 which is representative of adults living in
239 private households in Germany (Goebel et al., 2019). Members of selected households aged 16
240 years or older were asked to participate in annual interviews. Households were initially chosen
241 using a multistage random sampling technique with regional clustering; later, some refreshment
242 samples were added to increase the sample size and maintain representativeness. Ethical
243 permission was granted by the Scientific Advisory Board of DIW Berlin.

244 Four levels of exclusion criteria defined the different analysis samples (see Figure 1): First,
245 we excluded observations with missing data on life satisfaction (17,049 observations, 2,113 of
246 whom declined to answer), gender (13 observations), or birth year (3 observations), resulting in
247 the samples underlying the individual event models with maximal sample size (models I1).
248 Second, we excluded observations prior to wave 2007 because we wanted to model the impact of
249 all life events jointly and the last event of interest to be added to the SOEP questionnaire (death
250 of a child) was included in 2007. Thus, samples underlying the individual event models were
251 limited to years 2007-2020 (models I2). Third, in order to model all events jointly, we excluded
252 observations with missing data on any of the events. Together, application of these exclusion
253 criteria yielded 40,121 respondents with 184,020 observations (53.84% women and 46.16%

¹ After signing a contract on data distribution, the SOEP data are available for scientific use for free. More information can be found on <https://www.diw.de/en/soep>.

Figure 1

Respondent Flowchart



Note. Resp. = respondent; obs. = person-year observation. Dotted arrows represent exclusion of observations.

254 men², $M_{age} = 42.02$, $SD_{age} = 16.02$), resulting in the analysis samples underlying both combined
255 event models (models C1, models C2) as well as the individual event models based on the
256 combined event sample (models I3). This exclusion strategy is in line with previous studies but
257 extended to modeling multiple events jointly.

258 Additionally, for each life event we excluded observations from the non-event group (i.e.,
259 those who did not experience this event who served as a control group to account for normative
260 age effects) if they were not eligible to experience the event in the first place. For example, for
261 the event retirement, only individuals who were still part of the workforce (i.e., not yet retired)
262 were included. The criteria for inclusion in the non-event group are outlined below (see
263 Analytical Strategy).

264 **Measures**

265 *Life Satisfaction*

266 Life satisfaction was measured with a single item using an 11-point Likert scale: “In
267 conclusion, we would like to ask you about your satisfaction with your life in general. Please
268 answer on a scale from 0 to 10, where 0 means completely dissatisfied and 10 means completely
269 satisfied (see Figure S2 for the distribution of responses). How satisfied are you with your life, all
270 things considered?”. Studies on the quality of such single-item measures indicate satisfactory
271 retest reliability (Lucas & Donnellan, 2012) and high criterion validity (Cheung & Lucas, 2014)
272 with longer scales such as the Satisfaction With Life Scale (Diener et al., 1985).

273 *Life Events*

274 We generated 14 different types of life events as dummy-coded variables (0 = “*Event did*
275 *not occur*”; 1 = “*Event occurred*”; see Table 1).

² The German language uses a single term, *Geschlecht*, to refer to sex and gender. In the SOEP, this variable was assessed in a binary manner for all waves included in our analyses.

276 **Death of Father, Mother, Partner, or Child.** Several events were based on respondents'
277 annual report of family-related changes (e.g., in 2014 “Has your family
278 situation changed since December 31, 2012? Please indicate if any of the following apply to you
279 and if so, when this change occurred.”). Comparing monthly information from this item to the
280 month of the interview, we coded death of father (“Father deceased”), death of mother (“Mother
281 deceased”), death of partner (“My spouse / partner died”), and death of child (“Child deceased”).

282 **Child Moved Out.** The event child moved out was also drawn from this annual report of
283 family-related changes (“My son or daughter left the household”).

284 **First Job.** Information on respondents starting their first job was gathered from the
285 response option “I have entered employment for the first time in my life” to the item “Now a few
286 questions about your new position. What type of an employment change was that?”

287 **Unemployment.** We coded unemployment based on the item “Are you officially registered
288 as unemployed at the Employment Office (‘Arbeitsamt’)?” However, in this case we only coded
289 an affirmative response as an event occurrence if it was preceded by two waves of not being
290 registered as unemployed.

291 **Retirement.** Retirement was coded based on the response option “Reaching retirement age
292 / pension” to the question “How was this job terminated?”

293 **Childbirth.** Information on childbirth was obtained through a combination of yearly
294 questionnaire data and retrospective biographical information to trace and update the birth
295 biography of each respondent (“biobirth” dataset; Schmitt & SOEP Group, 2020). This provided
296 the birth year and month for each child in order of the birth biography.

297 **New Partner, Cohabitation, Separation, Marriage, and Divorce.** For these events, we
298 also relied on biographical spell data, which denote time periods with a defined start and end
299 (“biomarsy/m” and “biocouply/m” datasets; Hamjediers et al., 2022). For example, a marriage

300 spell would be defined by its start date (year and if available month of marriage) and its end date
301 (which is set to the most recent wave if the person is still married). We used these spell data to
302 code the biographically first and later occurrences of the events new partner, cohabitation,
303 separation, marriage, and divorce. Compared to the usually employed coding of marital and
304 relationship status events based on the annual report of family-related changes (see above), this
305 had the advantage that we were able to differentiate repeated events based on their biographical
306 sequence.

307 *Repeated Life Events*

308 In the full sample, we examined multiple occurrences of the same event type. Table 1
309 shows how often each event occurred in total and repeatedly within respondents. Repeated
310 occurrences of the same event type were coded as separate events (e.g., first divorce, second
311 divorce) based on two considerations: First, to ensure sufficient sample sizes we included
312 repeated occurrences only as a separate event if at least 500 respondents reported it. Second, for
313 substantive reasons, we were only interested in the first occurrence of first job, retirement, death
314 of mother, and death of father (where we assume that later occurrences are mostly the results of
315 inaccurate reporting). Including repeated occurrences of the 14 event types in this way resulted in
316 30 life events in total (see Table 1).

317 *Analytical Strategy*

318 *Model Features*

319 *Fixed Effects to Account for Time-Invariant Confounding.* To analyze the effects of life
320 events on changes in life satisfaction, we used fixed effects models (Allison, 2019; Hamaker &
321 Muthén, 2020; for similar analytic approaches using SOEP data, see Richter et al., 2019; Seifert
322 et al., 2023), which are one of the standard approaches in economics and sociology to account for
323 nested data. In longitudinal settings, fixed effects models exclusively analyze within-person

324 variance which is achieved in ordinary least squares (OLS) regression by including a cluster
325 affiliation dummy variable for each person. Variables that have no variation within persons are
326 dropped. Conceptually, this is similar to person-mean centering of all Level-1 variables in
327 multilevel models (Hoffman & Walters, 2022).

328 We see two main advantages of fixed effects models for our analytical purposes (McNeish
329 & Kelley, 2019): First, they are not susceptible to bias from omitted time-invariant confounders.
330 This means they “automatically” control for any unobserved, time-invariant background
331 characteristics such as prior education, intelligence, or stable personality traits. Second, through
332 straightforward OLS estimation, fixed effects models can deal with large amounts of time-
333 varying predictors. Furthermore, fixed effects models rely on fewer assumptions (McNeish &
334 Kelley, 2019); for example, they do not assume that clusters are randomly sampled.

335 ***Discrete Time Dummy Variables to Allow for Nonlinear Pre- and Post-Event Effects.*** For
336 each life event, we coded time in relation to the event using discrete time dummy variables (with
337 values 0 or 1; Perales, 2019). We used five dummies to model trajectories (see Table 2): *Year 2*
338 *before [event]* == 1 if the respondent experienced this event during the second year after the
339 current interview; *Year 1 before [event]* == 1 if the respondent experienced this event during the
340 next year after the current interview; *Year 1 after [event]* == 1 if the respondent experienced this
341 event during the year before the current interview; *Year 2 after [event]* == 1 if the respondent
342 experienced this event between one and two years before the current interview; *More than 2*
343 *years after [event]* == 1 if the respondent experienced this event more than two years before the
344 current interview. Using these mutually exclusive dummy variables to represent time in relation
345 to the event had the advantage that it did not impose a functional form on the pre- and post-event
346 change trajectories.

Table 2

Dummy Variable Coding Schemes, Exemplarily for the Focal Event First Divorce and only First Marriage and Second Marriage Displayed out of the Nonfocal Events

Measurement Wave	Event Reported	1st Marriage: Dummy Variables					1st Divorce: Dummy Variables					2nd Marriage: Dummy Variables				
		-2	-1	+1	+2	≥ 3	-2	-1	+1	+2	≥ 3	-2	-1	+1	+2	≥ 3
Individual Event Models, Combined Event Model with Total Control Strategy (Model C1)																
1	no	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1st Mar.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
3	no	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
4	no	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
5	1st Div.	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0
6	no	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0
7	2nd Mar.	0	0	0	0	1	0	0	0	0	1	0	0	1	0	0
8	no	0	0	0	0	1	0	0	0	0	1	0	0	0	1	0
9	no	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1
10	no	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1
Combined Event Model Controlling for Past Events (Model C2) with First Divorce as the Focal Event																
1	no	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1st Mar.	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
3	no	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
4	no	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
5	1st Div.	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
6	no	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0
7	2nd Mar.	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0
8	no	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0
9	no	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0
10	no	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0

Note. Mar. = marriage; Div. = divorce; -2 = year 2 before [event]; -1 = year 1 before [event]; 1 = year 1 after [event]; 2 = year 2 after [event]; ≥3 = 3 or more years after [event]. The first eight rows show the coding scheme used to represent time in relation to the event for the individual event models and the combined event model with total control strategy (C1). The last eight rows show the coding scheme used for the combined event model controlling for past events (C2) where all nonfocal event dummies that came after the focal event (in this case, first divorce) were recoded to zero.

347

348 ***Non-Event Group to Account for Normative Effects.*** We estimated separate models for

349 each life event. These models included two groups of observations: (1) all person-year

350 observations from respondents who ever experienced the event during panel participation, and (2)

351 the person-year observations from respondents who never experienced the specific event but
 352 were in principle eligible to experience it. Thus, the combined event models differed in the size
 353 of their analysis samples because different inclusion criteria of the respective non-event group
 354 applied for different focal events. This ensured that respondents in the non-event group offered a
 355 realistic counterfactual for the estimation of the effects of each life event as they *could* have
 356 experienced it. For example, for second separation, the non-event group only included those who
 357 have not reported the second separation before entering the survey or during panel participation
 358 (the first separation did not matter for inclusion). For death of child, we only include parents in
 359 the non-event group. The complete list of inclusion conditions based on eligibility to experience
 360 the event as well as some additional explanations can be found in Table S2. The non-event group
 361 was relevant for the intercept estimation and also had the purpose to control for normative age
 362 trends (Luhmann, Orth, et al., 2014), which is achieved by estimating slopes of age on the joint
 363 analysis sample of event group and non-event group.

364 ***Resulting Models***

365 In total, we ran five models for each life event, three individual event models (referred to as
 366 I1, I2, I3) and two combined event models (C1, C2; see Figure 1 and description below).

367 ***Individual Event Models.*** The formula for models of an individual event predicting life
 368 satisfaction for a person i at time t reads:

$$369 \quad LS_{it} = \alpha_i + (\theta_{-2}E_{-2,it} + \theta_{-1}E_{-1,it} + \theta_1E_{1,it} + \theta_2E_{2,it} + \theta_{\geq 3}E_{\geq 3,it})female_i + \beta_1age_{ti}$$

$$370 \quad \quad \quad + \beta_2age_{ti}^2 + \beta_3three_years_{ti} + \epsilon_{it}$$

371 α_i represented the person fixed effect (i.e., the cluster-specific affiliation dummy). This
 372 approach is equivalent to demeaning all variables by subtracting the person-mean from each
 373 person-year observation, leaving only within-person variation (McNeish & Kelley, 2019). The
 374 five E_{it} variables represented the dummy-coded predictors describing the temporal relation to the

375 event. These dummies were interacted with *female_i* (0 = male, 1 = female) to model gender
376 differences in the trajectories. Even though gender had no within-person variation in our sample
377 and, thus, dropped out as a main effect in the fixed effects model, we could estimate its
378 interaction effect with the time-varying event dummies (conceptually equivalent to a cross-level
379 interaction in multilevel models; McNeish & Kelley, 2019). We added age and age-squared in
380 order to account for trends in life satisfaction over the life span³ (Fujita & Diener, 2005) and a
381 dummy variable for the first three years of survey participation to account for initial elevation
382 bias (Kratz & Brüderl, 2021; Shrout et al., 2018). We ran three individual event models per event
383 which progressively restricted the sample size until the third individual event model had the same
384 sample size as the corresponding combined event models. Estimating the three individual event
385 models had the purpose to rule out that differences between the individual and combined event
386 model could result from differences in the sample composition (I3 and C1/C2 share the same
387 analysis sample), while also making use of the full data (I1) and checking whether inclusion
388 criteria affected conclusions (I1 vs. I2 vs. I3).

389 ***Combined Event Models.*** We first estimated a combined model for each focal event (FE)
390 that controls for the dummy variables of all other nonfocal events (NE) regardless of when they
391 occurred (C1, *combined event model, total control strategy*). Second, to address issues of
392 overcontrol bias described above, we estimated models that only control for preceding and
393 concurrent nonfocal events (relative to the occurrence of the focal event; C2, *combined event*
394 *model, controlling for past events*). Control for preceding life events, even if they are
395 confounders, may still introduce spurious associations via collider bias by opening up more
396 complex confounding paths (Elwert & Winship, 2014). Depending on the precise underlying

³ In the preregistration, we stated that we plan to control for *person-mean centered* age and age-squared. However, for linear age trends, the person-mean centering makes no difference; and after person-mean centering, the squared age term would fail to capture curvilinear effects over the life span (and instead model curvilinear patterns relative to each respondent's mean age).

397 causal graph, control may both reduce and introduce bias (M-bias or butterfly bias; Thoemmes,
 398 2015). Here, we nonetheless favor adjustment based on the assumption that the confounding
 399 influence that is removed exceeds the more subtle bias that may be introduced. This seems a
 400 plausible default assumption in the absence of a more precise understanding of the causal net
 401 linking life events (which may also vary between individuals).

402 The resulting model formula can be restated as:

$$\begin{aligned}
 403 \quad LS_{it} = & \alpha_i + (\theta_{-2}FE_{-2,it} + \theta_{-1}FE_{-1,it} + \theta_1FE_{1,it} + \theta_2FE_{2,it} + \theta_{\geq 3}FE_{\geq 3,it})female_i \\
 & + \sum_{j=1}^{29} ((\theta_{-2,j}NE_{-2,j,it} + \theta_{-1,j}NE_{-1,j,it} + \theta_{1,j}NE_{1,j,it} + \theta_{2,j}NE_{2,j,it} \\
 404 & + \theta_{\geq 3,j}NE_{\geq 3,j,it})female_i) + \beta_1age_{ti} + \beta_2age_{ti}^2 + \beta_3three_years_{ti} + \epsilon_{it}
 \end{aligned}$$

406 In the combined event models with total control strategy (C1), effects of the focal event
 407 were controlled for the confounding influence of all other, nonfocal events, whose time dummy
 408 variables were represented by the sum of the $NE_{j,it}$ variables (of the 29 nonfocal events).

409 However, as described above, a more sensible control strategy involves controlling for life
 410 events that precede the focal event (which could potentially confound the association between the
 411 focal event and well-being), but not for events occurring after the focal event (which could
 412 potentially be consequences of the focal event). Thus, for the combined event models controlling
 413 for past events (C2), we recoded all nonfocal event dummy variables such that they were zero for
 414 all nonfocal events following the focal event (i.e., events occurring in years after $FE_{1,it} == 1$;
 415 see Table 2). This offers a sensible compromise to estimate the causal effect of the focal life
 416 event under the transparent assumption that it is only confounded with life satisfaction via
 417 preceding nonfocal life events. Based on our assumptions about the causal structure of potential
 418 confounding through co-occurring life events, we believe that the combined event model

419 controlling for past events (C2) is the one better suited to estimate the effects of each focal life
420 event on life satisfaction.

421 **Transparency and Openness**

422 Analyses were conducted using Stata (Version 15.1; StataCorp, 2017). Because of the
423 clustered nature of the data we used panel-robust standard errors throughout (Brüderl & Ludwig,
424 2015). Plots were created in R (Version 4.2.1; R Core Team, 2023) using ggplot2 (Version 3.3.6;
425 Wickham et al., 2019). Analysis scripts can be found on the OSF (<https://osf.io/qdtb5/>). We used
426 $\alpha = .01$ as our main inference criterion.

427 **Results**

428 First, we present substantive results for all 30 life events of 14 event types based on our
429 preferred model, referred to as the combined event model controlling for past events (model C2;
430 see Figure 2). Second, we compare different models based on the same analysis samples to
431 investigate undercontrol and overcontrol bias, along with life event co-occurrence (see Figures 3,
432 4, S6, S7, & S8). Differences between the individual event models relying on samples with
433 varying inclusion criteria (models I1, I2, I3) are reported in the Supplemental Materials (Section
434 A; see also Figures S3, S4, & S5).

435 **Substantive Results for all Life Events**

436 *New Partner*

437 Finding a new romantic partner was associated with post-event increases in life satisfaction
438 (see Figure 2a,b,c,d). These increases were long lasting beyond three years for the first and
439 second occurrences. For later occurrences of finding a new partner, life satisfaction still increased
440 after the event but not consistently in a significant way.

Figure 2

Life Satisfaction Change Trajectories in the Combined Event Model Controlling for Past Events

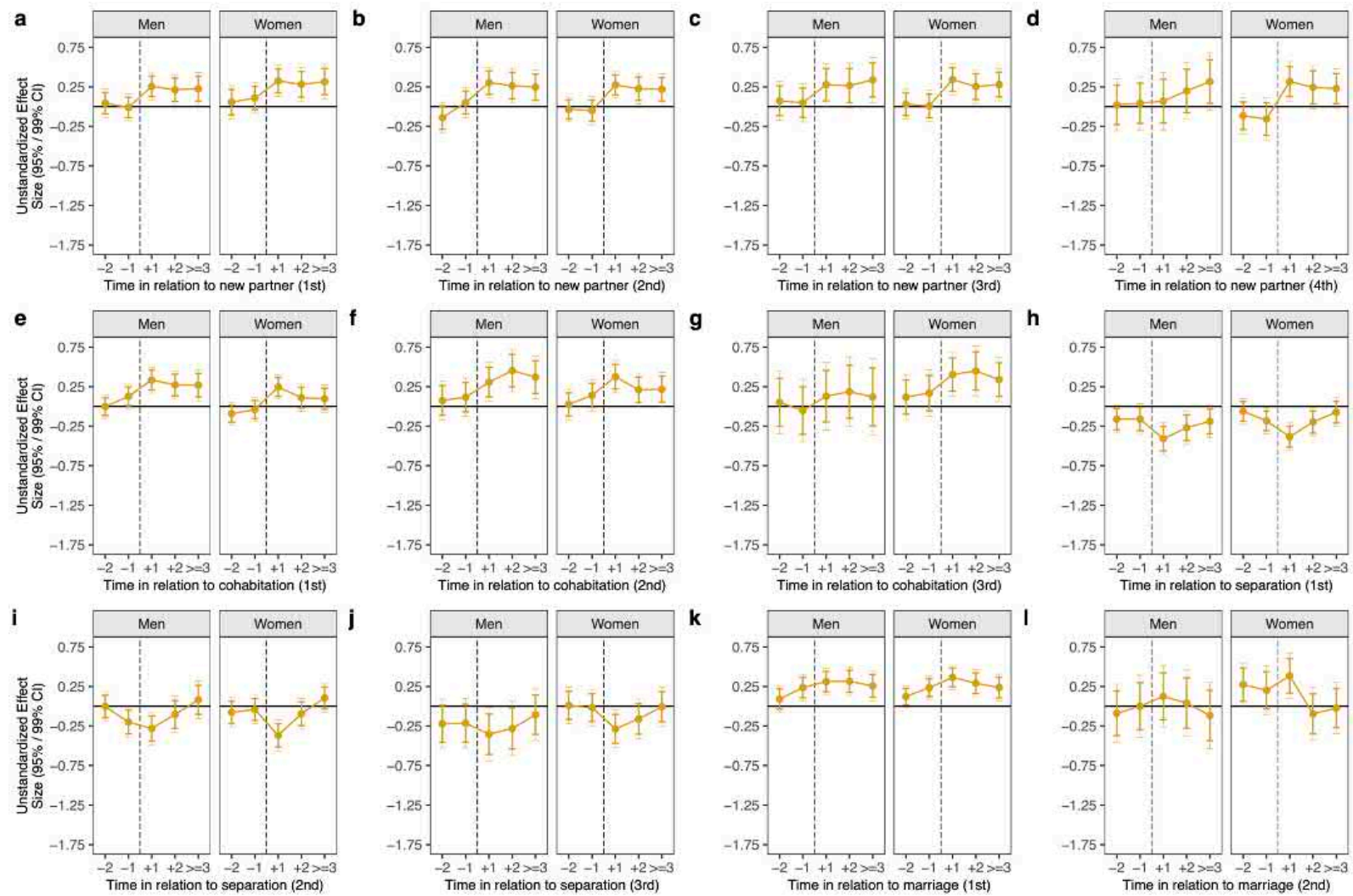


Figure 2 (continued)

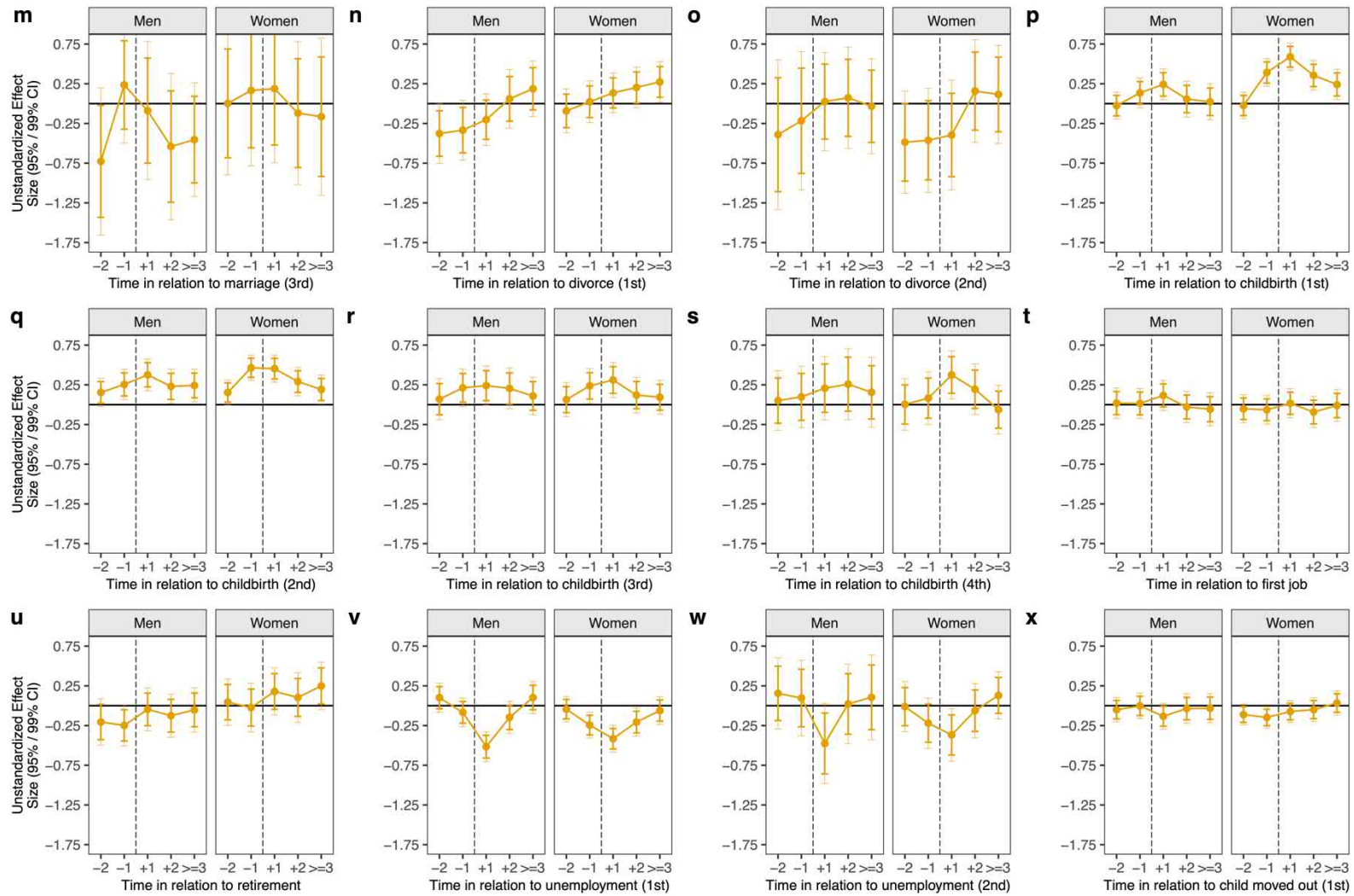
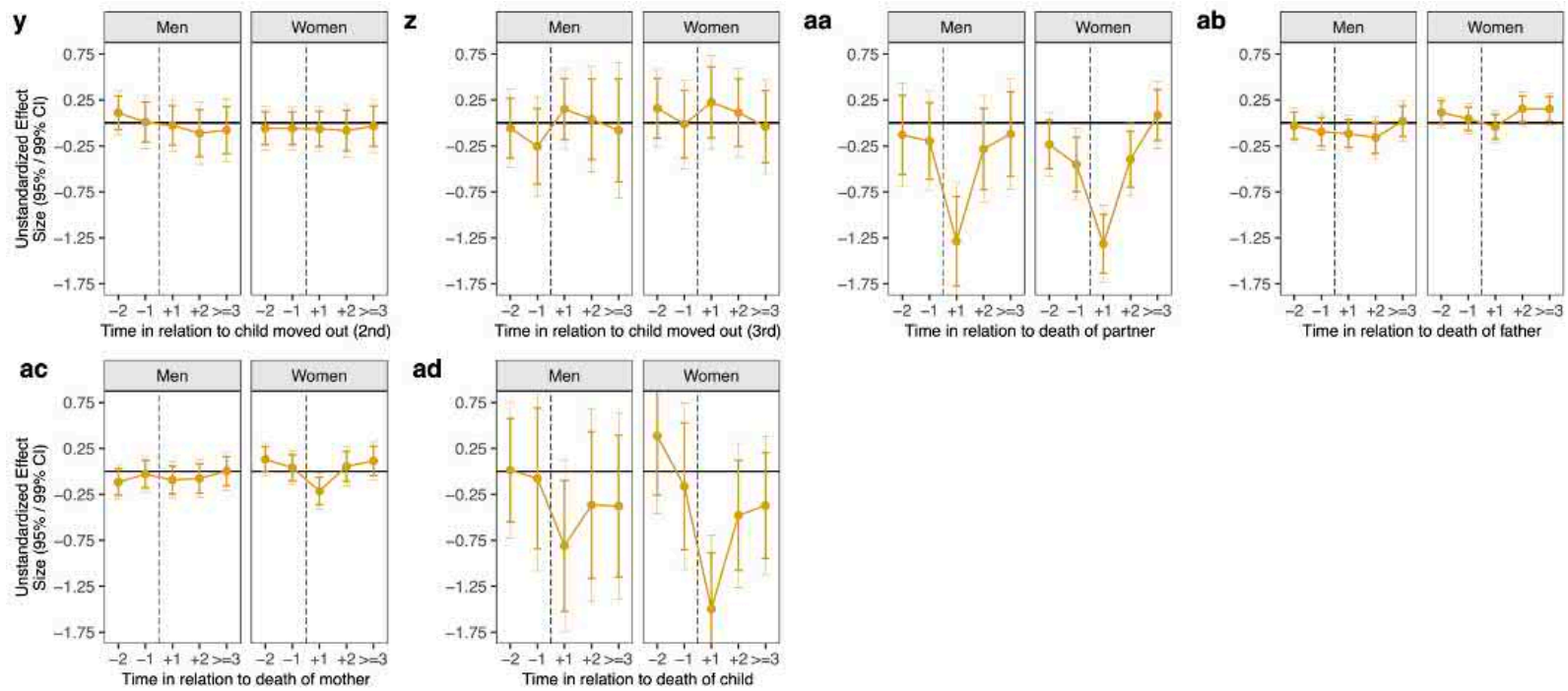


Figure 2 (continued)



Note. The dashed line represents the approximate time of event occurrence. The plot panel background color indicates the grouping by life event types. Effects should be interpreted on the 11-point scale used for life satisfaction ($SD = 1.80$). Confidence intervals (both 95% and 99%) reflect the precision of the estimated effects.

441 Cohabitation

442 Entering cohabitation with a partner was associated with gains in life satisfaction in the
443 year afterwards (see Figure 2e,f,g). The positive effects persisted for men for the first and second
444 occurrence and for women for the third occurrence, indicating long-lasting effects.

445 Separation

446 Separation from a partner was related to post-event decreases in life satisfaction for both
447 men and women (see Figure 2h,i,j). In addition, women's life satisfaction was already decreasing
448 in the year before the event occurred for the first time. The post-event decreases were slightly
449 more pronounced for the first event occurrence than for the second and third occurrences. For the
450 second and third occurrences, this decrease in life satisfaction was only significant in the first
451 year after separation.

452 Marriage

453 Experiencing marriage for the first time was associated with significant increases in life
454 satisfaction already starting before marriage and peaking in the year directly afterwards (see
455 Figure 2k). Effects then declined in size but were still positive and significant at more than two
456 years after the event suggesting a long-lasting influence. Effects were comparable in size for men
457 and women. For second marriage, effects were smaller and only significant for women in the first
458 year after the event (see Figure 2l). For third marriage, precision of the effect estimates was too
459 low to reliably compare them to those of the first and second marriage (see Figure 2m).

460 Divorce

461 Going through a divorce for the first time was associated with lower life satisfaction in the
462 two years before the event for men (see Figure 2n). Women's life satisfaction was increased at
463 three or more years afterwards suggesting slight long-term benefits of divorce. Effects for second
464 divorce were estimated quite imprecisely (see Figures 2o).

465 *Childbirth*

466 In general, childbirth was associated with increases in life satisfaction before and after the
467 event (see Figure 2p,q,r,s). These effects were larger (1) in the year directly after the event was
468 first reported, (2) for mothers compared to fathers, and (3) for first childbirth compared to later
469 childbirths. Positive effects of childbirth were long-lasting beyond three years only for first
470 childbirth for women and for second childbirth for men.

471 *First Job*

472 There was no evidence that starting the first job was associated with changes in life
473 satisfaction (see Figure 2t).

474 *Retirement*

475 Retirement was also not related to significant changes in life satisfaction (see Figure 2u).

476 *Unemployment*

477 Life satisfaction declined in the first year after experiencing unemployment for the first
478 time (see Figure 2v). Women also experienced a significant decrease in the year before they
479 became unemployed and in the second year afterwards. For the second occurrence of
480 unemployment (see Figure 2w), effects were similar in size but estimated with lower precision.
481 Therefore, only women decreased significantly in the first year after becoming unemployed.

482 *Child Moved Out*

483 Experiencing a child move out of the household was mostly unrelated to life satisfaction
484 (see Figure 2x,y,z). Only for the first occurrence, we found a significant negative effect for
485 women in the year before the event that was small in size.

486 *Death of Partner*

487 The death of a spouse or partner was related to a large decrease in life satisfaction in the
488 year when the event was first reported (see Figure 2aa). Women also experienced a significant
489 decrease in the year before their partner's death.

490 *Death of Father*

491 We found no significant average effect of death of one's father on life satisfaction (see
492 Figure 2ab).

493 *Death of Mother*

494 For death of one's mother, we only found a single significant average decrease, for women,
495 in the year in which the event was reported (see Figure 2ac).

496 *Death of Child*

497 Experiencing the death of a child was associated with a large decrease in life satisfaction in
498 the year after the event which was more pronounced for women (see Figure 2ad; only significant
499 at $p < .05$ for men). Due the relative rarity of the event, error bars were wide.

500 **Variation Across Combined Event Models: Potential Undercontrol and Overcontrol Bias**

501 To investigate potential undercontrol and overcontrol bias, we now compare effects
502 estimates across the individual event models (I3) and the two combined event models (models
503 C1, total control strategy, and C2, controlling for past events). Differences in effects between the
504 individual event model and the combined event model controlling for past events (I3 vs. C2)
505 indicate potential undercontrol bias. Differences between the combined event model with total
506 control strategy and the combined event model controlling for past events (C1 vs. C2) indicate
507 potential overcontrol bias.

508 All things considered, we mostly found evidence for robustness of the individual event
509 estimates (see Figure S6). High similarity between effect estimates (and also their precision) was
510 especially evident for events unrelated to romantic relationships and family life (aggregated,

511 standardized effect size differences between models I3 and C2 indicating undercontrol bias: $M =$
512 0.33 , $Mdn = 0.31$ [IQR 0.12-0.46], $SD = 0.26$; aggregated, standardized effect size differences
513 between models C1 and C2 indicating overcontrol bias: $M = 0.15$, $Mdn = 0.09$ [IQR 0.03-0.20],
514 $SD = 0.17$; see Figures S4 & S7). Some of these events, notably retirement and death of a partner,
515 rarely co-occurred with other events, which may explain why confounding through other life
516 events may not be a big concern here (see Figure S8). Unemployment co-occurred in a rather
517 unsystematic way with many types of events, which again may explain why other life events did
518 not introduce systematic confounding. First job mostly co-occurred with events typical in young
519 adulthood such as first partnership and first separation; confounding effects may thus operate in
520 different directions leaving no large bias on average.

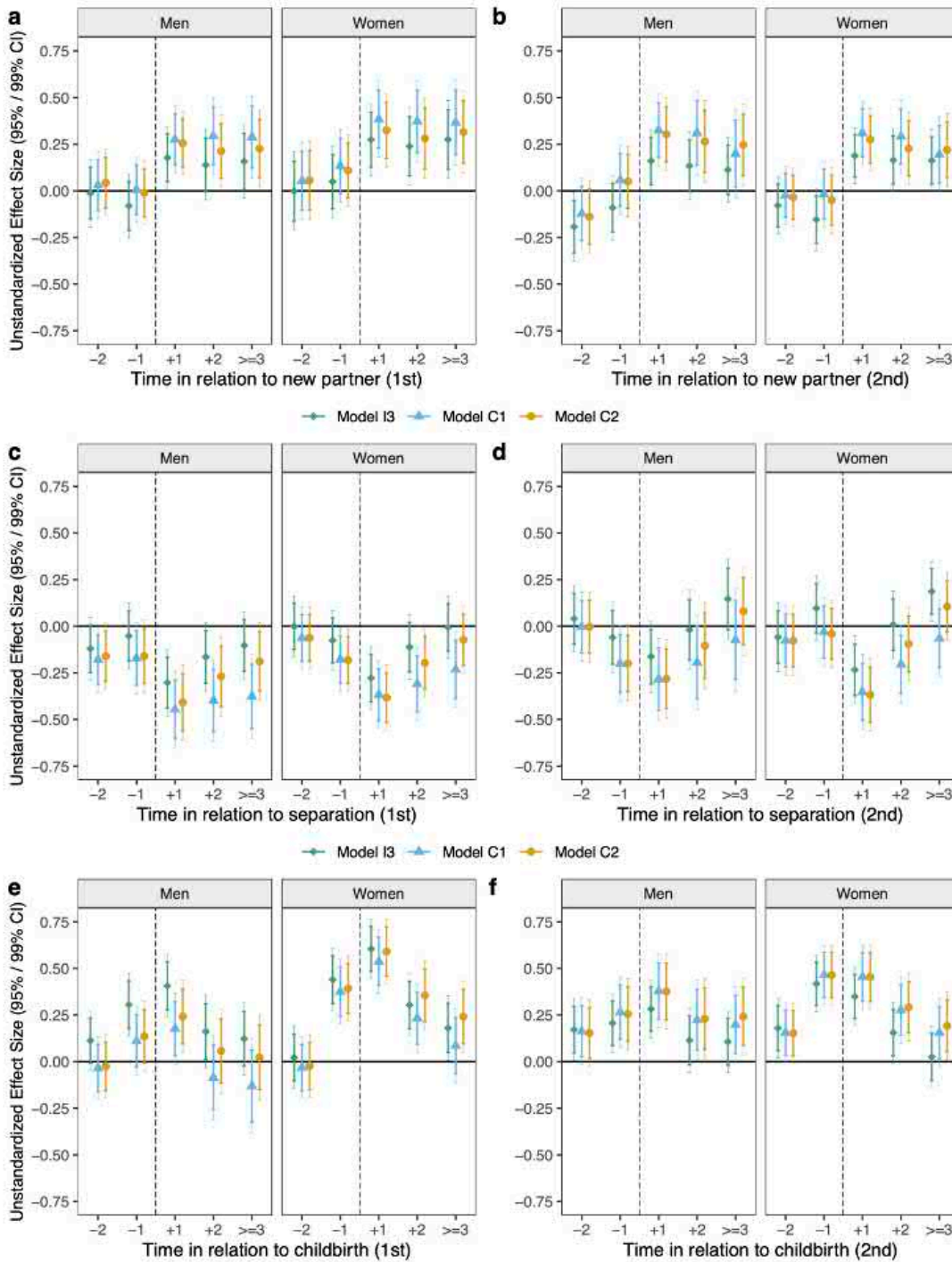
521 In life events related to romantic relationships and fertility, however, confounding through
522 other events played a substantially larger role (undercontrol bias: $M = 0.87$, $Mdn = 0.73$ [IQR
523 0.39 - 1.27], $SD = 0.60$; overcontrol bias: $M = 0.36$, $Mdn = 0.16$ [IQR 0.06-0.38], $SD = 0.50$; see
524 Figure S7). To illustrate how under- and overcontrol bias may play out, we will now discuss
525 differences in results across models for the events new partner, cohabitation, separation,
526 marriage, and childbirth. These events may play out in any order, and our estimates average
527 across the sequences that are in the actual data. However, these events often occur as a chain of
528 normative transitions, which can explain certain biases in the estimated average effects.

529 ***New Partner***

530 Results showed that effects of finding a new partner on life satisfaction changed in size
531 depending on the control strategy (see Figures 3a,b & S6c,d). In general, individual event models
532 indicated positive effects. These were estimated to be larger when controlling for preceding
533 events than in the individual event models, in particular for men and for the second new partner
534 (estimates in the year after finding a new partner, I3: $b = 0.16$, 99% CI [-0.01, 0.33]; C2: $b =$

Figure 3

Life Satisfaction Change Trajectories in the Individual (I3) and the two Combined Event Models (C1, C2)



Note. The dashed line represents the approximate time of event occurrence. Effects should be interpreted on the 11-point scale used for life satisfaction ($SD = 1.80$). Model I3 = individual event model based on the combined event sample; Model C1 = combined event model with total control strategy; Model C2 = combined event model controlling for past events. See Figure S6 for all life events. Confidence intervals (both 95% and 99%) reflect the precision of the estimated effects.

535 0.30, 99% CI [0.11, 0.50]). Finding a new partner mostly co-occurred with other relationship
536 events (see Figures 4a,b & S8c,d). Within two years, this event was frequently preceded by
537 separation events. If we fail to account for the negative effects of such preceding separations, the
538 positive effects of the event new partner can be underestimated due to undercontrol bias.

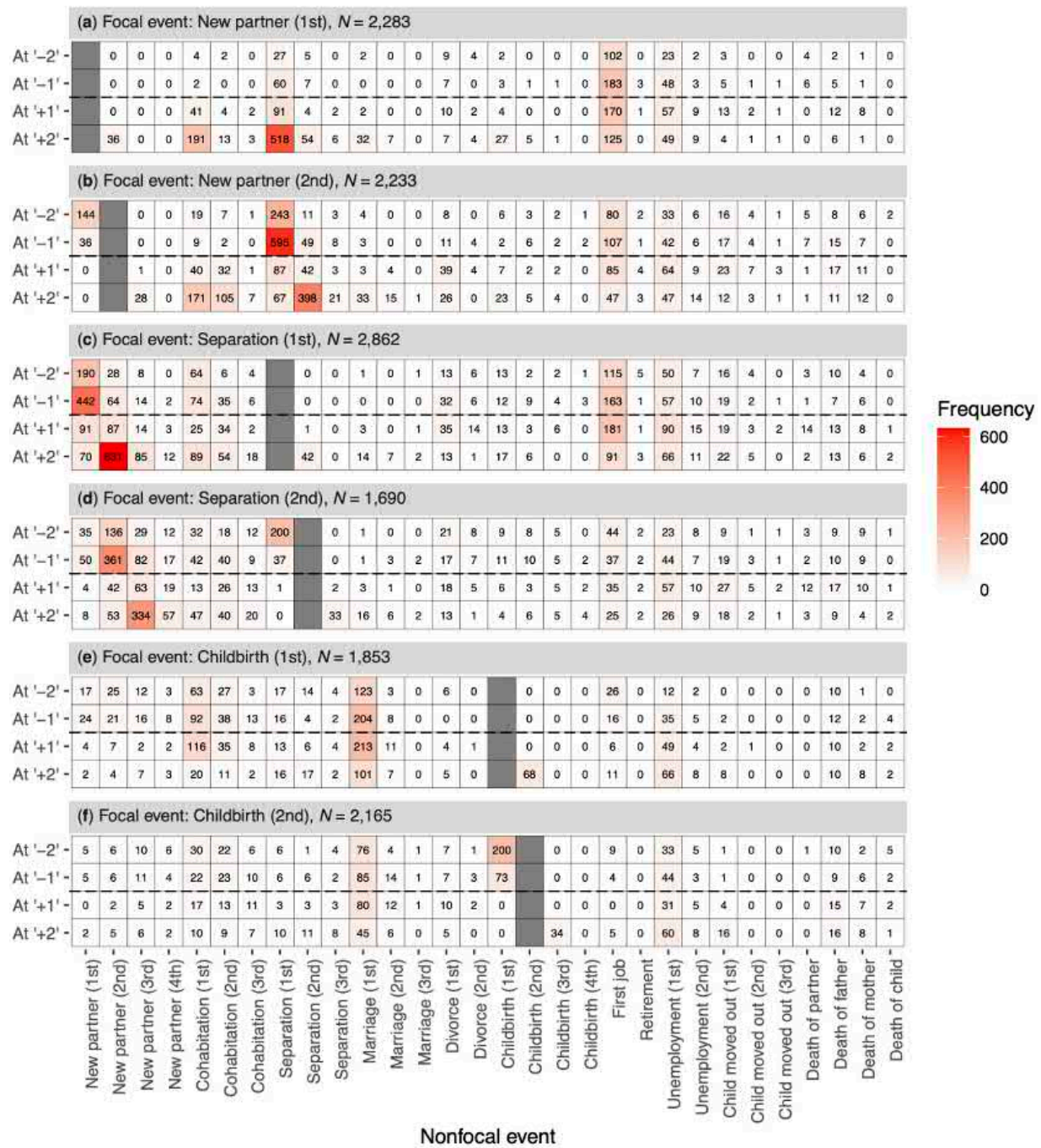
539 New partners were not only frequently preceded by separations, but also succeeded by
540 separations, which leads to concerns about overcontrol bias in the post-event trajectory. Two
541 years after the event, we found that life satisfaction increased to a larger extent in the combined
542 event model with total control strategy (e.g., women, first new partner, $b = 0.37$, 99% CI [0.15,
543 0.59]) than in the combined event model controlling for past events (first new partner, $b = 0.28$,
544 99% CI [0.07, 0.50]). The differences in magnitude here were, however, smaller than those
545 suggesting undercontrol bias (see Figure S7a,b,c,d). Thus, we may overestimate the positive
546 effects of new partners if we “control away” the effects of subsequent separations and thus
547 effectively condition on relationship success.

548 ***Cohabitation***

549 We also found evidence for both undercontrol and overcontrol bias in the post-event effect
550 estimates for cohabitation, but this pattern was different than the one for a new partner (see
551 Figure S6e,f,g). Changes to life satisfaction were generally less positive if we controlled for other
552 events, indicating that undercontrol leads to an overestimation. Estimates were also mostly
553 smaller in the model with total control strategy than in the model controlling for past events,
554 indicating that overcontrol may lead to underestimation. Considering the pattern of event co-
555 occurrence (see Figure S8e,f), one explanation for this pattern is that without control for previous
556 life events, some of the positive effects of finding a new partner are attributed to cohabitation;
557 with control for future life events, some positive downstream effects due to marriage and
558 childbirth are not attributed to cohabitation.

Figure 4

Co-occurrence of six Focal Event with the 29 Nonfocal Events



Note. The dashed line represents the approximate time of event occurrence. The Y-axis represents time in relation to the focal event (i.e., frequency of occurrence of each nonfocal event up to two years before and after the focal event occurred). N = overall event occurrence of the focal event in the respective final analysis sample. See Figure S8 for all life events.

560 ***Separation***

561 Another event where model comparisons suggested the presence of both undercontrol and
562 overcontrol bias was separation (see Figures 3c,d, S6j, & S5h,i,j). For women, we found that,
563 controlling for past events, life satisfaction already significantly decreased in the year before first
564 separation ($b = -0.18$, 99% CI [-0.35, -0.02]), and then further decreased and remained lowered in
565 the years afterwards ($b = -0.38$, 99% CI [-0.56, -0.21] and $b = -0.20$, 99% CI [-0.38, -0.01]).
566 These negative effects were underestimated in individual event models without control for co-
567 occurring events ($b = -0.08$, 99% CI [-0.23, 0.08]; -0.28 , 99% CI [-0.45, -0.11]; $b = -0.11$, 99%
568 CI [-0.29, 0.06]). Men's estimates displayed a similar pattern but to a lesser extent. Considering
569 the potential for overcontrol bias, models that also controlled for future events generally
570 overestimated the negative long-term effects of separation. Thus, model comparisons indicated
571 that the magnitude and significance evaluation of effects of separation depended on the model
572 choice and indicated both undercontrol and overcontrol bias.

573 Looking at the overlap of nonfocal life events co-occurring with separation (see Figures
574 4c,d & S8j), we found that it was most frequently preceded *and* succeeded by new partner events.
575 Thus, the pattern of bias can be explained by the fact that some individuals who separate still
576 have elevated levels of life satisfaction due to a newly started relationship, if we fail to account
577 for this higher starting point, we underestimate the decline due to separation. Conversely, some
578 individuals who separate subsequently find a new partner which renders the long-term
579 consequences of separation less grave on average. If we erroneously control away the impact of
580 future life events (which would not have occurred without the separation), the resulting image is
581 too gloomy. Later occurrences (second and third separation) were frequently preceded by the
582 previous separation two years before. Cohabitation also happened somewhat frequently around
583 separation.

584 Because separation is part of a causal chain of related romantic relationship events, an
585 appropriate control strategy is needed: The current results demonstrate that it is on the one hand
586 necessary to control for preceding events. Otherwise, positive events in the past, mostly finding a
587 new partner, produced upwardly biased change estimates. On the other hand, controlling for
588 events following separation, often finding a new partner, introduced bias. In this case, estimates
589 were downwardly biased because controlling for future events conditioned on those who
590 remained single.

591 *Marriage*

592 We found evidence for both undercontrol and overcontrol bias through other events in
593 estimates of marriage which was comparable in size to bias for the new partner events. However,
594 the direction of average bias adjustment was flipped (see Figure S6k). For example, men's
595 increase in life satisfaction in the year after marriage was adjusted downward in the combined
596 event models suggesting the presence of undercontrol bias through preceding positive events.
597 Most frequently, first marriage was preceded by cohabitation (see Figure S8k) which also showed
598 generally positive effects on life satisfaction. These lagged effects of an earlier cohabitation
599 might be wrongly attributed to marriage in estimates of an individual event model. After
600 marriage, women's long-lasting positive changes in life-satisfaction appeared smaller when
601 controlling for future life events, which may be explained by downstream positive events such as
602 experiencing childbirth within two years after marriage (see Figure S8k).

603 *Childbirth*

604 The magnitude of effects on life satisfaction when experiencing childbirth also depended
605 on the control strategy (see Figures 3e,f & S6r,s). Considering the birth of a first child in
606 particular, failing to control for past life events mostly led to more positive effect estimates,
607 whereas erroneously controlling for future life events led to less positive effect estimates. In

608 contrast to later childbirths, first childbirth was frequently preceded *and* succeeded by positively
609 valenced relationship events such as cohabitation and marriage (see Figures 4e,f & S8r,s).
610 Therefore, bias adjustment for first childbirth reduced the size of the effect estimates and
611 increased it again somewhat when only adjusting for preceding events but not for succeeding
612 ones (as we argue is the most appropriate control strategy).

613 *Life Events with no Substantial Patterns of Bias*

614 There were two events where bias was small and limited to either men or women: First, a
615 small amount of undercontrol bias through the experience of other events was evident in men's
616 reaction to first divorce (see Figure S6n). Second, effect estimates of child moved out were
617 overall very similar across models. Only women experiencing the second occurrence of a child
618 moving out differed in their estimates of post-event change depending on the control strategy (see
619 Figure S6y).

620 Even though first job and unemployment relatively frequently co-occurred with other life
621 events (see Figure S8t,v,w), differences between the individual event model based on the
622 combined event sample and the combined event models were small indicating no substantial bias
623 through other life events (see Figure S6t,v,w). For the remaining types of life events—retirement
624 and the deaths of a partner, child, father, or mother—we found neither substantial patterns of
625 event co-occurrence nor of undercontrol or overcontrol bias.

626 **Robustness Check**

627 Lastly, we also ran models for the combined event models that did not include the events
628 death of father, mother, and child, which allowed us to use a larger sample including more waves
629 of the SOEP (as these events were added to the questionnaire only in later waves). These events
630 did not show substantial undercontrol or overcontrol bias in the main analyses, which should
631 render their omission unproblematic. Results based on this larger sample largely supported our

632 conclusions and can be found in the Supplemental Materials (see Figures S9 & S10).

633 **Discussion**

634 We analyzed the effects of life events on life satisfaction in a large German panel data set.

635 In contrast to the vast majority of previous studies (cf. Kettlewell et al., 2020), we investigated

636 multiple events simultaneously and evaluated the degree to which effect estimates for each event

637 were biased by the influence of events that preceded, or by control for events that followed.

638 Across all life events, we found more evidence for the robustness of individual event models than

639 for substantial shifts in coefficients depending on the control strategy. However, for the

640 interrelated life events in the romantic relationship and family formation domain, whether or not

641 other events were considered did influence the magnitude of effects as well as their statistical

642 significance.

643 **Are Effect Estimates of Life Events on Life Satisfaction Biased by Other Life Events?**

644 The main goal of our study was to estimate life satisfaction change trajectories for each life

645 event, minimizing potentially confounding effects of other life events. We used three models with

646 different control strategies to investigate the interdependence of life events which often occur in

647 close succession over the life span (Bleidorn et al., 2018; Hutteman et al., 2014). This clustering

648 of events is especially prominent in the “demographically dense” (Manning, 2020, p. 799) period

649 of young adulthood (see also Bleidorn & Schwaba, 2017; Roberts & Davis, 2016). Recent

650 methodological pieces have emphasized the importance of selecting appropriate sets of control

651 variables, including the omission of inappropriate controls, such as collider variables (Rohrer,

652 2018; VanderWeele, 2019; Wysocki et al., 2022).

653 For many life events, we found little evidence of bias induced by other life events, adding

654 credence to previous studies that investigated within-person changes in well-being surrounding

655 events using individual event models (e.g., Clark & Georgellis, 2013; Denissen et al., 2019). We

656 found robustness across models for first job, retirement, unemployment, children moving out of
657 the household, and the deaths of partner, father, mother, and child. This is in line with Kettlewell
658 et al. (2020) who found highly similar effects for the events unemployment, retirement, and death
659 of partner in the individual event model and a combined event model with total control strategy.

660 Our systematic investigation of event interdependence corroborates that it is possible in
661 these cases to estimate effects that are unbiased by the occurrence of other events. Whereas the
662 deaths of father and mother did not, on average affect life satisfaction in our sample, we found
663 the largest overall changes for death of partner and death of child which were also the rarest
664 events (Asselmann & Specht, 2022; Moor & de Graaf, 2016; Reitz et al., 2022). These events
665 rarely co-occurred with other events.

666 For the much more frequent events first job and unemployment, it is less clear why no
667 interdependence with other events was found despite frequent co-occurrence. Other research has
668 shown severe declines in life satisfaction following unemployment that were in part moderated
669 by contextual factors such as re-employment expectations but also by having children (Lawes et
670 al., 2022b, 2022a; Lucas et al., 2004; Luhmann, Weiss, et al., 2014).

671 A different perspective emerged for events related to romantic relationships and
672 childbearing. Here, we found larger differences between individual and combined event models.
673 This was the case for new partner, separation, cohabitation, marriage, and childbirth. These types
674 of events are usually grouped non-randomly across the life span (i.e., clustered in early
675 adulthood; Hutteman et al., 2014) and causal relationships exist between them (see Bleidorn et
676 al., 2020). For example, both cohabitation and separation require finding a (new) partner
677 beforehand. Therefore, it makes sense that, for these events, we found more pronounced bias
678 through co-occurring events in predicting life satisfaction. The bias revealed by model
679 comparisons was relatively small in terms of the outcome (i.e., not larger than 13% of a *SD* in life

680 satisfaction) but sometimes quite substantial relative to the effects of interest (up to 68% of the
681 effect of the life event). While bias was not as large as to flip the direction of any effect in this
682 particular study, this could happen with other combinations of life events. Moreover, in multiple
683 cases the choice of model also affected the significance evaluation of effects. Thus, bias through
684 event interdependence can influence how research on the influence of life events on life
685 satisfaction is conducted and interpreted. This bias also affects the evaluation of popular theories
686 such as set-point theory regarding adaptation over time after experiencing a life event (Diener et
687 al., 2006; Luhmann & Intelisano, 2018). If, for example, the long-term effects of first childbirth
688 are biased downwards in models that control for future life events (see Figure 3e), this affects the
689 evaluation of set-point theory. Controlling for other life events regardless of when they occurred
690 could, thus, lead to a systematic underestimation of the long-term effects. These patterns of bias
691 also matter for “bad is stronger than good” regarding the stronger effects of negative compared to
692 positive events (Baumeister et al., 2001). A valid estimation of the effects of positive and
693 negative events is clearly a precondition for the evaluation of their relative impact.

694 Notably, patterns of bias varied between events. There was not, for example, a general
695 trend that adjusting for other events produced lower estimates or estimates closer to zero.
696 Following from that, we cannot assume that unadjusted, individual event models typically
697 provide an upper or lower bound for effects. Instead, we propose that the types of nonfocal events
698 that each combined event model typically controlled for and the nature of their effects on life
699 satisfaction determined the average direction of bias. Our analysis of the frequency of event co-
700 occurrence provided initial evidence for this. For example, for separation, we found evidence for
701 both undercontrol and overcontrol bias in a pattern consistent between the first and second
702 occurrence. Estimates right before and right after the event were biased upward by confounding
703 through previous life events (for the most part positive events such as the beginning of the

704 relationship or cohabitation). Longer-term effects, however, were biased downward when
705 adjusting for future life events (mostly finding a new partner) indicating overcontrol bias when
706 adopting a total control strategy. This is consistent with a recent analysis of effects of separation
707 on well-being that showed more positive post-event trajectories if re-partnering occurred within a
708 year (Brüning, 2022).

709 Taken together, these results emphasize the need to carefully consider the appropriate
710 control strategy (Rohrer, 2018; Wysocki et al., 2022) when estimating effects of clustered events
711 related to relationships and fertility. The examination of event co-occurrence revealed meaningful
712 clusters and sequences of interrelated life events that often transpire in a normative chain of life
713 events in certain developmental phases (Hutteman et al., 2014). This contrasts Kettlewell et al.
714 (2020) who speculated that event co-occurrence was simply uncommon (without actually
715 examining it). Thus, when attempting to estimate the causal effect of a single life event on well-
716 being we recommend controlling for other, preceding life events occurring in the previous two
717 years or earlier.

718 **How Does the Experience of Life Events Affect Life Satisfaction?**

719 Our study also provided substantive insights into the trajectories of life satisfaction around
720 important life events including more life events than previous studies and focusing on recent
721 decades in our main models (2007-2020). The life events we analyzed can be grouped into three
722 groups according to their effects on life satisfaction—positive, negative, and neutral or unclear.

723 ***Positive Events***

724 We found that the events new partner, cohabitation, marriage, and childbirth affected life
725 satisfaction positively (see Clark et al., 2008; Clark & Georgellis, 2013). Finding a new partner
726 was followed by post-event increases in life satisfaction (Kamp Dush & Amato, 2005; Soons et
727 al., 2009). For women compared to men, we found more significant positive effects beyond two

728 years at later occurrences.

729 Cohabitation was similarly followed by increases in life satisfaction (Blekesaune, 2018;
730 Kamp Dush & Amato, 2005; Soons & Kalmijn, 2009; cf. Perelli-Harris et al., 2019). These
731 positive effects were stronger and longer lasting for men for the first two occurrences.

732 First marriage had positive effects on life satisfaction starting in the year before the event
733 and persisting afterwards (Clark & Georgellis, 2013; Qari, 2014; cf. Perelli-Harris et al., 2019).
734 Effects for second marriage, however, were only positive for women in the year after the event
735 was reported.

736 Childbirth had a positive effect on life satisfaction in the year before and the year after the
737 event (Anusic et al., 2014a; Krämer & Rodgers, 2020). Effects were, however, more pronounced
738 for women, especially for first childbirth (cf. Nelson-Coffey et al., 2019). Effects of later births
739 were overall less pronounced (Kohler et al., 2005).

740 *Negative Events*

741 Conversely, separation, unemployment, death of partner, and death of child affected life
742 satisfaction negatively. In line with previous studies, we found a short-term negative effect of
743 separation on life satisfaction in the year after the event that was relatively similar for men and
744 women (Brüning, 2022; Rhoades et al., 2011; Soons et al., 2009). For first separation, there was
745 also evidence for a decrease in the second year after the event.

746 Unemployment was also followed by a decrease in life satisfaction (Clark & Georgellis,
747 2013; Lawes et al., 2022b; Luhmann, Weiss, et al., 2014). After one (men) or two years (women),
748 adaptation set in, possibly due to reemployment (cf. Lucas et al., 2004). As described in the
749 Supplemental Material (Section B), we found evidence for period effects (Bell & Jones, 2015).
750 Models based on all years from 1984 onwards indicated more severe effects than our final models
751 based on more recent data collected during times of low unemployment rates in Germany.

752 The deaths of partner or child both indicated very large decreases in life satisfaction in the
753 year after the event (Anusic et al., 2014b; Asselmann & Specht, 2022; Moor & de Graaf, 2016;
754 Reitz et al., 2022). Women also already experienced a smaller decrease in the year before partner
755 bereavement. Adaptation occurred within a year after the death of a partner was first reported
756 (Asselmann & Specht, 2022).

757 *Neutral or Unclear Events*

758 For the remaining events, divorce, first job, retirement, child moved out, death of father,
759 and death of mother, no consistent effects were found. In contrast to previous research on divorce
760 (Clark & Georgellis, 2013; Denissen et al., 2019; van Scheppingen & Leopold, 2020), we found
761 minimal effects, that is, only a small long-term increase in women's life satisfaction. Two facts
762 might explain this: first, unlike other studies we analyzed divorce as a distinct event from
763 separation. Second, our model based on all available survey years showed the previously found
764 negative anticipation effect of divorce, too (see Supplemental Material, Section A). Possibly, the
765 normative meaning of divorce for evaluating one's life has diminished in recent decades.

766 *Repeated Life Events*

767 Similar to Luhmann and Eid (2009), our results also demonstrate that the average effects of
768 life events can differ depending on how often people experience them over the life span. Going
769 beyond previous research, we included additional waves of data with more types of life events,
770 incorporated retrospective biographical information where possible (see Table 1), and controlled
771 for the occurrence of other events. Again, findings differ across event types: for childbirth, we
772 see evidence for attenuated effects of later occurrences (especially in the full sample, see Figure
773 S3p,q,r,s), whereas this was generally not the case for partnership, separation, and cohabitation.
774 For other, luckily quite rare events such as bereavement or divorce we can currently not make
775 reliable comparisons between repeated occurrences due to low precision at later occurrences.

776 Limitations

777 Our study used nationally representative panel data and employed fixed effects models
778 (McNeish & Kelley, 2019) to exclusively analyze within-person variation addressing threats to
779 both external and internal validity. Still, several limitations applied that future research might
780 address.

781 First, the list of life events we analyzed is not set in stone. Our selection was based on both
782 theoretical deliberations (i.e., discrete status-changing transitions) and availability in the data
783 source. Other important life events that were not available in the SOEP might also matter for
784 event interdependence. One example of a life event that is difficult to trace with panel data
785 because of higher drop-out rates is residential mobility. Still, in the domain of romantic
786 relationships and fertility where we found evidence for bias through other life events, the
787 selection is more or less complete and also goes beyond previous research by clearly
788 distinguishing repeated event occurrence based on biographical information.

789 Second, to interpret the effects of life events on life satisfaction as causal effects, we need
790 to assume that, beyond the included life events, no other time-varying confounds exist. For
791 example, if being promoted at work increases both the likelihood of entering a new relationship
792 and life satisfaction, this could bias the estimated trajectories for the life event new partner. At
793 the same time, fixed effects models allowed us to rule out the confounding influence of time-
794 invariant background characteristics (similar to a propensity score matching design but also with
795 regard to unmeasured confounding; McNeish & Kelley, 2019), and to focus on within-person
796 variance (similar to a person-mean centered variable in multilevel modeling; Hamaker & Muthén,
797 2020). We also controlled for aging (Luhmann, Orth, et al., 2014) and initial elevation bias
798 (Shrout et al., 2018). The problem of time-varying confounding is not unique to our study but
799 affects the literature on life events in general, at least within psychology. In contrast, studies from

800 economics frequently leverage so-called exogeneous variability to potentially achieve higher
801 internal validity (Grosz et al., 2023). For example, policy reforms may introduce variability into
802 retirement age which can in turn be used to identify the effects of retirement on well-being. Such
803 approaches come with their own assumptions, require sources of exogenous variation for each
804 life event to be investigated, and usually target narrower causal effects—thus, they do not
805 necessarily replace the within-person approach favored in psychological well-being research, but
806 they could be a valuable complement in future studies.

807 Third, we examined average trajectories of change, but the effects of life events of course
808 vary between individuals—for example, not every new relationship increases life satisfaction
809 equally. Other studies investigate such interindividual differences in change (Doré & Bolger,
810 2018), such as differences correlated with subjective event perception (Luhmann, Fassbender, et
811 al., 2021). The subjective perception of major life events in terms of dimensions such as
812 emotional significance or extraordinariness (Luhmann, Fassbender, et al., 2021), as well as
813 changes therein (Haehner et al., 2023), have been shown to relate to variation in well-being
814 during the experience of life events independent of other established covariates (e.g.,
815 personality). Such follow-up questions raise their own interesting inferential concerns (Rohrer &
816 Arslan, 2021)—for example, a correlation between a third variable and differences in effects does
817 not imply that the third variable causes those differences; scaling issues can introduce spurious
818 effect heterogeneity, and life satisfaction scales tend to be skewed—which should be tackled in
819 future studies.

820 Fourth, our findings only directly apply to the cultural and socio-economic context of
821 Germany. Previous studies have found that there is cultural variation in the normative timing of
822 life events related to personality maturation in young adulthood (Bleidorn et al., 2013). Still, we
823 believe that the phenomenon of interdependent, co-occurring life events is relevant in all cultures

824 with sequences of life events that occur clustered in the developmental phases of emerging and
825 young adulthood. Thus, patterns of confounding (and the risk of introducing overcontrol bias)
826 should be equally relevant.

827 Lastly, we relied on relatively normative life course narratives to interpret bias in the
828 context of common sequences of life events. But some supposedly less normative sequences
829 (e.g., marriage after childbirth, see Figure 2e,f) were just as common in the data, and the
830 estimated models considered event overlap regardless of normativeness. How much the societal
831 and subjectively perceived normativeness of individual event sequences matters for well-being
832 should be investigated in future research (e.g., extraordinariness vs. ordinariness dimension of the
833 Event Characteristics Questionnaire; Luhmann, Fassbender, et al., 2021). Paying more attention
834 to specific sequences may also help overcome some of the “artificiality” of our approach of
835 isolating the effects of individual life events. For example, for an individual, the effects of
836 childbirth may appear inseparable from the effects of a previous marriage. Considering sequences
837 of events as treatment packages may allow to detect such effects, even if it poses its own
838 inferential challenges.

839 **Conclusion**

840 We set out to comprehensively examine the effects of life events on life satisfaction while
841 considering the potentially confounding influence of other preceding or succeeding life events.
842 We did not find overwhelming evidence for such confounding in individual event models which
843 is good news for the field of well-being research. Still, for life events in the domains of romantic
844 relationships and fertility that are clustered and likely to follow a normative sequence, our model
845 comparisons revealed meaningful patterns of bias shaped by event co-occurrence. Therefore, we
846 believe that it is worth the effort for researchers interested in estimating effects of these life

847 events on well-being to carefully consider their control strategy and pay attention to confounding
848 bias through preceding nonfocal events.

849

Open Science Statement

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The study materials and analysis scripts used for this article can be accessed at

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<https://osf.io/qdtb5/> and the preregistration at <https://osf.io/kajrd>. Data access is given to

852

researchers at <https://www.diw.de/en/soep>.

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