DEMOGRAPHIC RESEARCH
A peer-reviewed, open-access journal of population sciences

*DEMOGRAPHIC RESEARCH*

**VOLUME 44, ARTICLE 47, PAGES 1133–1148**
**PUBLISHED 9 JUNE 2021**
https://www.demographic-research.org/Volumes/Vol44/47/
DOI: 10.4054/DemRes.2021.44.47

*Descriptive Finding*

# Period measures of life course complexity

**Michaël Boissonneault**

*© 2021 Michaël Boissonneault.*

*This open-access work is published under the terms of the Creative Commons Attribution 3.0 Germany (CC BY 3.0 DE), which permits use, reproduction, and distribution in any medium, provided the original author(s) and source are given credit.*
*See https://creativecommons.org/licenses/by/3.0/de/legalcode.*

# Contents

*Demographic Research*: Volume 44, Article 47
*Descriptive Finding*

# Period measures of life course complexity

**Michaël Boissonneault**[1]

## Abstract

**BACKGROUND**
Life course complexity has so far been analyzed from a cohort perspective, but period measures could allow the holistic analysis of the impact of temporary circumstances on it.

**OBJECTIVE**
We measure life course complexity from a period perspective and decompose the results according to age and transition type.

**METHODS**
Complexity is measured as the number of distinct states visited (NDS) and the average number of visits to each visited state (ANV). Measures are based on sequences taken from different cohorts from a similar age onward, until a common period of interest. Period complexity is the sum of the cohort-specific differences in complexity reached at the beginning and at the end of the period of interest, summed through years of age.

**RESULTS**
Analyzing life courses of Dutch women born 1977–2000, we find decreases in NDS and increases in ANV from both perspectives. Changes are explained by a decrease in transitions to being married and an increase in returns to the parental home and living alone.

**CONCLUSIONS**
A woman who would experience the complexity of the years 2017–2018 throughout her life course would visit fewer distinct states and return more often to the same states than any average woman born between 1977–1978 and 1987–1988 actually did. This means that life courses might continue to become less linear in the future and that some of the parts that constitute them might continue to become more often omitted.

**CONTRIBUTION**
Our approach allows us to analyze holistically the influence of temporary circumstances on life course complexity, which might prove useful in assessing the impact of the ongoing COVID-19 pandemic on the transition to adulthood.

[1] Nederlands Interdisciplinair Demografisch Instituut (NIDI), the Netherlands. Email: boissonneault@nidi.nl.

## 1. Introduction

Life course complexity refers to the degree of predictability of individual biographies. People who experience a greater number of life events and who experience the same events several times are said to have more complex life courses (Elzinga and Liefbroer 2007). Events correspond to transitions between household and marital statuses – such as living alone, cohabiting, and marrying – or between economic statuses – such as studying, working, and being unemployed (Abbott 1995). Life course complexity is usually measured among young adults as they typically experience more change than people at other stages of their lives (Rindfuss 1991). More complex life courses have been associated to childlessness, poorer health, and lower levels of well-being (Barban 2013; Jalovaara and Fasang 2017; Saarela and Skirbekk 2020).

The concept of life course complexity is part of sequence analysis, a framework that allows to analyze biographies holistically (Aisenbrey and Fasang 2010; Cornwell 2015). So far, research has concentrated on how life course complexity varies between cohorts and countries. For example, using retrospective survey data, studies find evidence for increases in complexity among younger cohorts coupled with important differences between countries (Elzinga and Liefbroer 2007; Hofäcker and Chaloupková 2014; Van Winkle 2018).

More recent research was interested in methodological aspects inherent to the different measures of life course complexity (Pelletier, Bignami-Van Assche, and Simard-Gendron 2020). One question that did not receive attention, however, is how to measure the impact of temporary circumstances on life course complexity. Temporary circumstances such as economic downturns can have a significant impact on the timing of life course transitions (Brückner and Mayer 2005). Research has measured this impact by concentrating on one event at the time, such as giving birth (Sobotka, Skirbekk, and Philipov 2011) or leaving the parental home (Aassve, Cottini, and Vitali 2013). Alternatively, measures could be developed that summarize the impact on multiple events, thereby retaining the holistic nature of sequence analysis. The goal of this paper is to present a method to estimate life course complexity from a period approach.

The method consists in supposing that people experience the complexity of the moment at different years of age. The resulting measures possess three advantages. First, they highlight the impact of temporary social and economic conditions that influence the timing of transitions. This impact is not easily identifiable using cohort measures because it is diffused through the different years over which life courses develop. Second, period measures can be computed for a period of interest across cohorts that have reached different years of age, whereas cohort measures can be computed only among cohorts that have reached some upper age boundary. This implies that period measures can be used to document more recent changes in life course complexity. Third, as shown below, considering life course complexity from a period perspective implies dissecting life courses into their subparts (Piccarreta and Studer 2019). This allows us to present two decomposition methods – one by age and one by state – that further help improve our understanding of what causes life courses to become more or less complex over time.

## 2. Background

Different measures have been used to quantify life course complexity. We succinctly present the most common ones and refer to Pelletier, Bignami-Van Assche, and Simard-Gendron (2020) for a more thorough description.

A first measure is Shannon entropy, initially developed in information theory (Shannon 1948). Its value depends on both the number of distinct states visited and the variation in the amount of time spent in each state. Entropy will be at its highest when each state is visited for the same amount of time. However, entropy does not take into account the number of visits to the same states, meaning that a sequence where each state is visited twice may have the same level of complexity as a sequence where each state is visited once. Elzinga and Liefbroer's measure of turbulence is defined in terms of the number of subsequences that can be extracted from an ordered sequence of states and the variance inherent to the time spent in each state (Elzinga 2006; Elzinga and Liefbroer 2007). Finally, Gabadinho et al.'s complexity index functions in a similar way as entropy, except that it additionally considers the number of visits to the same states (Gabadinho et al. 2011, 2010).

Each of the three measures described above are influenced by variation in the time spent in different states. This variation can be influenced by truncation (i.e., the ages at which sequences start and stop). As explained below, our approach consists in dissecting sequences into their subparts. Applying this procedure to the measures described above would distort the result. Hence, we favor measures that do not take time into account. This is still a valid approach since there is not an obvious way to determine whether complexity increases as sojourns become more dissimilar in length. On the one hand, sequences with more dissimilar lengths could be viewed as more complex because it is more difficult to predict how long a person will stay in each state. On the other hand, if people spend equal amounts of time in each state, it becomes harder to predict in which state a person will find themselves at a given point.

Pelletier, Bignami-Van Assche, and Simard-Gendron (2020) propose three measures that do not take time into account: the number of distinct states visited (NDS), the number of transitions (NT), and the average number of visits to visited states (ANV). The authors advocate for the joint use of NDS and ANV whenever possible, and for the use of NT if a single measure is needed or if transitions back to previously visited states are not possible (Ibid: 22). However, the use of all three would be redundant since as shown below, ANV is a direct function of NDS and NT. Since transitions back to previously visited states play an important role in our analysis, we opt for the joint use of NDS and ANV.

## 3. Approach

Existing measures are obtained by quantifying the complexity associated to a sequence of events that takes place among cohorts between two years of age, meaning that each younger cohort's sequence of events takes place later in time. To obtain period measures, we consider the sequences of events that take place among cohorts from a given age until the end of a period of interest, meaning that each younger cohort's sequence of events is shorter since it stops at a younger age. Period measures of complexity are based on the difference in complexity reached at the beginning of the period of interest and at the end of it. Values reflect the sum across different years of age of the additional complexity experienced during our period of interest.

Formally, let us first define NDS and ANV, the two measures of complexity used in our analyses. Let $x$ be the sequence of states visited by individual $i$ during a given period of time. Each sequence $x$ is composed of a $j$ number of sojourns $s$ in

$$x = \{s_1, s_2, \ldots, s_j\} \qquad (1),$$

where distinct sojourns correspond to different subsequent states in the time-ordered sequence of states. *NDS* is the number of distinct states visited and ranges from 1 to the size of the state space. *ANV* is the average number of visits to each visited state and is equal to $j$ divided by *NDS*:

$$ANV(x) = \frac{j}{NDS(x)} \qquad (2).$$

Estimating the period counterparts, we consider a period of time $P$ that can be divided into $n$ subunits of time (e.g., years) denoted as $p_1, p_2, \ldots, p_n$. Further, we consider ages $a$ and $a + P$, the lower and upper ages of interest (e.g., 18 and 30 years old), and calendar times $t$ and $t + P$, the first and last day of the period of time $P$. We consider individuals $i$ who reach age $a$ between $t$ and $t + P$ (i.e., born between calendar times $t - a$ and $t - a + P$). We further consider these individuals' sequences of events $x$ that take place between time $t_1, t_2, \ldots, t_n$ and time $t + P$, where $t_n$ represents the first day of the subunit of time $p_n$, in which a person reaches age $a$. We calculate ${}_{t+P}NDS_t$ and

${}_{t+P}ANV_t$ , the complexity associated to sequence *x* between time $t_n$ and time $t+P$, and ${}_{t+P-1}NDS_t$ and ${}_{t+P-1}ANV_t$ , the complexity associated to sequence *x* between time $t_n$ and time $t + P – 1$, where $t + P – 1$ represents the date that comes exactly one subunit of time before $t + P$. This allows us to calculate the additional amount of complexity specific to our period of interest *S* that corresponds to the subunit of time containing the range $t + P – 1$ to $t + P$:

$$ANDS_S = {}_{t+P}NDS_t - {}_{t+P-1}NDS_t \quad (3)$$

and

$$AANV_S = {}_{t+P}ANV_t - {}_{t+P-1}ANV_t \quad (4),$$

where *ANDS* stands for additional number of distinct states visited and *AANV* stands for additional average number of visits to visited states.

Note that each individual who reaches the lower age limit *a* during a given subunit of time $p_n$ will reach age $a + P – p_n$ between the subunits of time $t + P – 1$ and $t + P$ or, alternatively, age $a_n$. Our period measures of complexity represent the additional complexity specific to the period *S* summed across the years of age $a_1$, $a_2$, …, $a_n$ included between ages *a* and $a + P$:

$$PNDS_S = \sum_1^a ANDS_S^a \quad (5)$$

and

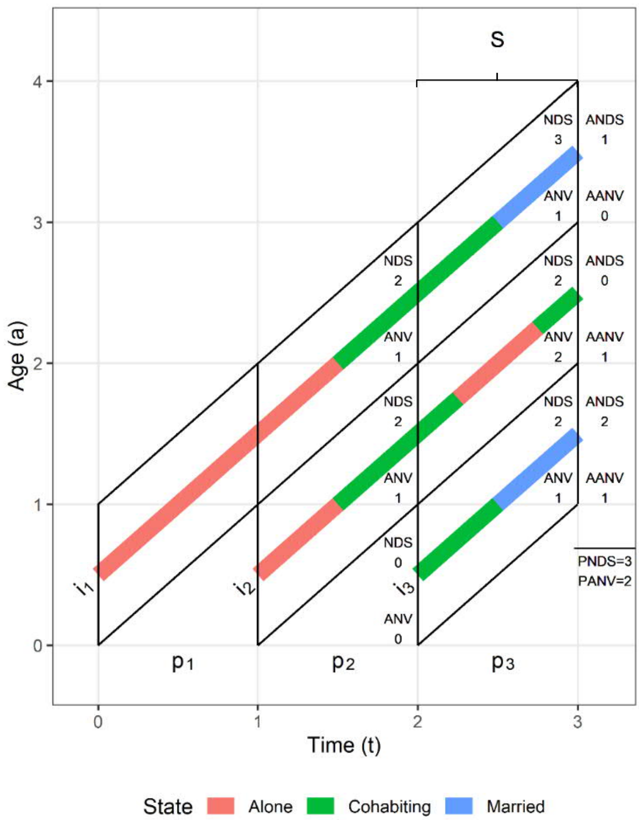
$$PANV_S = \sum_1^a AANV_S^a \quad (6),$$

where *PNDS* stands for period number of distinct states visited and *PANV* for period average number of visits to visited states.

The same measures can be estimated for any cohort *c* born between $t – a$ and $t – a + 1$, in which case *NDS* and *ANV* will be based on individual *i*'s sequence of events *x* that takes place between time *t* and $t + P$ (and thus between ages *a* and $a + P$). Results presented below represent the values of *(P)NDS* and *(P)ANV* averaged among all individuals *i* under observation during period *S* (period estimates) and among all individuals *i* who belong to cohort *c* (cohort estimates).

The approach is illustrated in Figure 1. We consider period *P*, which is composed of three subunits of time $p_1$, $p_2$, and $p_3$. The period of interest *S* covers the time span included between $t_2$ and $t_3$. Individuals are followed from the first day $t_n$ of the subunit of time $p_n$ in which they reach age *a* (= $a_0$) until time $t_3$. We consider for simplicity three states (single, cohabiting, and married) and three individuals $i_1$, $i_2$, and $i_3$ who enter observation at time $t_0$, $t_1$, and $t_2$, respectively.

**Figure 1: Illustration of calculations of period life course complexity at the hand of three hypothetical observations**




*Note*: Lines refer to individual biographies and colors to different states (see legend). Calculations for *NDS* and *ANV* are shown for the period included between $t_0$ and $t_3$ and $t_0$ and $t_2$, above and under each corresponding biography, respectively. The difference between $NDS_3$ and $NDS_2$ and between $ANV_3$ and $ANV_2$ (the additional amount of complexity attributable to the period of interest *S*, or $ANDS_S$ and $AANV_S$) is shown at the end of each corresponding biography, on the right hand side of the graph. The resulting values for period measures of complexity ($PNDS_s$ and $PANV_s$) are shown in the lower right part of the graph.
*Source*: Own elaboration.

We see that individual $i_1$ visits three distinct states between $t_0$ and $t_3$; her value of *NDS* thus equals 3 for this period. This is one more *NDS* unit than between $t_0$ and $t_2$; her value of *ANDS* – the additional number of distinct states visited during period *S* – thus equals 1. This individual's *ANV* value meanwhile equals 1 both between $t_0$ and $t_3$ and between $t_0$ and $t_2$. Hence, this individual's *AANV* value – the additional number of visits to visited states during period *S* – equals 0. The same exercise is repeated with individuals

$i_2$ and $i_3$. Their respective $ANDS_S$ values equal 0 and 1 and their respective $AANV_S$ values equal 2 and 1. Summing up the values of $ANDS$ and $AANV$ relative to period $S$ across ages $a_1$, $a_2$, and $a_3$, we obtain $PNDS_S = 3$ and $PANV_S = 2$.

## 4. Data

The method is applied to data from Statistics Netherlands' System of Social Statistical Datasets (SSD). The SSD is a harmonized set of microdata based on different Dutch population registers and surveys and was described in detail by Bakker, Van Rooijen, and Van Toor (2014). Information about each respondent's date of birth, change in household status over time, first child's date of birth, and change in marital status over time was provided in separate files and merged based on personal identifying numbers.

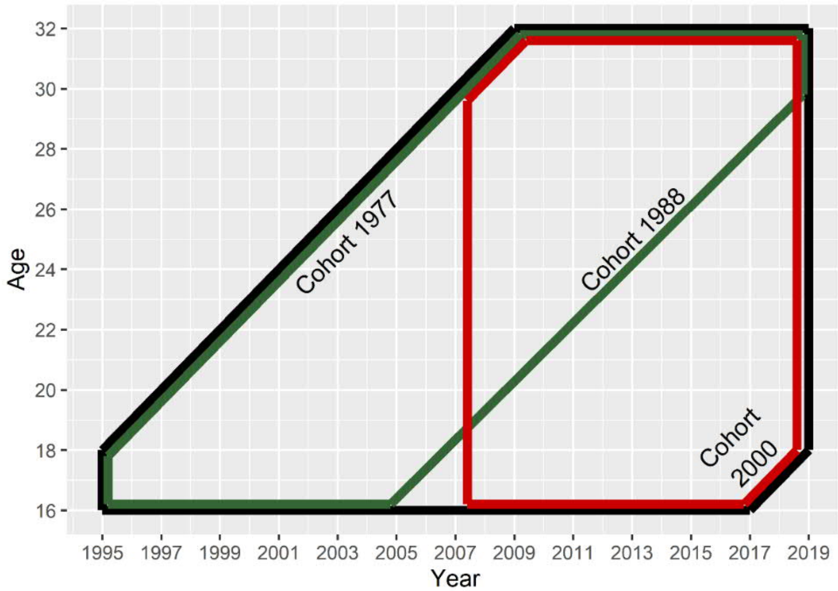
## 5. Analytical framework

We selected for our analyses 2,053,154 women born between 1977 and 2000 who uninterruptedly resided in the Netherlands between 1 January 1995 and 31 December 2018 (the period covered by the data). Time units of two years are considered. Results are presented for each two-year period consisting of the ranges 2007–2008, 2009–2010, …, 2017–2018 and for each cohort spanning the birth years 1977–1978, 1979–1980, …, 1987–1988 (Figure 2).

Period measures are obtained by considering sequences that stretch from the period in which a cohort reaches age 18 and the different periods of interest. Results cover the age span 18 to 30. Considering a younger upper age boundary would allow us to examine trends over longer periods of time and across more cohorts, while considering an older one would shrink the time period and the number of cohorts. Additionally, considering different upper age boundaries may lead to different trends in the indicators used if life events are being postponed or anticipated over time (Pelletier, Bignami-Van Assche, and Simard-Gendron 2020). Considering this, the supplementary materials present results using different upper age boundaries and shows that in our case this has little effect on the trends. It also presents results for ANDS and AANV for each combination of period and cohort found in the data, allowing results to be computed for any identity in the Lexis surface.

We consider in our analyses seven states: (1) living at the parental home, (2) living alone, (3) unmarried cohabitation, (4) married, (5) living alone with at least one child, (6) unmarried cohabitation with at least one child, and (7) married and living with at least one child. Transitions are assumed to occur on the first day of each month and a maximum of one state is assumed for each month.

**Figure 2: Lexis representation of the ages, periods, and cohorts considered in the analyses**




*Note*: Results are presented for two-year cohorts born between 1977 and 1988 (green parallelogram) and for two-year periods consisting of 2007 and 2018 (red parallelogram). Calculations for periods are based on cohorts born between 1977 and 2000 (black parallelogram), where each cohort is followed from age 18 until the end of the periods of interest 2007–2008, 2009–2010, …, 2017–2018. (See supplementary materials for a more precise depiction of the combinations of cohort and periods considered and the corresponding ANDS and AANV values.)
*Source*: Own elaboration.

Decompositions by age and transition type are provided for both NDS and ANV. These allow us to unravel how complexity changed between cohorts 1977–1978 and 1987–1988 and between periods 2007–2008 and 2017–2018. For the age decomposition, we use either the values of $ANDS_S$ and $AANV_S$ pertaining to a single cohort but different calendar years (e.g., $ANDS_{1995-1996}^{1977-1978}$, $ANDS_{1997-1998}^{1977-1978}$, …, $ANDS_{2007-2008}^{1977-1978}$) when assessing differences between cohorts or the values pertaining to a single period but different cohorts (e.g., $ANDS_{2007-2008}^{1977-1978}$, $ANDS_{2007-2008}^{1979-1980}$, …, $ANDS_{2007-2008}^{1981-1982}$) for the decomposition between periods.

For the decomposition by transition type, we calculated the proportion of the values of NDS and ANV that is attributable to each of the seven states constituting our state space. For NDS, this is the proportion of people who ever visits a given state in the state space. For ANV, this is the proportion attributable to a given state of the sum of the mean numbers of times that each state in the state space is visited (provided that it was visited at least once), multiplied by ANV.

We identify two events that may have had an impact on period measures of complexity. The first one is the increase in unemployment rates among people ages 15 to 25 in the context of the Great Recession. Unemployment rates in the Netherlands increased during most of the 2008–2013 period, with a temporary recovery in 2010 and early 2011 (Statistics Netherlands 2021). The other event is the introduction of the so-called social loan system by the Dutch government from 2014 onward, which abolished subsidies to students who live outside the parental home (Statistics Netherlands 2019).

## 6. Results

Table 1 shows the complexity reached among cohorts 1977–1978 through 1987–1988 and periods 2007–2008 through 2017–2018. For both the cohort and period perspectives, NDS generally decreases while ANV increases. Change is more pronounced when considered from the period perspective concerning NDS but somewhat less concerning ANV. The level of NDS reached among period 2017–2018 is the lowest among all periods and cohorts, while the level of ANV reached during the same years is the highest among all periods and cohorts.

**Table 1: Number of distinct states visited (NDS) and average number of visits to visited states (ANV) among cohorts 1977–1978 through 1987–1988 and periods 2007–2008 through 2017–2018**

| Cohort | NDS | ANV | Period | NDS | ANV |
|---|---|---|---|---|---|
| 1977–1978 | 3.60 | 1.26 | 2007–2008 | 3.56 | 1.33 |
| 1979–1980 | 3.58 | 1.27 | 2009–2010 | 3.55 | 1.36 |
| 1981–1982 | 3.54 | 1.29 | 2011–2012 | 3.37 | 1.41 |
| 1983–1984 | 3.49 | 1.32 | 2013–2014 | 3.28 | 1.47 |
| 1985–1986 | 3.41 | 1.38 | 2015–2016 | 3.14 | 1.53 |
| 1987–1988 | 3.28 | 1.47 | 2017–2018 | 2.97 | 1.54 |

Table 2 decomposes the change in NDS and ANV between cohorts 1977–1978 and 1987–1988 and periods 2007–2008 and 2017–2018 according to two-year age groups included between ages 18 and 30. Note that every individual enters observation with values of NDS and ANV of 1 (everybody visits at least one state), explaining the higher values at age 18. Decreases in NDS between cohorts 1977–1978 and 1987–1988 are mostly attributable to ages 22 to 28, while change at age 18 contributed to higher levels. Increases in ANV are mostly attributable to ages 22 to 28. When we compare periods, decreases in NDS are roughly equally attributable to all ages except age 30, where change was negligible. Most increases in ANV are attributable to ages 24 to 28.

**Table 2: Age decomposition of change in NDS and ANV between cohorts 1977–1978 and 1987–1988 and periods 2007–2008 and 2017–2018**

| | Cohort | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | NDS | | | | ANV | | | |
| Age | 1977–1978 | 1987–1988 | Difference | Percent | 1977–1978 | 1987–1988 | Difference | Percent |
| 18 | 1.04 | 1.05 | 0.01 | –2.9 | 1.01 | 1.00 | 0.00 | –0.5 |
| 20 | 0.31 | 0.35 | 0.04 | –12.0 | 0.07 | 0.07 | 0.01 | 3.3 |
| 22 | 0.49 | 0.43 | –0.06 | 17.5 | 0.08 | 0.12 | 0.04 | 17.1 |
| 24 | 0.50 | 0.42 | –0.08 | 25.9 | 0.06 | 0.11 | 0.05 | 21.8 |
| 26 | 0.48 | 0.39 | –0.09 | 27.8 | 0.03 | 0.08 | 0.05 | 23.0 |
| 28 | 0.44 | 0.35 | –0.08 | 26.4 | 0.01 | 0.05 | 0.04 | 20.7 |
| 30 | 0.33 | 0.28 | –0.06 | 17.3 | 0.00 | 0.03 | 0.03 | 14.6 |
| Total | 3.60 | 3.28 | –0.32 | 100.0 | 1.26 | 1.47 | 0.21 | 100.0 |
| | Period | | | | | | | |
| | NDS | | | | ANV | | | |
| Age | 2007–2008 | 2017–2018 | Difference | Percent | 2007–2008 | 2017–2018 | Difference | Percent |
| 18 | 1.06 | 1.04 | –0.03 | 4.3 | 1.01 | 1.00 | 0.00 | –0.5 |
| 20 | 0.35 | 0.26 | –0.09 | 15.8 | 0.07 | 0.07 | 0.00 | –1.5 |
| 22 | 0.45 | 0.34 | –0.11 | 19.2 | 0.11 | 0.14 | 0.03 | 13.6 |
| 24 | 0.49 | 0.37 | –0.11 | 19.0 | 0.08 | 0.13 | 0.05 | 25.1 |
| 26 | 0.45 | 0.37 | –0.09 | 14.7 | 0.04 | 0.10 | 0.05 | 25.1 |
| 28 | 0.43 | 0.33 | –0.11 | 17.7 | 0.02 | 0.07 | 0.05 | 24.2 |
| 30 | 0.33 | 0.28 | –0.06 | 9.3 | 0.00 | 0.03 | 0.03 | 14.0 |
| Total | 3.56 | 2.97 | –0.59 | 100.0 | 1.33 | 1.54 | 0.22 | 100.0 |

*Note*: Age is the average age of the observations in parallelograms defined by period and cohort. Values are higher at age 18 because subjects enter observation with values of NDS and ANV of 1.

Table 3 decomposes change in NDS and ANV between cohorts 1977–1978 and 1987–1988 and periods 2007–2008 and 2017–2018 by transition type. The decrease in NDS is principally attributable to a decrease in marriages, which had the effect of decreasing the proportions of people visiting both state (4) married and state (7) married and living with at least one child. This behavior explains the decrease in NDS from both the cohort and the period perspective. We further note the relatively strong increase in the proportion of people who ever visits state (2) living alone noticeable from the cohort perspective, while the same proportion slightly decreased from the period perspective. Meanwhile, most of the increase in ANV is attributable to increases in returns to the states (1) parental home, (2) living alone, and (3) unmarried cohabitation. This is true when considering both the cohort and period perspectives, although the effect of returns to the parental home is stronger from the period perspective. People born in 1988-1989 tended to return slightly less often to the states (4) married and (7) married and living with children than people born in 1977–1978. Likewise, our period measure captures fewer returns to these same states in 2017–2018 compared to 2007–2088.

**Table 3: Decomposition of change in NDS and ANV between cohorts 1977–1978 and 1987–1988 and periods 2007–2008 and 2017–2018 according to different specifications of the state space**

| | Cohort | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | NDS | | | | ANV | | | |
| States | 1977–1978 | 1987–1988 | Difference | Percent | 1977–1978 | 1987–1988 | Difference | Percent |
| Parental home | 0.95 | 0.96 | 0.01 | –3.1 | 0.37 | 0.47 | 0.11 | 51.7 |
| Living alone | 0.54 | 0.68 | 0.14 | –43.5 | 0.22 | 0.35 | 0.13 | 62.6 |
| Unmarried cohabitation | 0.71 | 0.74 | 0.03 | –8.1 | 0.25 | 0.33 | 0.08 | 37.6 |
| Married | 0.54 | 0.27 | –0.27 | 85.6 | 0.16 | 0.09 | –0.07 | –35.3 |
| Alone, with child | 0.09 | 0.12 | 0.03 | –9.2 | 0.03 | 0.05 | 0.02 | 8.7 |
| Unmarried cohabitation, with child | 0.21 | 0.26 | 0.05 | –15.9 | 0.06 | 0.09 | 0.03 | 14.6 |
| Married, with child | 0.55 | 0.25 | –0.30 | 94.2 | 0.16 | 0.08 | –0.08 | –40.0 |
| Total | 3.60 | 3.28 | –0.32 | 100.0 | 1.26 | 1.47 | 0.21 | 100.0 |
| | Period | | | | | | | |
| | NDS | | | | ANV | | | |
| States | 2007–2008 | 2017–2018 | Difference | Percent | 2007–2008 | 2017–2018 | Difference | Percent |
| Parental home | 0.95 | 0.97 | 0.02 | –2.9 | 0.40 | 0.61 | 0.21 | 97.4 |
| Living alone | 0.65 | 0.64 | –0.01 | 2.5 | 0.29 | 0.36 | 0.07 | 32.3 |
| Unmarried cohabitation | 0.70 | 0.67 | –0.03 | 5.4 | 0.25 | 0.32 | 0.07 | 33.0 |
| Married | 0.42 | 0.19 | –0.23 | 38.4 | 0.12 | 0.07 | –0.06 | –26.5 |
| Alone, with child | 0.10 | 0.09 | –0.01 | 1.5 | 0.04 | 0.04 | 0.00 | 0.7 |
| Unmarried cohabitation, with child | 0.25 | 0.21 | –0.04 | 5.9 | 0.08 | 0.08 | 0.00 | –0.5 |
| Married, with child | 0.48 | 0.19 | –0.29 | 49.2 | 0.14 | 0.06 | –0.08 | –36.4 |
| Total | 3.56 | 2.97 | –0.59 | 100.0 | 1.33 | 1.54 | 0.22 | 100.0 |

*Note*: Values are higher concerning the first specification (including living at the parental home and living alone) because subjects enter observation with values of NDS and ANV of 1.

## 7. Discussion

Our period analysis of life course complexity revealed change in individual biographies that cohort measures do not capture. A woman who would experience the complexity of the years 2017–2018 throughout her life course would visit fewer distinct states and return more often to the same states than any average woman born between 1977–1978 and 1987–1988 actually did. During the last few years, women of all ages have increasingly renounced to transitions to states including marriage and having children and have increasingly returned to the states living at the parental home, living alone, and unmarried cohabitation. In this period marked by the economic recession and cuts in the financial assistance provided to students (Statistics Netherlands 2019, 2021), one interpretation is that in less certain economic times, younger people prefer avoiding visiting new states and instead return more often to already visited states.

Although these changes were to some extent already documented in the case of the Netherlands (Statistics Netherlands 2019; Studer, Liefbroer, and Mooyaart 2018), our period approach allows us to summarize them into two convenient indicators of life course complexity. They show that for a given period of time, people within a given age range may have been visiting a more or less wide variety of new states than in previous periods and may have been visiting previously visited states to varying degrees. For example, women in 2017–2018 visited 0.59 fewer new states than in 2007–2008, while they returned to the same states 0.22 times more often. Considering the fact that NDS and ANV have minimum values of 1, these represent increases of 23% and 65%, respectively. This suggests that future life courses might continue to become less linear because younger people increasingly return to already visited states, and some of the parts constituting them might continue to be more often omitted because younger people marry less and are more often childless. However, this could change if the partially observed life courses of the younger cohorts significantly change at older ages in comparison to those of their older counterparts.

The method was applied here to data covering a relatively short time span. By applying it to retrospective survey data, longer periods could be covered, possibly revealing starker contrasts over time. On the other hand, the method could – where available – be applied to new prospective administrative data, unraveling the impact of the ongoing COVID-19 pandemic on life course complexity.

## 8. Replicability

The replicable material accompanying the publication contains the R code that allows to replicate the method described here.

## 9. Acknowledgments

This work was funded by the Netherlands Academy of Arts and Sciences (KNAW) under the project titled “The Life Course of the Young in the 21st Century: Risks for Increasing Inequality?” The author would like to thank Joop de Beer, Ingeborg Deerenberg, Erik Fokke, and Saskia te Riele for assistance with accessing the data.

## References


Aassve, A., Cottini, E., and Vitali, A. (2013). Youth prospects in a time of economic recession. *Demographic Research* 29(36): 949–962. doi:10.4054/DemRes.2013.29.36.

Abbott, A. (1995). Sequence analysis: New methods for old ideas. *Annual Review of Sociology* 21(1): 93–113. doi:10.1146/annurev.so.21.080195.000521.

Aisenbrey, S. and Fasang, A.E. (2010). New life for old ideas: The ‘second wave’ of sequence analysis bringing the ‘course’ back into the life course. *Sociological Methods and Research* 38(3): 420–462. doi:10.1177/0049124109357532.

Bakker, B.F., Van Rooijen, J., and Van Toor, L. (2014). The system of social statistical datasets of Statistics Netherlands: An integral approach to the production of register-based social statistics. *Statistical Journal of the IAOS* 30(4): 411–424.

Barban, N. (2013). Family trajectories and health: A life course perspective. *European Journal of Population/Revue Européenne de Démographie* 29(4): 357–385. doi:10.1007/s10680-013-9296-3.

Brückner, H. and Mayer, K.U. (2005). De-standardization of the life course: What it might mean? And if it means anything, whether it actually took place? *Advances in Life Course Research* 9: 27–53. doi:10.1016/S1040-2608(04)09002-1.

Cornwell, B. (2015). *Social sequence analysis: Methods and applications* (Vol. 37). Cambridge: Cambridge University Press. doi:10.1017/CBO9781316212530.

Elzinga, C.H. (2010). Turbulence in categorical time series. *Mathematical Population Studies* 38(3): 463–481 doi:10.1177/0049124109357535.

Elzinga, C.H. and 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. doi:10.1007/s10680-007-9133-7.

Gabadinho, A., Ritschard, G., Mueller, N.S., and Studer, M. (2011). Analyzing and visualizing state sequences in R with TraMineR. *Journal of Statistical Software* 40(4): 1–37. doi:10.18637/jss.v040.i04.

Gabadinho, A., Ritschard, G., Studer, M., and Müller, N.S. (2010). Indice de complexité pour le tri et la comparaison de séquences catégorielles. *EGC:* 61–66.

Hofäcker, D. and Chaloupková, J. (2014). Patterns of family life courses in Europe – between standardisation and diversity: A cross-national comparison of family trajectories and life course norms in European Countries. *Comparative Population Studies* 39(3). doi:10.12765/CPoS-2014-11.

Jalovaara, M. and Fasang, A.E. (2017). From never partnered to serial cohabitors: Union trajectories to childlessness. *Demographic Research* 36(55): 1703–1720. doi:10.4054/DemRes.2017.36.55.

Pelletier, D., Bignami-Van Assche, S., and Simard-Gendron, A. (2020). Measuring life course complexity with dynamic sequence analysis. *Social Indicators Research* 152(3): 1127–1151. doi:10.1007/s11205-020-02464-y.

Piccarreta, R. and Studer, M. (2019). Holistic analysis of the life course: Methodological challenges and new perspectives. *Advances in Life Course Research* 41: 100251. doi:10.1016/j.alcr.2018.10.004.

Rindfuss, R.R. (1991). The young adult years: Diversity, structural change, and fertility. *Demography* 28(4): 493–512. doi:10.2307/2061419.

Saarela, J. and Skirbekk, V. (2020). Childlessness and union histories: Evidence from Finnish population register data. *Journal of Biosocial Science* 52(1): 78–96. doi:10.1017/S0021932019000257.

Shannon, C.E. (1948). A mathematical theory of communication. *The Bell System Technical Journal* 27(3): 379–423. doi:10.1002/j.1538-7305.1948.tb01338.x.

Sobotka, T., Skirbekk, V., and Philipov, D. (2011). Economic recession and fertility in the developed world. *Population and Development Review* 37(2): 267–306. doi:10.1111/j.1728-4457.2011.00411.x.

Statistics Netherlands (2019). *Both studying and working young people leave home later*. Statistics Netherlands. https://www.cbs.nl/en-gb/news/2019/06/both-studying-and-working-young-people-leave-home-later.

Statistics Netherlands (2021). *StatLine—Arbeidsdeelname en werkloosheid per maand*. https://opendata.cbs.nl/#/CBS/nl/dataset/80590ned/table?ts=1617613243819.

Studer, M., Liefbroer, A.C., and Mooyaart, J.E. (2018). Understanding trends in family formation trajectories: An application of Competing Trajectories Analysis (CTA). *Advances in Life Course Research* 36: 1–12. doi:10.1016/j.alcr.2018.02.003.

Van Winkle, Z. (2018). Family trajectories across time and space: Increasing complexity in family life courses in Europe? *Demography* 55(1): 135–164. doi:10.1007/s13524-017-0628-5.