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Understanding changing patterns of placement type stability in the first two years of placement for looked after children in Scotland: A sequence analysis

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ABSTRACT

Placement stability is an important concern for children looked after. Sequence analysis has been proposed as a promising method by which to quantitatively assess care placement stability for looked after children. Previous uses of sequence analysis to understand care placement stability have focused on a cohort perspective – following children from birth to age 18 and then analysing their whole care histories. This cohort approach is less well suited to understanding care placement stability for the population of children in care at a given time, which is a limitation given interest in understanding how aggregate levels of care placement stability is changing. In this paper we demonstrate a complimentary use of sequence analysis to understand placement type stability in shorter periods. We combined sequence analysis with regression modelling applied to Scottish administrative data for children looked after between 2008–2017 to describe change over time in the average number of transitions between placement types – a placement stability measure derived from sequence analysis – for children in their first two years in care. Our results show that there was a slight overall decrease in placement stability by this measure between 2008–2017, but that this decrease appears attributable to changes in the composition of placement types over the same period.

1. Introduction

1.1. Research Background

Providing safe and secure placements for children looked after in out-of-home care is a principal objective for public child welfare systems across an extensive range of jurisdictions. In North America, Australia and the UK there has been increasing priority on providing permanence (stability and security) for children who are unable to remain in the care of their birth parents, whether in adoptive, foster or kinship care placements, or residential placement or treatment. In Scotland, the Permanence and Care Excellent (PACE) programme was established in 2014 to help more children experience stable care placements,[1] a theme also running through The Promise response to the Independent Care Review which concluded in 2020 (Scottish Government, 2022a). Nevertheless, despite this policy focus, placement instability, drift in care planning and delays in achieving permanence for children remain longstanding concerns in the care of children by the state (Rowe et al. 1989, Ward and Skuse, 2001, Schofield et al. 2007, Havlicek 2011, Andersen 2012, Biehal et al. 2019). Children in out-of-home care are likely to experience at least one short-term placement before permanence plans are in place and a substantial minority have the unsettling experience of several short-term placements and moves between different types of placement (Fallesen, 2014).

Previous studies have analysed longitudinal aspects of placement instability (Hartley 1984, Proch and Taber 1985, Courtney 1995, Wells and Guo 1999, Newton et al., 2000, Shaw 2006, Lewis et al., 2007, Oosterman et al., 2007, Ward 2009, Havlicek 2010, Andersen 2012), but despite this substantial research interest in placement stability quantifying instability is difficult. Definitions are problematic and apparent

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[1] See https://www.gov.scot/policies/looked-after-children/permanence-and-care-excellence/.

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stability can reflect a range of experiences including settled, well-functioning placements, or inactivity by professionals (Schofield et al 2007). Moves may be planned or unplanned and can be for beneficial or reactive reasons (Munro and Hardy 2006). Sufficient suitable resources may not be readily available and over-optimistic plans for rehabilitation can result in multiple moves between home and care (Munro and Hardy 2006). Hidden instability (where children are moved temporarily, for short periods, with alternate carers for example to cover the leave of regular carers) is difficult to capture within administrative systems.

1.2. Measuring placement stability with sequence analysis

Sequence analysis has been used by Fallesen (2014) and McGrath-Lone (2017) to provide an alternative method of understanding placement stability. Sequence analysis is a descriptive longitudinal method which provides a number of ways to describe chronological sequences of events. It is well suited to analysing care placement histories, as it allows us to compare each child's unique trajectories, defined as: "*a string of states of specific nature, with specific durations and a specific order*" (Gauthier et al., 2014:2) – with different states defined as different types of care placement. Sequence analysis provides two ways by which to understand placement stability: first, in can be used to quantify the complexity of an individual child's placement history by the calculation of sequence complexity measures. Second, sequence analysis can be combined with cluster analysis to group children into groups with similar placement histories to construct a typology of typical placement pathways.

Existing research using sequence analysis to describe care placement instability has focused on the second of these uses. In their analyses Fallesen (2014) identified nine trajectories of foster care placement in Denmark based on the number of foster care placements experienced by children born between 1982 and1987. Fallesen classified these trajectories into two short-term trajectories, three stable trajectories characterised by single placements, two trajectories characterised by having two placements, and two 'complex' trajectories featuring multiple placements. Short-term or stable trajectories comprised over 90 % of the trajectories identified (author's own calculations from Fallesen, 2014, p1865). Using this typology, a number of risk factors were associated with membership of the less stable groups including changes in maternal relationship status, death of mother, paternal absence, residential movement, maternal labour market inactivity, maternal age and being a Danish native. McGrath-Lone (2017) analysed 19,848 young people born in England between 1992 and 1994 using the English Children Looked After dataset. Six main groups were identified using sequence analysis of varying complexity. Two of these groups were characterised as more complex (i.e. less stable) with a larger number of placements than for the other groups. The less stable groups were differentiated by the timing and duration of changes in placement type.

As well as focusing on trajectories of care placements, both Fallesen (2014) and McGrath-Lone (2017) used sequence analysis to describe the placement histories of cohorts of children from age 0–18. This way of understanding instability looks holistically at a child's whole care history, from birth to adulthood. This *cohort* view gives a comprehensive view of the placement histories analysed, but can only give a limited view on how overall levels of placement stability for looked after children may be affected by, for example, policy changes. Setting up an analysis in this way focuses on change over *age* for a single cohort, rather than change over *period* for multiple cohorts. This is because practically, only a small number of birth cohorts can be analysed using sequence analysis, and this reduces the scope to analyse children of the same age in different periods.

In this paper we demonstrate a complementary way that sequence analysis can be used to describe looked after children's care placement stability, with a wider focus on the population of children looked after as a whole, rather than on the development of a particular cohort. This involves use of sequence complexity measures to summarise average levels of placement in/stability for children newly looked after in a given timeframe, combined with sequence analysis and cluster analysis to identify typical placement trajectories over a shorter timeframe than the cohort approach. As such we adopt a different approach to Fallesen (2014), McGrath-Lone (2017) and McGrath-Lone et al. (2020), analysing children's placement history within their first two years in care. Analysing sequences within the first two years in care means that we can compare children of the same age in different years, and of different ages in the same year. This gives us a sense of the overall stability of care placements in a given *period*, as well as how overall placement stability (measured by sequence complexity) has changed over time, stratified by age. This aggregate analysis can be supplemented by understanding how the mix of typical placement trajectories (identified by sequence analysis and cluster analysis) has changed over time. To account for age differences in placement stability (Munro and Hardy 2006, Oosterman et al. 2007, Rees et al. 2011, Rock et al 2015, Neil et al. 2019, Biehal et al. 2019) we also consider how placement stability varies with children's age at the start of being looked after. This gives us a way to assess whether overall placement stability in the *system* has changed. It is not possible to cleanly identify results from this approach as being due to period 'effects' – as in practice it is difficult if not impossible to separate out period effects from the effects of changing cohorts over time (Bell 2020) – and so only tentative conclusions can be drawn. Nevertheless, this approach provides a novel lens through which to review the operation of an entire system over time on this important dimension in the lives of children caught up in state intervention, and to review the potential influence of policy and legal change on looked after children's placement stability by describing how the average placement stability of Children Looked After in Scotland has changed over time.

1.3. Looked after children in Scotland

In this paper we use Scottish administrative data to explore patterns of stability/instability over time focusing on change across multiple cohorts. Scottish administrative data provide a valuable resource by which to understand stability and change in children's care placements. In the mid- 2010 s a majority of looked after children were subject to a compulsory measure of supervision through the Scottish Children's Hearings System (74 %, adapted from Scottish Government 2014). Children may also become looked after with the consent of parents and carers; roughly one in ten looked after children between 2005 and 2009 (McGhee et al., 2017). The Children's Hearings comprises a system of lay tribunals staffed by trained citizen volunteers who are the primary decision makers where a child might need compulsory measures of supervision by the authorities whether for concerns regarding juvenile delinquency and/or child protection. Looked after children may be supervised and supported by social work services. This may be in their own home,[2] or they may be placed in out-of-home care (e.g. foster care, a kinship placement, a residential unit, residential school, or in secure (locked) accommodation). All supervision orders are reviewed annually by the lay tribunal as a legal requirement. In the mid-2010 s the number of children in Scotland being looked after away from home was at the highest level on record and now represents the greater proportion of all children in care (Scottish Government 2014). Although absolute numbers of children being looked after has fallen the proportion looked

[2] Scotland is somewhat unusual in that children on supervision at home with parents in Scotland are classed as being looked after and are counted in official statistics as looked after children. Placement changes from living with parents to living away from home with other carers or in residential settings (and movements back and forth between home and placement) can be tracked providing detailed information on temporal as well as substantive changes in the stability of the child's living arrangements. As such CLAS data are not directly comparable to administrative data on looked after children elsewhere in the UK.

after away from home has remained high, in 2024 20 % of looked after children were living at home with their parents and 35 % were in kinship care, and 32 % with foster carers (Scottish Government, 2025). There has been a shift in the age distribution of children looked after in Scotland. Between 2007 and 2017 the proportion of children starting to be looked after who were under 12 months old increased from 8 % to 15 % (Scottish Government 2018), whilst the proportion of children starting to be looked after aged between 12 and 15 fell from 36 % to 28 %. The separation of young children (chiefly under 3 years) from their parents and siblings has grown in Scottish child welfare. Indeed, Raab et al. (2020) found that 1 in 85 children born in Scotland between 2008 and 2017 became looked after before their first birthday.

Previous analysis of the Children Looked After in Scotland (CLAS) dataset in the Permanently Progressing project followed a cohort of 1,836 children who became looked after in Scotland aged five or under in 2012–2013, following them to 2016 (Biehal et al, 2019). They found that a majority of the children had a single placement episode. They found that children under one year old were much more likely to start to be looked after away from home than children aged four or five (Biehal et al, 2019). This highlights the potential differences in typical placement types over relatively short age ranges. Permanently Progressing also illustrated a wide range of durations for being looked after at home, from under one month to almost four years, emphasising the variation in experiences amongst children looked after.

2. Research aims and questions

In this paper we aim to describe overall change in sequence complexity within the first two years of care for children starting new episodes of care in Scotland, between 2008 and 2017. We do so by answering the following research questions:

1. What typical trajectories of care placements are identified in CLAS data within the first two years of care for children starting new episodes of care?
2. How has the mix of these typical trajectories changed over time?
3. How has overall in/stability in care placements within the first two years of care for children starting new episodes of care changed?
4. How has overall in/stability in care placements within the first two years of care for children starting new episodes of care changed when accounting for changes in the mix of typical care placement trajectories?

3. Methods

3.1. Data

In this article we present a detailed analysis of the longitudinal sequences of the placements of looked after children in Scotland using the Scottish Government's Children Looked After Scotland data. This data has been collected from each Scottish Local Authority annually at an individual child level since 2008/09. The dataset contains the start and end dates of placements for all looked after children, details of their placement type and information about the child's characteristics such as sex and ethnicity. Further information about the dataset is available from Scottish Government.[3] For this analysis we used data collated by the Scottish Government to produce statistical returns on children's care placements in Scotland which include placement information for all children who were looked after at any point between 2008/01/01 and 2017/07/31. Scottish Government has constructed a longitudinal dataset of CLAS returns to facilitate analysis of children's care placements over time (see Macintyre et al. 2020). This data source enabled us to construct detailed placement histories describing both the duration and number of care placements recorded for individual children, and the comprehensive coverage and longitudinal nature of the data collection make these data ideally suited for the investigation of trends in placement stability. The CLAS data does not identify licensing changes for out of home placements as changes in placement, unless the change in license is also associated with a change in accommodation (Scottish Government, *personal communication*, 17 February 2025). This means that CLAS data do not pick up apparent changes in placement type that in reality reflect changes in the training status of carers.[4]

Previous analysis by the Scottish Government (2022b) has reported on the number of placements a looked after child has experienced in the previous year and our approach builds upon this analysis to investigate further the patterning of placement types, duration of placement types and number of placement types experienced by looked after children over a longer time period. In doing so we take an overview of the care system as a whole, to understand where instability is concentrated in the care system and to reflect the complexity and diversity of children's care experiences in Scotland.

Administrative data are particularly well-suited to studying placement stability of children experiencing out-of-home care, given their breadth of coverage and detailed information on the timing of placement beginnings and endings (McGrath-Lone, 2017). However, such data can suffer from lacking variables of interest, such as comprehensive data on legal status or why care placements ended. Whilst working with administrative records has its own set of ethical and legal issues (see Connelly et al., 2016), the secure access processes at the National Safe Haven, where the research was conducted, minimise potential problems.[5] The risk of disclosure of the identity of individuals is substantially reduced through de-identification of records within the datasets and processes of statistical disclosure control of research outputs. As a result no individual children can be identified based on the information presented in this article. Data access was covered by a data sharing agreement with Scottish Government.

3.2. Measures

3.2.1. Measuring placement type in/stability

We use the start and end dates of placement and the type of placement to construct a child's placement history for the period covered in the analysis. Unlike Fallesen (2014), McGrath-Lone (2017) and McGrath-Lone et al. (2020) who construct placement trajectories based on the number of placements, we focus on change between *types* of care placement. The raw data provided 12 different placement types, which were combined into seven types used for analysis based on the substantive similarity between categories and the small number of placements of other types (see Table 1): At home with parents, With friends/relatives, With foster carers, With prospective adopters, Residential, Other, No placement, and a second foster care placement after an initial foster care placement. This allows us to distinguish between a child's

[3] See https://www.gov.scot/publications/scottish-exchange-of-data-looked-after-children/ accessed 8/8/2022.

[4] For example, it would not show up in CLAS as a change of placement if a child is placed with a kinship provider and the kinship provider subsequently decides to complete a higher level of training (and so is updated to a higher level of care) – unless this also coincided with a change of address for the kinship provider. In the scenario that a child was adopted by a foster carer this would be identified in CLAS as the child leaving care, and it is likely that many of the carers in this scenario would have already been identified as prospective adopters at the start of the placement. In any case, only a small proportion of children are placed with prospective adopters at any given time – around 1.5% of the CLAS data analysed here (see Table One), which is consistent with published figures for all looked after children in Scotland (Scottish Government. 2022).

[5] For more information on the National Safe Haven see https://www.isdscotland.org/products-and-services/edris/use-of-the-national-safe-haven/ accessed 8/8/2022.

first and second foster care placement in a given sub-sequence (that is, a sequence of placements of the same types).[6] The benefit of this approach is that it allows us to understand shifts in the prevalence of different types of care placement over time, reflecting the policy interest in Scotland in placement instability between foster care placements. One limitation of this measure is that that our implementation of this measure only considers changes between types of placement. That is, consecutive placements of the same type will appear as no change in this analysis, even though they may represent a change in the child's experience. For example, a child who moves from a kinship placement with a grandmother to a kinship placement with an uncle will not show up in our analysis as a change of placement type. We focus on changes between type of placement on grounds of parsimony; sequence analysis as a method is limited in the number of 'states' that it can compare due to the computational burden of increasing the number of states and/or number of sequences (Liao et al. 2022), and in this paper we are particularly concerned with comparing placement stability for children with different types of placement. This is because the majority of changes in placement are changes in placement type – in CLAS overall, 82 % of placements were followed either by a placement of a different type, or by no further placements (see Appendix for a breakdown by placement types). Whilst there are some instances of separate episodes of consecutive placements of the same type, these are rare. Therefore, our focus on change in placement type also captures the majority of changes between placements.

3.2.2. Measuring overall sequence complexity

Once we have identified our 'alphabet'[7] of states, we must determine how to measure sequence complexity. There are eight sequence measures provided by the TraMineR R package (Gabadinho et al., 2011), each with slightly different emphases. We present results for the 'number of transitions measure', which shows how many times a child changed placement type during each two-year window analysed, as this is the sequence measure with the most straightforward interpretation. Lower values on this measure indicate fewer transitions between placement types, and so greater stability.

3.2.3. Observation window

As mentioned above, we measure placement in/stability during a child's first two years being looked after, as recorded in CLAS.[8] Formatting the placement data in this way solves a methodological problem; that sequence analysis requires the comparison of sequences of equal length, but the data used for analysis covers sequences of widely varying durations. By restricting the sequences analysed to only two years, we can compare children with differing lengths of care history. To some extent, any length of follow-up window we chose in which to analyse care placements would be arbitrary (see Francis et al., 2004). However, using two years as a window is in line with Neil et al.'s (2019) definition of long-term care as being greater than two years. It also means that we can capture disruptions to sequences caused after 12 month reviews, and aligns with the availability of other important datasets related to children in Scotland, such as the pupils' census, which are released every two years.

Focusing on care placements in the first two years in care raises an important question: what do we do with children's placements that are longer than two years? One option would be to divide a child's whole care history into two-year sections and include each of these sections in the sequence analysis. However, this approach could induce bias into the results, as we would be comparing children who had just entered care with those who had already been in care for many years, potentially in the same placement. Worse, this bias would vary by both age, as the youngest children would not be susceptible to having prior placements (by definition, a child can't have a two-year window of care placements younger than age 0), and time. The bias would also increase over time, as the follow-up window for the children who enter care in the earlier years covered by the dataset increases. Instead, we analyse the first two years that a child is first looked after. This means that we are consistently comparing like with like. It does also mean that our results may not be representative of all care placements; for example, with this approach we do not see any potential breakdown of long-term, stable placements. For a 12 year-old to be in our dataset, they must not have been in care prior to the age of 12 during our observation period. Restricting sequence analysis to the analysis of two year 'age-bands' means that the oldest child in the analysis was born in January 1992 and their care placements observed at ages 16 and 17 (between January 2008 and January 2010), and the youngest child in the analysis was born in July 2015 and their care placements were observed at ages 0 and 1 (between July 2015 and July 2017). A final implication of our approach means that conceptions of 'short-term' and 'stable' placements differ from those of Fallesen (2014) and McGrath-Lone (2017). For example, many of the care histories classified by Fallesen (2014) as being 'short' placements of these would be identified as stable placements in this analysis – the average duration of placement for the children in the first of the stable groups identified by Fallesen is over 24 months, which would show up as a period of stability in our analysis due to the differing observation windows of the two studies.

We adopt the same approach as McGrath-Lone et al. (2020) and analyse sequences based on a child's placements in a given month.[9] When a child had multiple placements in a given month, the last of these placements is taken to represent the whole month. Whilst this does mean that our sequence measure is an underestimate of change, it was rare for children to have multiple placements in a given month – for the CLAS data as a whole, 86 % of placements lasted longer than 30 days. Analysing placement histories at the month level gave us a maximum of *24* observations. As placement start and end dates were coded to the day of placement start and end, this involves aggregating information to the month level, and therefore losing information about changes in placements within month. As a result this time aggregation may emphasise stability in placements, given that a relatively small number of shorter placements are obscured in the analysis. However, the more fine-grained the analysis, the greater computational complexity required, which can make sequence analysis impractical (see McGrath-Lone 2017:239). Analysing placements per month strikes a balance between detail and complexity, and facilitated analysis that was computationally tractable.

3.3. Implementation

We conducted the analysis in three steps.[10] First, we identified a typology of sequences using cluster analysis (Müllner, 2013), based on the similarity of childrens' care placements in their first two years of care. We determined the optimal number of clusters in the sequence analysis, choosing the cluster solution that was favoured by the majority of fit statistics (see Appendix). Cluster analysis is a statistical technique which always produces groups out of the data analysed. We use the Average Silhouette Width (ASW) measure to assess the extent to which the typology identified represents structure in the dataset or an artefact

[6] We are not able to distinguish between a sequence with three consecutive foster care placements and one with two consecutive foster care placements; both would be coded as a first foster care placement followed by a steady state of second-or-more foster care placements.

[7] Alphabet is the term used to denote "the set of states used to identify the status of the unit of analysis at each time point" (Liao et al. 2022: 5).

[8] It is possible that older children may have been looked after before the CLAS observation window and be returning to care after a period out of care.

[9] Defined as a period of thirty days.

[10] We conducted the sequence analysis and cluster analysis using the TraMineR (Gabadinho et al., 2011) and fastcluster (Müllner, 2013) R packages respectively.

of the clustering algorithm. We describe the clusters produced with reference to the most representative trajectory in each cluster, but the placement of histories of the children assigned to the different clusters are not all identical – the names we give the clusters represent the 'majority experience' rather than the experience of every child. The cluster solutions are presented visually in a state sequence plot. We provide a worked example of to illustrate how a children's care placement sequences are visualized in a state sequence plot in the Appendix.

Second, we analysed the number of children grouped into the classes identified by the cluster analysis by time and age separately, to explore how prevalent these typical placement patterns are for children of different ages, and how the prevalence of these clusters has changed over time. This gives a qualitative assessment of how care placements in the first two years of care have changed in Scotland between 2007 and 2017.

Finally, we combined information on cluster membership to the calculated number of transitions measure for each child, as well as information about the child's age when they first became looked after, their sex and ethnicity, to describe change over time in their placement stability whilst controlling for these demographic characteristics. Sex was coded as male/female, and ethnicity as white/mixed or multiple ethnic groups/Asian, Asian Scottish or Asian British/African, Caribbean or Black/other ethnic groups/not known or not recorded. We describe the relationship between these characteristics and placement type stability using a regression model. Sex, ethnicity and the placement cluster identified by the sequence analysis are included in the model as dummy variables. Survey year is modelled as a linear, continuous independent variable. We model the average sequence complexity by age using a flexible function based on the data, specifically using a thin-plate regression spline fit using the *mgcv* package in R (Wood 2017). This kind of flexible model specification is recommended to model change in an outcome across age to allow for a non-linear relationship between age and the outcome (Harrell, 2015), which is important given the non-linear relationship between age and placement stability seen in previous studies (Neil et al. 2019). This approach allows the shape of this relationship to be estimated from the data, rather an imposing a specific parametric form (such as a quadratic relationship). We tested the time trend to see if there was evidence for a non-linear trend by using a thin-plate regression spline, but this indicated that a linear fit was preferred.

4. Findings

Table 1 shows descriptive statistics for the CLAS dataset. Almost one-third of the children in the dataset who became looked after for the first time were age 0, and similarly almost one third of children in the analysis dataset only had a single placement in the subsequent two-year period (this count is for placements overall, rather than placement types). Of placement types, *looked after at home with parents* was the most prevalence placement type overall, contributing around one-third of placement episodes.

4.1. Identifying a sequence typology

The sequence analysis preferred a seven-cluster solution (see fit statistics in Appendix). These clusters are visualized in Fig. 1 below. The main feature of these clusters is *stability*: five clusters are dominated by single placement types for the whole 24 months – with friend/relatives; at home with parents; with foster carers; residential; and, with foster carers in a second (or more) foster care placement. The other two clusters show placements which last 12 months and then are followed by no placement, and the final cluster show very short placements followed by no placement. This picture of predominant stability chimes with Fallesen's (2014) description of foster care placement trajectories in Denmark, where 'complex' trajectories comprised only around 5 % of the total trajectories identified (author's own calculations from Fallesen, 2014, p1865). We include the Average Silhouette Width (ASW) figure in the heading of each sequence plot, as well as the sequence identified as the most representative of the cluster, in the format Placement type/Number of months. These show, respectively, how homogenous the cluster is, and what types of sequences are included in the cluster. For example, the 'With friends/relatives/24′ cluster identified children who were in care placements With friends/relatives for 24 months as the most representative cluster. The ASW figures show that the last two placement clusters are not very clearly identified, with ASWs lower than 0.5. An ASW lower than 0.5 suggests that a particular class lacks structure (Kaufman and Rousseeuw 1990), indicating that the placement sequences in these clusters were more heterogeneous than those in the more stable clusters. By Kaufman and Rousseeuw's (1990) classification, the With friends/relatives/24 cluster shows a 'strong' structure, with the other clusters showing 'reasonable' structure (see Studer 2013: 15).

It is worth reiterating that sequence analysis is a technique for producing groups out of data, which groups together children with similar patterns of care placement types. The children brought together in each cluster do not have identical care placement histories, as Fig. 1 emphasizes, and the names of given to the clusters represent the most representative placement history – but this most representative placement history will be less representative of the other children in more heterogeneous clusters. For example, not all of those in the 'With friends/relatives/24′ cluster were actually with friends/relatives for the full period, and Fig. 1 shows that many children in this cluster had different placement histories to this most representative sequence – but this is the cluster which best described their care placement history based on the clustering algorithm.

4.2. Most common placement cluster types by age

Fig. 2 shows the relative prevalence of different placement type clusters by age at placement start. Relative prevalence is calculated by subtracting the overall prevalence of each cluster from the prevalence of the cluster within each year of age at placement start. This shows how common each placement type cluster is for each year compared to how common the placement type clusters are overall. The relative prevalence of placement types varied substantially by age. Children aged 1–12 show similar patterns of placement type clusters, but most common placement clusters are quite different for children aged 0 and aged 13–16. These results indicate the non-linear relationship between age and placement stability seen by Neil et al. (2019) is reflected in very different patterns of common placements by age. Children who start placements at age 0 have a different profile of care placements compared to other young children. Children starting placements at age 0 are much more likely than other children to be assigned to the 'With foster carers/24′ cluster, which reflects a high prevalence of stable foster care placements. Children aged 0 are also slightly more likely to be assigned to the 'With foster carers/2-No placement/22′ cluster, indicating a relatively high prevalence of shorter placements. In contrast, the 'At home with parents/24′ cluster was less common for children aged 0, as were the 'Residential/24′ and 'At home with parents/12-No placement/12′ clusters. These findings are in line with Biehal et al (2019) who found that found that children were looked after away from home under age 1 were likely to be placed with foster carers and very unlikely to be placed with kinship carers. Fig. 2 also shows, as expected, an increasing prevalence of the 'Residential/24′ cluster with age, particularly in the teenage years. For children aged 15 and 16 starting placements, the 'At home with parents/12-No placement/12′ and 'With foster carers/2-No placement/22′ clusters are also particularly prevalent, suggesting that children in their mid-teens were more likely than children of other ages to experience shorter placements and then leave care. The extreme differences in common placement types for children aged 16 also reflects the smaller number of children starting first placements at this age (see Table 1).

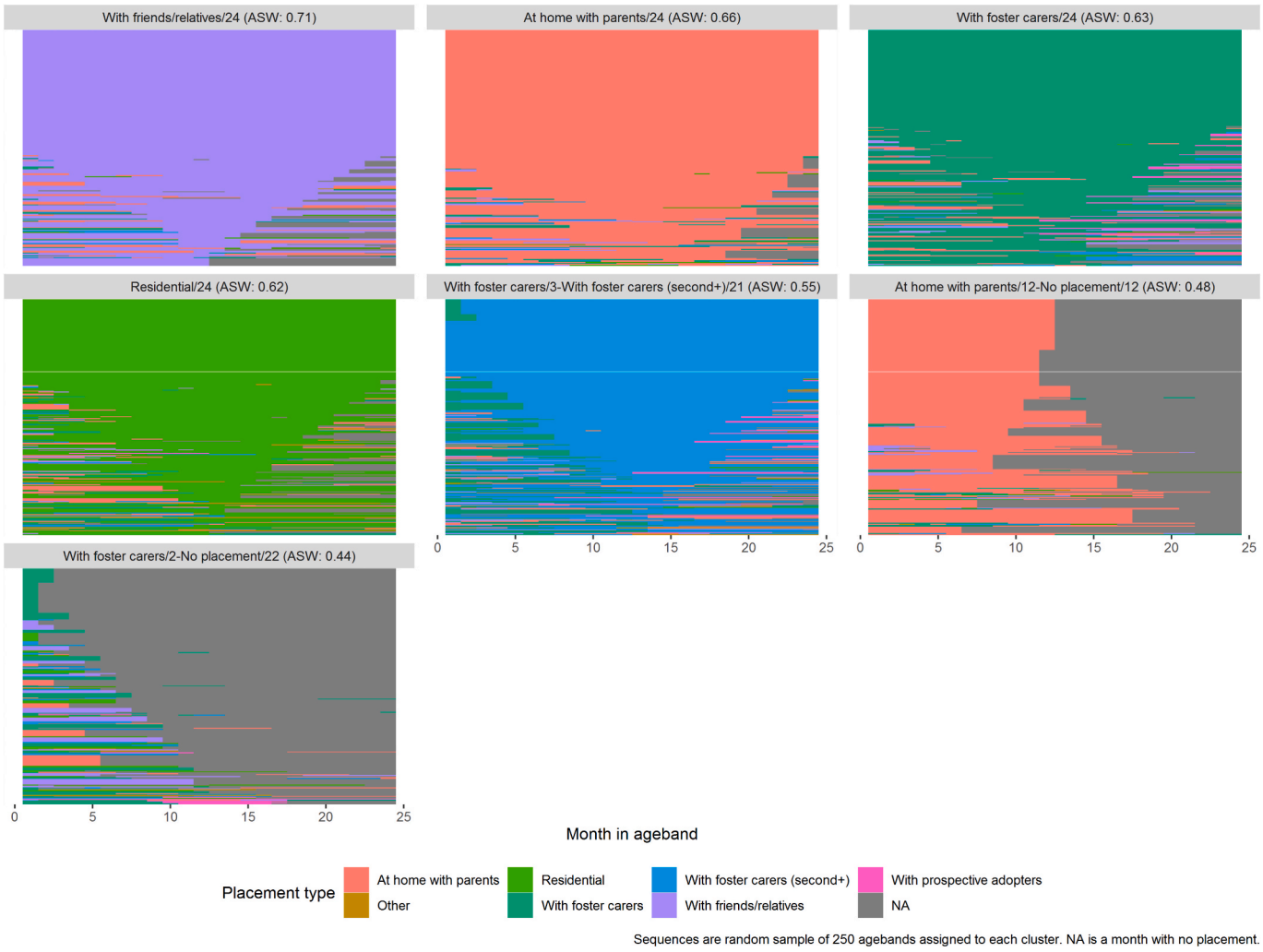

Fig. 1. State sequence plot of seven placement type clusters.

4.3. Changes in the distribution of placement cluster types over time

Our research design also lets us analyse change in the overall prevalence of different placement clusters over time. In Fig. 3 we can see that there has been a substantial change over time in the proportion of children classified into different placement type clusters. Most notably, there has been a marked fall in the proportion of placements that are at home with the child's parents for the full 24 month period – from more than 30 % in 2008 to around 20 % in 2015 – and an increase in the prevalence of short placements – as indicated by the 'With foster carers/2-No placement/22′ cluster – from around 10 % in 2008 to around 20 % in 2015. This increase was particularly marked after 2012. The proportions in Fig. 3 show the prevalence of different placement type clusters for all children starting to be looked after in each year, and so to some extent reflect changes in the demographics of children starting care placements. From Fig. 2 we know that the 'With foster carers/2-No placement/22′ cluster is more common for the youngest and oldest children starting care, and this increase in the proportion of short placements coincides with a relative increase in care starts for children age zero over this period. We also see a slight increase in the proportion of children assigned to the 'At home with parents/12-No placement/12′ cluster. Combined with the fall in the proportion of children in the 'At home with parents/24′ cluster, this may actually reflect an increase in children who are looked after at home but this is not continued at 12 month review – this highlights that quantitative estimates of placement 'instability' using sequence analysis may actually reflect positive change for some children.[11]

4.4. Placement type stability over time

We can now answer our main research question: have placements become more stable over time? Table 2 shows results from five regression models which model the number of transitions between placements types and our outcome of placement type stability. Because our outcome is number of transitions between placement types, higher values indicate more *in*-stability. The table shows a set of regression models of increasing complexity, building up from an intercept-only model (Model 1) and encompassing models which include the year of placement start only (Model 2), placement start year and age (Model 3), placement start year, age and demographic controls (Model 4), and finally adding placement type cluster (Model 5).

Our focus is on the estimate of the year start parameter. This is positive and statistically significant in Models Two through Four; these results indicate that placement instability has increased marginally over the period analysed. Converting the parameter estimates into estimates of the number of placement type changes, Model 2 implies that for every 1,000 children who became looked after in Scotland in 2008/09 there were between 890 and 925 changes of placement type. For 1,000 children who started their first care placements in Scotland in 2015/16,

[11] We thank Dr Linda Cusworth for highlighting this point.

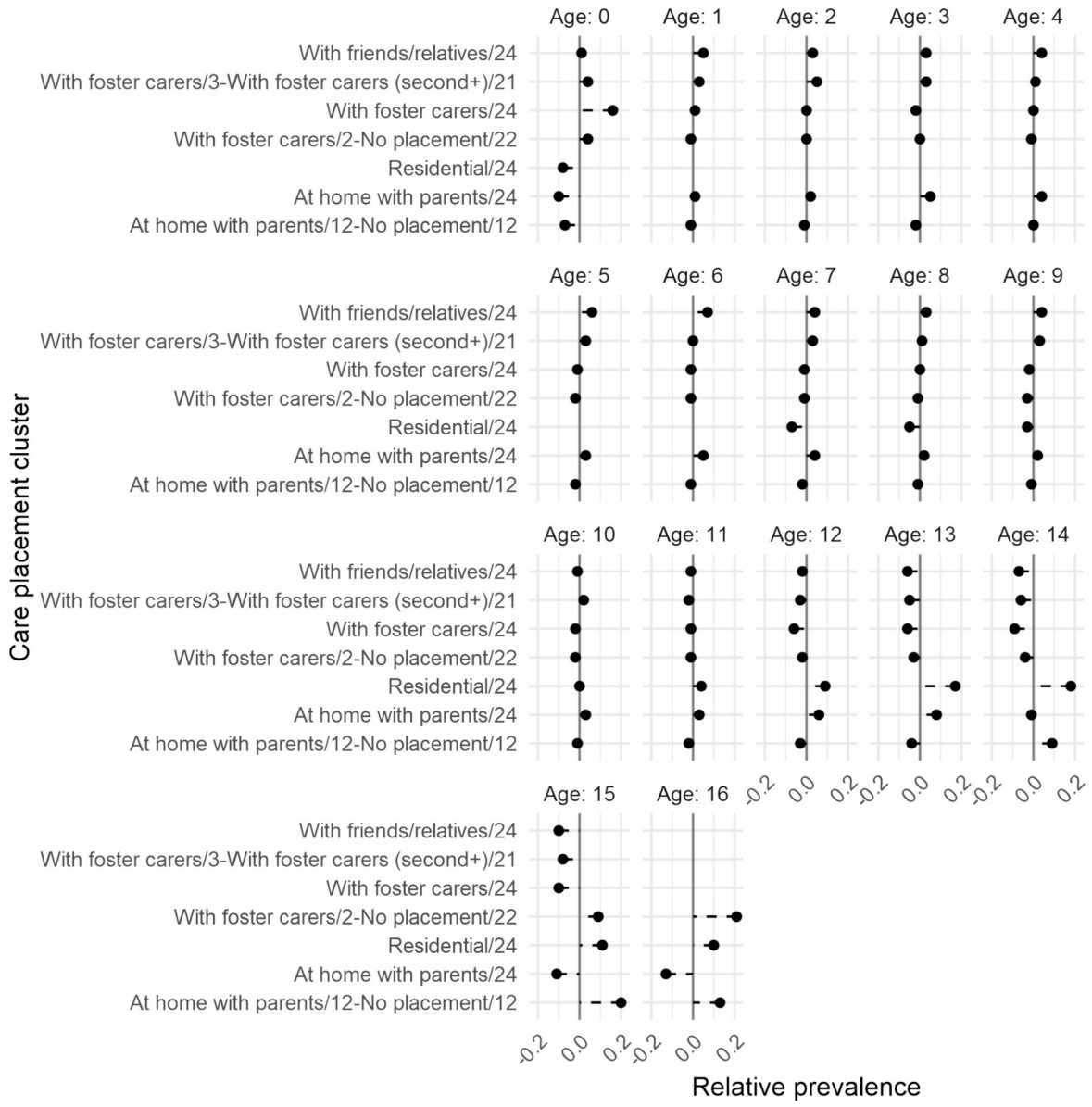

Fig. 2. Relative prevalence of care placement cluster by age.

Model 2 implies there were between 995 and 1050 changes of placement type.

However, the estimate for placement start year is not statistically significant in Model 5. This illustrates that once we control for the average differences in the number of transitions between placement type clusters there is no evidence of change over time in placement type stability. This makes sense; In Fig. 3 we saw that the proportion of placements *At home with parents* declined and the proportion of placements in the short-term cluster increased. Table 3 shows that 'At home with parents/24′ was one of the most stable clusters in terms of the number of transitions between placement types, as all other placement type clusters except for 'With friends/relatives/24′ had positive and statistically significant regression coefficients. In contrast the short-term cluster ('With foster carers/2-No placement/22′) is one of the least stable, with the second largest regression coefficient. As a result, the aggregate level of placement instability increases slightly as the mix of placements overall shifts away from one of the most stable placement types towards one of the least stable types. However, when we factor in the average differences in placement type stability between placement clusters, there is little evidence of change over time in the model's placement stability estimates. This suggests that this overall increase in placement instability is attributable to the change over time in the mix of care placements experience. This is also associated with the move towards a higher proportion of children starting their first placement being those in their first year of life, as we saw from Fig. 2 that these children tended to experience less stable care placements (see also (Raab et al., 2020)).

Fig. 4 shows the estimated relationship between age and placement type stability based on Models 3, 4 and 5. This figure shows a clear non-linear relationship between age and placement stability. In Models 3 and 4, the very youngest children and those aged 14–16 have the least stable placements. In Model 5, factoring in average differences in placement stability between placement clusters, the youngest children have a very similar level of placement instability, but the second peak in placement instability for those aged 14–16 has reduced. This indicates that for children aged 14–16 the higher levels of placement instability seen in

Table 1
Descriptive statistics for CLAS dataset 2008–2017, children starting first placement in care.

Number of children		
Total		*33,486*
With different numbers of transitions between placement types	0	10,851
	1	16,489
	2	4,006
	3 or more	2,140
Sex	Female	15,728
	Male	17,758
Ethnicity	White	29,675
	Not disclosed or not known	2,403
	Mixed or multiple ethnic group	549
	Asian, Asian Scottish or Asian British	337
	African, Caribbean or Black	301
	Other Ethnic Group	221
Age at placement start	0	5,158
	1	2,344
	2	2,036
	3	1,755
	4	1,646
	5	1,541
	6	1,516
	7	1,415
	8	1,393
	9	1,334
	10	1,361
	11	1,427
	12	1,669
	13	2,615
	14	3,318
	15	2,698
	16	260
Number of placements		
Total		59,222
Number of placements by placement type	At home with parents	21,385
	Other	549
	Residential	6,399
	With foster carers	13,484
	With foster carers (second +)	5,146
	With friends/relatives	11,337
	With prospective adopters	922

Note: Number of placements only relate to the first two years in care.

Models 3 and 4 are due to the mix of common placement types for children of these ages – mostly likely due to the prevalence of Residential placements. However, we do not find the same thing for very young children, suggesting that higher levels of placement instability for children entering care at age 0 is less contingent on the type of placement they enter. (Raab et al., 2020) found less than half of children under one year old (46 %) entering care had a single placement during their first episode of care. This was even lower (33 %) for those entering care under one week. Placement stability increases through early childhood until around age 6, at which point it remains stable until the mid-teens. This explains the findings of previous studies which have variously found that teenagers and/or very young children have the least stable care placements (Neil et al. 2019). Our results are in line with this previous analysis, and suggest that placement type instability has one peak just after birth and another in the mid-teens.

5. Discussion

Using sequence analysis to explore placement stability for children looked after in Scotland in their first two years in care has uncovered a series of distinct patterns within the CLAS data.

Our first research question asks what typical trajectories of care placements could be identified for children starting new episodes of care? We identified seven typical cluster of care placements, with five clusters dominated by single placement types for the whole 24 months, indicating periods of stability. A further cluster was focused on placements which lasted 12 months followed by no placement, with a final cluster grouping together very short care placements followed by no placement. The value of applying sequence analysis to this problem is that these different patterns would be occluded by conventional analyses which tend to only consider number of changes in placement type in a given period. The trajectories identified using sequence analysis help make sense of complex individual sequences and provide a simplified view of the most common experiences of children looked after in Scotland.

The application of sequence analysis also enabled us to explore temporal change in placement trajectories to answer our second research question, by examining how the mix of these typical trajectories has changed over time. This demonstrates a complementary use of sequence analysis to previous applications such as Fallesen (2014) and McGrath-Lone (2017) which focused on describing care histories for single cohorts from birth to adulthood, rather than examining how the mix of these typical placements was changing over different periods. Our results show a substantial change over time in the proportion of children classified into particular placement type clusters. The proportion of children that were placed at home with the child's parents for the full 24 month period has decreased, while those experiencing short placements has increased. To some extent this is likely to reflect the changing demographics of children looked after in Scotland; the proportion of children starting to be looked after who were under 1 increased from the mid-2000 s to the mid-2010 s (Scottish Government, 2016) and our results show that very young children tended to have less stable placements on average than older children, other than older teenagers.

Our final two research questions examined change over time in average placement stability, first looking at overall placement stability and then controlling for changes in the mix of typical placement trajectories as well as age, sex and ethnicity. There has been a small increase in overall placement instability between 2008–2017, measured by the number of transitions between placement types. Using the results of the sequence analysis, we identify that this is attributable to changes in the overall mixture of placement trajectories. Once we control for the changing prevalence of typical placement trajectories, children's sex and ethnicity we do not see any evidence of change over time in care placement stability. It is likely that the increase in prevalence in the short-term care placement cluster during this period explains the increase in placement instability observed, given that this was one of the least stable placement clusters. Therefore an increased prevalence of this cluster would naturally lead to more instability on aggregate. Together these results reveal an important dynamic in placement stability amongst children entering care in Scotland; the slight overall increase in placement instability that we see is driven by changes in the mix of placements children are experiencing.

Looking at the demographic control variables, in the final regression model (model 5) there was a small (−0.039) but statistically significant difference in the average number of placement type transition between boys and girls, with boys having slightly fewer transitions between placement types, after controlling for the effects of year, age, ethnicity and placement type cluster (model 5). Given the large dataset, it is unsurprising that these coefficients were statistically significant. In the same model, only the Not disclosed or not known group had a statistically significant difference in the average number of placement type transitions compared to the White reference group. These children tended to have fewer placement type transitions than White children (−0.104), once controlling for year, age, sex and placement type cluster. Considering our findings relating to age, we see a distinct U-shaped relationship between age and our measure of placement stability, with children younger than age one and older than age 14 showing higher levels of instability than other children. These groups also showed distinctive results in the cluster analysis, and were more likely than other ages to be classified into groups that had less stability, such as the

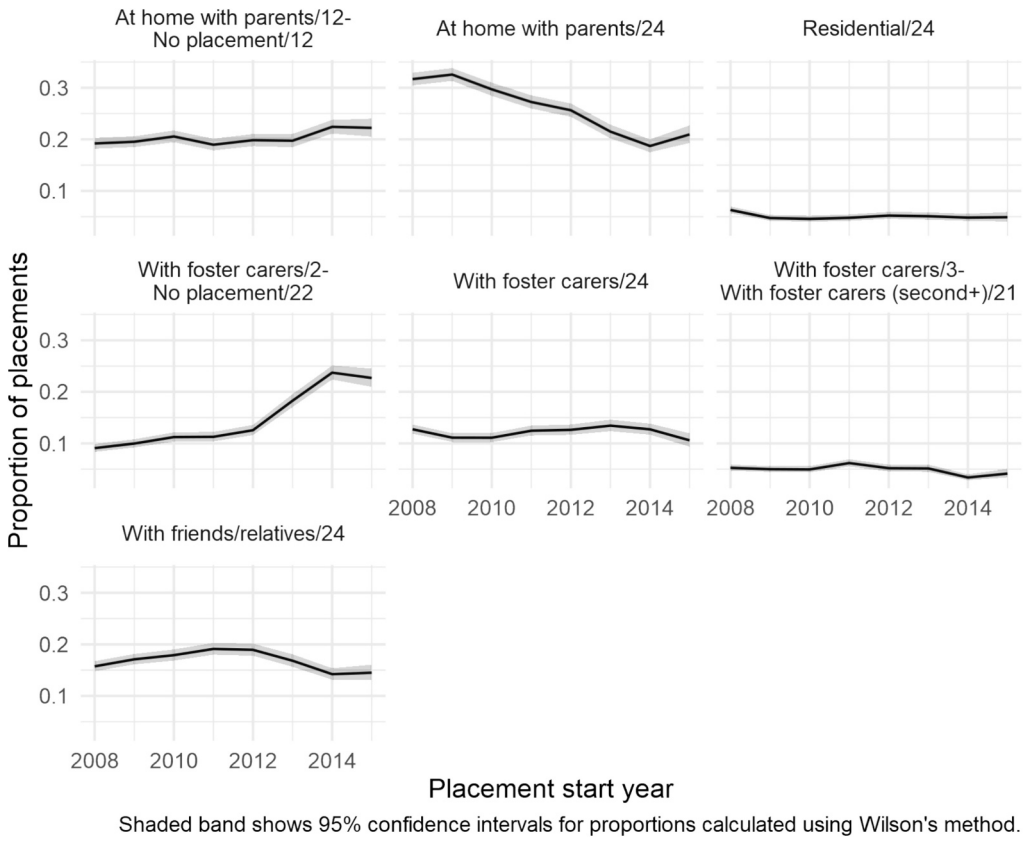

Fig. 3. Change over time in the mix of placement type clusters.

Table 2
Regression analysis of placement type instability over time.

Parameter	Model 1	Model 2	Model 3	Model 4	Model 5
Year start		0.015*** (0.002)	0.014*** (0.002)	0.014*** (0.002)	−0.002 (0.002)
Age			Fig. 4	Fig. 4	Fig. 4
Sex					
Female (reference)				–	–
Male				−0.038*** (0.011)	−0.039*** (0.011)
Ethnicity					
White (reference)				–	–
Not disclosed or not known				−0.05* (0.021)	−0.104*** (0.021)
Mixed or multiple ethnic group				0.051 (0.041)	0.029 (0.041)
Asian, Asian Scottish or Asian British				−0.004 (0.053)	−0.103 (0.053)
African, Caribbean or Black				0.117* (0.053)	−0.042 (0.054)
Other Ethnic Group				0.182** (0.06)	0.063 (0.06)
Placement type cluster					
At home with parents/24 (reference)					–
At home with parents/12-No placement/12					0.733*** (0.016)
With friends/relatives/24					−0.055** (0.021)
With foster carers/2-No placement/22					0.706*** (0.018)
With foster carers/24					0.294*** (0.021)
Residential/24					0.551*** (0.026)
With foster carers/3-With foster carers (second +)/21					0.727*** (0.024)
(Intercept)	−0.052*** (0.005)	−0.052*** (0.005)	−0.057*** (0.005)	−0.036*** (0.008)	−0.418*** (0.014)
% deviance explained	0	0.1	1.0	1.1	11.4
Pseudo R-squared	0	0.001	0.010	0.011	0.122
Residual degrees of freedom	33,485	33,484	33473.7	33467.7	33461.5
N	33,486	33,486	33,486	33,486	33,486

Note: Residual degrees of freedom can be non-integers due to the non-linear age term. Standard errors are in parentheses. * = $p < 0.05$, ** = $p < 0.01$, *** = $p < 0.001$.

multi-foster care placement cluster. Together, these results indicate that the very youngest and very oldest children have quite different care placement trajectories in their first two years in care than do children of other ages, and by our sequence measures both younger and older children experience greater placement instability. This finding is in line with the figures presented by Neil et al. (2019) which showed higher levels of placement breakdown, and fewer long-term placements for both those under five and teenagers. One possible explanation is that this reflects the different types of circumstances by which the youngest and the oldest children enter care. It may be that, on average, the very youngest and the very oldest children in care have different needs to other children taken into care.

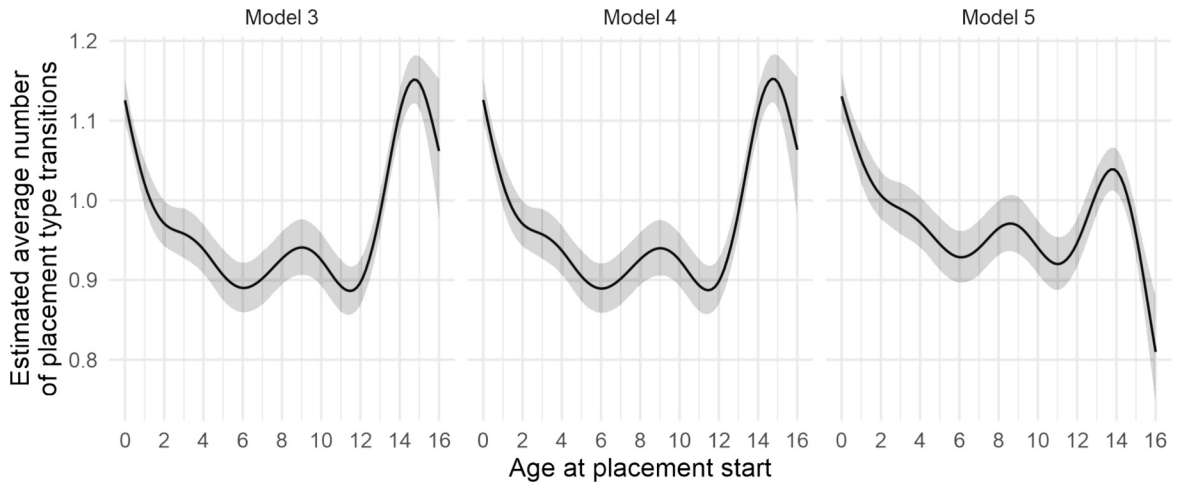

Fig. 4. Placement type instability by age.

Overall, our results have given a detailed statistical picture of care placement type stability within the first two years of care for children starting new episodes of care in Scotland between 2007 and 2017. Whilst this is a detailed account of the care system in Scotland, as noted in the literature review children in Scotland who are on supervision at home with their parents are classed as being looked after, unlike many other national systems. This complicates any international comparison of the results of this study with other jurisdictions which employ different classification systems, including other parts of the United Kingdom. In a sense this is not a limitation of our analysis – our main focus is on understanding the development of placement instability across the care system in Scotland, and our methodology was designed with this primarily idiographic focus. Any attempts to make the CLAS dataset more internationally comparable by excluding children who are either only looked after at home, or who are ever looked after at home, would only give a partial picture of the population of children looked after in Scotland and would not guarantee international comparability, given that the nature and type of out-of-home care varies between countries. However, this does mean a note of caution should be applied when trying to generalize our results to other jurisdictions, particularly as it is the relative fall in the prevalence of at home care placements which seems to be driving the overall increase in placement instability in Scotland. Given that this care placement type is not internationally common, it seems unlikely that this trend could be observed in other jurisdictions which do not include this classification. Were a similar analytical approach applied to placement type data from another jurisdiction which excluded at-home care placements, we speculate that the cluster analysis may produce groups reflecting stable placements of each placement type in that jurisdiction, as well as a more mixed cluster reflecting short-term placements. We think this suggestion is plausible based on the results presented here but might be a worthwhile topic for empirical investigation.

Finally, whilst our analysis has focused on increasing instability, it is important to consider the results in appropriate context. Conceptually, it is worth repeating that 'instability' by our measure of number of transitions between placement type is not necessarily harmful for all children if it means that they end up in a more suitable placement. Quantitatively, whilst almost half of all children looked after over the study period only had a single care placement, this also means that half of all children had at least two placements, with the average number of transitions between placement types being around 0.9. At the same time, the short placement group – which includes multiple short placements, and which was one of the least stable clusters we analysed – was one of the most frequent placement types for children who entered care in 2015/16. These findings highlight the diversity of experiences of children looked after in Scotland. Stability for infants is crucial for their development, and the risks of frequent changes of carer is long known. The use of short-term emergency placements for new born infants and very young children builds in the need for at least one placement move. Pre-birth child protection case conferences do not appear to have fully mitigated this risk for infants becoming looked after in the first week of life. Too often placement moves for adolescents create other adverse changes – of school, for example, – and difficulties in maintaining peer and sibling relationships. Despite strong policy focus on permanency for looked after children, Scottish child welfare has still much to do to better support its youngest and adolescent citizens and their families. The capacity to uncover these divergent trends demonstrates the value of our approach to disaggregating the data to analyse overall change in placement stability over time.

5.1. *Limitations*

Our approach, like any, has limitations. Sequence analysis is a method which can feature memory and computational time limitations when analysing large numbers of sequences (Liao et al. 2022), meaning applied researchers wanting to use sequence analysis methods to understand care placement in/stability have to make trade-offs between during analysis for the method to be practical. Typically this is achieved by constraining the 'alphabet' of states and/or the granularity of the time periods used. In our analysis these computational constraints led us to focus on changes between types of care placement as discussed in 3.2.1 which – whilst capturing more than 80 % of all transitions between placements – mean that our approach does not emphasise transitions between placements of the same type. Similarly, our focus on months as temporal units means that very short placements (of less than 30 days) are excluded in our analysis, although these placements made up less than 15 % of all placements. These kinds of trade-offs are typical when using sequence analysis to understand care placement histories (see e.g. McGrath-Lone et al. 2020).

A disadvantage to analysing the data using 2 year observation periods is that longer-term patterns of placement instability, such as those identified by McGrath-Lone and Fallesen and colleagues are not visible in our analysis. Moreover, results obtained using this strategy must be interpreted with care because it is not possible using this – or any – method to definitively distinguish between period and cohort effects in the observed results (Bell 2020). We encourage researchers who intend to use sequence analysis to analyse care placement sequences to think carefully about how they construct the cohorts they analyse, and whether an analysis of a full cohort's care history is of more interest, or – as in this analysis – the focus should be in change over time in the experiences of all children in care in a given period. Our analysis shows that sequence analysis can be helpful in understanding both kinds of

questions to give a richer picture of the dynamics of care placement stability.

6. Conclusions

The novel application of sequence analysis to the problem of understanding care placement stability we adopted for this study – dividing care placements into two-year windows from when child became looked after and measuring placement stability as changes between types of placement – has allowed us to see divergent trends in placement stability, and has given a greater understanding of how placement stability is distributed in the care system in Scotland. Our analytical approach allowed us to construct a placement typology which is more nuanced than one based purely on number of placements by also accounting for duration of placement and type of placement. Using sequence analysis in this way allowed us to examine change over both age and time. This shows a complementary use of the method to understand care placement histories to the use of sequence analysis to examine cohorts of children's whole histories. The age differences in placements between younger and older children that our application of sequence analysis identified are unlikely to be visible in the full-cohort analysis such as that adopted by McGrath-Lone (2017) and Fallesen (2014). This is because sequence analysis is – by design – a 'holistic' method which summarises all the data it is given in a single measure, and so early experiences may be may not be easily identifiable in analyses with long follow-up periods. By separating our analysis out into distinct age-bands, we were able to uncover these divergent trends. As such, we believe that the analytical approach adopted in this study can provide a useful complement to other quantitative approaches to understanding looked after children's care placement stability.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

Cluster fit measures

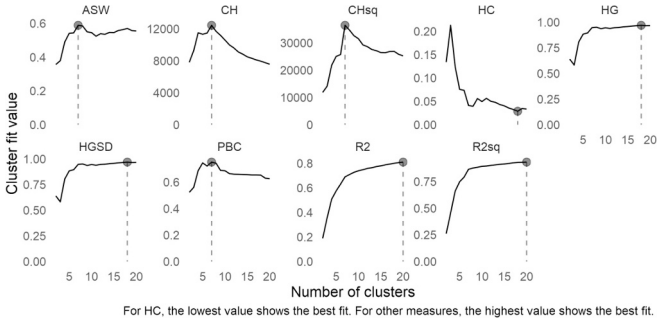

Fig. A1. Cluster fit measures for different number of placement stability clusters

Table 3
Preferred number of classes for different numbers of placement stability clusters.

Cluster fit measure	Preferred number of classes
Average Silhouette Width (ASW)	7
Calinski-Harabasz index (CH)	7
Calinski-Harabasz index with squared distances (CHsq)	7
Hubert's C (HC)	18
Hubert's Gamma (HG)	18
Hubert's Somers' D (HGSD)	18
Point Biserial Correlation (PBC)	7
Pseudo R2 (R2)	20
Pseudo R2 with squared distances (R2sq)	20

See Studer (2013:13) for definitions of the different fit measures.

Visualizing care placement sequences and clusters with state sequence plots

Fig. A2 provides a hypothetical example of three children's care placement histories in the first two years of care summarized in a state sequence

plot. Each row represents the care placement status of each child summarised as the last placement type recorded in a given month. These histories also record periods where the child was not looked after, either between care placements (as with Child 1) or if the child's period of care lasts for less than 24 months (as with Child 3).

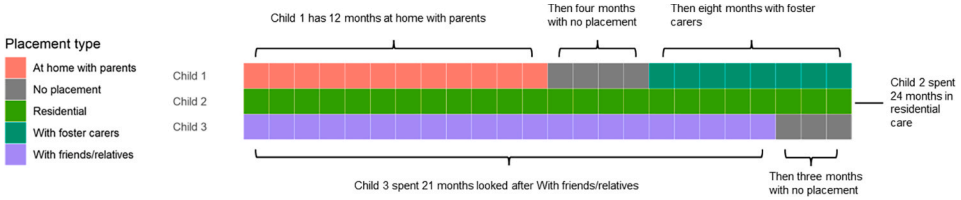

Fig. A2. Cluster fit measures for different number of placement stability clusters

Fig. A3 presents a second hypothetical example to illustrate the kinds of groups of similar care placement trajectories that cluster analysis may produce from the overall population of care placement sequences. In this example there are ten children's care placement histories in the first two years of care summarized in a state sequence plot on the left of Fig. A2. These can be grouped into two more homogenous clusters of sequences, one with children mostly looked after At home with parents, and the second with children mostly in placements With foster carers. The sequences in these two groups are not identical, but share broadly similar features.

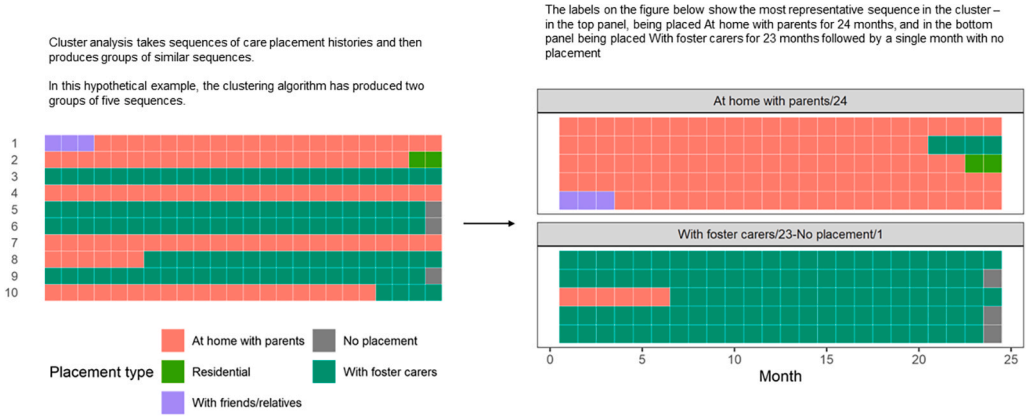

Fig. A3. Cluster fit measures for different number of placement stability clusters

Placement type transition matrix

Placement type	Type of next placement							
	At home with parents	Other	Residential	With foster carers	With foster carers (second +)	With friends/ relatives	With prospective adopters	No next placement
At home with parents	0.06	–	0.07	0.15	–	0.11	–	0.6
Other	0.08	0.28	0.13	0.23	–	0.07	–	0.21
Residential	0.14	–	0.41	0.1	–	–	–	0.29
With foster carers	0.16	–	0.06	–	0.36	0.09	0.05	0.24
With foster carers (second +)	0.1	–	0.09	–	0.44	–	–	0.28
With friends/relatives	0.16	–	–	0.11	–	0.17	–	0.52
With prospective adopters	–	–	–	0.05	–	–	–	0.91

Note: transitions with a proportion lower than 0.05 are not presented. Transitions include all placements in CLAS dataset (128,647), not just those for children included in the sequence analysis. Transitions to placements of the same type are highlighted in grey.

Data availability

The authors do not have permission to share data.

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