Lifecourse Modelling for Childhood Policy Analysis

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Abstract
The standard approach to analysing the long-term impacts of childhood policies involves separate modelling of different outcome domains for the treatment group only. We introduce a more informative and flexible approach which jointly models the dynamic co-evolution of diverse developmental, economic, social and health outcomes from birth to death for each child in the general population. This allows economic evaluation of diverse programmes using a common modelling platform. It also facilitates identification of new policy targeting options by pinpointing which kinds of children benefit most, and distributional analysis of impacts on lifetime inequalities. We illustrate by developing a birth cohort microsimulation model and using it to evaluate a training programme for parents of children at risk of conduct disorder.

Keywords
Simulation Modelling — Cost Benefit — Health — Human Capital — Skill — Inequality — QALY — Wellbeing

The full paper and technical details are available at: `https://equipol.org/projects/lifesim/`

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Background

Childhood programmes have important long-term consequences in terms of a wide range of outcomes [2, 6]. Trials and quasi-experiments are usually short-term and each study in isolation only provides insights about a few outcomes within a specific age range or demographic. Simulation modelling can provide the more complete long-term picture by combining different pieces of the puzzle. Our specific objectives are:

- to introduce a microsimulation model ("LifeSim"), capable of simulating both baseline levels of, and programme effects on, diverse life outcomes and public costs over the lifecourse for an English general population birth cohort;
- to conduct an illustrative lifecourse policy analysis of a training programme for parents of children aged 5 showing signs of antisocial behaviour [7];
- to show how lifecourse policy analysis provides new insights in terms of improved cost-effectiveness analysis, policy-targeting analysis and distributional impact analysis.

Methods

We simulate the life histories for 100,000 English children born in 2000-1. Outcomes up to age 14 are based on data from the Millennium Cohort Study. We then model the year-by-year co-evolution of later life outcomes using equations parametrised using the best available scientific evidence. The model structure was designed to align with knowledge about childhood development and its effects later in life, in consultation with an inter-disciplinary advisory group.

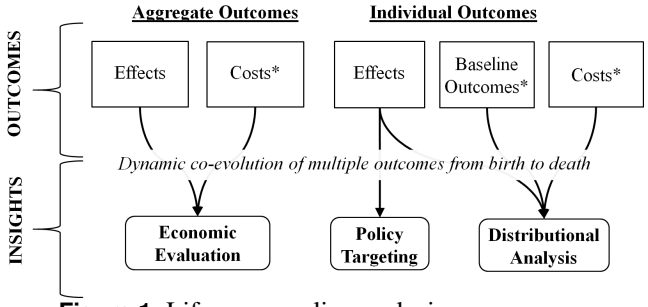

Figure 1. Lifecourse policy analysis: a summary.

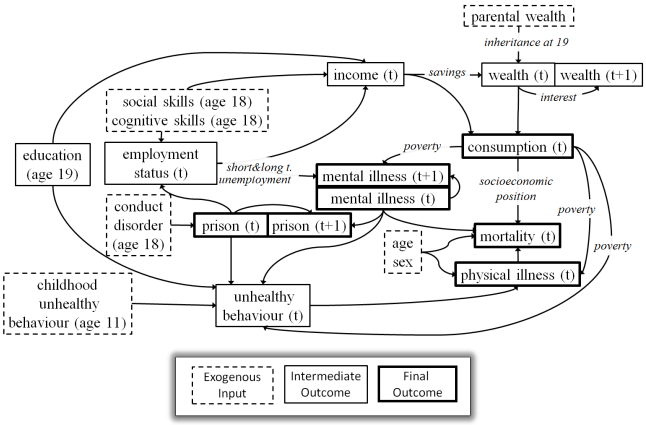

Figure 2. Model structure diagram for the 'working years'. See diagrams for the other life stages in the working paper.

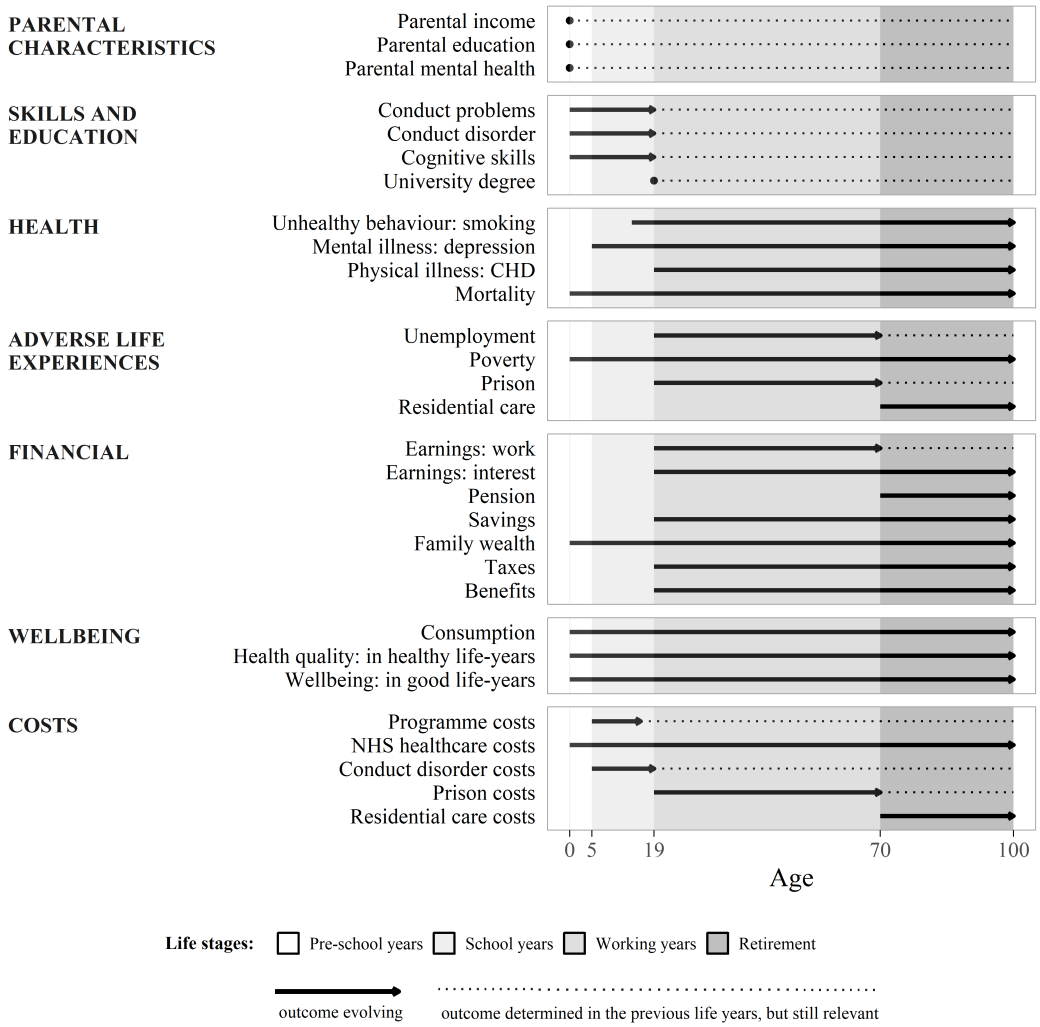

Figure 3. We model a wide range of life outcomes as they evolve throughout four life stages: preschool years, school years, working years and retirement.

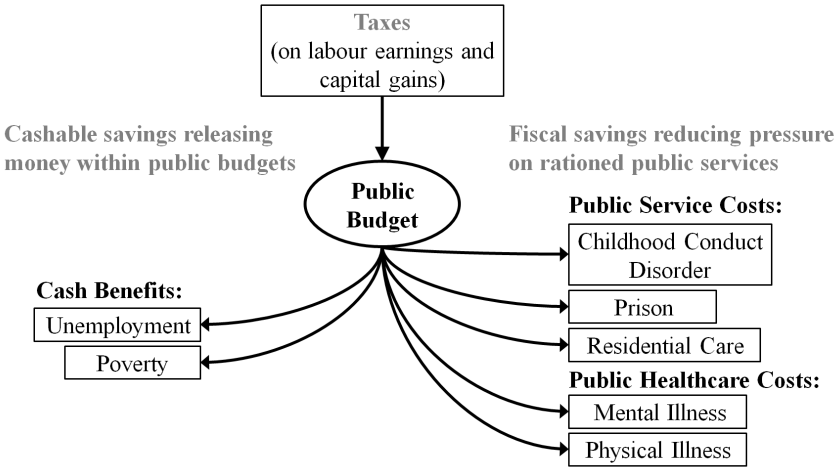

Figure 4. We model budget balance over time, taking into account the public costs over time associated with certain life outcomes, cash benefits paid to people in poverty and/or unemployed, taxes paid on individual earnings and financial gains.

We also model public budget balance (Figure 4), being able to assess the overall policy impact on the public budget as well as cost savings under different policy scenarios and over various time spans.

Primary Outcome Measure

We summarise lifetime benefits using **good years** which adjust for consumption as well as health [1]. A 'good year' corresponds to a year lived in full health, consuming the average income of a rich country.

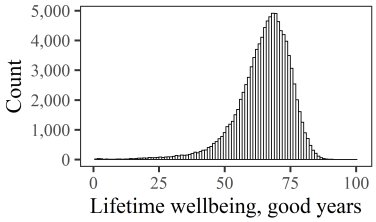

Figure 5. Distribution of good years in the simulated cohort.

Illustrative Policy Intervention

We illustrate how LifeSim can be applied to analyse the lifecourse consequences of a national parent-training programme, taking short-term effect data from a recent systematic review of randomised control trial evidence about the effects of the "Incredible Years" programme. We assume that the parent training programme:

(i) is delivered to parents of all 5-year old children screened as being at risk of developing a conduct disorder, based on a parent-reported SDQ conduct problems score at age 5 within the abnormal range;

(ii) causes an average 0.46 standard deviation decrease in the SDQ conduct problems and impact scores of a child recipient, with heterogeneous effects (relatively larger effects for the children of parents with mental health problems and for children with a higher baseline conduct problems score [7]).

In the online appendix we present results of sensitivity analysis to alternative assumptions about effectiveness.

Results

Average Effect on Conduct Disorder (CD)

	Without-policy	With-policy	Gain	SE
CD at age 5, %	34.18	18.01	-16.17	0.38
CD at age 18, %	17.67	12.48	-5.19	0.23
SDQ conduct problem score at age 5	4.73	4.03	-0.70	0.002
SDQ conduct problem score at age 18	2.96	2.35	-0.61	0.003
SDQ impact score at age 5	0.72	0.63	-0.09	0.002
SDQ impact score at age 18	1.05	0.94	-0.12	0.002

Table 1. The average effect of the parent training programme on conduct problems, among the 9,228 child recipients.

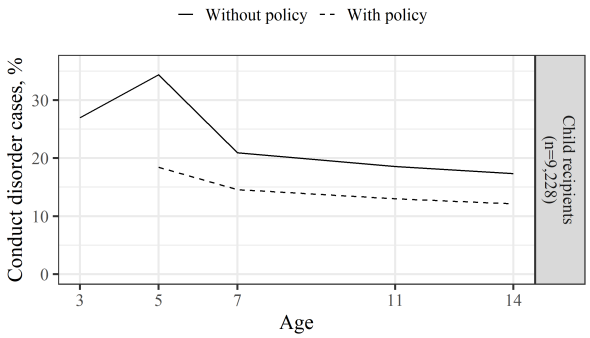

Figure 6. A reduction in CD cases at age 5, but the effect fades out over time.

Average Effects on Other Lifecourse Outcomes

	Without policy	With policy	Gain	SE
University graduates, %	33.24	33.95	0.71	0.09
Working years in unemployment, %	9.04	7.66	-1.38	0.04
Life years in poverty, %	33.85	32.52	-1.32	0.04
Working years in prison, %	3.14	2.26	-0.88	0.04
Retirement years in residential care, %	4.22	3.59	-0.63	0.04
Adult years as a smoker, %	15.28	13.53	-1.75	0.08
Adult years with CHD, %	6.37	6.40	0.04	0.01
Life years with mental illness, %	13.00	11.41	-1.59	0.06
Total life years (life span)	78.52	78.69	0.17	0.02
Premature mortality rate (before age 75), %	29.01	28.54	-0.47	0.07
Annual earnings (lifetime average), £	29,511	29,800	291.34	10.09
Annual savings (lifetime average), £	2,807	2,848	41.23	1.82
Annual interest (lifetime average), £	327	355	27.93	0.78
Annual consumption (lifetime average), £	21,589	21,876	286.62	8.44
Healthy years	66.03	66.46	0.43	0.02
Healthy years (discounted)	39.90	40.09	0.19	0.01
Good years	61.86	62.55	0.69	0.02
Good years (discounted)	37.54	37.85	0.31	0.01

Table 2. The average effects on other outcomes, among the 9,228 child recipients. Discount rate: 1.5% annually [9].

Public Cost Savings and Revenues

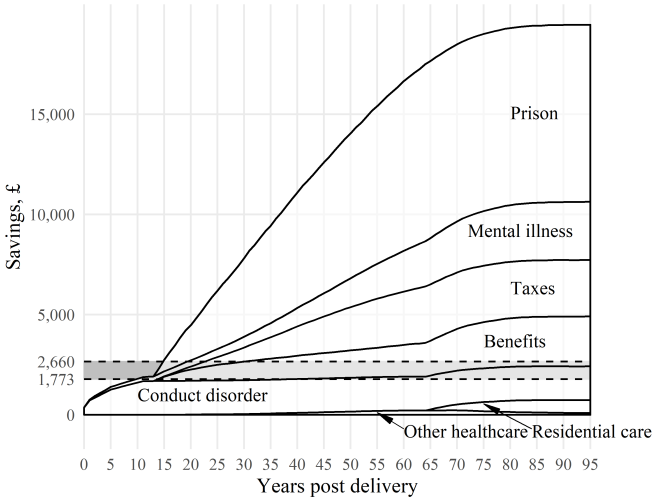

Figure 7. Estimated savings per child recipient over time in 2015/16 prices, discounted at 1.5 % annual rate [9]. The gray area marks the range of the programme cost [3].

Individual Level Gains

Even though the average benefits are relatively small, some individuals benefit substantially.

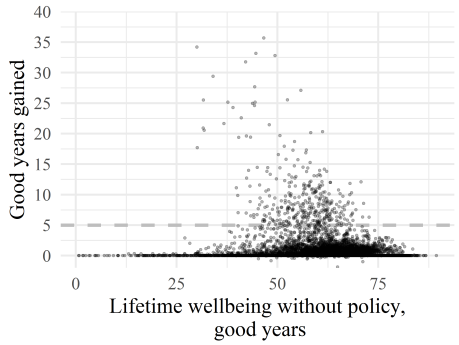

Figure 8. Good years gained versus baseline lifetime wellbeing among the 9,228 child recipients.

Good years gained	Recipient children	
	N	%
less than 1	7,785	84.36
1-2	732	7.93
2-3	194	2.10
3-4	99	1.07
4-5	72	0.78
5-10	245	2.65
10+	109	1.18

Table 3. Distribution of policy gains

We identify and evaluate two alternative ways of targeting the programme more narrowly: (i) offering training only to parents who live in poverty and have a 5 year old child with high conduct problems, i.e. SDQ conduct problem score 7 or above (scenario 2); and (ii) offering training only to the subset of such parents who have a university degree (scenario 3).

Policy Targeting

Sc.	N	Total policy cost, 1000£	Good y-rs gained/ recip-ient	Total good years gained	Cost/ good y-r gained, £	Lifetime cost sav-ings/ recipi-ent, 1000£	Pay-back pe-riod, years	Oppor-tunity cost, good y-rs lost	Net total good y-rs gained
1	9,228	20,454	0.69	6,367	3,212	19	15	1,490	4,877
2	494	1,095	1.27	627	1,745	40	15	80	548
3	42	93	5.45	229	407	147	4	7	222

Table 4. Policy cost-effectiveness after re-targeting: Sc.-scenario; the parent-training programme is assumed to cost £2,217 per recipient, and the opportunity cost of a good year to other public services is £13,724.

Distributional Effects

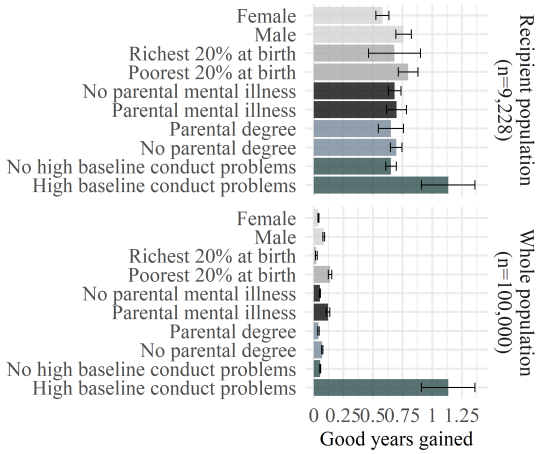

Figure 9. Lifetime impacts by childhood circumstance with 95% confidence intervals.

Childhood circumstance	N	Annual consumption, £		Lifetime health, healthy years		Lifetime wellbeing, good years	
		Baseline	Gain	Baseline	Gain	Baseline	Gain
Best off 20%	20,000	32,559	3	68.71	0.02	69.59	0.03
Worst off 20%	20,000	18,471	62	66.31	0.10	59.84	0.15
Difference		14,088	-58	2.40[1]	-0.08	9.76	-0.12
Extreme best off	12,149	32,909	3	68.81	0.02	69.83	0.02
Extreme worst off	26	16,808	914	62.16	1.78	54.51	2.55
Difference		16,101	-910	6.66	-1.76	15.32	-2.52

Table 5. Whole-cohort lifetime inequality impacts: absolute policy gain for the most and least advantaged subgroups, calculated based on childhood circumstances.

Discussion

We illustrate how lifecourse microsimulation can be used to improve analysis of childhood programmes.

Findings of the Illustrative Evaluation

We find that the beneficial short-term effects fade out after a few years, since many apparent socio-behavioural problems resolve in due course without parent training. Despite this fadeout, we estimate that public cost savings cover the cost of the programme within the first ten to fifteen years, and that substantial further savings accrue into adulthood.

We also find that later life benefits are small on average but that a subset of recipient children enjoy substantial gains in lifetime wellbeing – about 4% gain five or more years of good life. We are able to identify a set of family circumstances and child characteristics that predict capacity to benefit, and show how this information can be used to identify and evaluate

intelligent ways of re-targeting the programme to increase cost-effectiveness and reduce total up-front cost.

Our distributional analysis suggests that the programme disproportionately benefits children from socially disadvantaged backgrounds and contributes to reducing inequality of opportunity for lifetime wellbeing on various measures of distributional equity. For example, we estimate an extreme group gap in expected lifetime wellbeing between children born with the best and worst life chances, based on family circumstances and early life characteristics, and find that the programme reduces this gap by 2.52 good years.

Strengths and Limitations

The main strength of our framework is that it captures the dynamic interaction between a rich set of social, economic and health outcomes over the lifecourse, and shows how this generates substantial individual-level heterogeneity in long-term policy outcomes.

Another advantage is that our framework allows the application of new multidimensional summary indices of wellbeing [1, 8, 4, 5], which are more informative than conventional monetary valuation, as they account for the diminishing marginal value of consumption and other sources of heterogeneity in the marginal value to different individuals. However, applying these metrics requires detailed individual-level data on outcomes over lifecourse. The rich life history data produced by our framework can readily be used to construct such measures.

Our proposed approach is flexible and can easily be extended in order to incorporate a range of specific features, the current model has various limitations that could be addressed through such extensions. We have devoted considerable time and effort to parameterising each of our lifecourse equations. However, larger teams of researchers would be able to improve each equation by adopting more systematic approaches to reviewing evidence and to eliciting expert beliefs about biases in applying causal effects estimated using historical data to predicting future trends.

Research Implications

Despite the limitations of our illustrative model, the general framework within which it is embedded provides a flexible and informative new approach to long-term childhood policy analysis which opens up an exciting research agenda. Policymakers are often accused of "short-termism", and the lifecourse perspective often receives short shrift in public debates. Lifecourse policy analysis can potentially help keep the lifecourse perspective in view, by routinely providing policymakers with detailed and credible information about long-term policy consequences. We hope that this study will encourage others to develop better microsimulation methods, which address some of the limitations of our model and provide policymakers with useful insights about the lifecourse consequences of alternative policy options across all sectors of public policy.

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