UNIVERSITY OF PLYMOUTH

TIME FOR CHANGE: A STUDY OF ENROLMENT DECISION DYNAMICS FOR ADMISSION INTO ENGLISH SECONDARY EDUCATION

by

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A thesis submitted to the University of Plymouth in partial fulfilment for the degree of

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Acknowledgements

Finally, a useful reminder from the past that has helped the author disprove some personal assumptions and surface many mental models through the lensing capabilities of system dynamics:

"O teach me how I should forget to think (1.1.224)"

William Shakespeare, Romeo and Juliet.

Author's Declaration

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Doctoral College Quality Sub-Committee.

Work submitted for this research degree at the University of Plymouth has not formed part of any other degree either at the University of Plymouth or at another establishment.

The following external institutions were visited for consultation purposes:

Plymouth Admissions Authority; Plymouth Multi-Agency Support Hub; Ridgeway Secondary School, MAP Secondary School, Canbridge Special School; Livewell Southwest, Plymouth Advice and Information (SEND).

Publications (or public presentation of creative research outputs):

Carter, D., Moizer, J. and Lui, S. (2014). Using Scripts for the Construction of Management Simulation Models in the Context of Multi-Agency Engagement. *International Journal of Innovation, Management and Technology.*

Presentation at conferences:

Change by Design: Systems modelling and simulation in healthcare. NHS Confederation Conference, 26 - 27 November 2012. (Exeter);

UK Chapter System Dynamics Conferences (London) from 2014-2017;

ISDC 2013 student colloquium paper;

Prize award research paper "Using scripts for the constructing of models in the context of multi-agency engagement" presented at the 4th International Conference on Strategic Management and Research. Plymouth 3-4 July 2014.

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Title of thesis: Time for change: a study of enrolment decision dynamics for admission into English secondary education.

Abstract:

Cross-sectional studies suggest a prevalence of mental health problems from the age that children change to English secondary schools but there are few longitudinal appraisals of these issues and how enrolment policies influence psychological wellbeing. This research focuses on key factors linking competition for secondary schools and family responses to such challenges to determine enrolment policies that can sustain wellbeing longer-term.

Integrated, model-based multimethodology was used in this urban, case-based study. Views were induced from multi-agency, expert practitioners to agree a system dynamics concept model. Parental decision-making behaviours were deduced by survey to understand key factors for model calibration. Dynamic system sensitivities were abduced from the simulation model before comparing long-term psychosocial impacts on children from expert, policy-support suggestions.

Modelling demonstrates that two principal feedback loops influence family psychosocial systems when deciding secondary schools (parent-child wellbeing reinforcement plus knowledge of schools balancing parent concerns). Exogenous competition stressors on psychosocial systems can erode parent knowledge while testing student resolve. Competition guidance to remove risk-laden school options (league table comparison) before sequencing any remaining choices by profit (school visits), are not always used deciding urban secondary schools. Instead, families lacking experience can adopt decisive styles based on parent needs alone. Given autocratic leadership, child wellbeing rapidly deteriorates when student needs cannot be met by schools. Rather than ending student-selective entrance tests or raising knowledge of schools at visits, effective multi-agency support policy helps by increasing school choice debate frequency within families to address psychosocial system imbalances.

The research makes a clear, three-way contribution to knowledge. Firstly, intrinsic case study theory is enhanced by data triangulation between induced, deduced and abduced research approaches. Secondly, the system dynamics discipline is strengthened by studying compulsory school enrolment. Finally, developing practice-based policy through multi-agency groups endorses cooperative rather than unilateral solutions, for helping change lives.

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Glossary of Terms (acronyms are emboldened)

11+ - Eleven Plus examination. A common entrance examination used by selective secondary schools across England based on year 6 curriculum.

ABM – Agent Based Modelling.

Autocratic decision – families selecting schools only based on needs of parents (only half of the potential needs when student requirements are ignored).

Balancing. Behaviour resulting from a feedback loop that makes a stock become more horizontal when plotted over time.

Base run. Assumes the combined effects of external stressor assumptions and internal diverters on school choice dynamics. A diverting proportion of eighths and autocratic parents limited knowledge to 50% are used to configure the system for vulnerable standard and SEND families. Also see equilibrium.

Burnout. A stressor for child wellbeing where preparing for common entrance, KS2 and streaming tests in successive years requires additional home-based hours of work causing overshoot and collapse behaviours commonly reported in adults working over their normal workloads for overtime payments, etc. (Homer, 1985).

CAMHS – Child and Adolescent Mental Health Service. provided by Livewell Southwest (formerly Plymouth Community Healthcare - PCH) social enterprise in Plymouth to NHS clinical commissioners (Shotter, 2013).

Choices. 3 chosen secondary schools from available options around Plymouth in preference order on common application form (paper or online).

CCG - Clinical Commissioning Group (Zachariadis *et al,* 2013).

CLD – Causal Loop Diagram. Summary chart explaining reinforcing and balancing loop interactions based on SD simulated model behaviour.

Concept Model. A qualified system dynamics model capable of explaining key interactions relating to problem behaviour and associated structure.

Cross Impact Analysis. A means of analysing statistic survey returns to determine data trends by counting tabulated categories.

CSE - Certificate in Secondary Education.

CWB – Child Wellbeing.

CYP - Children and Young People.

Decision. Actions taken at a particular time resulting from applying policy rules to particular conditions that prevail at that specific instance e.g. school choice decision (also see policy and process).

Decision Maker. Adult applying for secondary school place on behalf of child.

Democratic decision – families selecting schools based on needs of all parties (all the potential needs when student requirements are included).

DES - Discrete Event Simulation.

Disadvantage. Children regularly experience disadvantageous factors living in families that serve to divert attention. These factors can accumulate where 2 offers little likelihood of suffering low wellbeing but more than 7 makes low wellbeing more certain. The factors are shared with adults in the family and therefore serve to divert attention away from issues concerning school choice.

Diverter. Division of an individual's attention or knowledge influencing behaviour within the family system that results in loss of focus over time (also see stressor for exogenous system losses).

Diverter */2. System halving the proportion of influence for each flow, representing one extra thing for parent but also child to consider.

Diverter */8. System dividing the proportion of influence for each flow by eight, representing seven other things for parent but also child to consider.

Dropout. A stressor for adolescent wellbeing where preparing for KS4 GCSE tests in successive years that requires additional home-based hours of work causing overshoot and collapse behaviours.

ELSA - Emotional Literacy Support Assistant. Assistant trained to help children with emotional wellbeing in primary schools (Leighton, 2015).

Equilibrium. Stocks within loops maintain levels throughout the simulation run based on diverter halving factor and constant exogenous losses for standard and special educational needs/disabilities children (also see STD and SEND).

Exogenous. External system stressors from schools competing for clients that reduce levels within a stock (assumed constant)

Family. A minimum of a student and decision maker applying for secondary schools.

FET – Fisher Exact Test. A means of analysing cross-impact survey results for bias within a small sample using deductive reasoning (Hess and Hess, 2017).

Flow – a rate of gain or loss, either into or away from a stock.

GAMIFY 7 – policy supporting weekly feedbacks in autocratic families on needs met by schools for parent and child using a standard board game.

GAMIFY F - policy supporting weekly feedbacks in autocratic families on needs met by schools for parent and child using a bespoke board game to local authority area.

GCSE - General Certificate in Secondary Education.

GMB – Group Model Building. Method for constructing system dynamics models from participant views using scripts. Results are generally qualitatively induced to produce a concept model.

HMG – Her/His Majesty's Government.

Hybrid - a combination of hard, quantitative techniques used to help solve OR problems.

IAPT - Improving Access to Psychological Therapies. A common approach for recording and comparing psychological therapy practices in England (Fonagy *et al*, 2017).

Inexperienced - families who have not previously sent siblings to city secondary schools.

K12 – Kindergarten to year 12.

KS – Key Stage. KS2 refers to the end of primary education with knowledge tests.

KNM - Knowledge of Needs Met. Number of personal requirements each school can satisfy at a point in time. A 50:50 split of needs equally between parent and child leads to 100 percent knowledge of the specific secondary school choice problem. Additional needs are likely as children become adolescents and a flexible response may therefore be necessary. A stock of ongoing knowledge enables rapid response to change should needs no longer be met and new providers needed.

LEA - Local Education Authority (Baxter, 2017)

LESS T - policy providing less exposure for children in autocratic families preparing for tests in year 5 of primary school by ending selective testing practices

Livewell Southwest. A social enterprise provider of community health and social care services to joint commissioners in Plymouth, UK replacing previous providers (Care Quality Commission 2016: also see PCH).

Looked after children - students who possess additional priority when selecting secondary schools who are not cared for by birth parents, but rather the local authorities.

MAG – Multi-Agency Group. A group of experts practiced in different disciplines and working for diverse organisations, supporting the emotional needs of children as they transfer schools aged 11. In Plymouth, the MAG was supported by CAMHS for health, Secondary schools for education plus MAST and PIAS for council services.

MAST – Multi-Agency Support Hub (Plymouth).

Modelling Multimethodology. A series of soft, qualitative and hard, quantitative OR techniques used together for generating and interpreting data within the modelling environment.

MORE K - policy providing greater knowledge for autocratic families of CAMHS services at school open events during the annual, two-month admissions window by assuming double the proportion.

NEET – Not in Employment, Education or Training.

NHS – National Health Service. National provision of health service free to British.

NSPCC – National Society for the Prevention of Cruelty to Children (charity).

Ofsted. Inspectorate for schools across England.

Options.17 Plymouth secondary schools and a further 3 nearby (Devon and Cornwall) from which to choose up to three indicating the most preferred.

OR – Operational Research.

Outdate. A stressor for family knowledge where rates of change between competing providers removes historical knowledge of available school options.

PCC – Plymouth City Council.

PCH – Plymouth City Healthcare. A former social enterprise provider of community healthcare services to health commissioners in Plymouth, UK (Care quality Commission, 2016: also see Livewell Southwest).

PIAS – Plymouth Information, Advice and Support. A council provided service for families.

Policy. Desired outcomes of operating process given the available inputs e.g. open choice policy (also see decision and process and specifically SHORTER, MORE K, GAMIFY 7 and GAMIFY F).

Preferred. The most preferred school choice.

Primary school - compulsory state education in England for children aged 5 to 10 years. Typically, KS2 SATS curriculum.

Process. The interpretation of policy aims stating how decisions rules are applied that arrive at a desired outcome reliably e.g. school admissions process (also see decision and policy)

PWB – Parent Wellbeing.

Referral. A request from professionals or now individuals, for assessment by CAMHS when low wellbeing threshold are exceeded.

Reinforcing. Behaviour resulting from a feedback loop that makes a stock become more vertical when plotted over time.

SAMHS - Secondary Age Mental Health Support (Plymouth City Council, 2012).

SAT - Standard Assessment Task (Connor, 2003).

Script. A design of process for eliciting model-based data from participants based on Scriptapedia.

Scriptapedia. An encyclopaedia for eliciting data from participants for building System Dynamics models.

SD - System Dynamics. A model-based method for abducing policy decision rules from structure (also see CLD and SFD).

SDM – System Dynamics Model. Quantified model calibrated using real-world parameters.

Secondary school - compulsory state education in England for children aged 11 to 15 years (typically GCSE curricula).

SENCO – Special Educational Needs Co-Ordinator (teaching appointment in schools).

SEND – Special Educational Needs and Disabilities. Category for students with additional needs (Robinson et al, 2018: also see STD).

SFD – Stock Flow Diagram. Diagramming notation for SD simulation model that also provides simultaneous equations with values describing motion of system.

Sixth form / further education college - compulsory state education in England for children aged 16 to 18 years (typically A-level curricula).

STD – Standard. Category that identifies mainstream students (also see SEND).

Stock. An accumulation that can be estimated or measured.

Stressor. Exogenous loss from a family's psychosocial system (also see diverter for losses within the feedback system). Chronic stressors take effect over a long period of time and reduce well-being whereas acute stressors are short-lived and associated with potential for learning from 'flight or fight' response exhibited by humans. Also see diverter.

Student. Child involved in transferring to and studying at a secondary school.

TCS - The Children's Society. A charity producing annual well-being reports on children and young people across England

Threshold. A value beyond which change may be necessary, whether higher or lower.

Well-being. Defined by the World Health Organisation (1948) as even contributions from physical, psychological and social personal resources, well-being ontologies have been refined over many years. Closely related is the concept of quality of life with objective aspects that cover socioeconomic status as well as subjective, personal experiences (Rapley, 2003). Rather than taking an ontological hierarchy perspective, Lawton (1991) suggests a causal model with influences between the individual's objective environment, their behavioural competence (incorporating physical health) consequent quality of life perceptions and resultant psychological well-being. Nordenfelt (1991) goes further by suggesting that psychological well-being may offer a reflective criterion, or feedback, on a good quality of life (used in the philosophic tradition of subjective hedonism and psychological eudiamonia). Self-reported well-being refers to the measurement devices used to capture personal perceptions.

Wellbeing. A composite measure of psychological well-being used for dynamic modelling that combines different types of short-term or hedonic and long-term or eudaimonic well-being responses from individuals into a single measure that describes the realisation of perceived, personal potential given their objective environment, behavioural competence and quality of life. The metric is normalised per person to reflect individual levels of wellbeing stock held by an individual at any particular point in time (PWB or Parent WellBeing and CWB or Child WellBeing reflect dynamic, psychosocial factors influencing families facing challenges for example). This definition of wellbeing does not reflect the physical potential of individuals. Instead it seeks to determine psychological confidence in deploying personal resources to sustain a good quality of life.

1. Introduction and background to CAMHS referral problem

1.0 Introducing referrals for children seeking behavioural support

Rising referrals for self-reported, low levels of well-being (see Glossary xxii-xxviii) are being experienced by Child and Adolescent Mental Health Services (CAMHS) as children prepare for, and then navigate, English secondary education. In 2013 only 45.4% of referrals to CAMHS came from children in secondary schools but as of 2015, over 48.3% of referrals for children occur during their time in Plymouth secondary schools with only 25.2% from primary school and 26.5% from sixth-form college (Plymouth Community Healthcare, 2015). Overall CAMHS referrals are rising for children aged between 5 and 18. A 13.5% reported increase between 2013 and 2015 across Scotland for example (Murphy, 2016) compares to an even larger rise in city of Plymouth where a 24.3% rise of children referring from primary and secondary schooling over the same period (Plymouth Community Healthcare, 2015). Such calls for emotional and behavioural support outpace rising numbers in secondary education, even though the greatest source of demand from the school roll count, places ever more pressure on limited CAMHS resources.

While demand appears to be rising, fewer of those children referring will pass high-set, threshold tests for treatable, mental ill health conditions (Western Health and Social Care Trust, 2012; Royal College of Psychiatry, 2013) and may therefore get referred elsewhere creating further demand on limited support services for children. Urban centres of population are therefore experiencing rising demand. The demand profile also rises with successive cohorts as they approach adolescence while passing through secondary schools up to sixth form college or other education, after which time referral rates remain steady before decreasing following two further years spent in Plymouth colleges for example (489 and 485 referred in GCSE (see Glossary xxii-xxviii) years 10/11 and A-level years 12/13 in 2015, compared to 410 and 416 in 2013).

Of course, local effects may mean less healthy families, potential increases in poverty following the banking collapse in 2008[2] or the rise of internet-based, mobile

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[2] Sub-prime mortgage lending to house owners in the US prior to 2008 is largely attributed with a collapse in confidence in the banking industry. As a global industry, banking shares risk and so inability to repay substantial loans made

telephony establish new bullying opportunities that place further demands upon child well-being (Tarapdar et al, 2013). However, such influences do not depend on a child's age and would be unlikely to offer explanations for rising referrals with age cohorts starting from the time where schools are changed. A more representative approach to the referrals problem would therefore seek to better understand the common emotional challenges associated with adolescence combined with the additional family stressors (see Glossary xxii-xxviii) of competing for secondary school places. The investigation will also consider age dependent changes in the wider school environment for children as competition seeks to optimise academic achievement.

Whereas child well-being can indicate a state of feeling healthy and happy, this research uses the term well-being to seek answers to the contentment and success dimensions of emotional happiness (Collins, 1994). For children referred to Child and Adolescent Mental Health Services (CAMHS), a reduced level of well-being has been experienced and/or observed that is sufficiently concerning to seek further help from the medical profession. This may not amount to a treatable, mental ill health condition for CAMHS professionals, at which point no further consultation is offered. Unfortunately, situations involving low emotional happiness left unsupported can rapidly deteriorate into conditions involving mental ill health over time (The Children's Society, 2013).

This explanatory research is designed to help understand what has greater effect on the common English trend of rising referrals with age in secondary school by modelling the impacts over time from school choice on well-being within the family setting to ascertain where support policy (see Glossary xxii-xxviii) may be improved that reduces CAMHS demand. Answers are needed to determine new insights that can be tested on the referral problem to determine a better way forward that can be sustained.

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through mortgages in the US became contagious, affecting not only US but also UK banks (Ivashina and Scharfstein, 2010; Popov and Udell, 2010). The reduction in income to the UK's exchequer resulted in austerity measures to reduce public spending and consequent unemployment.

The chapter scope therefore covers definitions of terms associated with state education and well-being for children, trends in mental health referrals for children, anticipated rises in students enrolling and the provision of support services. Recent changes in English legislation are also covered in respect of their impact on the provision of services to vulnerable children.

1.1 School choice and referrals

The research aim is to establish causal theory around competitive urban secondary school choice in England by answering a local question concerning connections between competition for school places and rising student referrals to Child and Adolescent Mental Health Services (CAMHS) as they progress through secondary school (other than those referrals explained by health, learning and other social vulnerabilities experienced by a small proportion of individual students). A key development from this research would be establishing what shared support from multiple agents for children transferring schools could be effective at countering any such behaviours. Chapter 1 explores extant secondary data surrounding the Plymouth case study issue.

Plymouth is a large city with a growing population of some 260,000 people (Goodwin, 2016) located in the South West of England but population can fluctuate over the course of a year as the university has, for example, over 30,000 higher education students enrolled during term-time each year. Such movements can place additional pressures on health services across the city but specialised general practice helps reduce routine demand for healthcare. Since 2015, the city now transfers growing numbers of students from primary to secondary schools across the city each autumn which represents the normal point of entry for most secondary students entering their new schools in year 7. While Plymouth experiences student immigration and emigration for the purposes of compulsory education, the majority of state students remain in Plymouth with 2,815 children anticipated to transfer into larger secondary from smaller primary schools in September 2018. Independent or private fee-paying schools are sometimes afforded when families are unable to get their most preferred (see Glossary xxii-xxviii) state secondary place offer within the city following competition for places at well regarded establishments.

Where bullying remains largely independent of time, the choice of school affects all children at the same age . The Admissions Authority enrolment process (see Glossary xxii-xxviii) in Plymouth is typical for many urban areas in England (excepting metropolitan London) when parents need to consider secondary schools prior to leaving primary education. Parents are asked to select up to three secondary schools in the order of preference at the start of the last year in primary school education when schools publish prospectuses and open their doors for families to visit. Both September and October are available for making decisions and submitting a form using paper and online systems to apply for secondary school places. Prospective school visits generally take place in the evenings when parents and children can attend and listen to teachers and students talk about their schools. Often, a teacher who is designated for managing year 7 enrolment will answer specific enquiries from parents and potentially arrange to meet them individually during school time.

One difference for Plymouth over some English cities is that such decision making may commence even earlier (year 5) for some families. Selective grammar schools are available that require high academic test scores on which offers of places are based. The tests are taken at the start of year 6 so that results can help inform which school to apply to if test scores are lower than required. As the test is based on year 6 curricula for primary education, home-coaching or professional-tutoring is often necessary to introduce the student to the year 6 material during year 5. Thus, additional work is required of such children to learn enough to answer questions accurately under examination conditions known as "11+"(see Glossary xxii-xxviii).

Table 1.1 presents associated terminology with English education with typical secondary school provider option types available in many urban centres of population. The table indicates all chronological education timings in rows along with a column for typical examinations taken by children in different school settings. It is notable that larger urban centres would have both university and city technical colleges where as such schooling would not necessarily be available to children in rural areas.

Table 1.1 English State Education Terminology and Secondary Options in 2017

Key Stage	Cohort Year Group	Examination	Age	School	Secondary school types
Early Years	Nursery		3-4	Optional with some voucher funding	(local school or fee-paying Independent)
	Reception Year R		4-5		
KS1	Year 1		5-6	P	
	Year 2		6-7	R	
KS2	Year 3		7-8	I	
	Year 4		8-9	M	
	Year 5	11+ coach and tutoring	9-10	A R	
	Year 6	11+ start SATS end	10-11	Y	
Transfer primary to secondary schools following Admission Authority process					
KS3	Year 7	Optional Streaming or Setting	11-12	S	Academy, Free, City Technical College, University Technical College; Selective; Voluntary, Beacon, Faith, Grammar, Comprehensive, Maintained
	Year 8		12-13	E	
	Year 9		13-14	C O N D	
KS4	Year 10		14-15	A	(or fee-paying Independent)
	Year 11	GCSE end	15-16	R Y	
Transfer secondary to sixth-form or further education college					

Ryan and Deci (2001) explain psychological well-being as changing humans for the better. Better is not just happier: while hedonic well-being is short-lived, a longer and

more resilient definition of better is offered by eudaimonic well-being or reserves of human potential. The stock (see Glossary xxii-xxviii) of well-being retained by an individual represents a resilience that offers recognised properties of anti-stress and resistance to disease for example. A negative affect stressor offers the individual an opportunity to recharge their emotional potential as well-being is drained away. Equally the value derived from positive relationships offers a means for quickly recovering levels of well-being compensating for any losses that are experienced. Of key importance to children transferring schools is the value placed in feedback from others that confirms their competence and autonomy in supporting the process of change both short and long term. The definition for an integrated term (not hyphenated) called wellbeing hereafter, combines short-term hedonics with long-term eudaimonia into a single, composite stock reflecting the degree of fulfilment perceived by a person that varies over time. This study quantifies the term wellbeing to mean the fulfilment of an individual's perceived potential where low wellbeing (0%) is represented by absolute frustration and (100%) high wellbeing reflects peak accomplishment at the opposite end of the scale.

1.2 Rising student numbers at school

As show in Figure 1.1, predicted student numbers from local government show a steady rise in numbers transferring from primary to secondary schools over the next ten years based on current population census records. The graph shows individual future years in cohort groups as students pass through Plymouth state education in primary (year R to y6) and secondary (y7 to y11) schools. It can be seen that a rise for numbers transferring in excess of 12% is anticipated between years 2018 and 2027 where increases are continuous as the population surge reaches year 11 culminating in GCSE competitive examinations up until 2027. While similar raised levels of demand have been seen in primary schools, first preference places are not always available as building extra capacity in popular schools takes time to catch-up with demand for school places in the area. The delay in meeting demand places pressure on council, education and health services associated with the city as they seek extra resources to cope, typically after recognising demand for CAMHS referrals across all supporting organisations and networks.
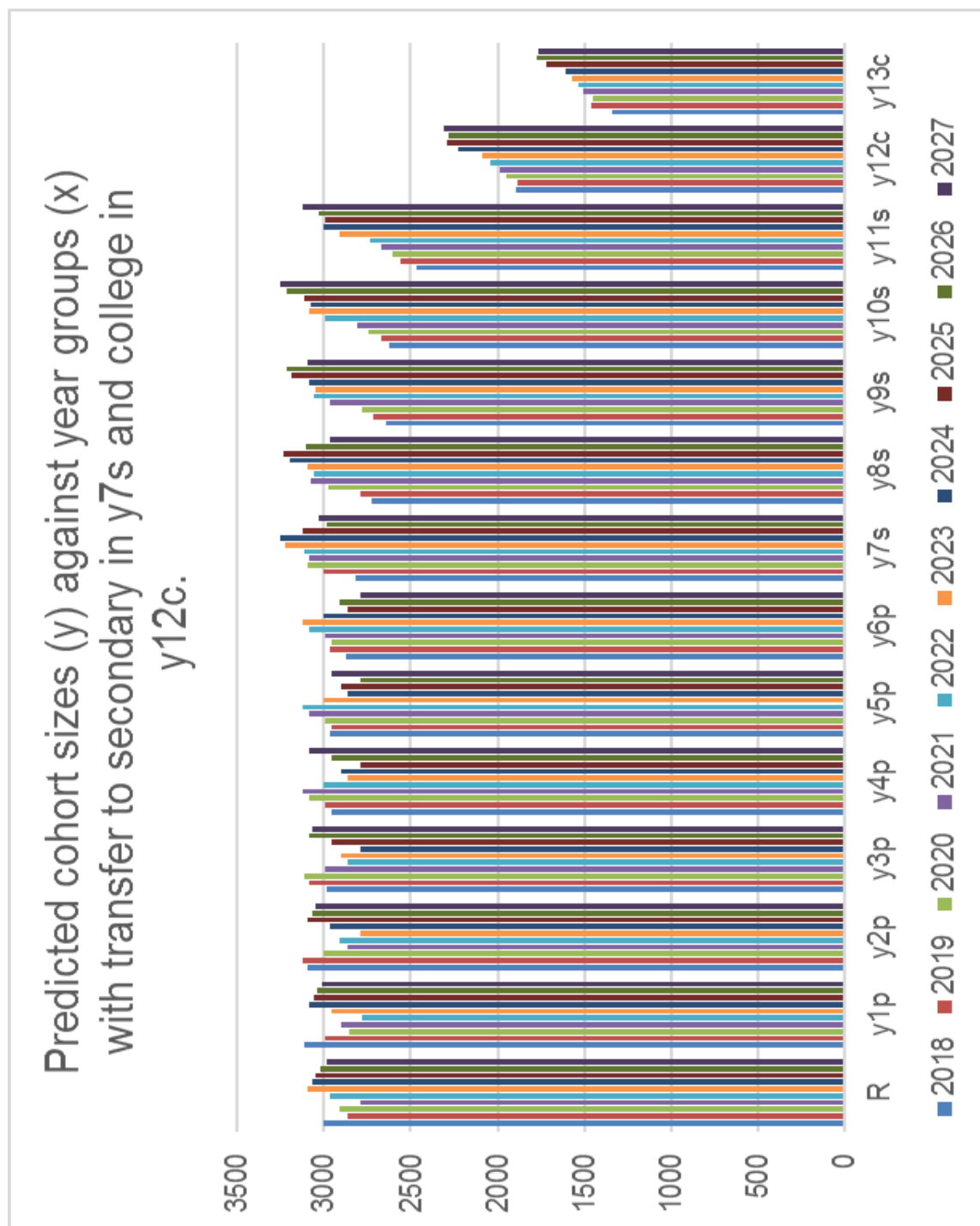
Figure 1.1. Predicted cohort numbers of Plymouth primary, secondary and college students over forthcoming years (source Plymouth City Council, 2017a)

1.3 Raised referral rates from preparing for transfer into secondary education

While successive cohorts may be healthier, there remains a well-established trend across England, but also in Plymouth, demonstrating how mental health referrals rise

with age until the end of secondary education, after which time they fall back once again. In a recent request for data from 66 trusts across England, the NSPCC reported significant CAMHS referral rises with 55% of those returned being attributed to referrals from children of primary school age[3] (Siddique, 2018). Exam pressures and social media[4] are commonly mentioned by young people calling the NSPCC's Childline[5] service. Those children refused further psychological treatment often ask the charity to mediate CAMHS support on their behalf. Where inadequate resourcing has raised threshold criteria for CAMHS accepting a referral, inability to access help also exacerbates the concerns of children calling the NSPCC helpline.

Figure 1.2 describes this trend for Plymouth referrals to CAMHS for the period 2010-2015. Each cluster of coloured columns defines one age of children referring for support, often following some period of unusual behaviour dominated by low-well-being. Each column within the band reflects numbers referring for each of the years in the five-year period covered by the data. Notable rises commence from age 9 (corresponding to year 6 in primary school) and continue through adolescent years until the age of completion of secondary school at 15 (year 11) after which time the trend in referrals reduces. Even though some issues with recording data may have affected particular years (when recording systems were changed in Plymouth for example during 2014) the Plymouth secondary rise in referrals is consistent with national survey data for England (The Children's Society, 2013). This would leave random, event-based personal factors (bullying, family break-up, ill-health, etc) unable to explain such increases with age just prior to changing school and therefore suggest systemic influences are present and operating to reduce well-being levels below acceptable thresholds (see Glossary xxii-xxviii) to either the child, their parents

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[3] The NSPCC sent 66 NHS Trust in England a Freedom Of Information Act request asking for the number of CAMHS referrals they have had from education settings in the last three years (April 1 to March 31, 2014-15, 2015-16, 2016-17 & 2017-18). This also included an age breakdown (11 and under, 12-15 and 16+) and the number of referrals who were and weren't eligible for treatment. 53 Trusts provided time series data for the total number of CAMHS referrals they have had from education settings: 25,140 referrals for 2014-15 and 34,757 for 2017-18. The NSPCC do expect the number to be much higher as some of the Trusts didn't provide information for all four years. Not all of the 53 Trusts provided breakdowns for referrals eligible and not eligible for CAMHS treatment. Of those 45 Trusts that did respond, a total of 6,129 referrals were rejected in 2014-15 and 9,038 referrals were rejected in 2017-18.
[4] Where exam pressures are based on age of child, those relating to social media are not.
[5] Such concerns are also voiced by a recent joint publication between select committees from health and social care plus education in the House of Commons (HOC, 2018) with the additional (repeat) demand on CAMHS raised by student exclusions for mental health issues to Pupil Referral Units.

or both. The upward referral trend is anticipated to continue with rising school populations in Plymouth. For example, year 11 in secondary school is predicted to rise by over a fifth in successive years during the period 2018 to 2027 placing even greater pressure on services.
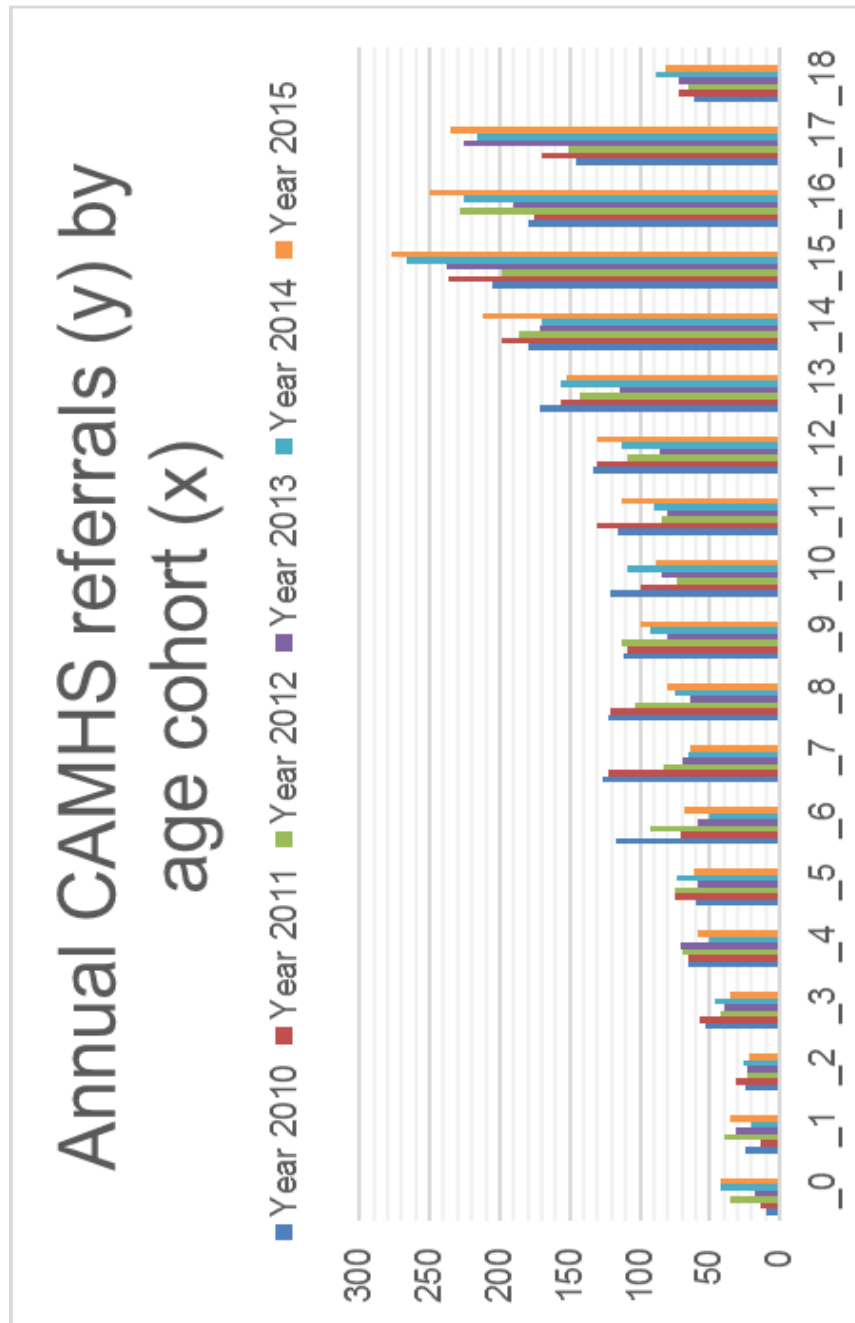
Figure 1.2 Rise of low well-being referrals with age to CAMHS for Plymouth students (source Plymouth Community Healthcare, 2015)

The length of time before low child well-being thresholds are breached is therefore an important consideration in the educational system. This cannot be influenced by time independent events affecting the emotional state of a child but is driven by needs changing for students as they pass through adolescence during their time in secondary education. Here the secondary enrolment process at the age of 11 allows families to select the best fit of school to the range of needs expressed covering five years starting in year 7. Based on extrapolating trends, it is noted that of 2,815 students planned to transfer in 2018 into Plymouth secondary schools, 110 are likely to refer in that same year 7, 120 in year 8 for 2019, 130 in year 9 for 2020, 180 in year 10 for 2021 and 260 in year 11 for 2022 (Plymouth City Council, 2017a; Plymouth Community Healthcare, 2015). Of the original 2,815 cohort moving through secondary education in the city from 2018, some 800 referrals over successive years will be experienced, of which some may represent repeat occurrences, especially if applicants were previously rejected or treatment was not successful. Even with non-concurrent health and education catchments areas, the causes of referral (when family concern thresholds are breached), require further investigation to determine ways forward to balance demand with resource. Move forward five years until 2023 and the numbers potentially rise by 14% to 3222 entering year 7 to start secondary school with additional demands on supporting referral services. Previous situations of high demand (Spencer, 2013) have been managed by raising admission thresholds from which point treatments can begin but this is unrealistic given the level of demand and shortage of resources.

Given that CAMHS services are constrained to deliver support to those children referring with treatable mental ill health conditions, many referrals for the lesser condition of low well-being are rejected based on stringent criteria designed to assess problems and manage numbers in treatment, especially in cities (Livewell Southwest, 2017; Bristol CAMHS, 2007). Some of the recurrent referral patterns may be attributed to children in care and these cases are generally allocated to fast track services in the region (Cornwall CAMHS, 2017). In the case of Plymouth, 260 children in the care system (not brought-up by birth parents) were looked after in 2016 (ONS) of which 175 were older than 10 years i.e. attending secondary school or college. The observed 1% rise in children in care (3 in 2016 for example) for the city is therefore unlikely to explain the rising trend for secondary referrals.

1.4 Better joined-up services for children in Plymouth

As serious consequences are reported concerning demand and referral waiting time increases (Plymouth City Council[6], 2014: p.4), integrated service commissioning between health and social services in the city needs to improve coordination across a number of issues that are explained in the following extract.

"There has been an increase in referrals to Child and Adolescent Mental Health Services (CAMHS) (… peaking … July 2014…); this has impacted on the waiting times as all of the referrals have required an assessment due to the high levels of risk. This is consistent with the increased levels of need we are seeing elsewhere in the system, and the service reports they are mainly due to self-harm and children with neurodevelopmental issues who present with co-morbid mental health needs."

The trend has clear associations with children losing protective, child well-being resilience reserves throughout their time spent in secondary school where there is potential to breach those lower well-being thresholds that would initiate a referral. More specific cases of disruption for children that are independent of age include personal ill-health, caring for others [200 hundred of an estimated 840 carers under 18 years old were known to Plymouth City Council (2015) in their assessment of well-being needs within the city], family poverty, family breakup and bullying from those attempting to exert their authority over others. A much-discussed accelerator for bullying is the advent of mobile telephony (see p.2) that can rapidly turn friendly networks into ones that criticise and taunt others through the misuse of words, speech and pictures outside the 'school gate'[7] (Smith et al, 2008). However even if families only provide mobile phones when transferring into secondary school (to ensure their children remained safe for example), when and where children were bullied through this media would still be time independent and could not therefore predict a trend such as observed in referral patterns for low well-being. There is information to suggest that the use of mobile phones by children now takes place in primary schools first (Sakellariou et al, 2012) and that counter-intuitively, rather than making bullies more powerful, mobile devices along with the internet can also offer a

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[6] Plymouth City Council is an elected body operating municipal services across the city.
[7] School gate refers to parents discussing common issues for primary school children while waiting outside the school at the end of classes for the day.

disguise for those being bullied to redress perceived power imbalances. Here causality remains unproven (Campbell, 2005).

Figure 1.3 shows a plot of Plymouth secondary schools identified by type. The figure indicates annual positions with regards to the composition of different types of school in the city and demonstrates the sudden and dramatic rise of academies to replace older comprehensive schools. No longer funded by the Local Education Authority, academies[8] are more immediately connected to national government and payment from students who enrol each year.
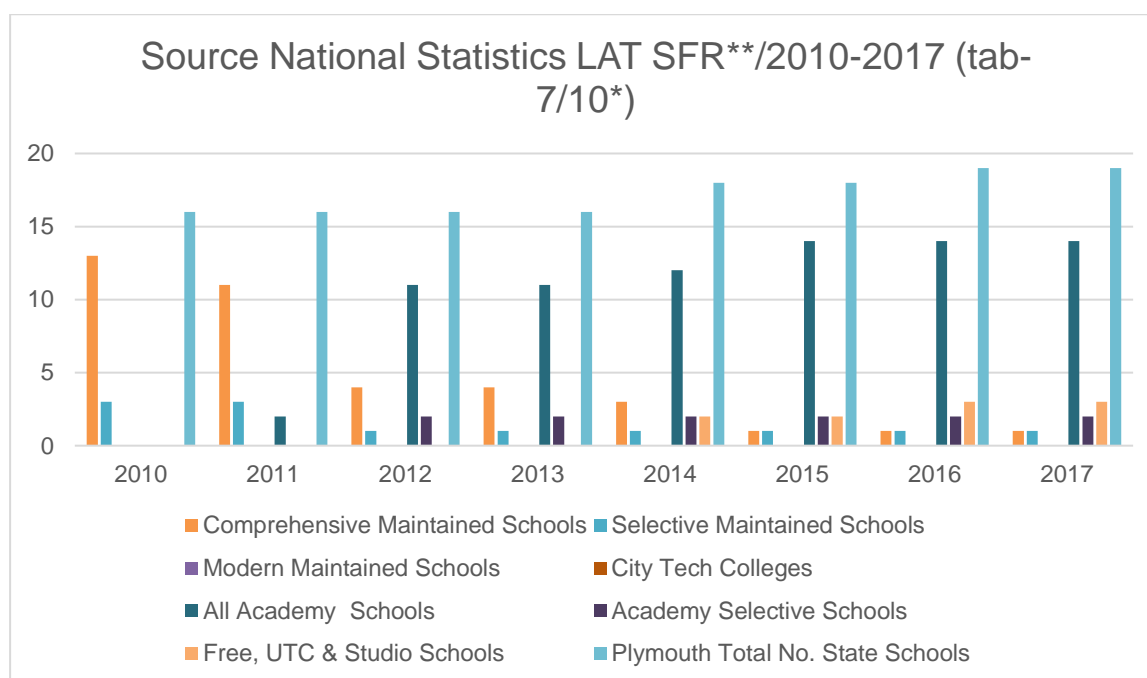
Figure 1.3. Change in status of Plymouth secondary schools (source ONS, 2017)

The rapid decline in state maintained Plymouth schools over the last seven years and subsequent rise in school choice in this and other English urban centres between academies, City Technology Colleges, Free and Studio schools as demonstrated in the chart serves to challenge parents on suitable and relevant secondary education providers in the local area (Sugarman *et al*, 1982; O'Brien and

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[8] Academies in England differ from those elsewhere in the UK as they refer to state school's managed outside of Local Education Authority control and enable management efficiencies to be implemented across different schools, whether vertically integrated with primary and secondary schools within the academy or horizontally integrated with mainstream and special schools – both of which exist in Plymouth.

Debs, 2016). Neither can children necessarily get the best new development in education that would best fulfil their potential where strict academic curricula can restrict other interests, leading to student uncertainty and disaffection. As Gaynor (2012) explains, the attainment gap requires change in the values of schools that avoids the best schools improving at the expense of the lower performing getting worse. Teachers also realise that the admission of more academic students reduces their own workload while promoting results in the English system of performance measurement. This reinforcing (see Glossary xxii-xxviii) behaviour then encourages that capable teachers move away from schools facing such challenges. New schools may be able to break such patterns but without a history of exceptional performance both students, parent and teachers are taking risks. For those lacking inspired teachers with plentiful resources, other support services can then become involved.

The pressure to attain improved grades in secondary schools has mounted over the years. ONS (2016) report significant rises in grades over the period of intensified competition between secondary schools.

Table 1.2 shows progress towards raising secondary education standards of averaged, academic achievement across England over a ten-year period. The achievement standards for every primary and secondary school in England are published online and in papers as a set of league tables of academic performance where schools are compared and deemed to be above or below average.

Table 1.2 Raising secondary school results across England at Key Stage 4 GCSEs with method adjustments between 2004 and 2015 (source ONS, 2014).

Academic Year	Number of pupils in secondary education across England	Percentage of children achieving 5 or more A*-C grade GCSEs or equivalent including English and Mathematics
2004/05	636,119	44.7%
2005/06	648,833	45.6%
2006/07	655,146	46.3%
2007/08	653,083	47.6%
2008/09	634,496	49.8%
2009/10	639,263	53.4%
2009/10 including IGSCEs	639,263	53.5%
2010/11	627,093	59.0%
2011/12	620,617	59.4%
2012/13	632,397	59.2%
2013/14 (2013 coursework and test methodology)	618,437	56.8%
2013/14 (2014 end test only methodology)	618,437	53.4%

Whereas governments expect rising academic standards of achievement they also wish for children to remain safe, especially when considered vulnerable. Social Services departments within the local authority traditionally engaged Plymouth youth in keeping them safe from harm and well engaged, changes in child protection (UK, 2004) have concentrated their efforts on those believed to be most vulnerable leaving health, schools and charities to support those reporting low levels of well-being who are not deemed to be at risk from immediate harm to themselves or others. The distortion concerns how children are now referred for support by Social Services in increasing numbers (Bilson and Martin, 2016). Raised demand for referrals to social services, those generated by Child Protection guidance touching multiple agencies, can quickly overwhelm the system and even prevent real and immediate problems affecting vulnerable from being identified.

1.5 Every child matters from 2004

The Children's Act (UK, 2004) refocussed councils towards statutory requirements to protect the most vulnerable children, social services supporting the majority have also been scaled-back and refocussed to address the new priorities. While only 4 out of 5 referrals getting investigated by limited council resources, tighter thresholds for accessing the three levels of care intervention (early help for cases of neglect supported through other agencies; complex multiple needs for social services and; acute need for reasoned cause of significant harm to child) mean that children who only exhibit low-well-being, potentially fall through the supportive joint-commissioning infrastructure or get re-referred to CAMHS where, once again, they may not meet elevated threshold tests for mental ill health. With almost 60% of child protection plans targeting those under five years of age in 2010 (Ofsted, 2015), there appears to be considerable scope for older children and adolescents to add to the statistics who may not yet be considered, thereby raising demand and widening the search for children in acute need (for whatever reasons).

The idea that a sudden rise in demand volume overpowering a system designed to support the vulnerable, is regrettably illustrated in England by the recent call on CAMHS support services from the Grenfell Towers fire in London (McKee, 2017).

Nevertheless, the attention of joint-commissioners[9] for children's services has a natural focus on this pressing issue for infants unable to help themselves at the expense of older children and adolescents currently rebounding between criteria for obtaining support for either Social Service or CAMHS services. This study seeks to understand how rises in low well-being levels may occur in urban settings as children transfer into secondary schools and what services may need commissioning in the future across multiple agencies group that support them to address demand from referrals.

As noted in the latest national report on Children's Services in Plymouth (Ofsted[10], 2015), key areas for improvement included co-ordination of early help across the whole partnership to meet need when it arises and prevent the demand on specialist services plus; quality of assessments and multi-agency outcome focused planning across health, education and social care services, both in early help and social care. The report indicated that Plymouth was well below many other English cities with only 5% of children in primary and secondary school with English as an additional language and therefore not a common reason for rising referrals to mental health services from this sector of the community.

The children's commissioner for England recently indicated (Longfield, 2016) that CAMHS had to change given that 28% of referrals for children's mental health support were turned away in 2015 and that half of these were for life-threatening conditions. As the West of England makes the largest percentage of referrals wait for appointments of all the regions, then delays can be considerable for problems that can be life-threatening. UK government select committees are now joining together in recognising such challenges requiring coordination between departments (HOC, 2017). The reported trade-off between fulfilled potential (or psycho-social well-being) and an academic focus (achieving results) is not believed to be a cancelling or zero-sum[11] activity according to the highly regarded, select committee's membership.

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[9] Joint commissioning between health and social services reflects the move of public health functions to local authority control in England and subsequent needs to coordinate more closely with community health services provided by the NHS where patient care is often a shared responsibility and can become duplicated where communications between providers fail.
[10] Ofsted is a UK government agency providing inspection and regulation of services provided to children and young people.
[11] Zero-sum refers to a gain creating a loss elsewhere. Also known as a nil-sum game, greater academic achievement may come at a cost to personal wellbeing for example.

Instead, resilient stocks of personal well-being for students can lead to greater academic achievement. The report notes that "*Government and schools must be conscious of the stress and anxiety that they are placing on pupils and ensure that sufficient time is allowed for activities which develop life-long skills for well-being.*" (HOC, 2017 p.8). The joint report even suggests that Ofsted (see Glossary xxii-xxviii) should improve the paucity of school inspectors reporting on well-being by making it a measurable quantity for reporting alongside academic league tables for schools. Such provisions however assume that such league table comparisons are read and acted upon when deciding schools.

Low well-being (associated with an anxious state) is noted to exist in school aged children across Plymouth. According to the South Devon and Torbay Clinical Commissioning Group (CCG) reports from hospital admissions of children and young people (15-24 years of age) there is good correlation between hospital admissions caused by injury and those resulting from self-harm.

As illustrated in Figure 1.4, this CCG area incorporating Plymouth has high self-harm and injury rates compared to nearest statistical rivals (see diamond). The chart also shows explains a consistent relationship between results of injury (resulting from unsafe risk taking behaviours for example) and self-harm within English CCG populations of young people. In the Plymouth report on Children and Young People (CYP) Needs Assessment (Plymouth City Council, 2014) experts noted that 'within the cohort of CYP, professionals are reporting increased anxiety or lack of social understanding, which can result in self-harm and suicidal thoughts…outbursts of rage and anger…depression…withdrawal from usual activities and attending school'. This suggests greater anxiety or lower well-being could therefore help explain 69% of variance between self-harm and injuries for CYP attending local hospitals.
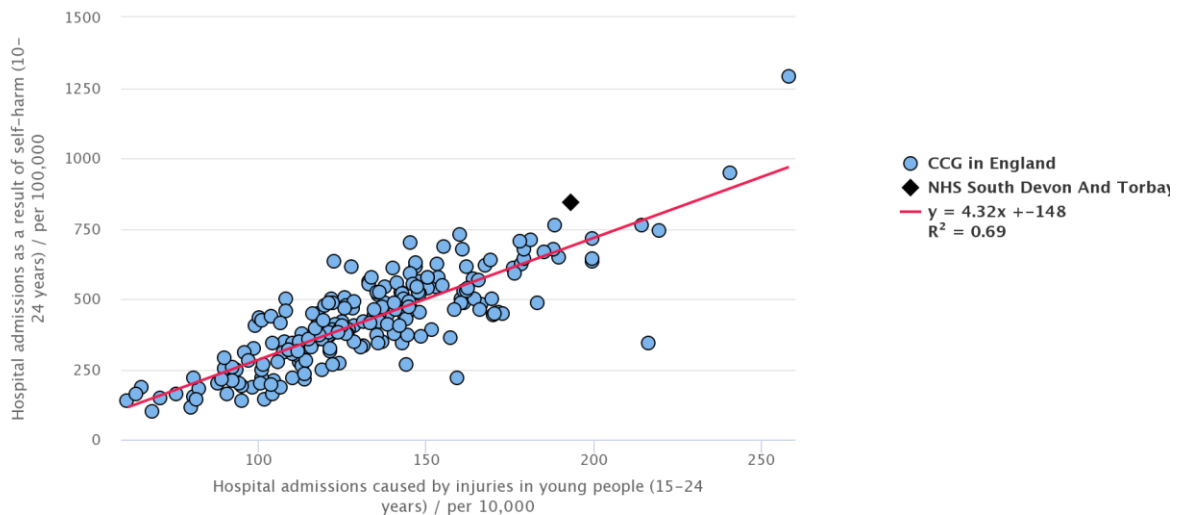
Figure 1.4. NHS South Devon and Torbay CCG compared to similar CCGs (source data.gov.uk, 2017)

1.6 Aim and objectives of study with associated research question

Significant CAMHS referral increases commence from the time of making preparations to transfer from primary to secondary schools in Plymouth and peak in GCSE examination year 11. The rising CAMHS referral phenomenon may be explained in the context of Admission Authority policies. Policies supporting fairer competition for secondary school places and associated parent decision making help to explain the state of affairs for student enrolment and their related outcomes as they play out over time. This study aims to model the associated influences of urban secondary school choice on psycho-social wellbeing variation over time in families changing schools. System Dynamics is used to simulate the impact potential policy interventions for reducing CAMHS referrals resulting from low levels of wellbeing.

Supporting the research aim, three objectives have been acknowledged.

Firstly, to describe how competing to enrol in secondary schools can influence family decision making behaviours that may affect CAMHS referrals resulting from low levels of wellbeing in children (concept objective).

Next, to identify how parents decide between secondary schools for children in an urban, case study setting of Plymouth, by testing perceptions of key factors influencing family decision-making behaviours (behaviour objective).

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Finally, to demonstrate how child wellbeing can be affected by choice of secondary school, starting from preparing to enrol in secondary school, alongside policy interventions from support agencies that might sustain levels of psychological health (policy objective).

The research question is therefore:

Which key factors might help explain the phenomenon of rising student referrals to CAMHS during secondary school for helping target support agency policy interventions?

This research question can be answered by considering three, interrelated areas in greater detail:

A. The key factors that connect school choice to potential CAMHS referrals derive from competitive state education systems in Plymouth, causing referral demand rises throughout secondary school.

B. Parental leadership decisions between secondary school alternatives for their children, (coincident with lower socio-emotional wellbeing and rising CAMHS referrals) can be understood by considering what contributes to less effective selection of schools based on how families approach school choice decisions.

C. Multi-agency policy changes, relating to choice of school, that have the largest effect on reducing referral demand over time (before and during secondary school) for different family types

1.7 Chapter review

The chapter has helped define key terms associated with state education and well-being for children. It has demonstrated rising trends in mental health referrals for children, projected rises in students enrolling and the provision of support services. Recent changes in English legislation have been shown to improve the provision of services to vulnerable children while leaving others with less demanding psycho-social issues to rely even more on their family for all their support. A contribution to health and social care practice within a competitive educational setting is offered by this research into more effective policy designs from describing and enumerating key

causal theory in helping children to develop their full potential under testing conditions.

Following discussions with agencies supporting children across Plymouth, the case study question hypothesising a connection between subsequent CAMHS referrals and competition while transferring to secondary schools has been posed. In the case of Plymouth, secondary student age-related referrals increase significantly around adolescence (small gender variations exist) suggesting that the educational needs of students may change in schools that can be difficult to accommodate given their focus on competing for GCSE examination, league table results. This differs from conventional explanations of personal vulnerabilities associated with a small proportion of students (the largest of these groups lack parents in a cohesive family unit, having been placed in care for example, or having to care for their own parents) where losing access to peers and changing the educational workplace also impact a child's ecological microsystem (Bronfenbrenner, 1979; 1992). Equally parents select between urban schools at the same time as children have to prepare for competitive tests in primary education. Under such circumstances, needs within the family may be misrepresented where secondary schools are selected that cannot meet future student needs longer term, while other test preparation demands from secondary providers thwart relaxation for some children in the short term. Indeed, certain secondary schools make offers that are subsequently, withdrawn following the annual per capita payment each autumn. Such actions suggest payment may take greater priority than meeting complex student needs (Bardwell-Jones, 2013).

As a social scientist seeking to relate cause and effect for the problem of school choice and decision-making behaviours influenced by system parameters, the researcher's experience in system dynamics modelling (developed during the study) has proven useful in understanding the recent academic developments in the field of psycho-social system dynamics. The researcher has co-authored work from the research study published in a peer-reviewed academic journal. Appendix 1 gives full details of the published paper relating to inductive problem structuring using selective Group Model Building (GMB) scripts with a representative pilot group of local expert practitioners. The paper was presented at ISCMR 2014 and was awarded the best paper prize for the afternoon conference session.

The thesis is laid out as follows. The extant data surrounding the case city and potential explanation of rising referrals through secondary school, is focussed on competition, decision making and policy simulation in Chapter 2. In Chapter 3, a modelling methodology is outlined that is capable of offering new insights around cause and effect in the educational and social systems supporting child development and well-being as they become adolescents. Chapter 4 describes more of the research design for collecting data from diverse groups of support system actors. Chapters 5, 6 and 7 describe the model-based multimethod associated with inducing problem structures, deducing decision biasing and abducing systemic effects. Policy testing based on the system dynamics model developed is conducted in Chapter 8 to identify robust policies supporting families making primary to secondary school choices and conclusions, shortfalls and further work are considered in the final Chapter 9.

2. Literature review with secondary choice data for England

Chapter 2 first explores current literature on adolescent stressors resulting from schools' competition then follows with an explanation supporting works on decision making and modelling multi-methodology using simulation techniques. The approach employs a narrative review, rather than a formal systematic review, as the purpose is to knit together disparate topics to produce a concise appraisal of relevant contributions. In reviewing evidence from the research, a primary stance is taken favouring sources that help generalise results for overall populations of interest such as secondary data from national studies of child well-being and parent decision-making. In this way, the material also affords the research study an informed starting point for establishing a suitable research design by considering a selection of secondary data sources relevant to competing for secondary schools in England.

2.0 Introducing literature and secondary data of school choice and well-being

From the background to the referral problem, preparations for competitive secondary enrolment have been hypothesised as an initiator for lower well-being for those with multiple and complex problems (Callaghan *et al*, 2004). Low levels of well-being can result in subsequent student referrals to CAMHS through their teenage years. Two possibilities are evident and therefore the literature of school competition in England alongside the dynamics of emotional overshoot and collapse with shorter and longer-term demands, need considering in order to understand how cause and effect may relate.

The chapter scope therefore covers literature around competing for school places and the development of English state education systems and the issues of competing for schools encountered by families making important decisions. Management theories contribute insights around effective decisions and how the problem of school choice may vary for different families. A significant consideration is the alternative to such rational choice described by behavioural decision theories and the range of information available to support the selection of secondary schools. Importantly the values of parents and emotions of students at this important life juncture have been identified across England in a series of studies for government and a leading children's charity. The secondary data generalises the case of Plymouth with larger survey samples and is therefore discussed in detail and highlights employed in

developing models. Types of policy modelling technique are mentioned and compared for applicability before considering how data could be collected through a bespoke, model-based multi-methodology. Inductive problems structuring techniques are also reviewed to gather relevant insights.

2.1 Competition and parents deciding between state schooling providers

2.1.1 Competing for school places in England

As noted by Burgess et al (2006) over 36% of urban areas in England have three or more schools within two kilometres whereas across England more than 75% of homes have this number of schools within four kilometres. This suggests that opportunities for English schools to compete are widespread, no more so than in English cities. Adnet and Davies (2003) confirm that competition in English cities has the potential to distort overlapping school markets by more popular schools being able to choose students (grammar and faith schools in larger population centres have additional criteria upon which students are selected) while others accept those school places that remain. New academy schools are organised upon commercial lines (Eyles *et al*, 2017) and compete for student enrolment through new leadership and business practice. Current competition also exists between state and independent, fee-paying schools for all ages of children in England suggesting a complex range of choices for families to negotiate.

2.1.2 English state education development

Derived from earlier church monopoly of learning based on Latin and Greek literature, the protestant reformation movement in England promoted religious learning in English, following the new Bible publication for King James in 1611). This action had the effect of raising literacy levels throughout England, far beyond what Latin grammar schools were able to provide for paying students. Still based around Greek and Latin texts, the Sunday School Movement allowed boys, indentured as apprentices who were working a six-day week, to learn on Sundays in church settings at the end of the Eighteenth Century (Ryan, 2016). With the abolition of compulsory apprenticeships in 1814, Sunday School education rapidly expanded. A University of London merger between University College London and King's College London, produced the first English secular college in 1836 to compete with extant Oxford and Cambridge domination of higher education since the Middle Ages

(religious terminology still prevails in today's university management hierarchy for example).

Against this background, the Factories Act (UK, 1833) set out the need for compulsory, state education of elementary (primary school age) children across England however, comprehensive cover for England was only established in 1870 by Forster (UK, 1870). Compulsory education for primary school aged children between 5-10 years old was set-out in the Elementary Education Act (UK, 1880). While fee-paying for most, the poor were exempted. Greek and Latin grammar education that had been available from providers called grammar schools for some time, was widened to encompass the sciences in the Grammar Schools Act (UK, 1840). Here competitive scholarships were also offered for those academically-minded students whose families were unable to afford fees.

In Education Act legislation (UK, 1902), Local Education Authorities replaced the inconsistent governance arrangements for schools provided in some cases through local school boards and the Church. Post-war reforms in education saw many secondary schools taken-over and run by the state (UK, 1918) including the majority of grammar schools as the school leaving age rose to 14. The Eleven Plus examination arrived with the expansion of academically selective or grammar schools, when secondary education was mandated for all children by Butler as minister of education (UK, 1944). Here, state students were required to take academic tests to select the best performers suited to a grammar school education, leaving the unsuccessful to attend local secondary modern and technical schools. At this time, voluntary controlled schools were two thirds supported by government grant with the remainder coming from the church authorities.

The compulsory school age rose to 15 as it was argued that adolescence had at least completed by this time, reducing emotional stressor for children facing the transition to work. The provisions within the Education Act (UK, 1944) came into force between 1947 and 1951, both School and Higher School Certificates were replaced with General Certificates at Advanced and Ordinary (A and O) Education levels. This form of student competition for places was again replaced (many local authorities phased-out grammar schools in favour of comprehensives during the 1960s), so that all children attended their nearest schools that were managed by Local Education

Authorities[12] (LEA). The system was based on their primary school being part of a feeder network for designated secondary schools. With the 1965 government move to comprehensive schooling (Manning and Pisckhe, 2006), Certificates in Secondary Education (CSE) were introduced for those not sitting O-levels.

Some selective grammar schools remained as the 1970 Government's Office of State made grammar schools optional once again (Edwards et al, 1999), when the city of Plymouth became one of the education authorities that decided to continue supporting selective education. In 1988, the Department of Education launched the National Curriculum which saw the introduction of competitive Standard Assessment Testing (or SATs) across a range of subjects and ages enabling academic performance of schools to be assessed through published league tables at Key Stages[13] (KS) in the educational development of children. Currently only KS2 (end of primary school) and KS4 (end of secondary school) are examined. KS3 became optional and was soundly rejected by secondary schools plus KS1 proposals for testing were withdrawn in 2014. KS4 testing produces GCSE qualifications for students for continuing their education into college.

This period of change in secondary school provision produced numerous options for parents to select from within English urban settings (rural remain based on zoned or feeder networks with subsidised transport from villages to larger towns; whereas children in cities generally pay for their own transport given proximity and choice). The Education Reform Act (UK, 1988) also produced the first quasi-market conditions in English education, with funding based on student enrolments. Alongside the joining together of CSE (see Glossary xxii-xxviii) and GCE qualifications into the new GCSE standard at KS4, parents were now encouraged to choose between available schools. Prior to this designated primary schools were assumed to supply each secondary school with children, where offers of places were managed by schools. Open choice of schools is now managed by Admission Authorities in the local authority to support market demand by providing free and fair selection. Grant-maintained schools were supported to opt-out of local educational authority control. These became either foundation schools or re-joined the local

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[12] Local Education Authorities are departments within local councils responsible for state maintained schooling.
[13] Key Stages correspond to academic development against standard curricula that can be tested.

system as grant-maintained when the new 1997 Labour Government was elected. In response to the decline in unskilled jobs, the school leaving age was raised to 18 from 2015 (GOV, 2017). Now young people had to either be in full time education, have joined a modern apprenticeship or spend at least 20 hours in community service each week.

Among the current options for secondary education are university technical colleges, studio schools, free schools, city technical colleges and developing networks of academies[14] (UK, 2010) where management responsibilities are often shared. For example, Plymouth now offers academy school networks able to teach secondary Special Educational Needs and Disabilities (SEND) and standard curricula safely or offer combined sites for nursery[15], primary, secondary and sixth form students where preference is given to students already established in the school feeding pipeline. Given such an accelerated development over the past sixty years, knowledge from earlier generations becomes less relevant to today's secondary school choice problem that decision-makers face.

Table 2.1 summarises the history of competition on an accelerating timescale from when English state education (2 hours a day for those aged 9-13) was originally mandated for all children (UK, 1833). Since this time, the education industry has expanded to cover a wider range of student ages and subject matter delivered in various ways by different types of schools such as grammar (academically selective), secondary modern (non-selective), comprehensive (contributing to grammar and secondary modern schooling arrangements), free, city technical college, academy, amongst others.

Different generations are considered to have an average 30-year intergenerational gap (Abrahamson, 2016) as indicated by 0 (no gap or current generation), -2g (60 years prior) and -4g (120 years before). Here a child aged 17 would have been born in 2000 (current generation) and is likely to have parents who at 47 years old on average based on this system.

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[14] The free market reforms in educational service provision have introduced a number of innovations for compulsory education in the UK that tend towards specialisation. Some schools commence from 14 and most specialisations are available to students in Plymouth.
[15] Kindergarten in US education

Table 2.1 Accelerating history of urban choice from English state school's competition (approximate intergenerational timescale indicated)

Provision:	primary	secondary modern	comprehensive	Free/CTC/Ac.	grammar
1900s-4g	X				(wider locations)
1960s-2g	X	X			X
1990s-1g	X		X		(limited locations)
2020s-0g	X			X	(limited locations)

The timescale column also shows the 30-year intergenerational gaps and associated changes in education provided at each juncture that illustrates how perceptions of a good school become outdated. Parental perceptions and sometimes the influence of grandparents and other relatives, is often the starting point for decision making around school choice yet the chart shows the recent expansion in types of provider within the last generation period (often occurring in urban areas where demand is high). Grammar schools have selected based on academic ability over many years and have found favour over the years with supportive government policies (Richardson, 2017).

The most recent education policy for England suggests that a return to grammar school education standards is once again desired by government manifesto (Rayner, 2017). Where only some local authorities have retained grammar schools, the policy suggests that more academic learning will now be encouraged in all regions. This proposed shift in national policy may mean that more children are likely to experience the effects of preparing to take selective entrance examinations in the future. In the case of Plymouth, two girl's and a boy's grammar have been retained[16]. The education is largely directed by the national curricula on a range of standard subjects that all children study prior to KS2 and KS4 testing. Preparation throughout year 7 for

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Grammar schools typically offer single sex education but have recently developed co-educational sixth forms to widen their appeal to students seeking to remain in education in year 12 who qualify for an offer to study preferred A-levels.

KS2 is now commonplace and two years preparing for KS4 GCSE curricula is also necessary in all state schools.

In Plymouth, optional or elective participation for selective entrance tests to grammar schools can extend preparation for children beyond year 6 into year 5 (2 years total of coaching in family or tutoring with outside professionals). As most secondary schools stream to encourage different ability groups, the period spent preparing for tests extends into the first year (year 7) of secondary school. Only years 8 and 9 are presently not likely to be involved in preparations for testing and this may continue to influence perceptions of choice for children as further academic demands are made on learning time both within and outside of secondary school.

2.1.3 Competition distortions

The objective and subjective factors for deciding between schools are numerous and vary between families. In a study of applications for secondary - or high schools - across New York city (Pallas and Reihl, 2007), results suggest the immense variety in available state schools presents parents with the challenge of finding high quality information that enables them to compare schools efficiently while avoiding social isolation for their child (white children in mostly black schools, black children in mostly hispanic schools, etc). Such biasing away from social isolation in the United States is also indicated by a study of Washington DC state schools (Schneider and Buckley, 2002) where parents were asked to equate school features on a comparison website to assess preferred alternatives. The results suggest that parents can fail twice in their choice of school, often not selecting based on quality but sometimes preferring the demographically similar schools for student compatibility reasons when subjected to excess information that counteract the benefits of choice.

English state schools are considered to operate an oligopoly across much of the country where limited numbers of providers control elements of the market lacking sufficient resources for families to be able to choose differently (Buckingham and Scanion, 2005). Some initiatives, such as free schools' have aimed to increase the numbers of suppliers and these have raised competition (Higham, 2014) especially within urban settings, including Plymouth. Far from creating a free market where competition removes school inefficiencies through open choice, Adnett and Davies (2003) suggest that a quasi-competitive market produces different effects than those

planned. As schools operate in local markets (parents and children seeking educational support capable of meeting their developing needs) they suggest that rebalancing competing towards cooperating schools can produce further educational improvements that the marketplace model has so far failed to deliver.

A wider range of choice is available in urban environments where school transport is not provided and is therefore a less important factor in any decision when schools are close to home and supported by public and school-based transport networks for example. Performance indicators allow those who compare schools to decide their school selections in a short time window, based on comparisons of academic result rather than educational need. The first mover superiority of schools that exploit resource and innovation more effectively to gain advantage over the educational market place (or perfect competition where a first mover prevents knowledge or resource transfer to the competition that maintains their advantage in the market place) is disrupted under quasi-market conditions by several factors explained by Dixit (2002):

Barriers to entry. Reputation, established over many years, can act to block others for gaining greater market share in local markets. For example, a reputation for academic superiority can be developed by 'cream-skimming' (West et al, 2006) through the use of selective entrance testing. Alternatively, 'cropping-off' is also observed[17] in the quasi-market place of English education (Mascini and Braster, 2017). Here all applications are accepted by offering places before subsequently rejecting those students whose specialised needs cannot be met once fully evaluated. Typically, such reviews are undertaken only after enrolment at the start of the academic year (removing those children who are perceived to absorb more resources for little academic return). Equally permanent exclusions offer schools another way to implement such practices through post-offer selective practice to enhance academic results but such events are justifiably scrutinised.

It is noted that reputation developed through skilled management can be replicated within failing schools using the academy model where other schools are incentivised to repeat a successful management model for innovation at other localities in the

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[17] Cream skimming refers to accepting those above certain academic grades whereas cropping off indicates a threshold below which students are rejected.

state system, especially where parties are not considered to be local rivals. Competitive success for schools depends on a number of important factors (West, 2006).

Uncertain Needs. There are many parties involved in educational needs, which makes optimising resource to meet conflicting demands difficult to judge and deliver. As goals are not precisely measurable, educational value-adding is therefore hard to determine.

Professional vocation. Determined by professional standards, the management and teaching within schools are, in-part, motivated by public service considerations. Such mechanisms may not function effectively when challenged by market-based incentives.

Local oligopolies. Given limited buyer power in the education market, those with constrained resources (there are costly search, travel and relocation implications related to school choice for families) may have to settle for options offering the best local fit to need.

Feedbacks through popularity. Popularity differs from success for schools and is based on the social value to students attending the same school as their friends before they engage in education. This means that some schools retain popularity in local markets, even though failing academically based on lower rankings in league tables.

Labour saving schemes can help to reduce input costs for providing education and teacher turnover brings in the latest ideas from newly qualified teachers, typically those costing less than existing teachers with experience who may be leaving a school. With few opportunities to exploit resource for efficient servicing of markets (academy chains may now engage in bulk buying of consumables where savings vary, depending upon their size), competition from schools moves away from reducing input costs towards greater enrolment volumes. One way to achieve this is through marketing themselves more effectively to gain greater market share (Wiborg *et al*, 2017). Such efforts can distort what is presented as fact, making the illusory appear real for those deciding between their available options. Either wittingly or not, those providing educational services possess and use up to four factors to persuade

clients to use their school from others available within the market place (Tomala and Rucker, 2015).

Behavioural above rational decisions are encouraged in English state secondary schools by applying the four levers of consumer certainty which comprise consensus, repetition, defence and ease of selecting organisations that market their services.

Consensus. School league tables are exploited by those establishments performing at the pinnacle of academic achievement (government-endorsed by Ofsted inspection) by demonstrating that most of the population agree that schools are good at educating students, no matter the monoculture of student enrolment this policy fosters. Parents perceive such reinforcing feedback to be valued by subsequent educators and eventually industry. Indeed, there is substance in the suggestion that some universities not only look at A-level grades but now seek GCSE results to reduce oversubscription to popular courses (Stringer *et al,* 2017). However as with all reinforcing feedbacks, the opportunity to distort decision making in favour of performing schools and away from Ofsted failing schools is immensely powerful but does not reflect where resources are currently being invested, for example, when schools placed in Ofsted's special educational measures[18] receive extra help. Gibson and Asthana (1998) review the issue of league tables and publishing results that remain uncontextualised for schools in England, suggesting that bias is already present in this key comparison system feedback based on results that are at least a year old.

Repetition. Sharing insights on a best school between parents offers another reinforcing mechanism capable of distorting school selection away from objective factors. The liking of a school via a social network shared between parents is one such mechanism for enabling repetition to create a viral presence in the minds of key decision makers (see Glossary xxii-xxviii). Even more concerningly, given peer to peer networks for mobile phone applications, children in primary can like secondary schools in a reinforcing spiral that leads to poorly informed preferences, according to Phillippo and Griffin (2016) studying school choice in Chicago. Where schools are

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[18] When a school is deemed to be unsatisfactory by Ofsted inspectors, it can be placed in special educational measures to effect a recover in a set period of time based on introducing additional resources.

more able to influence conversations at the 'school gate', the opportunity for providers to stimulate discussion and distort decisions can also increase.

Defence. Parents can also be challenged to remain loyal to their selection of a school when it fails an Ofsted inspection for example. This is akin to inoculation where the family have experienced the school and the decision maker is now challenged to defend their choices. Such defences can become reinforcing when the school at risk of failing is perceived as the victim of a bigger system, for example networks of commercial academies. Public school closures in Australia have attracted an adverse public response (Burkhardt and March, 1991). Here the social networks of parents can quickly spread reasons why the school needs defending and these can be effective in helping to counter perceptions of failure.

Ease. Ease of recalling a potential secondary school by parents is a daily occurrence by academies branding their educational services on city bus networks or over commercial radio broadcasts. Previously school names were often established on the basis of location not educational value added to the student for example. This also meant that they were not memorable to those deciding between the school options. However, with the rise of academies and free schools competing for student enrolments, the opportunity to simplify names and make them memorable not only allowed old secondary school reputations to be abandoned but also new myths to be established about the value now offered. In New York city public high schools re-branding is commonplace according to DiMartino and Jessen following liberal school reforms (2016). Here the three-character acronym is more easily recalled than a long place name (the latter offering little value other than to a local community). Some schools even name themselves after their internet address to demonstrate easy access to the services they provide, thereby making them a more attractive proposition to the prospective decision makers.

On the issue of families navigating school options confused by a sea of marketing, resilient families who adapt to such challenges may do better. Walsh (2003: p.5) suggests that "…with social and economic transformations of recent decades and a growing multiplicity of family arrangements, no single model of family health fits all. In fact, family diversity has become common throughout history and across cultures and a growing body of research reveals that well-functioning families can be found in a

variety of formal and informal kinship arrangements…What matters most in dealing with adversity are effective family processes, involving …committed relationships." Thus, the process of selecting schools is one such test of commitment that all families experience that needs the question of how schools can meet future needs answering rather than what school produces the best academic results. A rational evaluation of all family needs that must be met by schools is therefore a valuable starting point in understanding how families might determine a preferred education provider in a competitive marketplace.

2.1.4 Rational Choice through decision analysis

Exploiting potential gain while limiting possible loss when selecting between options assumes complete information to inform absolute comparisons, whereas satisficing relates to making decisions based on bounded rationality (Simon, 1955; 1956; 1990). Where information is incomplete, a 'first past the post' target achievement is often the driving imperative behind selecting one from many alternatives. Both are forms of rational choice that can be tested with decision makers to understand if such techniques apply to the school choice problem.

Two different selection processes are offered from management theory, based on either 'calculated gain' or else 'perceived benefit'. The rationale for preferring an option over other alternatives can be based on quantified or qualified criteria that can be aggregated to indicate the best fit of provider to user needs that maximises gain to those deciding between alternatives. In the case of school choice by parents, the theory of rational choice can help model social and economic behaviour based on individual preferences. Preferences are presumed to be complete (A is preferred over B and C or that no options are preferred) and transitive (if a preference for A over B and again for B over C then A must be preferred over C) according to Belton and Stewart (2002). By considering all available information, event likelihoods, potential gains and losses, the decision maker can select the best alternative for meeting their needs.

Coyle R.G. (1972) discusses the practical value of decision theory (analysis using quantitative methods) and suggests five contributions in decreasing order of importance.

1. treatment of uncertainty;

2. clarity of assumptions;

3. comprehensiveness;

4. consistency of decisions;

5. technique specialisms.

Coyle indicates that calculated decision making theories are frequently based on estimated gain and loss to organisations from the alternative outcomes considered. As the future is indeterminate, treatment of ambiguity can be broken down into objective and subjective types of support for decisions involving uncertainty (Tripathy et al, 2016). Of the subjective decision support available, either moral selections guided by rules (religious schools aligned with family values) or rule-based choice guided by intuition (maximum distance to walk home from school) prevail. By contrast, statistical league tables explaining historical school results reflect quasi-rational comparisons using an ontology produced from testing students. Where fact replaces opinion when guided by knowledge, the epistemology used for deriving understanding can offers scientific rigour, enabling all stakeholders to come to the same conclusions (determining a school by meeting most user needs). Quantitative selection based on analytical objectivity does not replace the behavioural decisions guided by moralistic and intuitive rules for family units, such as those facing the challenge of changing schools. League table results do however receive much attention from successive governments when measuring their education reform programmes where parents are also encouraged to compare schools for academic performance. In the same way, decision making styles used in business also vary depending upon situation rather than personal characteristics alone, suggesting that multiple styles may apply to complex decisions involving different choices.

Those responsible for making strategic decisions between complex alternatives typically use as many as four styles of decision making on a regular basis when considering information inputs and focussed output(s) according to Brousseau et al (2006). Where focus is directed towards deciding a single option (most preferred school from three choices) or a range (three school choices from seventeen options) and information inputs are used to alternatively maximise or satisfice a decision, four

possible decision styles arise from the framework. Hierarchical (single option using maximum information could suit a most preferred selection); Decisive (single option using satisficed information); Flexible (option range using satisficed information could suit choosing a small number from multiple options); and Integrative (option range using maximum information) can all be used by those with responsibility for making selections. The decision style classification framework is presented in table 2.2.

Table 2.2 Classifying behavioural decision-making theories by their style (adapted from Brousseau et al, 2006)

Framework of decision making styles		Information usage by decision maker	
		Satisficing (less information)	Maximising (more information)
Number of alternatives considered	Single focus (a single preference without substitutes)	*DECISIVE STYLE. Direct, efficient, fast and firm, this decision style also reflects autocratic situational leadership.*	HIERARCHIC STYLE. Analysis able to stand the test of time, this decision style also reflects maximising benefits from the profitability decision stage of Image Theory
	Multi focus (many options could be substituted)	*FLEXIBLE STYLE. Rapidly adapting for changing courses, this decision style also reflects minimising risks from the screening*	INTEGRATIVE STYLE. Broadly framed, multiple inputs/outputs that can evolve, this decision style also reflects a democratic course

		decision stage of Image Theory.	or group based situational leadership.

Integrating both situational leadership and image theories together provides a hypothetical explanation for selecting between secondary schools in a city. Here, semi-rational sequencing by removing options presenting most risk before ordering choices by greatest benefit (Beach, 1990) could describe the process of deciding between schools when comparing league table results before visiting potential choices, as a sequenced pair. However, the decisive style of decision making reduces the potential fit between parent-preferred provision of secondary education and student need. Where changing decision making styles from decisive towards a sequenced pair may take time, the alternative is to persuade parents to look at multiple options for the greatest profit to the whole family as this may realistically achieve improved fit between student need and the secondary school services provided, given sufficient time.

When considering how decision-making styles change with management experience and seniority, the private thinker and public leader styles of decision making vary for an individual manager. As a line manager, private thoughts centre on making daily corrections moving towards more widespread, continuous improvements in an efficient, fast and firm manner. The private thoughts at director/vice president mid-management levels move towards critical thinking. Cross-functional, systems thinkers are in demand at chief executive levels for considering multiple sources and keeping abreast of shifting situations. By contrast the leadership styles in public are different to those thoughts expressed in private. At line management levels clear instruction and reporting is necessary when focused on taking action. At middle management, teamwork-based communications and listening skills are developed. At chief executive levels role modelling based on partnership and openness is valued in social and responsive manner.

In a similar way to experience and seniority on the management ladder, psychology also suggests scales for measuring styles of decision making (Vroom and Jago, 2007). Here the decision-making situation accounts for 75% of the variation between

the presented problem and adopted decision making style with the remaining quarter explained by personal disposition. Thus public-facing, situational leadership styles vary on a five-point scale between A1 unilateral autocrat at one extreme, C1 collaborator in the centre and G2 multilateral democrat at the other extreme (Vroom and Jago, 1988).

Whereas types of decision support may be obvious for how rational choice problems are resolved that businesses face every day, it can also help resolve why flaws in behavioural decision making exist. Thus, behavioural sciences of how people decide issues such as school choice can be better supported through analysis of the problem not only from the statistical league tables provided by information systems but also key insights from management science's quantitative methods. Decision making styles for some families include support from disciplines such as information systems (many now use the internet) and quantitative methods derived from economics and other disciplines. Further qualified support for selecting between competing schools is provided through composite admission guides produced by all Admission Authorities.

The Plymouth Admission Authority offers guidance (Plymouth City Council, 2017a; Plymouth City Council, 2017b) on selecting and applying for secondary schools however, without a group-based process (such as those devised by firms buying-in goods and services) to instruct rational choice, behavioural theory becomes more prominent in decision making on personal matters of choice. Such approaches to making selections can also introduce the potential for bias. In addition, emotions within the family group setting have significant roles in decision making (Beresford and Sloper, 2008) and these are better understood through the focus offered by behavioural decision theories.

2.1.5 Behavioural decision-making alternatives

Where rational choice can be used to facilitate school selection based on potential gain from different options, behavioural selection is based on perceived gains for different types of family. Here reasoned selection is tempered by the personal goal of minimising negative emotion during selection and maximising justification to oneself/others post selection (Bettman et al, 1998). The fit of school to need is determined by decision maker perceptions of the available school options and

choices rather than absolute comparators using standard metrics. Minimising negative emotion is well researched and could apply to cases of additional needs for example. By decreasing cognitive processes or even inducing coping theories to problem-solve, decision makers are driven by negative emotion indicating importance of their solution (Folkman and Lazarus, 1988). Equally reducing decision distress can be achieved through deferring (Anderson, 2003), devolving or abdicating (Luce, 1998). Deferring or abdicating can be used as decision making strategies in highly-charged, life trade-off circumstances where high stakes lead to difficult emotional compromises.

Speed of decision making will be affected by whether intuitive or analytical thinking is used. Simon (1983) suggests that serious and complex thinking relies on both types of thought process. Analytical thinking (also known as system 2 thinking[19]) takes time to arrive at a judgment as it is rule-based and has capacity limits on working memory; whereas, intuitive thinking (system 1 thinking) is largely unconscious and dominated by certainty. Under time constrained conditions, heuristic 'rule-of-thumb' decisions can help avoid threats in nature if the problem is straightforward[20] but these can also influence how more complex problems are treated, especially by those lacking sufficient experience to manage cognitive loads with ease and especially where their time is short (Gilbert and Gill, 2000).

Two types of behavioural decision making are commonly used by those making strategic selections at transformative or transitional life events such as children transferring between primary and secondary schools. The type of decision by the head of the household can also vary depending upon situation and the degree of acceptance. For example, at one extreme, a leadership situation lacking time and needing a determination between complex options may offer a number of choices to a group supporting selection that is based on historical facts as a consulted or even group-based process. By contrast, another situation may favour autocratic decision (see Glossary xxii-xxviii) speed over democratic voting, resulting in one preference

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[19] Kahneman in 2011 describes such evidence based method of decision making that describes System 1 and 2 non-linear biases in detail.
[20] Flight or fight response is a common term in behavioural decision making suggesting the simplification of response to immediate danger for most animals that demands instant decision making by engaging the amygdala region of brain function.

meeting fewer overall needs. The latter is typical of military decision made in the theatre of war where speed rather than quality can win the battle.

A logical network structure, representing a decision tree of influences, can help leaders understand the selection situation they face. Vroom and Jago (1988) described their contingency model for normative decisions using a tree structure of influencing factors. The second approach to behavioural decision making considers economic prospects (Kanehman and Tversky, 1979). The prospective outcomes for a child from education are one type of behavioural bias that decision makers can apply. Here perceived gain and loss can matter far more than measured gain and loss leading to the introduction of non-linear biasing into personal decision-making processes. Such flawed mental models can be expose through discussion and debate.

Reay and Ball (1998) note several types of behavioural decisions made by families in respect of secondary school choice in England. At least four clear categories of behavioural decision would appear to be present when deciding on school choice, based on economic Prospect Theory. A fourfold outline helps categorise decision making behaviours using calculated non-linear relationship between perception and reality on gain and loss based on gaming experiments (Tversky and Kahneman, 1992). When plotted on dual axes (perceived vertically and measured horizontally centred on zero), a fourfold pattern of risk aversion and risk taking becomes apparent where larger distortions occur when people are locked into high perceived and measured gain (averting risk) or seeking the best of limited alternatives where perceived and measured loss is highly likely (seeking risk).

Figure 2.1 positions these decision-making behaviours based on economic prospects onto axes of actionable perception (y) and measurable reality (x). The resulting relationship starts on a low positive gradient (where parents achieve real reductions in risk for little perceived risk reduction) and then steepens (here parent perceived reductions accompany minimal real reductions in risk). Upon passing through the origin, a reduced positive gradient indicates that little real gain is still perceived worthwhile by parents before the gradient flattens where greater real gain is perceived with some indifference.
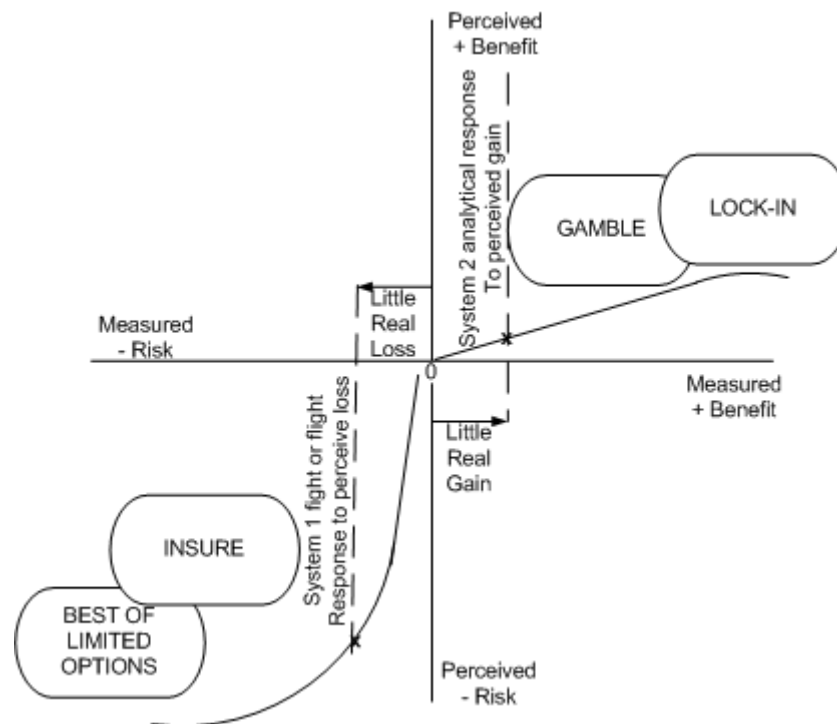
Figure 2.1. Fourfold graph of decisions based on prospective economic gains and losses (adapted from Kahneman, 2012)

Four aspects of the framework apply to those deciding using such behavioural influences (small losses are perceived three times more persuasive than small gains for example even in relatively linear sectors).

Locked-in as a risk averse decision behaviour that seeks to overvalue a preferred option, while already in a strong position for obtaining high perceived and real gains. Where maximum perceived gain and maximum measured gain coincide on the framework axes, decision makers stick with existing selections even when overpaying for actual benefits to improve their economic prospects. Such phenomena are observed in school choice by parents: "In a way I was very naughty. I used that a bit to sell it to her, at a stage when she was having a sort of dodgy area…and I said well all these children are queuing up to get into Lockmere because it's been oversubscribed for the last two years…but you'll get first choice place because you have a sibling there." (Reay and Ball, 1998: p.433). This position locks-in the student to concentrate upon advantages offered from attending a school over others.

Gambling for low perceived and real gains as a risk-seeking decision behaviour. Where minimal perceived gain and minimal potential gain coincide on the framework axes, decision makers are likely to gamble on perceived gains for unlikely actual benefit to improve their economic prospects [father]: "Well really my wife and I discussed the choice. I don't think it's appropriate to discuss too much with the child, except that one obviously wants to hear what impression he had of the respective schools." (Reay and Ball, 1998: p.436). This position gambles on the student not having strong opinions.

Insuring for low perceived and real losses as a risk averse decision behaviour. Where minimal perceived loss and minimal potential loss coincide on the framework axes, decision makers tend to insure against failure from perceived losses to improve their economic prospects [parent discussing daughter]: "…she doesn't want to leave school at 16 so she said the way she looks at it she wouldn't have to leave an ordinary school at 16 and find a college place because you can stay on there until 18." (Reay and Ball, 1998: p.435). This position insures against having the turmoil of changing school following GCSEs.

Best of Limited Options for high perceived and real losses as a risk seeking decision behaviour. Where maximum perceived loss and maximum potential loss coincide on the framework axes, decision makers grasp any available change, no matter how unlikely, to improve their economic prospects [parent discussing children]: "No I've always believed … you sort of let them go where their life takes them… where they end up wanting to go…never had any preconceived ideas of what they were going to end up doing." (Reay and Ball, 1998: p.433). This position abdicates decision making to favour a child's view of requirements that need to be met, which restricts options without challenge.

Reay and Ball (1998: p.436) continue by suggesting that working class families may be more egalitarian in their approach to secondary school choice in England than their middle-class counterparts. The examples suggest that some behavioural decisions however are less balanced where roles reverse and only student views on which school best meets the specific family needs are considered (the working-class child, as well as the middle-class parent, become autocrats). While not all parents listened to or were influenced by student views, Reay and Ball (1998: p.437) identify

open debates within the family setting for resolving school preferences which help to facilitate the process of achieving a good fit to most needs. Not only are different contributors considered in behavioural decision making, so are perceived sources of knowledge of how needs are met that can help confer 'certainty' on the decision maker.

The additional behavioural factor for many decisions is called certainty (Tomala and Rucker, 2015). Certainty is the confidence individuals possess in their beliefs on, for example, preferred schools that are heavily influenced by subjective factors. Certainty bears no relationship to making objective decisions and is importantly based on the subjective perceptions of decision makers. Certainty can therefore offer an affective validation of objective conclusions where the most preferred option 'feels right' to the person making the decision based on qualified views held concerning factual accuracy, measured completeness, quantified relevance and truthful legitimacy (representing important levers for a school's marketing campaign). Certainty can also offer overriding persuasive evidence to some individuals of the specific benefits of one choice over the shared disadvantages of the remainder. Where certainty of belief for decision makers presents the potential for bias when selecting between alternatives, a multi-stage approach to complex decisions helps reduce innate predispositions.

Entitled Image Theory, Beach (1993) suggests that people make their choices by adopting three schematic knowledge structures or images of an individual decision. The value image represents what the decision must eventually accomplish. The objective goals along the way are expressed in the trajectory image. The strategic image reflects the plans to achieve each defined objective. Both compatibility and profitability decision tests can help make either screening and/or choice selections. Businesses commonly make adoption decisions when recruiting new staff by applying the concepts of screening to reduce risk from available options before selecting the most profitable of the remaining choices that have been shortlisted free from risk. Progress decisions, reducing shortfalls between forecast and planned goal achievement, are frequently determined by project managers to understand how to adapt plans to keep business changes on track. The standards set by each of the three images thus determine the degree of screening applied to options that minimise risk-based, image violations alongside the amount of choice for maximising profitable

benefits in the final preference. While such carefully considered approaches to making decisions exist, the allure of a well-designed marketing campaign can serve to influence selections between alternatives. Marketing efforts can also be designed to flag levers that help make people more certain.

Marketing becomes an important tool for secondary schools competing across cities for example where offering a differentiated education is seen as an advantage to aspiring parents selecting state schools where higher quality, competitive education can be accessed by all (Bosetti and Pyryt, 2007). Knowledge developed and used as a strategic national asset is an important factor for England to remain competitive across international markets once European Union membership ceases. Stemming from perception of 'comprehensive mediocracy', a choice meritocracy between academies, free schools, faith and private providers within an urban setting is currently considered advantageous. However, the Bosetti and Pyryt argue the reality is represented by a credential meritocracy, as promoted in competition between schools where levels of qualification, rather than skill and ability, are rewarded with rising student intake revenues. In their study of urban elementary or primary schools, Bosetti and Pyryt establish that rational choice based on the best interests of the child is mediated by the social and cultural context in which the family find themselves (the quality of family circumstances). A good education in the knowledge economy of a modern, western state may be restricted to fewer individuals if parents and children are unable to access such provision (qualifications becoming the new currency that separates society).

Parent influence is important during the time spent at school. In a study of primary school influences, models of parent involvement in children's education have been established (Hoover-Dempsey and Sandler, 1995; 1997) that demonstrate emotive factors in gaining parental support for choosing a school.

2.1.6 Decision support for selecting schools

Knowledge of how schools fulfil family needs can be obtained through researching what is available in the marketplace. Several systems can help supply invaluable information including networks providing word of mouth recommendations, admission authority composite guides, school prospectus brochures, third party internet providers and visits (whether at open events or private appointments). However,

knowledge of needs to be met is specific to each family and this type of information can be difficult to acquire and compare between the options available due to the diverse nature of family needs. In Plymouth for example, the authorities have an electronic route planning system based on postcodes for home and potential school giving exact details of bus and footpaths with estimated journey times – such data not being required for those families with access to personal transport.

In a US study, Neild (2005) notes the lack of information provided about acceptance rates for schools admitting students as a fundamental flaw in the enrolment process. Commonly available information on secondary schools within the unitary authority area of Plymouth is available from the local council in a composite prospectus that is published annually (Plymouth City Council, 2017a: Plymouth City Council, 2017b) and their supporting services (including those for families of SEND children) but that this represents the starting point for research rather than reflecting all specific needs the family may have and the way to structure their specific, decision problem i.e. to choose the right school.

The dynamic, moving picture transmitted by today's competing urban secondary schools can serve to confuse those deciding between providers. While league tables offer quantitative comparisons of performance through previous years and school acceptance rates are compared in council guidance, there are limited comparison resources available to parents with questions beyond academic outcomes capable of offering results that can help answer questions quickly in a reliable manner. Wikeley and Hughes (1994), report parents in the South West of England being concerned about the introduction of SATs (see Glossary xxii-xxviii) and potential for student disruption for little obvious gain other than league tables that left parents dissatisfied. As many parents also have other concerns that divert attention (work, friends, other family members, etc), priority to conducting a thorough research of all potential options is unlikely, unless time allows and skills abound. The response to the school choice challenge for parents is either to support the child by conferring a degree of certainty or, to express concerns within the family, raising further doubt for those preparing to transfer.

2.1.7 Dynamics of family decision-making

Family couples employ a golden mean rule (the middle way between the extremes of excess and deficient solutions) to resolve disagreements and therefore jointly decide suitable holiday destinations using 15 factors according to Bronner and Hoog (2008) They conclude that the family topic of selecting holidays has become more consensual over the past 30 years in their longitudinal study. Su et al (2008) consider spousal decision-making dynamics when making important family purchases. Their research identifies a sense of fairness that serves to mediate decisions between partners. Monteiro (2015) suggests young adults remaining in the family home, alongside adolescents growing-up there, can influence purchasing decisions in Portuguese households. In such situations both offspring age and their employment status increase the strength of influence in relationships, where the needs of young people lacking a clear direction may not be taken into account.

2001 Lawler generalises such dynamic effects in the Affect Theory of Social Exchange. The theory suggests that positive or negative feelings, rewarding or punishing individuals, are generated by exchanges within social units defined as individual pairs, groups or networks where reward is sought-out and punishment avoided. A strong sense of shared responsibility for the exchange task and non-separable contributions increases the level of task jointness within a social unit based on dynamic, social relationships. Stronger 'individual to collective ties' are reflected in producing unilateral benefits, expanding areas of collaboration, forgiving periodic opportunism and staying in relationships despite access to alternatives. The theory helps to explain why failing relationships within individual families can be supplanted by children seeking support from wider, friend and school networks.

Whereas spousal influence studies from earlier decades explained household decision making, the changing social context of twenty first century America caused Belch and Willis (2002) to re-examine family decision making dynamics where the wife's influence now features more strongly and where marketing efforts should be directed. In particular, the wife was involved in researching and analysing alternatives where they had superior knowledge of both problem and solution.

A sequenced, decision making process helps share the complexity of some decisions made by families (Ferber and Lee, 1974; Crompton and McKay, 1997; Sirakaya and

Woodside, 2005). With less time to spend with families when both parents work, children are encouraged to engage in holiday decision making processes from the outset (Nickerson and Jurowski, 2001). The markets respond by offering packages to holiday resorts designed to entertain children as well as adults. Offers where children go free or obtain discounts are frequently used to encourage purchases of bundles that can include transport, accommodation and resort entry are used by business to entice families to select their holiday offer (Wang et al, 2004). Festivals are another growing area for families spending time together where the range of activities can be wider and more varied than those offered in resorts.

A five-stage model of family decision dynamics is proposed by Kim et al (2010) around selecting festivals. First is pre-travelling, then travel to venue, followed by on-site participation, next is returning from venue and finally, post return evaluation to understand who in the family unit has primacy over selection between alternatives at each stage. Child influence is considered to vary by stage in the process as well as age of child, type of family, family communications, product category, expertise and usage based on empirical studies (Assael, 1995; Caruana and Vassallo, 2003).

Whereas adult couples might compromise over individual constraints for a festival venue, children can pose additional constraints that more easily cause a proposed festival to be abandoned (Gram, 2007). Whereas adult partners are found to alternate primacy over various decision-making phases, children are engaged in evaluation post festival event with mothers when posting views online according to Kim (2010). It is noted than Korean children in this study have potentially less influence over travel plans than others based in Western societies, as offspring obedience is an expectation while their spending power is limited. Child influence on the dynamics of family decisions extends beyond holidays to entertainment venues such as museums (Wu et al, 2010). Both healthcare (Wee at al, 2015; Wöhlke, 2017) and restaurant selection are also influenced by sons and daughters (Adhikari and Rao, 2013) alongside education (Ladd and Walsh, 2002).

The dynamics of secondary school choice was investigated in the highly competitive, metropolitan London area by Reay and Lucey (2000). In a study involving child views of making or receiving a decision on which secondary school, it was discovered that both black and white working-class boys living in metropolitan council estates had

less influence over their secondary school selection where parents demanded schools offering discipline to keep their child safe. Many working-class children can become the experts in the local secondary school market as competition increases and parents relinquish final preference selection (up to six choices can be specified at present in the London boroughs) to their child. Both rejection and failure emotions are experienced by students vetoed by their most preferred choice where uncertainty increases due to the delayed decision on which other school will offer a place. Kidger *et al* (2009) sampled teacher and student views around adolescent mental health and found that greater support was considered necessary to avoid adverse psychosocial environments that English secondary schools can create. Such environments can change during adolescence, where different needs require accommodating, and relevant information is not available when families decide upon secondary schools but could support dynamic, ongoing family decision making.

2.2 Psycho-social student well-being and competition stressors

2.2.1 Educational impacts on child emotional states

Educational influences on the emotional states of children and adolescents have been noted in literature, including adverse impacts associated with mental ill health problems. From a US longitudinal study by Farmer et al (2003), it is noted that educational establishments provide the most frequent access route into mental health services for children between 9 and 16 years old. Specialist mental health services for those aged 9-13 plus juvenile justice for those aged 14-16 were the second most used point of access to mental ill health services. The education sector therefore has a primary role as the most-used entry point to mental health services.

However, interagency collaboration with health is also essential to provide the range of services required by children. Overall the sex of the child was not significant in accessing emotional help but African-American children would also access through child welfare services provided through government support. In a longitudinal study of adolescents and young adults, Zivin et al (2009) show that of the half of students now attending post-secondary education at a university, 60% of those suffering a mental health problem at the initial baseline survey retained a problem when sampled two years later. It suggests that early treatment for young people is important to counter long-term effects of mental ill health.

Hunt and Eisenberg (2010) suggest more effective medication of mental ill health conditions in high schools leads to increasing numbers of students attending college that require additional levels of support whether presenting externalising (substance abuse/ conduct disorder) or internalising (depression/anxiety) mental health issues. Stein (2013) also confirms that greater numbers of young people suffering from mental ill health are attending university in need of support. Where prescribing powerful anti-psychotic drug treatments for children is more carefully controlled, the emotional influence of parenting styles on children varies.

Baurmind (1971; 1991) first identified the value of authoritative parenting as offering responsiveness for children while delineating the social norms that they should follow to be accepted by others. Parents failing to do one or either regulating actions expose their children to worse social, psychological and academic outcomes. This parenting style differs from authoritarian (strong controls lacking feedback) and permissive (offering guidance but make few demands) approaches. The question of 'how' rather than 'which' parenting styles influence children was answered by Maccomby and Martin (1983) using a two-by-two matrix of responsiveness versus demandingness, where permissive parenting was clearly separated into indulgent (high demandingness) and neglectful (low demandingness) approaches to raising children.

Steinberg *et al* (1991) established a further breakdown of how authoritative parents supported children achieving positive outcomes through (a) parental acceptance and warmth; (b) strictness and behavioural supervision; (c) and psychological autonomy granting. Where many of these contributions now feature in survey tools for understanding child emotions, it is notable that management science literature also defines situation leadership styles in similar terms as those used for authoritarian and authoritative support (permissive approaches including indulgence and neglect do occur in business but cannot be used to represent successful leadership styles and are therefore excluded). According to Vroom and Jago (1988), a spectrum of situational leadership decision making styles also vary across a spectrum from unitary (authoritarian) autocratic through to group (authoritative) democracy.

2.2.2 Secondary data on English parental support for children changing schools

Parental involvement in supporting their children at school depends upon many variables according to the model of parental involvement (Hoover-Dempsey and Sandler, 1995; 1997). Child outcomes can be moderated by such parental engagement based on static status and dynamic process variables for parental and teacher inputs. A student's personal sense of doing well at school is tempered by the degree of fit between school expectations and parent involvement through psychological mechanisms. With such role models demonstrating success by espousing desirable outcomes in adulthood, reinforcement of good work and instruction, with or without reflection by the student.

Critically, the forms of parent involvement not only depend upon their relevant skills but also the ad-hoc demands of student/school (times when parents and children attend school events together, for example at specific festivals or sports events) and the diversionary demands of work and wider family members. Thus, a parent may be willing but unable to help if they lack domain knowledge. Equally a parent may have more pressing demands from other diverting influences where they have to allocate more of their time and attention. Such parental engagement is driven by parent views concerning the scope of their role, general contribution to family and school life, plus efficacy from helping students succeed. If parents gain emotionally from helping a child to flourish then children also gain from direct or vicarious experiences, verbal persuasion and aroused emotional states being reinforced in such relationships (Biehle and Mickelson, 2011).

In a significant study of secondary school admissions across England for the Department for Education and Skills (Coldron et al, 2008), 2,950 parents were asked to provide views on wide range of issues that could influence their school choice decision making preferences, following changes to the system addressing admissions fairness based on new codes of practice. The study demonstrated that school policy changes had adjusted the composition of schools by ensuring that looked after children (see Glossary xxii-xxviii) were given priority in the admissions system while selective practices, including interviews, were curtailed (voluntary aided schools were found to be less compliant with the new code of practice (DfES, 2007) than other types for example). Whereas league table information enabled informed

choices for academically minded students seeking high-performance schools, it offered far less information for meeting the needs of poor and low ability students where school choice matter most (Alan and Burgess, 2013). According to Leroux (2015) parents may be driven by different objectives for selecting schools that range from feeling at ease with the school (reducing rejection and failure risk for 4 in 10 less confident parents) to obtaining a high-performing school (reducing risk of poor qualifications for wealthier and more opinionated parents).

Coldron (2008: p.85) reviews several important factors for parents deciding secondary schools from a large sample of parents across England. In part of the DfES study, parent experiences with secondary school admissions are captured and views expressed around when helping their child locate suitable schools. While parent satisfaction with national admission arrangements across England was high with 85% getting their most preferred school, the figure dropped in metropolitan London where 28% were unable to obtain their first choices suggesting the pressures of urban competition reduced satisfaction even though more options were available to parents. It is noted by Coldron (2008: p.ii) that less educated parents on lower incomes used fewer information resources, and that local authorities supporting selection experienced greater social segregation, with fewer disadvantaged parents being offered first choice schools for their children and correspondingly, more appeals to reconsider from this group. Parent education programs in the US have been used to reduce social stratification in urban schools according to Benson and Martin (2003).

The willingness for those with sufficient resource (time, money, social and cultural capital) to invest in their children's education is confirmed by statistics for England (Coldron, 2008: p.iv). Admission techniques such as banding and lotteries are seen as ways in which to avoid social segregation during admissions with removal of streaming or setting practices post admission to produce balanced learning environments following admission. Only limited pre-admissions selection processes remain legal and are now encouraged by government. Even though unlawful, in 2008

the practice of schools using First Preference First[21] strategy as a criterion for making an offer remained high at 30%.

The admissions process is summarised as a series of steps (Coldron, 2008: p.85).

Publish Previous Results. Admissions Authority publish local schools' information from previous year including oversubscription criteria and results;

Common Application Form. Parents and carers submit a single form application to their local Admissions Authority even if applying outside of their area of control;

Multiple Preferences. Form allows up to three (sometimes more in metropolitan areas such as London where fewer first preference school offers were made) preferences to be stated;

Preference Ordering. Decision makers are asked to list their preference order of schools and submit form by the deadline, either online or by post;

Equal Preference Applied. Plymouth applications are processed against school criteria and offers made for a single school place, five months after deadline with subsequent opportunities to appeal, no matter which local authority involved.

Parents lacking previous experience of secondary admissions were not significantly associated with using formal sources of information, for example to compare schools for meeting student needs (85% of respondents were mothers according to Coldron, 2008: p.89). Sibling attendance was noted to reduce the demands for seeking further information and the evidence valued from school visits including student appearance and behaviour. School websites were now being used instead of paper-based school prospectuses by parents to support their decision making. Ofsted attainment data for comparing performance between schools, was more used by parents where competition was greater in urban and metropolitan areas (Coldron, 2008: p.97).

Some two thirds of parents apply for less than three schools. Reasons cited for taking the risk of an allocation by Admission Authority include a perceived risk reduction of not being offered a place at their most preferred school with a sibling

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[21] Schools were offered students according to the order in which they are put on the application form and had the freedom to prioritise those applicants ranking them first. This was replaced by an equal preference system administered by admission authorities in England.

already attending for example (Coldron, 2008: p.108). While some parents chose to take a risk on oversubscribed schools (typically those decision makers with surplus opportunities), other parents with SEND (see Glossary xxii-xxviii) children avoided such risk to ensure greater certainty of being offered what they had researched for best meeting their additional student needs. A notably London-metropolitan strategy involved defaulting to an independent provider, should affluent parents fail to gain offers for their children at oversubscribed, state-maintained schools. This group of parents are called outsiders by Dronkers and Avram (2010) who are intent on finding a better alternative rather than insiders seeking social class reproduction which are common traits across Europe.

Parents are noted to take specific actions when schools had special application requirements (Coldron, 2008: p.119). Coaching their children or obtaining extra tuition were considered ways to overcome such barriers to entry, being twice as likely when a parent's first preference school had special application requirements. Ireson and Rushforth (2011) note that tutoring is highest in year 6 with 7.6% mathematics and 8.1% for English of those students surveyed having used such services. London-based parents were also twice as likely to specify their most preferred school as one with special application requirements. This suggests a connection between competition pressures in large cities and the need for parents to prepare their child for succeeding in measures designed to select students for different types of school. Most parents applying to schools that were oversubscribed compared selected schools' criteria in order to decide preferences (even though a fifth found them to not be useful, potentially resulting from their complexity), with a quarter of first preference oversubscribed parent applications gambling on unlikely offers (Coldron, 2008: p.123). Further application complexities were noted for parents who also applied outside of their local area.

In 2000, when parents mostly sought academic outcomes when selecting schools, to 2006 when they favoured good reputation alongside good exam results for supporting their decision parents appear to be adapting to quasi-market competition. Equally, reasons for not applying to the closest state-maintained school were poor results, behaviour and discipline (Coldron, 2008: p.128) where choices were plentiful, but this tended to reduce outside of urban areas resulting from other logistical factors such as transport. Some 8% in 2000 and 5% in 2006 of parents applying for their

child thought they could have chosen a better state-maintained secondary school in hindsight. Whereas Coldron points out the risk of assuming parents make rational choices that reflect in results, qualitative studies suggest other techniques such as using the informal parent 'school-gate' network or minimising anxieties for example (Coldron, 2008: p.129). Appeals were also higher in areas where parents applied to other local authorities and not their nearest state-maintained schools. Reasons given for applying further away were based on voluntary aided status and/or faith, single sex, specialisms, larger in size (the latter possibly with the addition of a sixth form college reducing the need for subsequent change prior to A-levels[22]).

Only 53% of mothers thought that fathers were very involved in school selection whereas 76% of fathers considered that mothers were also very involved in deciding secondary schools for their children. This suggests that many families rely upon the mothers to lead decision making where 45% fathers are at best, only partially or not at all involved according to their partner (Coldron, 2008: p.140). Here, parents separating and creating new family structures may be another variable. Almost 4/5ths of respondents indicated that children were very involved in school selection. However, pressures were applied in some cases for children to become involved in taking special action to overcome barriers to entry such as preparations to be professionally tutored or coached at home (sometimes teachers may coach children if they see the academic potential for students who would not necessarily be helped by parents) for the Eleven Plus examination, especially from ethnic backgrounds or when lacking sufficient parent experience of selecting secondary schools (Coldron, 2008: p.142). Skipper and Douglas (2016) note that student emotional states change when taking such tests and that taking examinations can produce maladaptive, fixed views on what constitutes intelligence in those who are selected. Other students either failing or not invited to take the examination exhibit consistently negative outcomes over time.

Based on multivariate analysis, white parents are statistically more successful at obtaining offers from their most preferred school (Coldron, 2008: p.144). Speculative reasons for white children succeeding in obtaining their first preference offers might include parents being more vociferous than other ethnic groups in appealing faulty

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[22] In Plymouth, A-level places are now re-competed at least two academically selective academies for maximising resulting A-level grades.

decisions, having clearer standards of English demonstrated in the application, improved understanding of the process or children better able to succeed when taking special actions to gain offers from partial or fully selective schools through greater understanding. The latter suggests that ethnic parents preferring selective schools may be unwittingly placing their children under additional pressures when transferring between schools. One in ten parents felt less satisfied with the outcomes for their children compared to their beliefs before attending secondary school which could lead to negative associations for the student (Coldron, 2008: p.146).

While the research demonstrates that most valuable information sources were qualitative visits and talking with others including staff at the schools (a quarter of parents surveyed did so on normal school working days for example rather than pre-arranged open events), the rising use of the internet for comparing schools' data is pronounced for more quantified comparisons of suitable secondary schools between 2000 and 2006 in the longitudinal study. Better educated parents make more use of marketing prospectuses from schools as well as benefitting from access to other internet resources, both in the UK and also in the US (Delale-O'Connor, 2017).

Rather than parents lacking information on their personal secondary school choice problem, raised levels of information combined with other considerations (the risk from financial and social cost impacts of an unsuccessful application for example) may represent a larger incentive for uncertain parents to obtain their most preferred school rather than consider risk-laden alternatives that could be better positioned to meet the needs and capabilities of their child. Experience of applicable information, is potentially more relevant in obtaining a most preferred offer for those with recent knowledge of school choice (Coldron, 2008: p.148). It is noted that appeals are most common in local authority areas where first preference, selective school applications had been made (Coldron, 2008: p.151). This includes Plymouth Unitary Authority area with three grammar schools (Plymouth City Council, 2017b).

Communicating such concerns within families can be initiated by the child, for example while parents transport children to and from school each day to discuss things that matter with a parent. Equally initiation can start from a sibling or parent gatherings at family meal times when many families meet for example, in the evening after work. The health benefits of such debates are established and include both

physical and emotional gains for participants. For example,, Neuwmark-Sztainer et al (2007) demonstrate protective effects against eating disorders in pre-teens. Fewer behavioural issues are encountered for children up to 12 years of age with time spent eating family meals (Hofferth and Sandberg, 2001). Not only can the physical benefits of healthy eating introduced through dining together, the social-emotional improvements of sharing problems and finding solutions cannot be ignored when facing significant stressors. However, the power of such emotional gains is reduced where families produce separate child meals or allow favourite take-away or frozen meal choices where separate preparation arrangements disrupt core-time spent eating together. This can encourage making food one of the few issues for some children where personal choice is exercised (Fiese and Schwartz, 2008) either overtly, when their favourite is not on offer, or covertly when concerned about weight and looks for example. For adolescent students in the US (Neuwmark-Sztainer et al, 2010) the frequency of dining together extends from regular practice to 14% never eating together and only just over 7% doing so once a day. This leaves 79% of adolescents in the USA seldom meeting adults. This suggests encountering opportunities for supporting student emotional challenges reduce in frequency, just when demand for stability and independent views may be greatest.

Not only are parents challenged with the uncertainties of choice, especially if unfamiliar with the problem, Towns (2010) suggests that children also face doubt when contemplating changing schools. When homework increases as students prepare for their final year in primary education, competitive tests and examinations in English state schools, parents can be invaluable in helping to explain what questions might mean and how to go about answering. Equally, parents discussing what secondary schools might mean to a child still in primary school is another important factor in students gaining confidence (Akos et al, 2002; Falbo et al, 2001; Paulson, 1994). When transferring between primary and secondary schools, the opportunity to help children manage time and plan for important changes can make the difference between getting the best fit of school to developing student need or one that is unable to adapt with unhappy consequences.

As identified by ONS (2016) in child well-being statistics (Table 2.3 shows how often children seek information from parents), there are significant numbers of families who discuss things that matter to children less than weekly with the affected children.

Where many single parent families have a mother making all the decisions, for those families with only a father this issue may be more acute should the approximate 60:40 proportion of more often to less often than weekly discussions reverse with parental gender. Whereas the topics of concern to child will vary depending upon age and the challenges they face, such discussions represent and important way to learn from the experience of others and gain confidence in their future.

Table 2.3 Family discussion frequency for 10-15-year-old children (source ONS, 2016)

	Percentages from sample						Sample size numbers		
	2009-2010		2011-2012		2013-2014		2009-10	2011-12	2013-14
	More than once a week	Less than once a week	More than once a week	Less than once a week	More than once a week	Less than once a week			
Talks to mother	62.6%	37.4%	63.4%	36.6%	63.6%	36.4%	4,806	4,367	3,504
Talks to father	38.0%	62.0%	39.9%	60.1%	42.1%	57.9%	4,494	4,100	3,305

Confidence for children can be bolstered in other ways through different relational networks. In a study of 588 primary year 6 and 81 secondary year 7 students, Weller (2007) describes how students can be excited when friendships continue through the transfer into the new school but anxious if not. Chedzoy and Burden (2005) examine the significant psycho-social effects of changing schools in South West England. Parsons et al (2000) demonstrate up to a third of Plymouth families move out of local school catchment areas as competition increases amongst schools in Plymouth. They suggest that poorer, inner city areas experience most movement away from

traditional feeder school arrangements (designated primary schools supplying students to or feeding a local secondary school) to benefit from the new market place in Plymouth education.

It is noted that in a parallel study of children moving from primary to secondary education in Beijing, the data also indicates that parents can decide poorly in situations where enrolment is open to all (Lai et al, 2009). Making such mistakes leads to less success in secondary education for the child and corresponding disappointment for both them and their families. The authors conclude that such parents need help when facing a confusing enrolment process and complex range of secondary education providers when children move-on from local primary schools in the district.

2.2.3 Secondary data on emotional challenges for children at school in England

The Children's Society[23] (TCS) produce annual Good Childhood well-being statistical reports based on surveys of children at critical ages including before and after transferring to secondary schools across England (The Children's Society, 2011-2017) for comparison with other countries. Based on an annual report (The Children's Society, 2013), specific insight of self-reported well-being is available concerning the challenges of changing schools in England at this critical life juncture and beyond into secondary education. Where annual differences are reported then adjustments to the data are provided to compensate for change in the data set assumptions for students across England. This provides a level of consistency that is not easily verified from other sources due to the nature of the data being collected. However certain data is sourced from other reports and these are listed as sources for each annual report.

Whereas some 10% of respondents aged between 11 and 15 were unclear concerning psychological questions on eudaimonic well-being (involving longer-term issues around life feeling worthwhile), greater response accuracy was demonstrated for current life contentment (satisfied today) and hedonic or affect (recently happy), scores concerning levels of happiness in the surveys conducted with children and adolescents (The Children's Society, 2013:p.9). All three types of measure show

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[23] The Children's Society is a charitable organisation based in the UK with origins in Sunday School movement who support disadvantaged children and young people with research and development amongst other things.

reasonable similarity of curves (a skewed normal distribution centred on a score of 8), where life satisfaction ranks slightly above happiness and being worthwhile on a normalised scoring scale of 0-10. With all three normalised levels plotted over days of the week, the weekend rise in hedonic well-being for children is pronounced. However, a lesser rise can also be observed in life satisfaction but effects become averaged-out in psychological measurements of well-being.

This suggests that eudaimonic well-being may be better suited to capturing measures of longer term impacts on psycho-social well-being for children even if measures are less certain for the younger elements of the target audience. However, shorter term measures are also stable when averaged over extended periods (even when days of the week show happiness variation linked to the weekend) of a year or longer. For example, plots of life satisfaction on a scale of 0 to 20 show rapid well-being decline from age 8 (15.1 points) down to age 15 (13 points) with subsequent gains in well-being from the age of 16 onwards. This is the period when many children are preparing to change from primary schools to study for secondary school qualifications and the onset of adolescence in children. A similar trend was noted in in eudaimonic well-being from the students in the sample and both trends are believed to relate to the amount of choice made available to children which changes upon departing secondary school (The Children's Society, 2013: p.14).

Results therefore concentrate on life satisfaction issues which are more stable when measured on a scale of 20 point (high) where the modal score for children aged 8 to 18 is 15 on this scale (reflecting 13 percent of the sample). When scores fall below the midpoint on this scale (10 points) then children are defined as having low well-being, so 50% therefore represents a threshold value. Disadvantaged groups of children can suffer from greater occurrences of low well-being (The Children's Society, 2013: p.13). For example, those children not living with parents who are often in care, are up to five times more likely to suffer low well-being than others who live with parents. Personal factors reflecting the family situation only account for 10% of well-being variation suggesting that systemic factors may cause more substantial variations within a population. This corresponds to typical CAMHS referral demand (Livewell Southwest currently provide a team of specialists to support children in care between the ages of 5 and 19) for low well-being as well as mental health. Such a mix of demands reflecting a key responsibility of shared service provision for

children's services by joint commissioners for Plymouth where vulnerable children require supporting to avoid descent into areas requiring child protection.

On a hedonic scale of happiness from 0-10, mean happiness reduces for all 10, contributing factors with age. Family remains a major factor even though experiencing a 10% reduction between 8 and 15 years of age before recovery begins. In a similar trend, the lowest contributor remains happiness about the future which starts at just above 7 and reduces to 6.5 over the same timescale before recovering in later years. As mentioned, by far the largest potential recovery gain for those age 16 and 17 is in happiness over issues of personal choice, gaining 5% in just a year. By contrast the largest drop in happiness is for the school category between the ages of 10 and 15, aligned with admission and transfer to secondary education (The Children's Society, 2013: p.15). The reduction from a mean score of 8/10 or 80% aged 8 to 6.6 or 66% aged 15 measured on the Good Childhood Index represents a trend that suggests English children suffer chronic loss of well-being during this period of their lives.

Such emotional losses from school must be compensated for by higher ranking substitutes sources of happiness such as family and home (absent for those in care) or friends (assuming good health but illness also reduces ability to retain well-being) within the individual's social relationships (rather than social media associated with technological trends). An absolute drop of 14% over the period does not necessarily mean low well-being thresholds are breached based on school alone (mean value set at 50% for defining low well-being) for the average child, depending upon their initial rating. However, school remains a common factor for boys and girls facing adolescence that makes the possibility of breach more realistic. This is especially true if other emotional compensating mechanisms[24] are not working effectively or are under pressure from other sources of personal unhappiness including appearance, time use, choice, the future plus money and things.

It is notable that personal choice reduces for children as they prepare for tests where time must be managed carefully to retain essential emotional balances. Rising happiness with choice in sixth form or technical colleges (The Children's Society,

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[24] Bronfenbrenner (1979: 1992) explains the reliance on influences from the child's microsystem and beyond in his Ecological Systems Theory approach to child development.

2013: p.29) suggests that the effects of competitive examination pressure restricting choice before and within secondary education need further investigation, as choice widens once again at college. Both authorised tests for English education take place at the end of primary (KS2 SATs) and secondary (KS4 GCSEs) school where preparation time studying the course material is mandated. In Plymouth, elective test preparation for entry into selective schools commences from the age of 8 in a 2-year restrictive period which is the same time taken to prepare for GCSE examinations during secondary school.

Annual gains in levels of English student well-being have yet to redress significant losses around the time of preparing for tests. Even though baseline levels of happiness have continuously risen between 2001 and 2008 with similar trends for life satisfaction, where English children at ages 11, 13 and 15 have gained over their counterparts in other countries (The Children's Society, 2013: p.16) this has not countered emotional loss trends during the period of preparation and transfer into secondary education where English school performance remained problematic compared to most of the 29 countries in the sample.

Children who have exceeded low well-being thresholds for life satisfaction are likely to have fewer friends (self-reported as insufficient), do not like the way they look, are not able to express their opinions freely, do not look forward to attending school, do not think their life has purpose, do not get on with their family, feel unsafe at home, have experienced recent bullying and feel that fewer people support them when compared to others with average to high levels of well-being. Not being able to express opinions is six times more frequent for the low well-being group of children (36%) than those with average to high levels of well-being (6%). Whereas only 5% of average to highly satisfied children experience family conflict, those with low well-being are over eight times more likely to encounter family disputes at 42%. For others not feeling safe at home can be a problem that is twenty-four times more likely in cases of low well-being (24%) than with children who report average to high well-being levels (The Children's Society, 2013: p.17).

These statistics suggest the value of a supportive, communicative and safe family environment in sustaining student well-being as they negotiate their concerns when transferring into new school working environments and transition between childhood

and adulthood. Whereas four out of five children in England are seen as flourishing with mid-point well-being scores or higher, of those who are not, one in ten exceed low well-being thresholds, making them vulnerable to many other factors in which family relationships feature strongly. Charted well-being gains up to 2008 (those that focus on different aspects of a child's life rather than external events, as derived from life satisfaction surveys), also appear to have stalled for children across England following the financial crisis (The Children's Society, 2013: p.18). Of the ten factors influencing 52% of well-being variation in life satisfaction, family and choice rank as most the most significant.

Harmony rather than structure within family determines well-being for children and over a third of the variation in subjective well-being is attributed to the quality of family relationships. Across 79 state schools and with 6,064 participating children, the dimensions of family relationships were investigated further. Whereas harmony showed differences in gender and socio-economic responses (out of work households and females reporting greater conflict), those responding to autonomy and support questions remained. Constant. Of the half with higher life satisfaction scores, this group also recorded 10 percent higher scores in each of the influential contributing categories of support, autonomy and harmony than the remainder scoring less than 50% for life satisfaction (The Children's Society, 2013: p.25).

High conflict and low support families are identified as potential sources of low well-being for children (The Children's Society, 2013: p.26). Such families deciding between secondary schools may be at-odds over which schools they prefer (high conflict) and not willing to consider each other's view (low support) for example. The issues of selecting schools and subsequent courses would commonly raise levels of discord and disquiet within such families. The term used to describe the views of another person not being accommodated, or even listened to, by those deciding an important matter is known as autocratic leadership in decision-making (Vroom and Jago, 1988). Another popular typology for defining family relations again uses four styles defined using two dimensions of responsiveness/ warmth/ acceptance and control/demandingness but the latter is less easily applied than the reinforcing autonomy-granting concepts of Soenens and Bayers (2012), autonomy granting offers a positive correlation (remaining high for higher levels of well-being). By comparison to family relationships having significant influence over child well-being,

social deprivation can only explain less than 2% of the variation (Rees *et al*, 2010) i.e. in large areas of Plymouth where social deprivation is elevated (Devonport is one of the poorest wards in the country for example), this would not explain age-related, child well-being reductions. Here external stressors that test family relationships could offer greater insight.

Developing policy to support children for raising levels of well-being is considered through Bronfenbrenner's ecological systems model (Bronfenbrenner, 1979; 1992) for children that relates different levels of influence in a child-centric view (The Children's Society, 2013: p.31). The model of human development describes different levels of influence on well-being from a child-centric perspective. At the closest and therefore most influential level, their work (school teachers), friends (neighbourhood peers) and home (family members) provide supporting networks that are key to stable emotional development. In the original model this microsystem also extends to influential religious beliefs and for some minorities this is still the case today in the UK. The mesosystem describes the established connections between elements of the child's microsystem beyond which the macrosystem exists such as the services children use, local bodies and national standards where culture, attitudes and values all serve to influence child development. The final model component reflects the changing nature of these influences over time and is called the chronosystem. Given the changing context of society with time, different generations can have very different views on what most influences their development as children, especially when a memorable (good or bad) childhood fosters important learning to pass on concerning schools over the years (Leonard, 2011).

It is acknowledged that influencing family relationships and parenting styles may be difficult for policy to address and that other areas may be more amenable to affect change. However, this is the challenge for policy makers when research demonstrates that relationships offer the most sensitive area for achieving gains and reducing subsequent demands on supporting services. While the UK is mid-ranked amongst 29 countries with 86% of children scoring above the midpoint for wellbeing scores (lowest being Romania at only 76.6% with the Netherlands highest scoring at 94.2%), improvements from developments elsewhere such as Iceland (90.2%) or Spain (89.8%) could inform emotional support policy developments for example and

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identify local variations to target for improvement interventions (The Children's Society, 2013: p.33).

Whereas low well-being does not imply mental ill health, the conditions do overlap. Low well-being associated with life satisfaction, while not as disabling as mental ill health, has implications for poor attainment and emotional, cognitive and behavioural disengagement (The Children's Society, 2013: p.34). Such disengagement can be associated with in drop-out during secondary school as well as burn-out in preparing to transfer from primary school. Both features have high costs to society and appear to be better indicated by low well-being (children not faring so well with school or family) rather than higher degrees of mental ill health which could be identified and treated through existing community health providers (The Children's Society, 2013: p.35). It is noted that those children in the survey suffering low well-being were least likely to talk to their parents, either weekly or more frequently about things that matter to them. With some 47% of those identified with low well-being who discuss less frequently, this group requires more from family relationships and connections with school teachers to remain resilient to the challenges they face.

A survey of 1,500 young people between the ages of 10 and 15, reveals several significant gaps in well-being between those who perform the activity most days and others who hardly ever do so, suggesting opportunities for self-help to improve well-being for children. Typically for 10% who hardly ever and 20% who do so daily there remains approximately 70% who only occasionally take notice of their emotions, physical fitness and surroundings, teach and learn about new things, play non-team sports and see relations who live elsewhere as recommended ways to improve well-being retention (The Children's Society, 2013: p.36).

While some children possess self-help abilities, for the majority connections with family members remain an important determinant of well-being for children and talking to family about things that matter is a key contributor that exhibits a linear positive behaviour between raised well-being and increasing frequency of debate (The Children's Society, 2013: p.39 plots the chart using a five-point scale of frequencies of never, hardly ever, less than weekly, once or twice a week and daily). As noted by the authors on measuring for low well-being to inform specific interventions and prevent further entrenchment (The Children's Society, 2013: p.45)

"…children who have low life satisfaction but do not meet thresholds for mental ill-health are more likely to experience a range of poor outcomes in relation to school, family and health behaviours..." New insights are therefore needed to provide help to emotionally vulnerable groups of children to help avoid the societal failures of the past.

The amassed data since 2011 and all consecutive years for children across England entering or within secondary education "… shows children's direct experiences are much more important for their well-being than factors that are more removed from them, and also that factors that are known to be related to adults' well-being are not necessarily linked to children's well-being." (The Children's Society, 2016: p.49). The relationship of factors affecting children reverses when considering family disadvantage. Children and adults questioned about 27 potential disadvantaging factors divided among parent-child relationships, family/household, material and neighbourhood over the previous five years suggested a linear, positive relationship between low child well-being and number of disadvantages.

Where children and adults noted seven or more disadvantages, 29% of children responding would have low well-being where without such pressures only 3% experience low well-being (The Children's Society, 2017: p.52). Whereas pairs of disadvantage were commonly encountered such as debt and struggling with bills or depression and worry over crime that could reduce life satisfaction for not only an adult but also a child. Disadvantage has a cumulative impact on well-being where experiencing seven or more over a five-year term would reduce mean life satisfaction for children from 7.4 to 6 points out of 10. Notably only three parent-child relational disadvantages are measured in the sample including emotional and supervisory neglect plus the child as a young carer and while damaging for child emotions, they are relatively rare (The Children's Society, 2017: p.45). The 25 remaining disadvantages mostly relate to issues primarily challenging adults that also influence low well-being in children. Where two disadvantaging factors may be manageable, when adult attention is diverted elsewhere and not directed towards the child, seven represents a far less controllable situation for family members and associated emotional impacts. Uniquely, Good Childhood offers longitudinal-themed insights on adolescent challenges.

School choice represents an opportunity for self-expression that directly affects the child as well as their family and helps establish important emotional connections for all between parents and children. Policy supporting family decisions through better information on school options can struggle to offset the pace of change in secondary school competitive provision in urban centres such as Plymouth. Equally referrals for emotional help and intervention – those that do not pass criteria for mental ill-health – remain largely unsupported where larger risks are perceived elsewhere. Of course, providing greater opportunities for children to emotionally self-help and develop greater emotional resilience can contribute solutions but assume both child and family understand such benefits and want to engage in preventative measures.

Models of family resilience help establish dynamic relationships between individuals that can explain change over time. Rather than relating to single events alone, psycho-social stressors reflect a changing set of conditions with past-histories and future courses (Rutter, 1987) exemplified by divorce, where no single coping mechanism always succeeds for everyone and pathways should be adapted. Where coping with immediate crises may be successful for many families, retaining the same solution longer-term may not cope with persistent challenges. When stressors pile-up over time, families can be overwhelmed. Based on Hill's original concept (1949;1958), McCubbin and Paterson (1983) develop a framework that reflects the accretion of stressors that make families more vulnerable to subsequent emotional problems where adequate coping mechanisms are not available. Their ABC-X model shows that an adverse event (A) triggers the use of family resources (B) that adjusts their perception (C) of coping or not. If resources are inadequate then a crisis (X) results in stressors piling-up and the need for the family to adapt.

What would therefore be useful is a policy testbed that allowed different suggestions to improve support for children experiencing declining well-being to be tested on the family's emotional system. Here emotions for parent and child can balance before being put under tension by exogenous (see Glossary xxii-xxviii) competitive stressors. Simulation would appear to offer ways in which policies could be compared for their effectiveness in correcting low child well-being in a family setting.

2.3 Simulating through dynamic integration to abduce relationship strength

All simulation types can be used to support decision making whether at resource, process or system levels. Monte Carlo simulation is discounted for the purposes of this review as it uses mathematics to generate statistical variances in existing models such as cost plans for example to gain confidence in cost to completion in the presence of risk which does not change over time. The three remaining types of simulation have different purposes in supporting decisions by simulating the effect of choices over time. For Discrete Event and Agent Based Modelling types, discontinuous modelling allows process tactics and group strategies to be developed and tested for understanding and influencing decision rules. By contrast the system dynamics approach uses continuous simulation to understand and influence decision rules by identifying effective policy levers in non-linear systems. Social and psychological systems commonly share feedback between group actors and from specific experiences. Feedbacks intrinsically make problem solving far more difficult when shifting paradigms from linear thinking to non-linear dynamics. Typically, non-linear systems respond and adapt to interventions aiming to address linear cause and effect assumptions. This ensures that interventions remain ineffective and waste proliferates when attempting to sustain change in the psycho-social systems involving families and school choice. Dynamically complex decisions can be supported by simulation techniques that use real world data to predict future trends. The three approaches are discussed further to understand potential contributions in the context of secondary school choice in Plymouth and connections to rising referrals for mental health services.

2.3.1 Agent Based Modelling (ABM) for bottom-up decisions rules analysis

A form of discontinuous event simulation based on detailed events, ABM (see Glossary xxii-xxviii) employs low level decision rules, common to individual but independent agents, that can be described by simple 'if…then…else' learning algorithms to change states of heterogeneous, interacting groups of agents at specific times based on logic statements. The system behaviour emerges from modelling agent interactions based on rules of interaction describing system evolution. Operating as an integrated group but made from individual, autonomous agents, ABM enables derivation of group behaviour from multiple, individual agent interactions dictated by simple rules. For example, Isern and Moreno (2016) provide

a current review of agents applied in healthcare including their use in decision support systems that include ABM. In summary ABM behaviour emerges from agent interaction at discrete points in time where agents forming the system operate logic sentences based on personal objectives, properties and social ability of those acting within the system.

ABM simulations addressing geographical problems are a common theme that has been applied to education. In particular central planning of Local Education Authority school developments has been studied alongside the new freedoms for school development based on community demand in England with the advent of free schools. Harland and Heppenstal (2012) reveal an AMB model that demonstrates accurate matching of student numbers and school capacity in urban centres but inefficiencies beyond the city. Educational change is also studied by Akoyl (2016) in seeking to understand the effect of voucher schemes on the composition of school enrolment between private and public-sector education providers in the US. He reveals that while encouraging competition, stratification between schools by student ability can be significant.

The behavioural patterns of a group are therefore predicted based on rules commonly using sound, visual or touch inputs from which to decide a response. By contrast, family decision making mechanisms are likely to be complex where predicting policy outcomes reflects a top-down rather than bottom-up process.

2.3.2 Discrete Event Simulation (DES) for process improvement

Processes represent elements of systems that produce outputs in a systematic manner. Processes can be represented using DES (see Glossary xxii-xxviii). The key process in this thesis relates to school admissions and DES could offer key insights on queues and waiting times that families experience when transferring into secondary education in Plymouth for example, if policy considerations were aimed only at admissions. A relevant process map describing major admission features could be created and simulated with Plymouth data using DES. However, while the problem involves pressure from obtaining competed places which would rise over forthcoming years, the few currently being rejected for their first-place preferences would be unable explain the rise in referrals and therefore modelling process may not offer adequate explanations.

DES use in healthcare is relatively commonplace, due in part to the simulation technique offering a process perspective on treatments. Gan *etal* (2017) describe the application of DES to simulate improvements in patient flow for hospital treatments of psychiatric disorders in women and children. Brailsford (2015) shows that health simulation hybridisation between DES and ABM types of simulation is possible but complicated. The impact of DES in healthcare is significant where 65% of simulations models are reported to use DES (Arisha and Rashwan, 2016). DES now extends to the workplace where production lines are simulated using the technique to understand impacts on worker well-being and design improvements (Dode *etal*, 2016).

DES is therefore frequently used to aid decision making processes concerning levelling resource allocations within dynamic process maps at operational and tactical levels rather than at individual agent level. Blocks of time separate recalculation on networks of queues (the stocks equivalent in system dynamics for example). The interaction between constrained resources drive the model through instantaneous, discrete time steps. DES models are stochastic in nature and use statistical distributions to produce events with elements of randomness. While DES logic is black box and highly embedded in mathematics the visual representations for DES can offer advantages over other techniques when considering detailed data sets (McHaney, 2009). Unfortunately, the process technique is less applicable for supporting policy decisions across wide-ranging psycho-social systems involving qualitative views of those versed in the problems and quantified views of decision makers.

2.3.3 System Dynamics for relational causal structures of behaviour through feedback given variable assumptions

Industrial Dynamics was the starting point Forrester (1958;1961) to apply his ideas (gained from a career in systems engineering) for gaining insights on seemingly intransigent problems on important issues affecting business management. By offering causal explanations of business-related phenomena regularly observed but little understood, the influence of time and space could now be clearly explained when relating cause to effect in an ever-increasing complex world. The discipline of System Dynamics had arrived and with it the ability of industrialists, economists,

social scientists and others to explain trends over time that could represent the underlying problems affected by feedback.

By offering a way of thinking, doing and believing, Forrester was able to propose scientific explanations for problems with supply chains for example: the renowned 'bull-whip' or Forrester effect describes increasing distortion of supplying resources (in this case people) in proportion to the distance from the originating source of demand from orders. According to Forrester, system inferences or thinking can then be derived from rigorously structured and tested models, including causal loop diagram summaries. Since this time, causal loop diagrams and other 'view-expanding' scripts have been used to widen the debate on system feedbacks beyond academia by engaging stakeholders. However, difficulties relating this wide range of topics to simulated system behaviours (ones that are based on hard simulation numbers rather than softer relationships that lack stock or flow structure) have been noted by academics (Coyle, 2000; Homer and Oliva, 2001; Lane, 2008).

Given the ability to cover many issues facing the world today such as the rise and collapse of ecosystems (Forrester, 1971) or the role of business in society (Sterman, 2000), social systems can be abstracted and modelled to not only reflect upon observed behaviours (social phenomena) but also devise policy interventions (decision rules) to which such systems respond. By testing for sensitivity (one variable's change impacting upon other system element's value for example) in dynamically complex, non-linear systems more leverage points can be determined that offer strategic policy advantage for tackling problem behaviours. The modelling technique is summarised as behaviour derived from system structure where feedback produces causal relationships defined by algebraic formulae in continuous time to produce variable plots over time from stock flow diagram representations. In this context, causal loop diagram provides a valued tool for abstracting summaries of system interactions that are relevant to the problem behaviour and alternative policy solutions.

Psycho-social systems have also been addressed using systems dynamics. The impact of overtime on an individual's effectiveness to work involves the psycho-social dynamics of personal stress and demands of employment. By studying the interaction between social work demands and the psyche's ability to perform, a

model predicting the impact of burnout that exhibits systemic overshoot and collapse becomes a tangible tool for testing policy interventions according to Homer (1985).

To appreciate the concepts underpinning SD, it is useful to explain some basics of stock-flow diagramming notation and their summary chart format known as a causal loop diagram.

First, consider the stock of water held in a bathtub. It has dimensions that can be measured (the volume of water in cubic meters) that are associated with the level of water it contains. At least two flows are necessary for the bathtub to operate: an inflow from one or more taps[25] and a controlled outflow to release water from the bathtub once used. Both flow devices have associated rates where the tap can be varied by the user depending upon desired water temperature for example, the plug is either set to no flow when filling the bath or full flow when removing the water. All devices have measurable flow rates (plug and tap) that can be specified in cubic meters per second. When flows-in equal flows-out then the level of water within the bath remains the same. The bathtub dynamics can therefore be drawn using the SD (see Glossary xxii-xxviii) stock-flow diagram notation where clouds, at the flow extremities where water enters the system and is subsequently removed, represent the rationalised, system boundaries. This metaphor is illustrated in Figure 2.2.
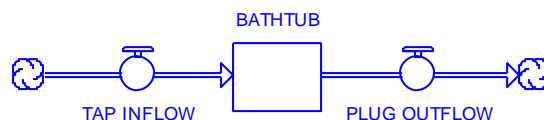
Figure 2.2 Stock Flow Diagram Notation

The bathtub also represents a simple closed system as it contains additional (and automatic) controlling logic called the overflow (Kyoto, 2010). Here at a target level of water depth in the bathtub, should inflow exceed outflow rates then a second outflow opens to keep the water from overflowing the bathtub onto the floor. This checking or balancing (see Glossary xxii-xxviii) behaviour (B is used to indicate balance whereas R would refer to reinforcing control characteristics involving feedback) forms a closed loop and can be sketched-out as a simple, mathematical equation represented in

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[25] A tap is a valve device allowing the control of water entering a bathtub or basin– also known as a faucet elsewhere in the world,

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stock-flow diagram notation using depth in meters to calculate when the overflow begins to work i.e. open overflow when maximum or target depth minus bathtub depth equals zero (Figure 2.3 gives further details of these feedback controls that involve variables such as target minus bath tub difference, overflow rate and stock of water held in the bath). Note, change of units from cubic metres per second inflow to metres for accurate feedback control based on a pre-set overflow height from the base of the bathtub.
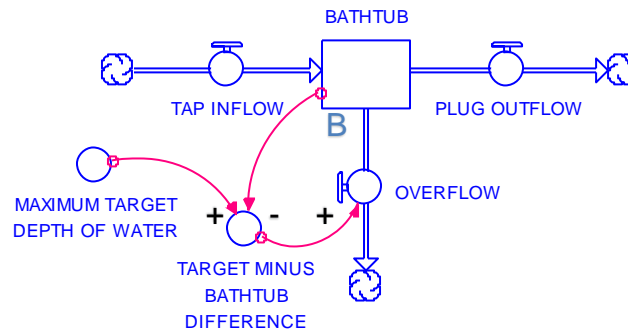
Figure 2.3 Stock Flow Diagram showing closed control system of an overflow.

The stock-flow diagramming convention commonly applies mathematical symbols ('+' or '-') to arrow heads indicating whether interconnected factors within a stock flow diagram rise together (reinforcing each other so when one rises so does the other by using a '+' sign) or oppose each other (balancing each other or when one rises the other falls by using a '–' sign). These are the same signs also used for arrows on Causal Loop Diagrams to summarise the behaviours within the system based on important relationships that may need emphasising. An equal number of + signs and – signs within a loop indicates overall balancing behaviour (conversely, an odd number or just one type of sign present in the loop suggests reinforcement). An abstracted causal loop diagram of the bathtub control loop is shown in Figure 2.4 for demonstrating bath water rising above the overflow level wastes more water for example. As wasted water increases the water remaining in the bath decreases back below the level of the overflow mechanism, given a sufficiently large overflow. The diagram therefore helps infer behaviours around issues of interest to help explain policy implications, in this case around management of running water for a bath and wasting (cold) water. Here the causal loop diagram has an implied purpose that is derived from stock flow diagram analysis relevant to a particular issue i.e. to save

clean water then either heat water instantaneously and use only what is required or have a separate drain that enables recycling cold water for another use.
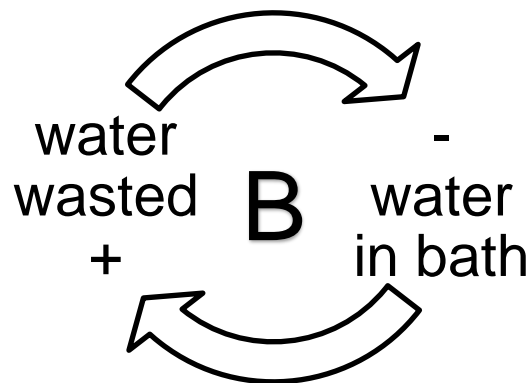
When observed as behaviour of stocks over time (the volume of water in the bathtub in this case) a balancing behaviour would make the graphical plot of cubic meters held by the bathtub become more horizontal. Conversely, if the control was reinforcing then the behaviour over time plotted in cubic meters would become more vertical, whether rising or falling (Hayward, 2017).

Moving away from the engineering case of a bathtub, it is possible to imagine what other stocks could be measured either in absolute terms such as cubic meters held in a bathtub or depth of water in meters, or in normalised or relative terms that compare values such as percentages (out of 100) or proportions (out of 1). This opens the possibility to mix together all types of system and scale within a single platform to represent new combinations of influential feedbacks across a dynamically complex system whether at personal (psychological) or system (social) levels for example.

As illustrated by the bathtub model, a system dynamics approach allows modelling scale to be captured which can translate between different influences across social structures for example. The technique readily supports integration between different types of data (Xu and Zou, 20006). Relationships can be represented at international, country, corporate, community, familial or any mix thereof by selecting appropriate units within a system of stocks and flows (Forrester, 2016: pp 189-191). This makes

mixing different influences in a social system a realistic and flexible proposition for representing views of many within a cohesive model of key inferences that can be rigorously tested. Competition effects on referrals concerning knowledge and well-being, help to identify system structures that can explain observed, dynamic patterns of behaviour. With the recent upsurge in numbers of natural scientists, system dynamics is one of the few techniques embracing complexity that is capable of transcending multiple categories of discipline to find lasting, 'high-leverage' answers to 'wicked' problems (Pidd, 2003).

Faulty 'mental models' of those tasked with deciding between complex alternatives also have potential for bias that can be revealed using system dynamics. According to Forrester (2016: pp192), the faults common to personal mental models can be improved through interaction with simulating the dynamics of a system. This interaction is also bi-directional as further insights from mental models of a decision-making process can help improve the accuracy of predicting trends using system dynamics. Senge (1990) expands upon the idea to describe seven learnt disabilities commonly encountered within business. He considers that hierarchical management structures preclude taking wider system responsibility where the larger the structure, the more persistent this influence. Blame is always considered to be external to the system being operated, at whatever level. Problems can never therefore originate from within the system in the mental models of people working in an organisation. Proactivity is a cloak for reacting to whoever or whatever was allocated the blame as the ostracised enemy. Slow changes go unnoticed by organisations only able to sense event-based variations. This ensures that businesses become mal-adapted to their environment over time. Strategic outcomes take a long time to implement and therefore senior managers hardly ever learn from experience, even more so now that time limited contracts are a common feature for employing top executives. Management teams tend to sub-optimise their own functions to show the value of what they do compared to others (cashflow, headcount, sales, quality, energy consumption, etc).

Given such predispositions, agencies supporting children during formative years may therefore struggle to reach consensus on the source of the problems and more effective interventions for recurring issues, especially when time and money are limited.

Importantly, 'spirals of decline' can be observed within many social settings. Family members of those experiencing psychiatric difficulties (Forrester, 2016: pp197-198) all know the problem exists and want to help. However well-intended or conceived, help can serve to make matters worse rather than solve psychological problems. Such support may be well intentioned but lack sufficient leverage to have significant impact on the behaviour caused by the issue or, worse still, serve to generate unintended consequences. Indeed, the capability of system dynamics modelling to surface and challenge assumptions is paramount in such contexts. Forrester suggests that blaming poverty-stricken countries supplying drugs to larger neighbouring markets may be politic but modelling the system of supply and demand ensures the right questions are asked: "why is our country (United States of America) the largest market for drugs?" Accurate attribution of cause and effect is important in a complex world. Forrester also notes parents blaming schools for reduced levels of student competence whereas lacking pre-school guidance or unsuitable home-lives might also need challenging to ensure longer-term, intergenerational contributions from members of society.

Other contributors in system dynamics around the issues of selecting and using secondary schools, that detail aspects of enrolment from Kindegarten to year 12 (K-12[26]) learning have been noted by Kennedy (2011). The review of system dynamics contributions suggests a paucity of views on the dynamic issues around changing and enrolling in schools in this age group, with detailed contributions to the system dynamics literature focusing upon higher education (university wide and within faculties) plus national and regional governance matters. Even though aimed at government policy towards university education, quasi-market reforms are discussed and modelled by Mackintosh et al (1994), with dual drivers of tax-funded support for competition and private funding from student fees. Perceptions for university enrolment were collected through a survey mechanism by Frances *et al* (1994) when seeking to understand quality of high school and college students for establishing their willingness to engage with higher education in Texas. Considerations determined from the survey included accessibility, cost, willingness to borrow,

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[26] K-12 is a commonly used description in the USA for children in school age cohorts commencing education at Kindergarten and completing in year 12 of high or secondary school.

availability of student aid and benefits alongside income expectations from studying in a system dynamics model comprising seven sub-systems.

The management and quality of reforms for private examination bodies[27] has also be studied (Leslie and Sherwood, 2014; Richardson, 2014) where systemic influences appear unable to counteract the commercialisation effects on diminishing educational standards as grades (grade inflation is currently being countered with new GCSE standards for England by introducing 1-9 numerical grades to replace A*-E scores from 2017) continue to rise under pressure from grade marking appeals from schools. Notably sub-optimisation based on competition that maximises individual school incomes reflects badly as it can represent a tragedy of commons archetype (Senge, 2006) for state-maintained education (in 2017, English budgets remain constrained) moving away from lethargy of the common good. Guevara et al (2005) examine the impact of managerial policy on dropout (see Glossary xxii-xxviii) performance over five years of primary education using system dynamics. Set in Nicaragua, the study reveals that rather than linear interpolation of predicted outcomes over a 30-year period from 1990 to 2020, a system dynamics approach offers considerable benefits under conditions of dynamic complexity where quality rather than quantity can reduce wasted potential from children dropping out of school. Aleluia (2014) also employs system dynamics model to predict teacher demand for state education in Portugal using national census data to identify demand from high or secondary schools.

For simulating the impacts of policy on human behaviour, the dynamics of resourcing schools has been studied by Zimmerman et al (2016) looking at a supply-demand resource prediction problem who observe that the greater the proportion of additional needs children in a classroom, the faster teaching staff turnover in the classroom. Above all they note the value of participatory system dynamics for triangulating stakeholders' expertise, data and simulating alternative implementation plans for evidence based psychotherapies in cases of mental ill health. Lyon et al (2015) also use SD to demonstrate the contribution of estimating resource demand from a comprehensive programme of screening children in a school for mental health difficulties to enable targeted support at the earliest possible stage. The work

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[27] England now has many examination boards that set and mark papers from student examinations to determine grades at GCSE, A-levels, etc.

concludes that contract-based resourcing policies could help alleviate demand on a full-time psychologist employed to support up to 1000 children in a hypothetical high-school setting. It is concluded that system dynamics has a future in supporting both small and large-scale policy decisions through scientific analysis of school settings that support the emotional demands of students.

Within simulation models, fixed goals are regularly represented. System dynamics however can readily reflect changing or eroding goals for representing the true complexity of the problem at hand by changing the simulated value from a constant to a variable for example. When striving towards a specific goal, the decision maker temptation to reduce the value of attainment increases as decision implementation fails to achieve what was originally set out (Forrester, 2016: pp199). High grade entrance criteria for certain schools may be diminish in their importance if the requisite examination grades are not attained for example. Equally, maximising the potential for a preferred school to deliver all of the family's needs may change under such circumstances towards satisficing only those needs that must be met at the expense of others that could have been met by other schools in the area. Inability to decide or 'decision paralysis' (Mintz and Wayne, 2016) from too great a choice of schools can even create further anxiety within the family unit where the solution shifts from meeting student needs for continued peer networking or, for greater academic results towards logistical demands for attending the closest school.

2.4 Modelling Multimethodologies

Social science has expanded numbers of modelling methods available to help solve real world problems addressed using a case study approach (an approach originally development and analysis in 1950s at Cambridge, Massachusetts). This case study research approach is used to explain, and address issues derived from real world problems. Having enjoyed considerable growth over the past sixty years, case study research often employs operational research techniques for collecting and analysing data that have proven to be useful over the intervening decades.

Both hard (describing techniques that adopt a mathematical approach) and soft (generally problem structuring techniques) have been added to scientists' repertoire, that offer greater insights into intransigent problems: solving issues that can be

addressed using various techniques such as mathematical analysis (Ferreira, 2012) and data mining (Brown et al, 2006) in combination for example.

By assessing the use of multiple methods amongst the UK operational research community, Munro and Mingers (2002) identified trends in using model-based multimethodologies. Combining two and three methods is common practice based on a mix of hard and soft techniques. System dynamics offers both hard and soft methods as part of a modelling multimethodology. Problem structuring is sometimes achieved using the causal loop diagramming technique to engage users in describing the dynamic problems encountered when systems react and adjust to change. By avoiding numbers, it is found that people readily offer their contributions and are able to take away key messages produced when using such diagramming techniques (Van den Belt, 2004).

The harder side of system dynamics involves defining problem structures using enumerated stocks and flows. Constructing system dynamics simulation models does involve additional efforts beyond people contributing their views. In return, system dynamic simulation offers the potential to demonstrate and validate systemic cause and behavioural effect along with the opportunity to test new decision-rule based policy suggestions within a safe environment. System dynamics therefore contributes a proven and reliable multimethodological mix to the Operational Research community, especially where problem structures are developed in stock flow diagram notation and establishing parameterised equations for performing simulations before summarising problems and testing potential solutions using causal loop diagrams that can be communicated to a wider, non-systems audience.

The multiple perspectives demanded for solving wicked problems are not necessarily available from a single research method and especially where different participant views need accommodating to generate a rich picture (Mingers and Brocklesby, 1997). Different aspects of real-world complexity can be represented through a multimethodological approach where subsequent stages require alternative techniques to successfully interrogate the issues at hand. While offering benefits, potential changes in perspective derived from adopting a modelling multimethodology can become a source of confusion if not coherently applied to the issue being researched (Kotiadis and Mingers, 2006).

System dynamics is a popular technique for combining with different Operational Research methods for addressing dynamic complexity. An example of multimethodology is the causal mapping technique known as Journey Making (Ackermann et al, 2011) to help inform the system dynamics model development. Here the softer, information management tool supports stakeholder contributions towards improving policy for tackling complex problems. Softer OR techniques such as Soft Systems Methodology, are employed to stimulate ideas around structure for a real-world problem are commonplace. Expertise is required however for analysing solutions using harder simulation tools used in a modelling multimethodology but this is not the only configuration that works. Complimentary OR research techniques have been developed to address specific issues.

Again, a consulted system dynamics model that stakeholders appraise using multi-criteria decision analysis for policy option development was employed by Santos et al (2008). The approach surveyed different health provider views on alternative resourcing policies by those with applicable experience using the model. Aggregated scoring through multi-criteria decision making then offers an overall rating of relative contribution towards agreed objectives from each policy alternative. Howick and Eden (2011) employ causal mapping and followed by system dynamics to investigate resourcing issues in the police for example.

Whereas softer data capture techniques help expand views across the topic being considered (especially true for improving participation), harder methods are used to challenge and shrink the issues raised to the only reflect influential system features and subsequent model-abduced results (Morecroft and Sterman, 1994). Hard numerical quantitative combinations of data collection and analysis techniques also exist that can provide tangible benefits. For example, specific tool platforms have been developed to access the important features of different types of simulation model where data can be easily integrated between System Dynamics, Discrete Event and Agent Based simulations (Anylogic, 2015). Combining System Dynamics and Discrete Event Simulation for example can offer multiple advantages, depending upon the manner in which they are combined.

Healthcare is one such area where such model-based multimethodologies have been successfully applied. Where one tool may generate data through simulating

behaviours over time, another tool may be adjusted to display the data in formats that are useful to others. For example, by using a coding approach to process management, Unified Modelling Language and System Dynamics are combined to provide healthcare insights (Bérard et al, 2011). Known as hybrid (see Glossary xxii-xxviii) modelling by operational researchers, combining system dynamics with other hard, numerical models that interact together can help develop organisational strategy for example (Wang and Moon, 2012), reducing human bias with genetic algorithms (Yu and Wei, 2012) or support production management decisions (Jovanoski et al, 2013). Although hybrid modelling offers a narrow definition of combining quantitative techniques[28], the wider modelling multimethodology description encompasses both qualitative and quantitative Operational Research methods that are suited to concurrent, participative modelling.

2.5 Model building with groups for negotiating policy decisions

In order to generate a "rich picture" (Checkland, 1999) of problem structure, it is important to engage those who regularly encounter the difficulties associated with the issues under investigation. User engagement is a key component of OR research and relevant techniques have been developed over many years to assist in this process. A standard set of succinct data collection techniques have been assembled for gathering data relevant to constructing System Dynamics simulation models called scripts (Hovmand et al, 2012). A script comprises a series of short instructions to facilitate a conversation with a group of participants who are unfamiliar with SD, to assist capturing features in the model construction. Whereas first generation scripts are a published in document format, a second-generation encyclopaedia is available online that updates the initial document, detailing further scripts. The document called Scriptapedia (see Glossary xxii-xxviii), specifies many rapid data collection techniques that others building System Dynamic models have already found useful. The scripts help engage contributors by collecting relevant System Dynamics data without participants having to understand the details of quantitative model construction. The data facilitated through individual scripts often has a direct and specific purpose within a System Dynamics simulation model.

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[28] Hybrid model indicates some level of interaction between hard, simulation techniques.

The process of using scripts shortens data collection into periods where participants can retain levels of interest while remaining engaged and contributing to the modelling process. Periods of reflection are also useful for generating additional insights that may not arrive immediately in a person's consciousness. Designing optimum contributions that induce data from participants through scripts, requires a minimum of two workshops separated by a suitable period of reflection. The final workshop also needs to be followed-up with a further period of reflection before presenting and debriefing modelling results. Short and succinct modelling efforts also suit those deciding policy as their time is often limited. Time is in even shorter supply for those individuals working alongside others in multi-agency settings (Andersen et al, 1997). Once content with the approach to modelling development through Group Model Building (GMB), delegates can be co-opted by senior managers to ensure continuity with policy modelling outcomes.

Franco and Montibeller (2010) suggest that both hard and soft OR techniques can be facilitated within a group or workshop-based setting. GMB (see Glossary xxii-xxviii) is the collective term for all activities associated with constructing facilitated System Dynamics models with participants (Vennix, 1996). Both softer graphical patterns of behaviour and harder interactive simulation tests can be built in such group-based settings with the support of a facilitator with modelling skills and relevant scripts. Through the process of encouraging those who observe repetitive but seemingly insoluble problems within their own sphere of practice where repeated efforts have not succeeded, problem owners readily engage with new insights that the group can share and understand through the model-based approach that System Dynamics offers. Problem owners not only benefit from sharing their own perspectives with others in GMB, they also gain from potential policy solutions that may not previously have been considered thanks to the scientific development process. In particular, System Dynamics offers 'white box' clarity between cause and effect using acceptable, standard terms upon which decision rules can be applied to make more effective corrections (Andersen and Richardson, 1997). By contrast, the 'grey' (not easily observable) and 'black-box' (unobservable) coded explanations offer little by way of understanding for decision makers regarding the relationships between system structure inputs and problem behaviour outcomes that exist in complex, non-linear relationships.

Expert practitioners who are well-versed in managing the issues presented by regulatory systems, are better positioned to work in collaboration with other agencies who support different aspects of associated social systems. Practitioners with sufficient experience are able to verify inputs and validate outputs from such systems and make proposals for change based on their knowledge. Group Model Building can provide unique insights associated with complex problems where time and distance separate cause and effect (Van den Belt, 2004). Through a process of rational description and reasoned assumption, Group Model Building offers the potential to construct simulators designed for specific purposes (Hoppenbrouwers and Rouwette, 2012). Revealing and sharing group-based insights derived from models helps all stakeholders support strategic, policy-level system decisions on a common problem that multi-agent groups encounter for example. The Group Model Building process helps stimulate consensus by trialling suggestions to understand their impact before committing to take specific and coordinated action (Akkermans and Vennix, 1997).

Establishing a common language for features associated with the problem under consideration is made available through the process of Group Model Building (Rouwette et al, 2002). In particular, a simulation model with clearly defined relationships between related factors helps ensure that terms are unique and possess a specific meaning associated with their function, whether a converter, variable, rate or stock for example. The System Dynamics approach of combining structure with available information helps reduce 'rule of thumb' decision-making or heuristics that can lead to inaccurate responses to problem behaviour (Rouwette, 2011). Personal mental models are also tested and can be demonstrated to be less reliable when compared to system trend predictions. Qualitative data capture can be enabled by Group Model Building prior to constructing quantified simulation models (Luna-Reyes and Andersen, 2003). Multiple types of data can be captured through facilitating Group Model Building scripts with participants which can offer several uses within System Dynamics models (Richardson and Andersen, 1995; Vennix ,1999).

Bérard (2010) suggests that multiple scripts used in a sequence of workshops can help develop System Dynamics models. The sequence of workshops relates to the various stages of the model construction process and the availability of participants in supporting the combined effort. Typically, more visual techniques are first employed

to gain traction and credibility with participants (causal mapping is one such method suggested by Ackerman et al, 2010) where shared, mental models emerge from supportive and imaginative facilitation. Sharing insights gathered from System Dynamics policy simulation modelling is now becoming more practical due to the range of software available online at little or no additional cost.

Where problems lack the clarity of why a cause has an effect (the problem structure) but also offer those researching the problem no clear method of how to address the issue (a policy or decision rule for problem) the problem is described as messy. Such messy or wicked problems generate a wide range of views from those contributing to the Group Model Building effort. Fortunately, Group Model Building enables such views to be tested before reaching an acceptable consensus between participants (Vennix, 1999). GMB is the process of gathering participants in workshop groups to discuss and develop causal structures capable of explaining dynamic phenomena. Whereas contributors may initially disagree on cause and effect, through their active participation in the model construction processes, individual views are renegotiated during the workshop phase, where fuzzy ideas are clarified from the stories told by individuals giving their insights on context-specific, dynamic complexity that can be shared by all (Luna-Reyes et al, 2006) in a common language of terms enforced by the logical rules of simulation.

Group Model Building has been used to examine a number of issues over many years where public policy setting is at stake. Ecological problems are a fertile area where models have been developed to help understand complex interactions before proposing shared interventions (Stave, 2002; Château et al, 2012). Problems in managing the public sector can become messy and intractable issues, due in part to the numbers of stakeholders that become involved. Supporting problematic decisions using Group Model Building has been successful across a number of such policy contexts including shipping (Vennix, 1995), managing emergency support (Luna-Reyes et al, 2004) and, providing law and order (GilGarcia and Pardo, 2006, Newsome, 2008; Howick and Eden, 2011).

By encouraging the recounting of stories within a group setting, example cases can be determined for use with the simulation model. The value of consulting those with extensive knowledge of the problem they observe is recognised by Rouwette et al

(2011). The contribution of specific knowledge on how system elements interact is often crucial to creating a coherent model at the level and scale required for policy investigation, whether for adjusting personal behaviour or making corporate decision rules. Such contributions are essential for addressing real-world problems using causally tested theory. Coyle also notes the values of contributing stories and what he describes as 'pet theories' referring to potential policy interventions. In his SD modelling text he offers a five stage process for mapping out the dynamics of a system (Coyle, 1996:p.11) that covers recognising the problem, conceptually understanding the key features, collecting together bright ideas and pet theories in a qualitative analysis, simulation model testing once parameterised, policy design and test. He notes that pet theories are obtained from experienced people which, even if found to be wrong, offer an important source of insights for researchers using SD.

In a wide-ranging account of influences between high schools competing for students and subsequent non-completion or drop-out from education, GMB provides important feedbacks for students through a wide range of qualitative contributions where policy changes impact on graduation rates in Australia (Kasman et al, 2017). Causal loop diagramming is used for summarising the influences on children studies the issue of student resilience, amongst others, over two GMB workshops employing processes indicated in Scriptapedia. The research identifies the issues for children in care around stability and transition to adulthood, but also school pressure and the quality of family circumstances that lead to independent livings skills that reinforce student resilience in high school. Resilience is also connected to participating in school whereas student perception of choice (lacking autonomy) is indirectly linked to participative relationships with teaching staff at school. Where bullying is identified as a balancing effect on resilience it also is believed to reduce mental health for children.

The main reinforcing mechanism for retaining mental health is parent capacity to support their child in school (based on parent literacy levels underpinned by educational attainment of parents). While disability reduces parent capacity to influence their child's mental health, so do transitory phases such as moving from primary to secondary schools. Peer pressure to use drugs and alcohol has a balancing effect on mental health but quality of family circumstance helps support healthy student minds. The qualitative views of the complex interactions between

concepts of mental health, resilience and family/peer influences for children give useful insights on what may affect drop-out rates for non-completion in Australian high schools but offers no quantification of such disengagement from education that potentially starts much earlier in English cities. Equally the research finds no complex system explanations to date across SD, ABM and DES model-based research for school competition.

2.6 Chapter review

The chapter has helped establish key literature around competing for school places and the development of English state education systems as well as the issues of competing for schools encountered by families making life changing decisions. Management theories indicate how effective decisions can be made and how behavioural decisions feature in using available information to support the selection of secondary schools. English secondary data enables Plymouth to be positioned within the national context for parental school choice and child well-being before, during and beyond transferring schools when aged 11. A System Dynamics modelling technique offers policy assessment for aggregated family data and a research design for data collection is viable using a model-based, multi-methodology including problem structuring with expert practitioners providing support to children with emotional difficulties and parent surveys. Furthermore, the research offers a contribution to the System Dynamics body of literature with knowledge of K12 (see Glossary xxii-xxviii) enrolment modelling and simulation.

From the literature reviewed, system dynamics offers policy interventions that can be generated by contributing agencies where behavioural decision making appears to offer greater explanations of how families might choose schools to best meet family needs. This suggests that more than one data collection technique is needed in a model-based multimethodology to enable student emotional support policy tests. It is noticeable that families appear to make behavioural decisions when facing their own school choice problems. Such behavioural selection of secondary schools can be tested to understand if biasing applies when parents decide secondary schools. Students also experience anxieties that reduce levels of well-being before and after changing schools aged 11. Competition would appear to offer choice but at the expense of producing psychological stressors for those involved. Parents are stretched by the latest concepts in education which were not available in their time

spent at secondary school. Children are required to tutor for new examinations in primary (11plus and KS2 SATS) then streaming tests in secondary, adding to stressors that can produce burnout effects when time is not actively managed. The confusion introduced by competition between English schools into family decision dynamics is therefore considerable and may lead to less accurate selection when schools are no longer flexible enough to meet student needs as children develop through adolescence.

Three lines of enquiry result from the review of literature linked to the problem behaviour (details of all three lines of enquiry are summarised in Appendix 2 where problem owners describe the issue with expert practitioners developing policy alternatives, parents indicate decision mechanisms and model testing reveals more effective policy implementations).

3. Philosophical approach to research study

3.0 Introducing the research philosophy

While research already conducted to simulate education-related policy has been considered in the literature, there is little to suggest that coordinating the support between multiple agents may offer benefits that cannot be delivered in isolation as unilateral policy. Different ideas and technologies have been applied to decision making and policy simulation for business management but the study of emotional well-being has largely remained within the domain of psychological investigation. Yet child well-being levels are the precursor to referrals for many support services within a unitary authority and now have considerable attention from government in the UK and elsewhere (O'Donnell *et al*, 2014). By reducing occurrences of low well-being in children and young people, the greater the opportunity for a wider group of students to succeed in contributing to society during adulthood, rather than draining support services. The overall structure for the research follows a description suggested by Saunders *et al* (2016) that commences with detail on the theoretical underpinnings of the work by defining philosophies, approaches, strategies, choices and time horizons. The research design for collecting data is tackled separately in subsequent chapters

It is useful to have a visual depiction of the overall document structure and how the layout follows the development process outlined by Coyle (1996). The look-up chart format is used in Figure 3.1 and shows five columns corresponding to stages (S1-S5) of which only one uses a white background to indicate the corresponding research chapter(s) and related content in bold. The remainder are in small fonts with a greyed-out background and therefore of less relevance to the current section and chapter(s) within it. By contrast Chapter 3 has further detailed and emboldened content to illustrate the content that can be expected from stage 2.

S1. Problem recognition / interests	S2. Problem understood /system influences described	S3. Qualitative analysis of bright ideas and pet theories	S4. Simulation modelling / model (behaviour) testing	S5. Policy test / (re)design
CHAPTER 1 rising Child and Adolescent Mental Health referrals	CHAPTER 2 literature including secondary data **CHAPTER 3** **Selecting a methodology:** **- philosophy** **- approach** **- choice** **- strategy** **- time horizon** CHAPTER 4 Data collection techniques	CHAPTER 5 Problem structure CHAPTER 6 Decision biasing	CHAPTER 7 Testing model sensitivity	CHAPTER 8 Testing policy alternatives CHAPTER 9 Concluding support policy .

Figure 3.1 System Dynamics process look-up table (adapted from Coyle, 1996:p.11)

As presented in the look-up chart, having considered the problem context of rising mental health referrals (first stage[30] S1: chapter 1) and reviewed historical competition in providing education for England along with alternative methods for conducting explanatory research linking cause and effect into testing policy (S2: chapter 2), the adopted methodology now needs definition (S2: chapter 3). Having reviewed the narrative literature on different types of causal relationship and depending upon the questions posed, methodologies selected for educational research will vary. If the research aim was to understand instances of personal decision-making on the group preparing to transfer into secondary school then ABM may generate useful behavioural decision-rule insights. Should operational admission processes require improvement from a research objective then a DES simulation of input transformed into output could shed light on unblocking bottlenecks that can delay the individuals affected. However, for patterns of behaviour that derive from educational structure such as admissions policy while affecting families differently, then policy testing using system dynamics may be appropriate. The

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[30] Adapted from Coyle (1996) where five stages to developing simulation models are described commencing with recognising the problem and competing interests, understanding the problem and influences that may impact, seeking possible explanations and evaluating causal structures, examining data assumptions for leveraging problem, evaluating problem with available levers before concluding on issue.

impact of school choice on CAMHS referrals from low well-being would suggest a non-linear causal explanation might offer the greater insights based on modelling psychological (personal relationships) and social (school choice) systems together. This chapter therefore consider the philosophical aspects of the research that could support the development of intuitions are absent in the literature.

It is important to define and select a methodology that can produce new insights beyond the existing literature when tackling social problems that appear resistant to successive interventions. As children progress though secondary schools, more refer to CAMHS. Many targeted interventions have been trialled in England but while small gains have been achieved in pilot areas (Murphy, 2016), such as early warning networks of trained teaching assistants (see Glossary xxii-xxviii, where primary school Emotional Learning Support Assistants – ELSA - coverage is far more developed than Secondary Age Mental Health Support - SAMHS - provision of in-school, emotional well-being support services [Plymouth City Council, 2012]), the rising-age referrals issue continues unabated though secondary schooling in the city. This does not have to be the case as high levels of self-reported well-being is the norm in comparable Dutch schools for example, so the origins of the problem need investigating in England. Where time and space separate cause and effect (Senge, 1990) it is essential for the chosen methodology to clarify complex system behaviours based on valid and scientific techniques that can reflect empirical results.

The chapter scope therefore covers a methodological description of the adopted research philosophy and an approach for inferring policy solutions to better support child emotional development under stress from schools' competition. By adopting a strategy involving a single, detailed case study, the modelling multi-method can be chosen to obtain relevant data in a short time window. As multiple data collection techniques may be required to address different contributors, any flaws with the preferred methodology need further consideration alongside issues of external validity.

3.1 Ontology and assumptions about reality

Schools competing for student enrolments across English local authority districts create not only supply chain issues where demand outstrips provision but also tensions within the family unit. Families preparing and selecting secondary schools

through local Admission Authority processes define the start of rising, age-related referrals into CAMHS that reverse following GCSEs. Such aspect of social science mean that a realist view is called for where objectivity exists in the world beyond human thoughts and beliefs (the alternative extreme of ontological assumption for social science is called nominalist subjectivity based on human description, consciousness and action according to Burrell and Morgan, 1979). By making such assumptions, researchers are afforded the opportunity to observe behaviours and uncover the relationships that help support and maintain social structures across multiple levels. An effective multi-agency coordination ensures that suitable policy can be derived that addresses behaviours observed with CAMHS referral rises in Plymouth secondary education.

Olaya (2009) discussing System Dynamics modelling complex systems suggests that the power of the modelling approach rests in the ability to identify personal and shared assumptions. Such insights provide opportunity to review and change mental models to ones that offer potential solutions in the real world (past-thinking can only produce previous results, making problems appear resistant to change initiatives without offering any new understanding). Indeed, distractions from other sources of literature can only lead to confusion of terms, superficiality and misdirected arguments.

3.2 Axiology and personal judgements about value

As a social systems enquiry to support integrated policy development for children experiencing emotional difficulties while negotiating secondary school education, the case study problem posed by Plymouth can be influenced by personal views of the researcher established over 10 years spent in a rural primary school as a parent governor. This experience could introduce bias that needs considering and minimising wherever possible for the research method, results and interpretation. Two possible bias mitigations already exist. Firstly, the locality differs having selected a competitive urban schooling environment for the study but more importantly, as an ex-primary school governor for an adjacent authority, the school environment differs as does the level of competition (competing for place offers from secondary rather than primary schools). Furthermore, the type of school has changed from primary to secondary.

However, the potential for researcher bias remains and therefore a careful selection of methodology that triangulates different sources of evidence is therefore important. In this situation both qualified and quantified data can be collected to fit the subject matter within the adopted functionalist paradigm where admissions regulation and family-stability social theories concerning secondary enrolment intersect with objective structural theoretical explanations of causal competition and referral effect (Burrell and Morgan, 1979). Lane (2001a) refers to the functionalist quadrant of the framework when describing system dynamics. However, he goes on to suggest that elements of the modelling technique extend into other quadrants of human versus structure framework, depending upon how they are used. Lane (2001b) suggests that while this is problematic for the existing social research paradigms and new way is available to place system dynamics at the centre of social research.

3.3 Epistemology of valid and attainable knowledge

Realism offers a clear way forward in such messy contexts. Whereas direct realism emphasising direct awareness of a phenomena typically relies upon the five human senses for detecting change in the environment (such as using touch, smell, taste, sight and sound to understand a new school), critical realism describing connections between natural and social worlds offers greater opportunity to examine connections between schools' competition and rising CAMHS referrals.[31]

Abducing results through simulated replays based on available measurements is well understood by the critical realist. However, inducing problem structure and deducing decision styles within the context of a simulation model offers a realistic contribution to methodological knowledge where assumptions need exposing. The triangulated approach also provides new insights and shared policy solutions capable of addressing rising referrals into and during secondary education.

3.4 Methodology defined

Based on Saunders et al (2016:p.164), a research methodology can be defined that has several layers described by the concentric ring structure analogy of an onion in

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[31] In the analogy of a tennis match umpiring role, a direct realist would judge a served ball hitting the net by noise from the impact and sighting a change in ball trajectory, however if a player questioned whether the ball was inside or beyond the area of play a critical realist would employ cameras to allow a statistical replay of whether the ball touched or was outside the line of play through the lens of simulation.

cross section. Staring from the outside layer, six elements need defining to adequately describe the approach to a research design that include Philosophy; Approach; Strategy; Methodological Choices; Time Horizon and Data Collection.

3.4.1 Critical realist philosophy adopted for school choice problem

A critical view of reality is used in this work where perceptions can influence choices. This philosophy is preferred over positivism (only what is seen can be acknowledged) or interpretivism of what people understand, or pragmatism of what could be. The problem is based on case study issues that suggest causal links between CAMHS referrals from students and schools across England competing for custom at the time of preparing selecting and transferring between providers at the age of 11.

3.4.2 Approach to infer policy solutions

Through the process of simulating family relationships induced from experts providing levels of emotional support to children and deduced from parents, abducing policy designs using simulation offers a viable way forward. The novel approach using System Dynamics enables supporting interventions to be tested that can be coordinated through multi-agency support in association with deducing behavioural decision styles from surveys. By inducing the problem structure behind system behaviours from those with expertise[32], the basis of a triangulated research study offers greater modelling reliability than single approaches in isolation.

3.4.3 Single case study strategy

Yin (2009; 2013) advocates not only case study strategy but the potential of developing answers for 'how' and 'why' types of research question associated with only one example:the single case study strategy. Such a strategy supports the development of causal theory that generalises from the case being studied (analytical generalisation) rather than the more common statistical generalisation (the latter deriving from surveying significant samples of a population). The risk of being unable to simplify patterns and generalise concepts from the complex description of the multi-faceted problem is recognised when adopting the strategy (Stuart et al, 2002)

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[32] Practitioners who support the emotional needs of children from different support agencies across Plymouth including health, council, and schools.

but mitigated by using integrative modelling techniques that employ data from different sources.

The advantages of using a case study approach include problem data and context can be examined together (Yin, 1984). Case studies can use qualitative and quantitative analysis in combination that a modelling multimethodology can develop. Where qualitative descriptions from case studies can help explain real-life complexity, the addition of a mathematical simulation ensures repeatability on the research design for others to follow and develop.

The limitations for adopting a case study approach comprise a lack of rigour where evidence thresholds are set too low that can be offset by multiple sources of information. Also, large amounts of documentation that can be difficult to organise for a researcher writing about the research and small sample numbers offer little ability to generalise findings.

Hamel *et al* (1993) by contrast indicate the microscopic examination value of a single case study suggesting that establishing real-world parameters and setting objectives is far more reliable.

On the three types of single case study, Stake (1995) suggests:

Intrinsic case studies are where the researcher examines the case for its own sake.

Instrumental case studies are where a small group of subjects are selected by the researcher for examining a certain pattern of behaviour

Collective case studies require the researcher to coordinate data from several sources to answer different aspects of a study as a bridge across paradigms.

In order to ensure scientific rigour in the strategy, a case study method must be able to prove six separate points. The method represents the only viable method to elicit implicit and explicit data from the subjects. The case study strategy offers an appropriateness to the research question. The method follows properly applied procedures. The case strictly adheres to the scientific conventions of social sciences. 'Chains of evidence' are systematically captured through discussion and observation. Finally, the case study links to theoretical frameworks (Tellis, 1997)

As an illustrative, single case of Plymouth secondary school choice, this research study adds realism and detailed examples concerning competition policy effects in state education provision. However, the exploratory nature of the research question on how competition affects selection explaining why child emotional states might suffer, suggests that an exploratory case study is required to generate new causal theory. While nomothetic critics suggest that adopting single case study strategies can lack scientific rigor and reliability for making generalisations (including potential bias introduced by researcher interpretation), the benefits for employing the strategy include the internal consistency and plausibility of explanation of phenomena, while widely disseminating results of interest to others researching the field.

Employed for Plymouth families facing secondary school choice selection, abduction of policy design is simulated through a problem structure (induced from GMB) adjusted by decision biasing influences (deduced from survey) using a modelling multimethodology. Even when inducing views of participants using GBM (normally considered qualitative), the selected scripts can allow direct quantification of potential policies into final policy test designs, offering potential quantified model inputs. While a case study strategy predominates, a survey strategy also contributes validated relationships within a modelling multimethodology.

3.4.4 Modelling multi-method choice to collate and develop study results

Covering qualified and quantified models, multi-methodology combines different types of pre-validated research result into a case study of the local problem around Plymouth secondary competition and how parents decide schools. Result validity testing is based on small groups samples (Group Model Building workbook validation and Fisher Exact Testing[33]). Neither action research[34] nor ethnographic[35] choices are suited to this study as multiple views of the problem are needed.

3.4.5 Cross-sectional time horizon from project as of 2015

2015 was the planned date for establishing research study results. Deductive surveys over specified periods alongside participative modelling through GMB fix the

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[33] Fisher Exact Test (FET) is an accurate statistical test that requires fewer samples than the more commonly used Chi-Square Test.
[34] Educational communities of practice to assist those taking action to improve method and outcomes.
[35] Studying people in their own environment through observation and interview.

time horizon for this cross-sectional case study where policy impact assessments are designed for suggesting future trends rather than specifically understand the past.

3.4.6 Multiple data collection techniques engaging practicing experts and parents

Both data collection and subsequent analyses are based on inducing a problem structure within functioning family units facing the challenge of selecting a school from 17 complex options. Deducing decision biasing influences that could distort and reduce the number of needs met by a particular school requires parents to contribute their views. Finally, abducing (decision rule design thinking) support policies to help prevent causal competition producing referral effects concludes the types of data captured. The next chapter provides full details of how data was obtained to populated simulation models.

3.5 Potential flaws with methodology

History. There are no historical school choice problem disasters in the news that might influence decision makers or policy designers in the recent past.

Testing. Research study outcomes are unlikely to modify parent or expert answers.

Instruments. There is consistency between parent decision making styles collected in 2015 and 2016 admission windows and the views of expert practitioners obtained in 2014.

Mortality. While some issues have been noted with changes in CAMHS management that have had limited impact on timelines, there have been no major changes affecting model development and testing.

Maturation. No overlapping events have been observed during the course of the research that could influence results such as the change in GCSE grading structures for making English examinations harder for students in 2017.

Causal directionality. Independent variation of schools competing for students and dependent CAMHS referral variable associated with low levels of child well-being are unlikely to reverse in relational direction.

3.6 External Validity

The Multi Agency Group affirmations through participating in model construction, parent interviews using the flashcard survey instrument to provide instant thoughts on school selection in the critical decision window and presenting results to the Livewell Southwest (see Glossary xxii-xxviii) executive team all provide feedback opportunities that have been positive during the course of the research. The contacts with parents and expert practitioners were regulated according to terms of the ethical approvals committee.

3.7 Review

The chapter has established a complete methodological description based on social research methods detailing a critical realist philosophy, a research approach involving multiple inferences induced from expert practitioners and deduced from survey of parents to finally abduce policy solutions through simulation that better support child emotional development under stress from schools' competition. The single case study strategy assists adequate detail to be developed in the required cross-sectional time horizon. The multiple data collection techniques required to address different contributors are defined alongside flaws with the adopted methodology and multiple views providing external validity.

In summary, by adopting a critical realist view of potential connections between low well-being in children (the point of referral to CAMHS) and schools competing for students, offers the potential to identify and describe problem structures that exist in the real world, beyond the confines of the mind. While realism helps to interpret an admissions process, such a philosophy struggles as what you can see is all that there is. Human behaviour on the other hand relies of intuition and feeling, neither of which are tangible concepts. Rather than attempting to understand only the observable aspects of human behaviour associated with competition and choice between schools, by taking a critical realist approach behaviour can be examined to gain a family perspective of the school choice problem.

While the research onion construct explains the clear elements of a methodology developed to research the issues stemming from school choice in urban centres such as Plymouth, this does not suggest how research data collection will proceed. A research design is therefore needed that can obtain sufficient detail to enable a

cause and effect to be related in ways that explain observed behaviour before considering how best to intervene. The key contributions are anticipated from parents who decide schools and others who manage supporting services to children in an urban setting such as Plymouth.

4. Research design for psycho-social system dynamics

4.0 Introducing designs for collecting data

Having now understood a philosophical approach for developing the research based on the work of others on the dynamic behaviours from psycho-social systems, it is time to examine the ways in which data can be collected relating to the problem, the people deciding schools and the types of support policy that may offer improvements to families challenged by competition between secondary education providers.

The chapter scope therefore covers the research design for collecting data using a multi-methodology including the identification of secondary data, investigating aspects of problem structure encountered by those seeking to support children as they develop emotionally through adolescence and concluding with parent views just preceding their selection of secondary schools during the September and October window for submitting applications (normal point of entry rather than in-year). The simulation model not only offers the opportunity to integrate such widely varying sources of validated information, it can also be tested to validate structural and dynamic integrity before assessing alternative policy implications for different children needs and their families who support them. Details of statistical and problem structure inference tests are also discussed alongside other practical techniques for collecting data.

S1. Problem recognition / interests	S2. Problem understood /system influences described	S3. Qualitative analysis of bright ideas and pet theories	S4. Simulation modelling / model (behaviour) testing	S5. Policy test / (re)design
CHAPTER 1 Issue of rising Child and Adolescent Mental Health Service referrals	CHAPTER 2 Literature including secondary data CHAPTER 3 Selecting a methodology **CHAPTER 4 Data collection techniques - induce problem structure - deduce decision bias - abduce policy impacts**	CHAPTER 5 Problem structure CHAPTER 6 Decision biasing	CHAPTER 7 Testing model reliability	CHAPTER 8 Testing policy alternatives CHAPTER 9 Concluding support policy .

Figure 4.1 System Dynamics process look-up table (adapted from Coyle, 1996:p.11)

As suggested in Figure 4.1, the data collection techniques involved in a modelling multi-methodology vary depending upon the associated research questions. Answering the question of what problem structure best reflects the system is induced from those dealing with the problem outcomes whereas determining answers to where decision biasing might arise employs deductive parent surveys. This chapter explores how to collect and combine evidence from different sources including policy interventions abduced through simulation.

Using multiple data collection methods can generate insight on the observed problem behaviour (Pollack and Remington, 2012). Collecting several insights using different approaches guards against potential bias. Maslow (1966) notes "I suppose it is tempting, if the only tool you have is a hammer, to treat everything as if it were a nail." This implies that the approach to a problem (or fastening issue for the anecdote) may only relate to the types of research (the hammer tool used) of which investigators have the necessary experience. So, if the nail becomes a screw type fastener, the researcher may have to hit the problem both harder and longer with the hammer to achieve any result. In the case of school choice, causal effect is established through simulated iterations that cannot be determined using deductive

reasoning alone for example. The research benefits from access to key stakeholders in the local school choice problem including council, health and schools providing support amenities along with parent views on the issues facing families who use their services. Facilitated modelling workshops and individual consultations, alongside relevant secondary data already available in literature, offer reliable, triangulated sources of data available for collection and interpretation.

Parental views on the primary to secondary decision-making process are also confirmed by surveys of Plymouth-based families to help categorise the styles used for addressing the school choice problem. Such multiple methods help develop a full description of cause and effect for simulating case study problems and potential decision rule, or policy, interventions aimed at improving social systems (Mingers, 2006). However, different sources need combining into a resultant model of school choice and one way of achieving this identifies data used in the model, separately to the issue of problem structures that are capable of causing repeated referral events.
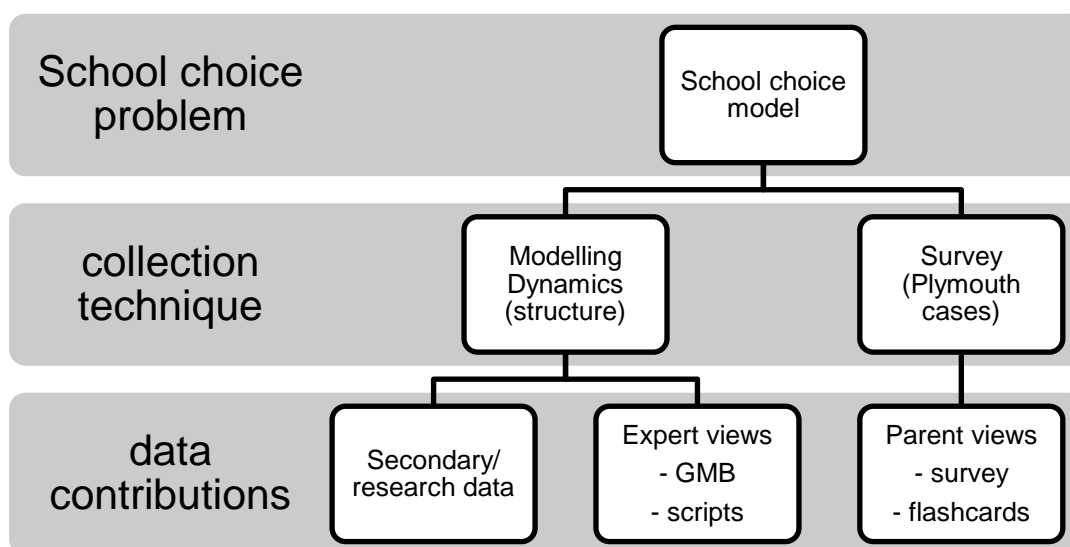
Figure 4.2. Data collection technique contribution structure for research study

As indicated in Figure 4.2, by using several qualitative/quantitative data collection techniques within a modelling multimethodology, it is possible to first combine expert and secondary data into a problem structure creating behaviours. Parent views of decision making styles are then added to a model of the emotional dynamics within families selecting Plymouth secondary schools. The collection technique of non-

linear, complex interactions also uses secondary data from relevant studies across England to enumerate causal structures. Group debates, developed through workshops, are the preferred manner for collecting relevant behavioural information on the emotional problems for students that are encountered by experts as each session was self-regulating (Moizer et al, 2015). Different agencies working together help to rebuff extreme views held by individuals in such situations.

Initial pilot views were obtained from parents to determine potential decision-making factors. Fully structured interviews with some participants working in higher education (based on availability sampling due to ready access to intranet announcements and online survey tools), who were also parents experienced in school choice, demonstrated that rational choices between schools in Plymouth were uncommon, even among those well-educated. Belton and Stewart (2002) discuss the various ways in which rational choice can be tested by weighting agreed criteria for scoring complex alternatives. Collecting parent data through surveys on different aspects of the school choice problem, as seen by local families, was aimed at addressing more behavioural decisions encountered in Plymouth. Surveying parents enables identification of specific styles of family decision-making and exploration of how people relate to others within the family.

With time-constrained respondent availability (lower right box Figure 4.2), surveys using flashcards help capture the widest set of views on school choice quickly, spending less than ten minutes discussion per person. It is considered that face-to-face contact would offer better returns than remote electronic approaches or detailed interviewing once pilot results had been established from electronic targeting surveys. The selected data collection tools reflect the research objectives and therefore support the overarching aim of the research. Even so, collecting primary data using flashcard surveys remains time-intensive and limits the numbers who can express views through this style of participation. Therefore, the research employed secondary data to confirm admission system behaviours supports the wider view that helps to explain emotional changes in families selecting secondary schools.

Qualitative views can be obtained using Group Model Building (GMB) scripts administered at workshops. Scripts help to ensure that all information is realistic, being of sufficient quality (determined through peer questioning) while managing the

variety of terminologies employed from the multiple agencies represented. The modelling methods that scripts describe help the researcher to abstract data for inclusion within simulators (built using System Dynamics) to reduce subjectivity by calculating aspects of contributor perceptions. Scripts are also able to reflect upon information already captured within management information systems. This supports the functionalist paradigm adopted to explain how cause and effect may be connected through the research process.

While hard or quantified methods can be less popular in many strands of management research that social scientists predominate (the field favouring interpretive, softer, qualitative studies may be evidenced by a Google Scholar search for terms "management research" "popular" where adding "qualified" gave 81 potential results whereas replacing latter with "quantified" returned only 13), model-based techniques have succeeded in many areas where complexity and ambiguity co-exist and facts concerning structure and data can be revealed. For example, health and education are two such domains where complex social science factors are at play and theory-based models have already contributed to knowledge. Here relationships are noted from qualified, concept models but without being able to validate cause and effect through key indicators (Paasche-Orlow and Wolf, 2007). This difficulty is particularly acute where problems span more than one organisation which can fail to be inclusive (Rosenbaum, 2002). Multi-agency approaches are becoming more common in the UK but few employ modelling to determine cause and effect for supporting children (Hood, 2014), specifically to test who in the multi-agency group is best able create and sustain a coordinated intervention for greatest overall impact, prior to deciding the final implementation plan.

Participative modelling employs a mix of inductive questioning and deductive logic approaches where the flow of conversation is determined through choice of topics, as determined by scripts, and facilitated by the researcher (Siokou et al, 2014). This combination provides greater depth from assembled views (Herrera *et al*, 2016) and data than either one approach on its own, while still upholding the functionalist paradigm perspective. A case study can help provide examples to establish a common causal theory from empirical data (Köthke *et al*, 2013; Kim *et al*, 2013). Even though time consuming and labour intensive, a case study allows the detail of the case to establish relevant causal theories. Here representation from council,

health and education all experience the issues resulting from choice of schools made by parents and their children changing schools when aged eleven. Complex health and education problems can therefore be investigated using scripted GMB techniques (de Ager *et al*, 2015).

Figure 4.3 shows the order in which data collection techniques were performed prior to analyse using simulation techniques. Developing beyond secondary data (initially collected in the literature review where selecting secondary schools and family emotions play a significant role when transferring schools), stage 1 sought to discuss the causal structures behind recurrent behaviours that had been observed by expert practitioners working in the field. Stage 2 then helps quantify family case examples of decision making in Plymouth from parent views, whether experienced in local secondary school choice or not. For stage 3, the parent inputs are subsequently assembled within a system dynamics simulation model that is capable of being tested. By reliably indicating behaviours as well as explaining sensitive levers for effecting change, new policies can be developed. In this way, the workflow for collecting data involves multiple methods that help establish and quantify the issues surrounding school choice in a competitive education market.
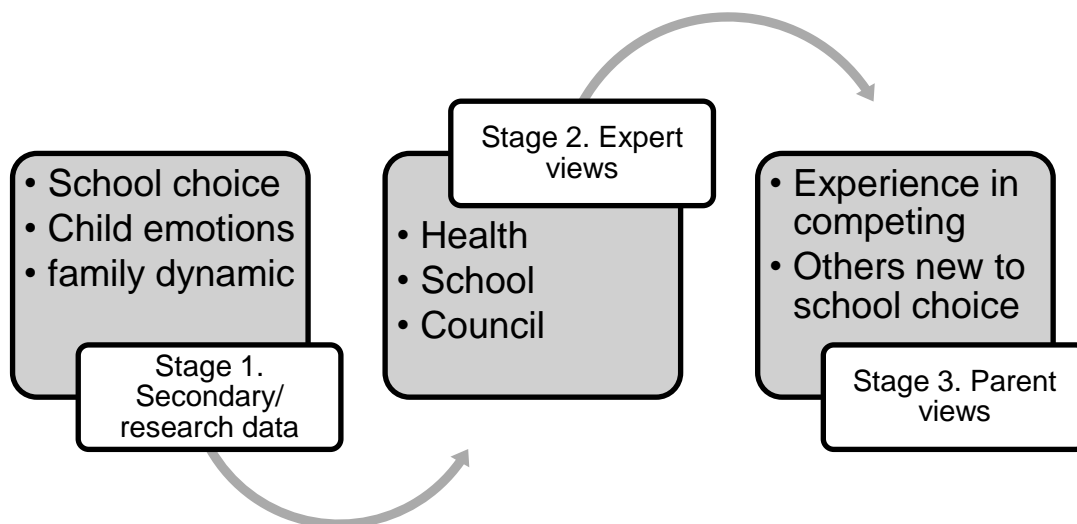
Figure 4.3. Data collection workflow diagram for the research study

4.1 Modelling multi-methodology for policy implications

Ease of access for different groups to inform and confirm simulator design is a key consideration for establishing new causal theory. Social sciences frequently use questionnaires to deduce relationships between independent and dependent variables through statistical analysis. Regression coefficients can then indicate the degree of relatedness or correlation between such variables but cannot suggest directionality between cause and effect. Surveys can therefore be useful for understanding respondent views across the range of issues being considered while helping to categorise the types of answer received for subsequent analysis. Based on feedback relationships, system dynamics can be used to capture complex, relational data along with directional cause and effect. As Levine et al note in their post-hoc psychological modelling of a family under stress using system dynamics (1988:p266), this approach to modelling family dynamics "also allows one to embed many psychological theories into a network of loop processes" and therefore offers a valid approach to understanding such case study behaviours linked to descriptive theory.

4.1.1 Secondary data across England

In principle, there is a high-quality supply of secondary data covering large sections of the population who have been involved in transferring between primary and secondary schools across England. Data based on experienced views of the problem structure and relationships that could be at play is important for simulation studies. Such data makes it entirely feasible to enumerate aspects of a system dynamics model using data collected by others including aspects of common English admission structures into secondary education. However, this would not allow Plymouth details to be established (for example decision making cases under conditions where policies include additional competition in earlier years for selective grammar school places for example), nor would it provide adequate explanations for local variations that might lead to observed effects. Under such conditions further knowledge of local decision making is necessary within the selected urban setting of Plymouth.

4.1.2 Expert views for developing dynamic problem

Accurately collecting expert views in shorter periods presents a challenge for the researcher proposing new causal theory. Limited availability of experts and suitable

(knowledge-based) returns for investment of time demands data collection techniques that are robust and accurate while being easy to operate and understood by participants. Operational Researchers have developed various helpful techniques that can assist the researcher, some of which involve information technology, for example to replace the supporting role of a Group Model Building recorder when capturing results (Scriptsmap is one such example script authored by Ackermann et al, 2012). System Dynamics research could rely on taking time for educating participants about the technology. However, this may be at the expense of participation when contributor time is limited. When groups must embrace the chosen technology first, before contributing effective views to the debate, engagement is likely to be partial and restricted.

Such risks around learning new technologies can be eliminated if key data sets are collected using targeted 'scripts' or route maps explaining the processes of collecting specific types of system dynamic model structure which can be understood by the whole group (Hovmand et al, 2012). The techniques not only have to address underlying causal structure for the observed problem behaviours, such procedures also must consider potential intervention policies that can be tested by simulation. The description of potential policies to test using simulation avoids the need to estimate policy impacts on the problem behaviour, given the potential for unintended consequences (those prevalent in socio-technical systems with feedback delays) around secondary school choice. Scripts therefore can assist the rapid development of problem structure from which observed behaviours emanate. While most aspects of shared or Group Model Building (GMB) are qualitative when seeking views, some types of script can be used to generate numbers (Carter et.al., 2012) for direct use within simulation models. More qualitative scripts can be used to summarise problem structure or even policy interventions. For example, scripts can be used with participants without model construction skills in the chosen modelling medium, to explore cause and effect within the system defined by school competition, when facilitated by others.

4.1.3 Parent survey returns on admission process

Parents views on deciding schools were required so as to be able to explain declining levels of well-being stemming from school choice. In order to get a

representative sample of recent views that could be analysed, focus groups and interviews were dismissed in favour of a standard questionnaire. Parents about to decide schools in 2015 and again in 2016 were asked to contribute to the survey as problem immediacy was important to gain quality insights. Whereas online returns were meagre, using flashcards to ask parents questions proved more effective in obtaining a reliable sample size capable of analysis using Fisher Exact Testing.

Methods for deducing behavioural decision mechanisms from a target audience of parents to show statistical relationships differ. Mostly based on answering survey questionnaires, the types of association that can be deduced between variables is often subject to sample size as larger samples generally offer greater consistency in predicting bi-variate relationships. One statistical test that requires fewer samples while remaining accurate is the Fisher Exact Test (FET). Giving similar results to the Chi-Square Test applied to larger samples (exceeding 5 in each category), FET (see Glossary xxii-xxviii) offers a reliable test on two by two categories of dependent and independent variables where sample sizes are limited and has been used in schools for understanding behaviour (Haight et al, 2014).

Where speed of data collection is important, asking questions in person can assist response rates. Flash-cards represent a valuable addition to speed-up ad-hoc survey data collection as they simplify explanations of questions for which responses are sought. However, a survey cannot assign directionality to a relationship and is therefore unable offer insights on which system output effects are observed in response to what causal input. Fortunately, surveys can collect a wide range of views in a timely manner and parents can therefore engage with providing answers once questions have been condensed and simplified to help comprehension. Once calibrated by type of respondent, perceived or tangible inputs and anticipated or achieved outcomes from selected schools are analysed for cross-impact influences within the simulation model cases of typical decision making being tested. Krull (2016) suggests that both theories of rational choice and behavioural economics have a part to play in school selection and behavioural decision making was the starting point for this exploratory survey where patterns of rational choice were not found during pilot interviews.

4.2 Integrating data collection using simulation modelling

This study combines results from scripts run at workshops with small groups of experts practicing in secondary education, parent advice and health support services, plus parameters collected from parents of Plymouth school children answering specific questions, within a system dynamics model. This form of elicitation offers the potential to establish a concept model representing a system capable of reflecting interacting psycho-social aspects of secondary school enrolment with least preconceptions. Such models can be fine-tuned with parent views on the influences surrounding school choice and how these might vary with time. Rather than more traditional evaluation and comparison techniques which review each aspect sequentially before assessing the strengths of interconnection between each, this method of collating pertinent information allows referent modes of behaviour to be established. After applying potential changes, where impacts can be evaluated and credible explanations developed, the simulated causal theory can then represent source and consequence alongside viable solutions offering better interventions.

The ability to abduce new implications from a simulation model depends on the facility to adjust parameters and repeat the experiment, time after time. Iteration is a feature of all simulation models that requires setting initial values and holding certain assumptions constant while adjusting others before understanding new outcomes. It is particularly useful when testing assumptions to understand their influence on the system behaviours being studied (Huebscher and McCann, 2004). Thus, if a value is unknown or uncertain, the most likely estimate can be assessed through iteration to recreate the causal effect observed in real-world behaviours. Such iterative techniques also apply when establishing system dynamic models in their balanced or steady-state model of operation and again when determining coordinated interventions that offer improved intercession levers for affecting the problem behaviours observed over time. Such abduced associations derived through simulation are complimented by other inference mechanisms employed within simulation models including deduced model component values and ontological compliance checks from unit consistency (Lorenz, 2009).

As the psycho-social, familial system being studied is in a state of flux during the period preparing for and making the transfer into secondary education, actions that smooth the fluctuating emotional states can be assessed for impact using simulation

techniques in a safe and secure environment for various types of family. This intervention testing method provides relevant insights into the Plymouth school choice problem facing parents and proffers more effective decision rules by reproducing desirable states where the gap between whole family need and school provision closes, averting subsequent system surprises and related demands on supporting agencies. System Dynamics can provide understanding where system structures (below surface of the observed, empirical data) are largely hidden, while developing knowledge of constituent components by connecting qualitative concepts and quantitative models together (Qudrat-Ullah and Seong, 2010; Frances et al, 1994).

4.3 Survey cross-impact matrices for parent decision style

Survey designs can be evolved, based on response numbers to help confirm or adjust secondary data calculations from larger surveys. Therefore, larger, deductive surveys covering bigger groups can offer better correlations between data sets collected from respondents if the questions are clear and simple enough to discover relevant information (Hussey and Hussey, 1997). Equipped with such deductive information, a large data set of historical values can then be projected forward using regressive techniques, all other factors being equal. Typically, such projections into the future rely on twice the amount of consistent, historical data.

Given volumes can be important for making predictions using deductive philosophies, the medium for delivering questions to participants becomes important for obtaining significant volumes of responses. Three media are commonly used to deliver survey questions currently. Electronic scripts that ask questions remotely (frequently via the internet) offer the quickest dissemination to those individuals using computers (html addressed link within an electronic document) or smartphones (QR code symbol link on an image). However not all people have or use such devices, while others that do are not familiar with using them to answer survey questions.

While offering slower dissemination, paper-based questionnaires are still regularly employed to survey participant views. They also allow time delayed responses where form collection and return are separated by time. This can benefit the respondent but often can reduce return rates if they are not committed to completing the questionnaire and returning it to the researcher. For best return rates and transfer of

other insights (by interview structured around survey questions) a discussion using flashcards helps engage the participant with easily understood question and a number of potential answers that they refer to while the researcher asks the questions and records answers with further insight. By asking contributors to answer then potentially sensitive questions using numbered responses, possible embarrassment can be avoided helping to increase participation for example (Ward et al, 2014).

Surveys of Plymouth parents are needed to confirm secondary data assumptions around decision timing from English population sampling as well as test for local decision biasing. The following sections describe aspects of individual survey design to support confirmation of secondary data sources.

4.3.1 Surveying for potential interviewees with experience of school choice

An intranet article with appropriate links for staff to read and follow was proposed to obtain electronic views of potential contributors to a larger survey for launch later on.

4.3.2 Surveying new and experienced parents from a wider cross-section of the community

An internet article with appropriate links for the public to read and follow was suggested to obtain a wider, convenience-based sample of parent views about to decide secondary schools in Plymouth.

4.3.3 Analytical method

Initially a Pearson Chi-square test was proposed but this was modified after initial returns showed a smaller than required sample to a Fisher Exact Test for establishing bias towards non-linear decisions by parent groups (see page 104). Appendix 3 has further details of the technique along with an example.

4.4 Modelling multimethodology data collection design

Model-based multimethodologies (referred to as multimethodology from hence forth) offer bespoke research designs for collecting and analysing data that offer greater insight, gathered from a wider range of perspectives, thereby reducing potential for bias. By offering verifiable consistency for building causal theories, simulations are often used as receptacles for contributing elements of a multimethodology (Morgan,

2014). This is because it offers the opportunity to iterate for optimum solution design. The iterative process therefore defines how results can be abduced from the selected research philosophy, but does not restrict what other philosophies can generate data for use within the simulation model.

Introduced on page 66, the three main types of available simulation technique offer to abduce different outputs based on diverse input data (El-Dabass in El-Shiekh, 2007:278).

Agent Based Modelling (ABM) employs decision rule inputs to abduce group action outputs. It is commonly used to understand natural decision rules employed by individual agents within groups of living organisms receiving similar inputs to ensure efficient conversion into output actions that support species survival aims for example. It uses individual events to generate patterns of behaviour over time.

Discrete Event Simulation (DES) uses timed, event-based inputs to abduce process guidance on outputs and bottlenecks. It is commonly used to understand the detailed event inputs within work-based processes to optimise expensive resource consumption economics for example.

System Dynamics (SD) simulation offers abduced values of system parameters from observed behaviours of the system over time. Commonly used to model top-down complex behavioural systems found in nature and elsewhere, SD simulation allows causal structures to be identified that underpin behaviours over time.

Where agent-based modelling may help explore decision trends in a group of parents selecting between secondary schools, discrete event simulation could help follow numbers passing through the competition-extended, admissions system process for example. In an agent based model of parent decision trends, Robinson (2006) suggests the ease with which models can be generated using the technique to represent the issues around social exclusion in school admissions. The modelling technique is criticised for underdeveloped modelling tool performance and the inability to predict the length of experimentation phases. However, the applied methodology was successful in identifying how league tables were being exploited to attract the wealthier middle classes capable of sustaining schools (leading to a widening divide between social classes and validating related mathematical theory

proposed by others). The same issue concerning social segregation has recently been explored using dynamical systems to simulate tipping point in Swedish school choice (Spaiser et al, 2016). On matters of choice, agent- based modelling and discrete event simulation have successfully been combined (Knight et al, 2012) to demonstrate individual agent decisions affecting process speed, in this case for NHS (see Glossary xxii-xxviii) healthcare.

To learn more about complex social systems, either a gaming and/or modelling orientation is needed (Gu *et al*, 2016). As few games exist that addresses school enrolment, whether based on resource planning response to chance or flight simulator response to system, a model orientated approach is adopted. As competition between secondary education providers relies on knowledge-based feedbacks to attract more students, a computer-based learning tool using model-orientated, continuous simulation with feedback is most appropriate for developing the problem and potential policy solutions shared between agencies based on the taxonomical description provided by Maier and Großler (2000) where the iThink/Stella platform is one of several possible model development tools that include Systo, Powersim and Vensim amongst others.

Most importantly, Hirsch et al (2007) suggest the SD modelling technique enables points of leverage influencing problem behaviour within the system boundary to be identified to optimise output policy design for greater effectiveness (more desired outcome from the available resource inputs). Thus, SD offers a collection receptacle for abducing policy outcomes constructed from insights onto the issues (qualitative problem structuring for a system) before locating potential change levers (quantitative sensitivity testing) to help identify more effective policies for addressing problematic behaviours over time: those emanating from the system where feedbacks and delays predominate such as social systems. For these reasons, SD provides suitable collection mechanisms for abducing support policy around the (secondary) school choice problem in cities.

4.5 System Dynamics principles

System Dynamics is a modelling technique that helps address issue of dynamic complexity where structures are associated with systemic behaviours that change over time. It encompasses both problem structuring and simulation design

techniques to assemble a relevant representation of the problem for testing potential solutions. Policies can be fashioned to reverse unwanted behaviours that resonate across the system, as defined by the boundaries of rational thought that is applied to the model. The system structure helps generate explanatory system behaviours. Systems do not have to be physical in nature and SD is now commonly used to study social dynamic systems and specifically psycho-social dynamics (Schiepek, 2003) amongst many other genres where the technique has been used with success (Sterman, 2000).

Representing dynamic complexity in personal mental models is limited according to Kim (1993) who suggested detailed complexity was more discussed and offered wider graphical interpretations when compared describing dynamically complex models. Figure 4.4 updates the original Kim table for explaining a System Dynamics approach. By adding a further category of spoken complexity derived from individual mental models, the full range of spoken, drawn and written definitions of complexity are available in a computer-based System Dynamics Model. Here the stories told by individuals can help reflect upon dynamically complex problems as well as those of detailed complexity.

Given written approaches to dynamically complex issues such as emotional turbulence for families facing school choice, system dynamics - specified in mathematical notation – offers the potential to accurately describe such matters (enhanced with a stock-flow diagramming notation that also allows for trajectories of key stocks to reflect drawn complexity of resulting parameter behaviours). Such technology to transcribe mental model complexity between individual communication media is recognised when describing intricate dynamic systems involving emotional relationships (Schiepek, 2003).
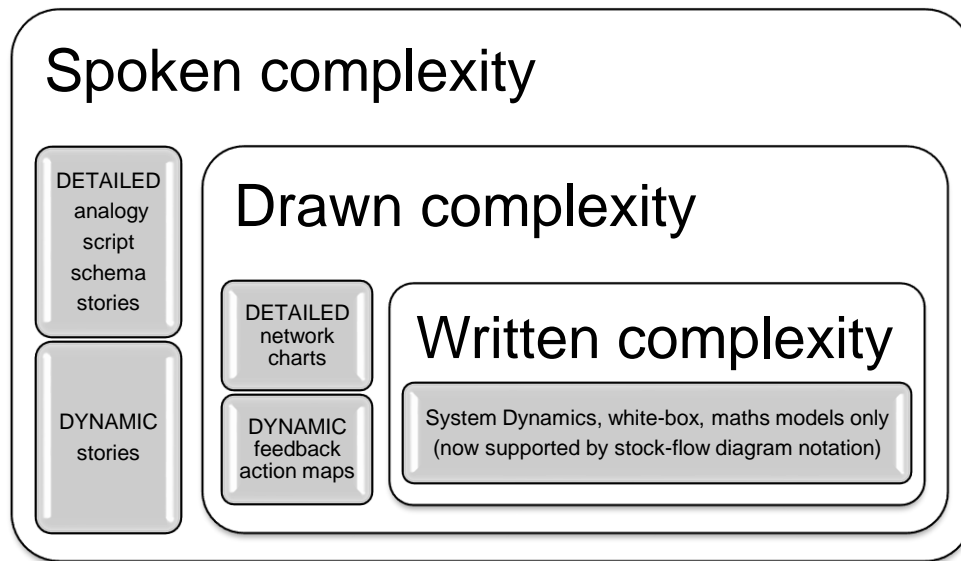
Figure 4.4 System Dynamics for describing the scope of System Dynamics as a data collection technique (adapted from Kim, 1993)

On SD causal loop or feedback diagrams and SD mathematical modelling Coyle states (1996:114) that "Complexity for its own sake is not a virtue in a model, but users are restricted only by their own understanding of a problem. There are no limits in the software on what can be modelled." The statement suggests that while views on the nature of a referral problem (that commences during enrolment and continues to worsen through English secondary education) may be contradictory, simplification of the main influences using a System Dynamics approach can improve shared understanding. This was found to be the case when SD techniques were piloted by a group with significant experience supporting children from across Plymouth (Carter *et.al*, 2014).

With SD offering the possibility to gather and make sense of different types of system and scale within a single platform, representing new combinations of influential feedbacks across a dynamically complex system can provide new insights, those that are not available from existing patterns of thought.

4.5.1 Induce qualitative problem structure from expert practitioners

Several techniques are used to gather data on the problem being studied for constructing SD models. These qualitative methods, based on GMB (see page 79),

also allow descriptions to be captured for combining with other secondary data for parameterizing and testing the resulting SD model from the original concept (Hovmand et al, 2012). Rather than using Delphi surveys of dispersed experts to establish the model remotely over time, GMB encourages focussed debate (led by a facilitator/modeller) between those with key insights in one or more workshops (Rouwette, 2016).

4.5.2 Abduce quantitative policy improvements for problem behaviour

Observed, real world facts induce explanatory relationships as formulated laws (whether explained using mathematics or described in symbols) that then enable future state predictions of the real world to be deduced. The predicted phenomena can then be verified against real world facts to confirm accuracy before reprocessing new results to discover additional knowledge through a process of recycling. Such result recycling processes are known by the common term, abduction.

A simple example of the process is the common real-world fact of wet grass in the morning. The induced relationship may suggest dew, given a cloudless sky at daybreak leading to reduced overnight temperatures that can cause saturated air to release water. The deduced forecast about tomorrow morning suggests more dew is likely as stable weather conditions are predicted over the next week in the area. The verification of this scientific method is more wet grass being discovered the following morning. The repetition of this process then abduces the most likely explanation for subsequent days.

A less likely explanation suggests rain occurring overnight, assuming all other wet grass variables are eliminated such as sprinklers. This becomes the dominant explanation once clouds appear in the sky as more turbulent weather arrives. Under such circumstances rather than a qualitative law suggesting overnight dew instead, large, quantitative, computer-based models capable of forecasting developments become essential to calculate the atmospheric implications for local areas. Therefore, the ability to project mornings when the grass is wet switches from qualified logic rules that repeat towards complex quantified cause-effect models that iterate towards solutions after considering many more interacting variables that could affect local outcomes.

As systems exhibit steady states from which changes can be measured, initial stock values must be abduced by repeatedly adjusting stock levels until all stocks remain constant. Under these circumstances a steady state system is described that is mathematically realistic.

The abducing principle repeats again when configuring a model for a baserun to represent the problem behaviour capable of disturbing the system's steady state in which no such divergent influences apply. Here some values may be known whereas others may have to be assumed, where they cannot be measured for example but may lie within a predetermined range. Using justified assumptions based on real-world values, representative problem behaviours are calibrated.

Potential problem solutions can also rely on abducing systemic interventions offering greater resolution than more obvious policy interventions. Given that validating SD models requires sensitivity testing to identify which outputs are disproportionality affected in the non-linear system from a changed input, abducing the most effective range for controls is achieved by iterating around combinations of input variables, those known as change levers (Georgantzas, 2009).

By consulting those who experience the problems of helping children exhibiting anxious levels of low-well-being, the opportunity arises to not only discuss the empirical patterns of behaviour that are observed but also explore the problem structures capable of creating such non-linearities. This results in a concept model. While not accurately reflecting behaviour with the right parameters, a concept model demonstrates underlying structure that influence trends over time that expert practitioner can recognise. The process for creating such a model using participant views is called Group Model Building in System Dynamics and involves a mix of qualified and quantified methods. Once a concept model is produced through the induce-deduce-verify loop of scientific discovery (Stone, 1978), SD computations can be applied to abduce further implications from observed system settings and consequent behaviours.

4.6 Deduced statistical associations for parents deciding schools

Parental views need capturing to understand the decision mechanism on secondary school selection is understood, given the substantial choice of options a family is confronted by in the urban environment. Initial parent views around rational choice

were piloted but proved inconclusive and so family behavioural decision-making styles are considered for further investigation as noted by Krull in 2016, where satisficing needs replaced the desire for some parents to maximise personal utility of their selected school from the wide breadth provided by competition.

Apart from three secondary schools close-by in Devon and Cornwall, Plymouth offers a geographically isolated or discrete pool of parents seeking secondary education providers in the city who would not choose or afford to look elsewhere. Of the seventeen-available state, secondary schools in Plymouth (Plymouth City Council, 2016), some are single sex and others require students to meet entrance criteria. By far the greatest majority are co-educational and therefore available for all families to consider. The freedom of choice for parents supercedes the feeder primary school admissions concept where the local secondary was 'fed' students from designated primary schools in the vicinity causing a price response in the local housing market based on secondary school allocations to their respective primary feeder schools. The updated approach to admissions (DofE, 2015) thereby raises the challenge of selecting secondary schools from a wide range of options that could meet their family's needs for parents across England, particularly in cities.

4.6.1 Survey design

Ensuring survey relevance to parents deciding secondary schools, either with or without previous sibling knowledge of selecting schools, is essential by using terminology and simple questions associated with admissions. As the purpose is to determine behavioural decision mechanisms that parents employ in Plymouth including previous generational experience of city-based secondary schools, maximising the opportunities to talk to parents must be established. A statistical analysis to demonstrate if decision bias is present in the sample population is essential. Demonstrating decision biasing can help identify target groups to consider for coordinated policy adjustments between multiple, supporting agencies.

Ensuring objectivity within the survey design involves spacing choices evenly (giving equal credence to any answer selected), randomising answers to questions to avoid pattern-formed answers (keeping the electronic mouse cursor in one place for example to answer yes to a set of electronic script questions) and avoid introducing question bias through a process of trialling survey answers before publication. In

effect, changing survey delivery mechanisms can also enable the introduction of greater understanding and objectivity when moving from electronic scripts to paper questionnaires or dialogue flash cards for example.

Cross-tabulation analysis, confirmed by Fisher Exact Testing (FET), was selected to help establish parent decision making styles when approaching secondary school admissions. This combination, widely used in mental health (Gara et al, 1998; Sim, 2006; McGaw et al, 2010; Song et al, 2015), allowed different relationships between factors to be examined and tested for statistical reliability within a small sample. For example, the time taken to decide schools was believed to be an important factor in establishing the dynamics decision making. When setup in a cross-tabulation of the final survey data against levels of enrolment decision experience, this could inform whether a bias towards quick or slow decision making for those lacking previous experience was present which could then be used in the model. Through a process of filtering and sorting data from the sample, smaller discrete tests could establish potential levels of bias within Plymouth using the technique that would provide data for constructing the policy simulation model.

The design for collecting samples cannot reflect the entire population as time is limited, yet offers the reliable derivation of statistically tested deductions. Without a suitable sampling frame, a representative sample of Plymouth parents selecting schools is required. While lacking quotas of parent categories, the sample may well be unrepresentative of the entire group of parents selecting secondary schools. While largely exploratory around potential decision biasing influences, piloting using self-selection demonstrated the potential for higher socio-economic groups to answers on-line survey questions. This suggested that while different decision cases were not difficult to identify (parent with a child aged ten prior to October common application form deadline) the sample would most likely be small as a more engaging delivery mechanism was needed.

Purposive sampling is therefore required and illustrative cases were demanded that explained differences in approach between extremes of decision making i.e. parents of standard or mainstream students and others whose children have Special Education Needs and Disabilities (SEND). Saunders et al (2016) suggest this type of purposive sampling has an illustrative focus. Where many families of more able

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children use local sports centres, a 2015 Plymouth Information Advice for SEND (PIAS) conference stand was used to collect views from those parents of children with more challenging needs. An initial target of some 10% of the overall sample was sought to reflect approximate proportions of parents considering secondary admissions for children with disabilities. Such a sample could then be contrasted against less constrained decisions for standard families without additional SEND needs to satisfy.

Methods for deducing behavioural decision mechanisms from a target audience of parents to show statistical relationships differ. Mostly based on answering survey questionnaires, the types of association that can be deduced between variables is often subject to sample size as larger samples generally offer greater consistency in predicting bi-variate relationships. One statistical test that requires fewer samples while remaining accurate is FET. Giving similar results to the Chi-Square Test applied to larger samples (exceeding 5 in each category), FET offers a reliable test on two by two categories of dependent and independent variables where sample sizes are limited and has been used in schools for understanding behaviour (Haight et al, 2014).

Visual appeal is also considered to avoid putting respondents-off. The initial survey was paper-based and rather technical given piloted comments. Whereas the electronic survey replicated this, the feel was improved using progress bars from the numbers of questions answered for example. Navigating was also clearer as the electronic version allowed automatic navigation to jump irrelevant questions that depended on specific situations.

Question structure ensured a limited number of open ended clarifications, only after selection of the primary answer. The only other free-format answers allowed were contact details for additional information if required by parents. Appropriate ordinal, nominal and other structures were used to capture parent responses with mutually exclusive multiple-choice answers. Neutral and those choices that were not applicable, provided as all answers were worded to include complete spans of possibility to keep survey questions simple.

To ensure survey flow, the survey engaged parents with a 'visual funnel' of options being selected into choices and a preferred school before asking some easier

questions. Duration expectations were set at 10 minutes to answer the flash card questions with those being surveyed. Key questions concerning behavioural decision making were asked after initial categorisation checks. This situation was largely confirmed beforehand through piloting the survey with only slight adjustments associated with the second round of surveys.

As question clarity is essential no acronyms were used and flashcards reduced the potential for ambiguous language that might need further explanations thereby extending the time taken to answer. Questions were set into a logical order and grouped together when looking at the same topic area. Areas investigated by survey for potential bias from behavioural decision making by parents included word of mouth from the experiences of others, normative decision models and potential economic prospects.

4.6.2 Flashcard deployment

The eventual survey design needs to target the Plymouth parent audience currently deciding which secondary schools best suit their needs, whether by mainstream or special providers. Special schools are fewer in number but take longer to decide based on a range of complex factors affecting selection (often health related but not always). Whereas many parents may attend the primary school gate to collect children for example, this is a high-pressure environment for conducting surveys that offers a researcher little time to collect parent views on school choice. By contrast, sports facilities dedicated to running team evenings for children do present parents waiting for children engaged in activities and therefore represent less pressured locations for answering questions. The final design of flashcards employed readily engage parents as shown in Appendix 4.

Potential sites were identified and contacted for permission to conduct parent surveys in-line with modified research ethical approvals. Two sites agreed to allow access in the foyer areas for surveying and dates were set at the Plymouth Life Centre and the Young Men's Christian Association at the Kitto Centre: the latter also providing a display table for a snakes and ladders gamification poster alongside survey questionnaires for recording answers. The results reflect many evenings spent seeking parent views within a wide sample of the population who wanted their child to participate in sport. As this approach, would have excluded views of parents

with children with additional needs, the stand was also set-out at the 2015 PIAS (see Glossary xxii-xxviii) Conference where several parents engaged with the research to provide survey responses, alongside insights into their own specific issues.

4.7 Chapter review

The chapter suggests a modelling multimethodology design based on System Dynamics for integrating data obtained from earlier studies, deduced from parents and induced from expert practitioners, using a multi-methodology before abducing policy interventions that improve well-being for children. Both statistical and problem structure inference tests demonstrate validity of results for each technique before combining into a simulation model capable of testing alternative decision rules to understand impact on the baseline problem behaviour as it unfolds over time where low well-being thresholds are breached with consequent CAMHS referrals. The final contribution to social systems research is based on the novel design of a modelling multi-methodology involving inducing problem structures, deducing non-linear decisions from sections of the community and abducing alternative policies that offer to improve well-being for children to fulfil their potential.

The selected modelling multi-methodology fits with the intended aim and objectives of the research topic. It involves sequential use of a problem structure induced from expert practitioners across urban support agencies. The resulting concept model is parameterised using views of parent decision-makers in Plymouth acquired through survey methods and analysed using cross-tabulated, two-by-two, Fisher Exact Tests to deduce all significant, statistical relationships for deducing potential behavioural decision biases. Once equipped with relevant data the system dynamics model can be tested to ensure consistency in behavioural response alongside supporting, static verification tests. The design criteria for the final model also includes structure to enable different policy tests to abduce a final contribution to solving the observed problem behaviour. In summary, data collection using multimethodology involves multiple inferences that can include:

- CAUSE + EFFECT = INDUCED LAW OR VALID CONCEPT MODEL;
- LAW + CAUSE = DEDUCED EFFECT OR NECESSARY DECISION BIAS;
- LAW + EFFECT = ABDUCED CAUSE OR SUFFICIENCY OF UNMET NEEDS

Fortunately, System Dynamics offers both induced relational laws on the problem structure around recurrent referrals through model building groups as well as policy solutions abduced for alleviating unmet needs. In this case the only other data collection technique required is the deduction of effects from decision making biases and this is determined from parent views on causal bias when deciding schools. In this way competition cause and referral effect are connected by the law or causal theory of unmet needs.

Lorenz (2009) suggests induction infers a valid law through repeated observation of cause and effect. Deduction infers a necessary effect from a law and observed fact. Perhaps more controversially, abduction infers a hypothetical cause from an explicandum derived through simulation (in this case the dynamics of a competitive enrolment system). While less clear and certain than inductive or deductive branches of analytical thinking, abducing a cause from observed effect and system-based laws offers "promise for producing advances" based on the "logic of what might be" (Martin, 2009).

Whereas recent studies have concentrated on qualitative views from parents and children involved in selecting secondary schools (Cotnam-Kappel, 2014; Trevena et al, 2016), this study seeks to quantify dynamic aspects of complex school choice that plays out within families. By furnishing a capability to validate shared decision rules between cooperating agencies abduced through simulation, support for children during their secondary school enrolment process can be designed to help reduce additional CAMHS referrals. Applicable to those children in primary school preparing to transfer schools, but also for achieving a better long-term fit between student need and secondary school provision, school choice remains important. If correctly addressed through scientific process, school choice offers the potential to lessen future demand on CAMHS during secondary school education.

Research design can therefore be summarised as a series of process stages that are referred to in the key given for Figure 4.5. Stages are colour coded to reflect the validation process applied to evidencing data for constructing the final model.
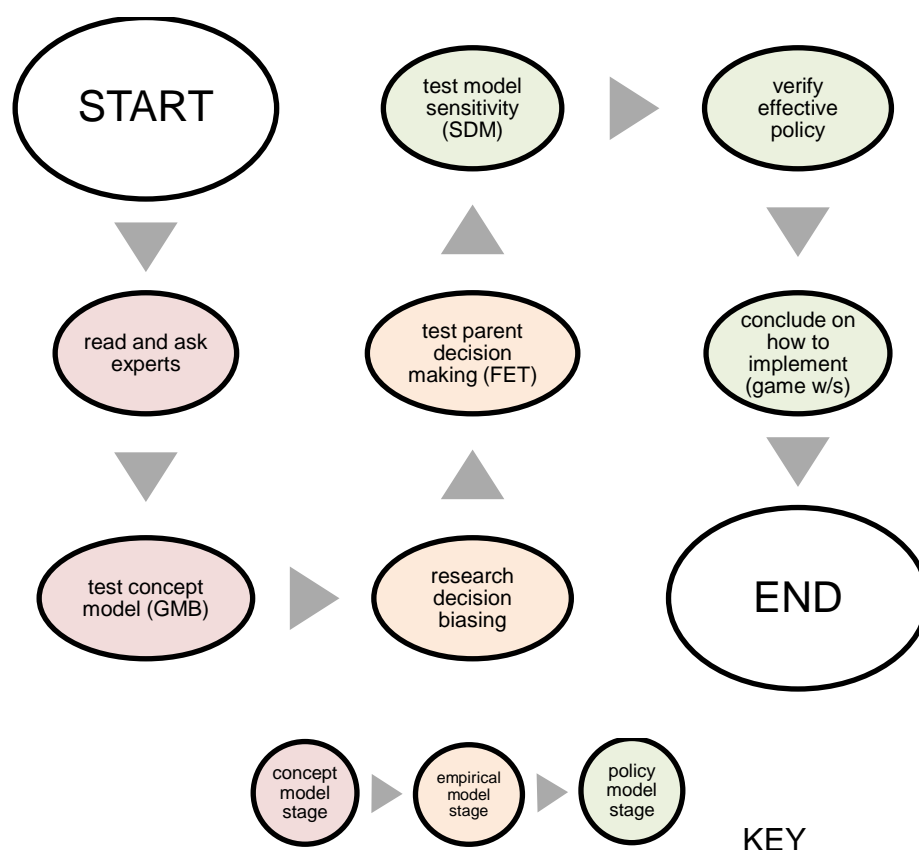
Figure 4.5. Research modelling design

Starting with stage 1 (pink), reading relevant literature on policy design, dynamic modelling and emotional impacts of competition enables group model building to design a concept model of why well-being might decline when changing from primary to secondary schools. Having researched the limited use of rational choice in selecting secondary schools, stage 2 (orange) relies on asking parents in the locality about behavioural decision-making practices to detect potential sources of bias leading to unmet needs for children that inform the empirical model. Finally stage 3 (green) seeks to test policies nominated by those experienced in tackling the emotional problems that students can encounter alongside others that model sensitivity testing suggests might offer suitable levers on the dynamic policy model. The work concludes with deciding ways in which new policies can be implemented to achieve modelled, design parameters that sustain levels of family well-being which are resilient to unforeseen personal set-backs during academic years 7 to 11, even with the pressures of systemic competition affecting everyone.

5. Workshops developing the concept model structure

5.0 Introducing inductive problem structuring

System Dynamics dominates data collection with both induced problem structures explaining recurrent referrals as well as policy solutions abduced for alleviating unmet needs. The first of the data collection methods involves talking with current practitioners with experience of the problems first-hand. For child mental health referrals during secondary education, not only are Child and Adolescent Mental Health Service (CAMHS) involved for more extreme matters, so are the council and even the schools themselves for less pressing emotional demands. For conditions where referrals repeat, the underlying problem structure must be determined. Here expert practitioner views are invaluable and can be harvested for the concept model construction using Group Model Building (GMB) techniques.

S1. Problem recognition / interests	S2.Problem understood /system influences described	S3. Qualitative analysis of bright ideas and pet theories	S4. Simulation modelling / model (behaviour) testing	S5. Policy test / (re)design
CHAPTER 1 rising Child and Adolescent Menatl Health Service referrals	CHAPTER 2 literature including secondary data CHAPTER 3 Selecting a methodology CHAPTER 4 Data collection techniques	**CHAPTER 5 Group model building - health - council - education - concept model** CHAPTER 6 Decision biasing	CHAPTER 7 Testing model reliability	CHAPTER 8 Testing policy alternatives CHAPTER 9 Concluding support policy .

Figure 5.1 System Dynamics process look-up table (adapted from Coyle, 1996:p.11)

As indicated in Figure 5.1, the research has established rising CAMHS referrals following transfer to secondary schools in Plymouth, UK based on Plymouth Community Healthcare (PCH) - now Livewell Southwest - case data showing rises and fluctuations. This chapter explores expert practitioner's views for inducing a problem structure supporting possible explanations for such an effect by answering

the question about how competition over choice of school might affect the future needs of adolescent children.

Other groups supporting the transfer between primary and secondary schools also benefit include Education (gaining attentive secondary school students involved with work rather than doubts) and the Council (identifying those families who need supporting). Relevant official reports include secondary data from The Children's Society series (2011-2017) of Good Childhood Reports and Coldron et al (2007) parental secondary school selection study for the Department of Communities, Families and Schools.

In addition to assembling group-based views of interacting system components, it necessary to determine responses over time, additional validation of modelling group suggestions can also support testing parents for potential forms of behavioural decision bias (e.g. predispositions for downplaying future student needs in favour of parental requirements) and inattention to time spent in alone by children preparing for tests.

Through participative modelling in workshops and one to one meetings, there is potential to quickly realise and determine key aspects of the problem behaviour that relate to pre-existing, often empirically hidden, system structures. Group Model Building can be used within the context of System Dynamics to enable qualitative Stock Flow Diagrams (SFD) to be constructed that represent the problem behaviour structure for subsequent enumeration. The diagramming technique, using the nomenclature of simulation (Lane, 2008) provides clarity and deals with the potential difficulties presented by the common method of qualitative participation using a causal loop diagram approach prior to quantified simulation. Causal Loop Diagramming (CLD) is a technique that helps identify reinforcing or balancing behaviours between key variables in the system. A proven summarising technique: applying causal loop diagrams to capture dynamic relationships from groups, can be problematic as definitions can be imprecise (lacking separation between stocks, flows and variables for example), since the ability to understand if the diagram is complete is key to matching group expectations to any subsequent stock-flow simulator structure.

An alternative way to meet group expectations involves creating a stock flow diagram concept model with the group that can be simulated (and therefore challenged) from a position of expert practitioner knowledge on behavioural responses, as demonstrated in group model building workshops (Rouwette, 2013). The technique for extracting group views on complex dynamic problems employs building model structures and behaviours during the workshop so that everyone can see and understand how structure informs behaviour in systems containing feedback (Figure 5.2 refers to three steps for explaining system dynamics conventions to participants, providing behaviour-over-time examples and finally seeking descriptive views for basing solutions). This ensures that only a group-built, concept model that is acceptable to participants is constructed.
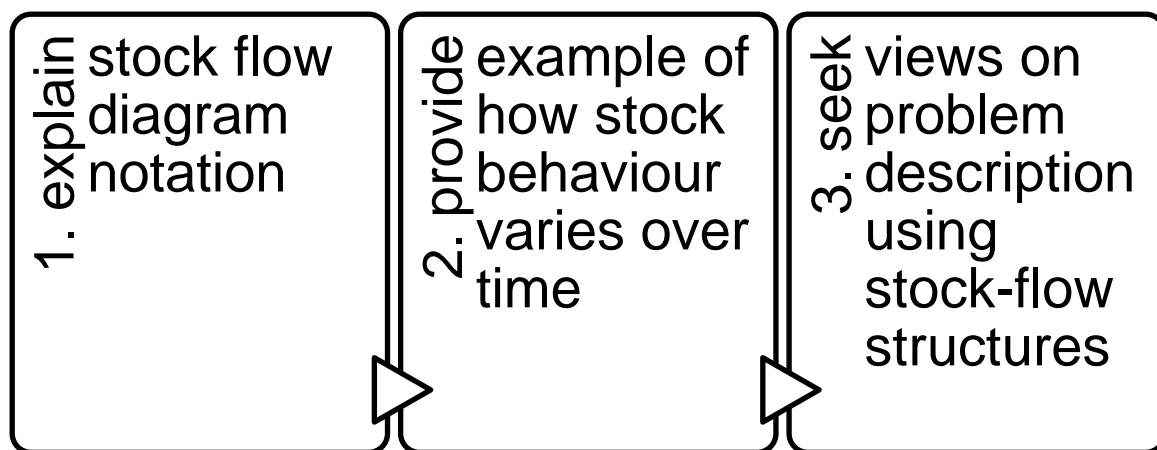
Figure 5.2. Process of constructing a qualified stock flow diagram underlying problem behaviours.

Such qualified concept models can then be quantified using different techniques, depending upon chosen scales. For example, a national statistic may require breaking down into regional statistics if such variations were important in the problem specification. While the resulting concept model offers numerical simulation to reflect on system behaviours, it remains an induced model only qualified by group views at this stage.

This chapter scope therefore covers the selection of Group Model Building scripts through a piloting process with knowledgeable practitioners in supporting children

before recording the results of various workshop outputs in order to trial a concept model of how selection may influence behaviours.

5.1 Piloting workshops for Group Model Building (GMB)

The pilot design comprised inviting potential healthcare gatekeepers to show some of the important scripts they would need to lead upon alongside a selection of participants from related support areas of education, health and council. Some contributors had recently retired from Plymouth but others were still employed by the unitary authority. Other than gatekeepers, it was not planned to invite the pilot group back but instead invite active participation from support agencies representing others to ensure expert practitioners views were eventually captured. A total of six working in groups of two were invited to pilot a range of potentially useful scripts. The outcomes of script testing by pilots showed that not only did gatekeepers receive value from early training, but also people not previously exposed to System Dynamics could gain insights for little additional effort.

Once scripts are confirmed, the value of new insights derived from a system dynamics approach makes the problem more evident (see page 121). Models constructed using System Dynamics techniques can help people understand social behaviours that unfold over time, such as those exhibited in the urban school choice problem, for families seeking suitable secondary education providers in a competitive market. Plymouth is a progressive authority offering seventeen, secondary school options under an equal preference system, as indicated in their guidance for families (Plymouth City Council, 2016). In total, three school choices can be specified by parents on the annual Common Application Form and the preferred choice identified for normal point of entry (term time entry being known as 'in year'). Employing a participatory technique for collecting model-based data is important for ensuring critical realism of the causal theory developed through the research process.

Modelling using group inputs employs more than one technique to elicit relevant data. For example, when expert time is precious and distance separates potential participants, system dynamics modellers can resort to Delphi-based questioning through multiple rounds of surveys (Wolstenhome and Corben, 1994) or when participants with specific knowledge from a section of the community are required then questionnaires can be used (Babader et al, 2016). By meeting participants in a

workshop setting, greater interaction and faster data exchanges become possible. The popular method for collecting data in workshops, known as Group Model Building is discussed on pages 79 and 112.

5.1.1   Agencies contributing to modelling effort

Three key agencies were considered to regularly encounter the emotional problems associated with secondary school transfer in Plymouth. The city council's Plymouth Information and Advice Service or PIAS (previously the Plymouth Parent Partnership) support families to locate suitable state schools in Plymouth, including telephone and visit support. The secondary schools offer advice at normal point of entry coordinated through their heads of year 7. Coordination for transferring emotionally stressed children is also attempted through Special Educational Needs Coordinators in primary and secondary schools although this service is being reduced in many schools as funding changes occur for such children. The emotional health of children also needs representing and this is provided by the problem originators in CAMHS contracted-out to Livewell Southwest (previously the service provider known as Plymouth Community Healthcare or PCH). No parents were consulted through a workshop process as they would not necessarily have encountered the wide range of issues seen by expert practitioners in the field. However, their views were important as the decision makers, providing Plymouth decision case examples and these were elicited in other ways described in later chapters.

Effective social policy can be established by individual agencies to help groups of people but multi-agency groups offer far greater scope when dealing with intransigent problems that resist attempts to redress the issues (Munro, 2012; Lane, 2015). So as to ensure more impact on secondary-age, referral rises, a group-based style (GII) is suggested for those deciding policy change based on the five categories of decision making when facing situational leadership challenges (Vroom and Jago, 1988). This represents the democratic end of the decision-making spectrum with an AI autocratic style at the other end and AII, CI and CII in between (see p.128).

For short periods between decision and result, feedback improvements from the process of deciding schools are more apparent to the decision maker. However, feedbacks from a enrolment process involving different secondary schools is convoluted and takes at least five months (November – March) with parent appeals

only extending the delay further to six or more months. The same concept applies to unilateral policy developments by individual agencies where policy supporting school children, may take less time if decided autocratically but will be less enforceable unless coordinated through multiple agencies. As limited feedback is available to A1 autocratic decision makers, views of others can be sought and/or acted upon where agency decision-making styles move through more consultative decision-making styles towards group-based democracy.

Developing problem structures using group-based model building initiatives that involve multiple agencies therefore offers significant advantages, if the focus can be maintained and the modelling input time kept short for participants. Involved in practicing policy that supports children and young people in Plymouth, the secondary schools, city council and health providers were all identified as potential participants in a group model building exercise comprising a number of pre-targeted scripts aimed at uncovering systemic problem structures and potential solutions.

Figure 5.3 indicates the value of consulting expert practitioners who may not set policy through decision rules but can influence improved outcomes for children across the city. The chart shows how agencies (lower row) can use various situational decision styles (middle row) to assemble views on a decision involving a multi-agency group. The emboldened Group Model Building (GMB) approach offers a Gii open decision style that offers many benefits for developing shared policy.
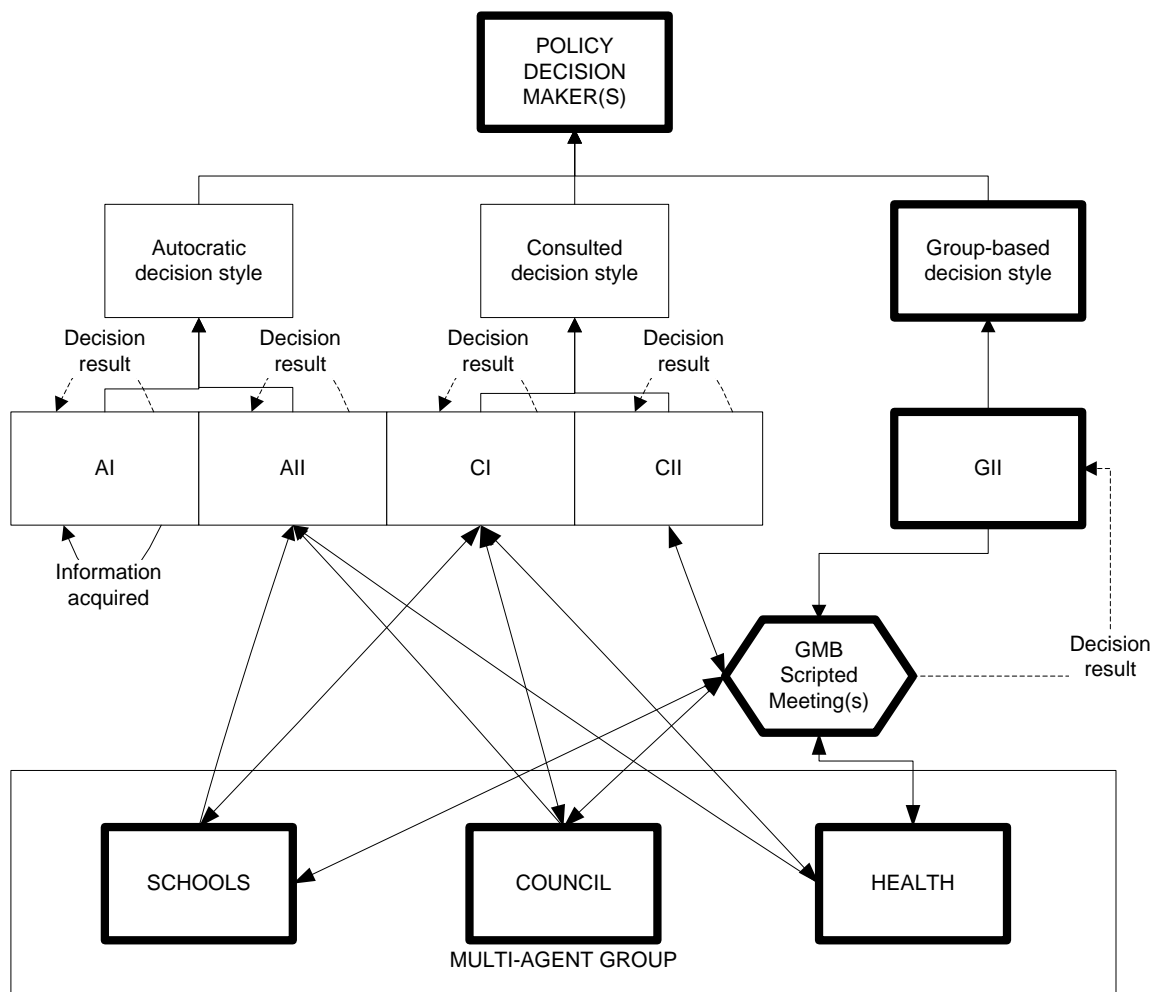
Figure 5.3. Policy decision making using a group-based style of facilitation between multiple agents supporting school choice problem (adapted from Vroom and Jago, 1988)

The particular agencies supporting children at this critical school change are the council, health and schools who provide essential assistance with limited resources. By engaging in multi-agency practice, the chart shows different styles of shared decision with resulting outcome can be achieved. Autocratic (AII), consulted (C*) and group (GII) styles of policy decision making involving multiple agencies, whether smaller or larger numbers participating, are catergorised by information required for taking a decision based on previous results. By contrast, adopting a completely autocratic A1 style requires no additional support to produce a unilateral policy decision for an individual agency but probably can only be effective in one aspect of

the problem behaviour or less. As more democratic styles involving other perspectives (from left to right in diagram) are adopted then the potential to influence multiple agencies in supporting shared policy decision rules become apparent. The Vroom and Jago (1988:p123) contingency model of leadership establishes different decision-making styles within a spectrum from autocratic through to group-based.

Typically, democratic group styles are slower than autocratic approaches to decision making but Group Model Building using scripts (Vennix, 1996) transcends this problem by constructing a valid model capable of being tested for reliability and therefore helping to explain potential policy outcomes thought a shared system of interacting dynamic elements. The Gii group style still employs inputs from all agencies in the multi-agency group, but the agenda is based on pre-formed scripts that allow the group to experience the potential policy outcomes of policy changes through an initial concept model developed in their meetings.

Democratic group model building facilitation employs a shared model to rule-out prospective policies that sub-optimise one agency's outcomes at the cost of another where decisions are complex and non-linear. Thus, multi agent groups of expert practitioners can explain their issues and democratically conclude on multi-lateral policies to help support families deciding between secondary schools where selection is wide and requirements complex.

Workshop sessions were organized by inviting a selection of expert practitioners from the local council, health and school service providers to attend a room equipped with essential presentation and simulation computing facilities. Combined with this, refreshments were also provided in the room to ensure that each three-hour session was fully utilized for gathering information on the problem structure and potential mechanisms to alleviate student referrals. The room was configured with desks arranged in pairs in a horseshoe shape around a presentation screen with a supporting flipchart. This arrangement was used to ensure maximum engagement with the available learning materials. The walls were then used to post individual and group-based outputs from each script for disseminating and sharing participant views.

The subsequent workshops used the most effective script combinations from the pilot group trials to produce results for inclusion within the concept model and subsequent

simulation developments. The room layout also evolved from the piloting phase where expert practitioner desks were placed in a semi-circle enclosed by the computer display screens and flip charts to ensure maximum legibility and interaction within the group.

Figure 5.4 shows some of the room layout (of the second workshop being held a few weeks after the first event) during an exercise designed to collect views on potential policy interventions. The recommended 'horseshoe' layout for tables was adopted to ensure that the small modelling group of expert practitioners had access to all the available information whether spoken, presented or drawn on paper (Franco, 2014).

Figure 5.4. Piloting the Nominal Group Technique script with expert practitioners from Plymouth

5.1.2. Problem structuring agenda for workshops

As mentioned, longer term decline in student wellbeing following school transfer (the original problem) required investigating through expert practitioners meeting in carefully scripted workshops. Carter et al (2014) explain the range of scripts operated during a pilot session. Testing different scripts in this way on a related problem not only helped the gatekeeping roles from CAMHS (one of two candidates for agreeing to accept the role for the whole group) to better understand some of the GMB process but also supported the shared selection of scripts that were subsequently employed in the context of rising age referral workshops. As shown in Figure 5.5, several scripts for problem structuring were considered useful but the plan was changed on the first workshop to include another script (process mapping) in response to new and relevant information offered by participants.

Initial pilot	1st workshop	2nd workshop
Hopes and Fears; Graphs Over Time; Nominal Group Technique; SCRIPTS SELECTED	Hopes and Fears; Graphs Over Time; Process Mapping; EXPAND IDEAS ON PROBLEM	Nominal Group Technique; Workbook; Stake in the Ground (with simulator concept model debriefs); CONFIRM CONCEPT
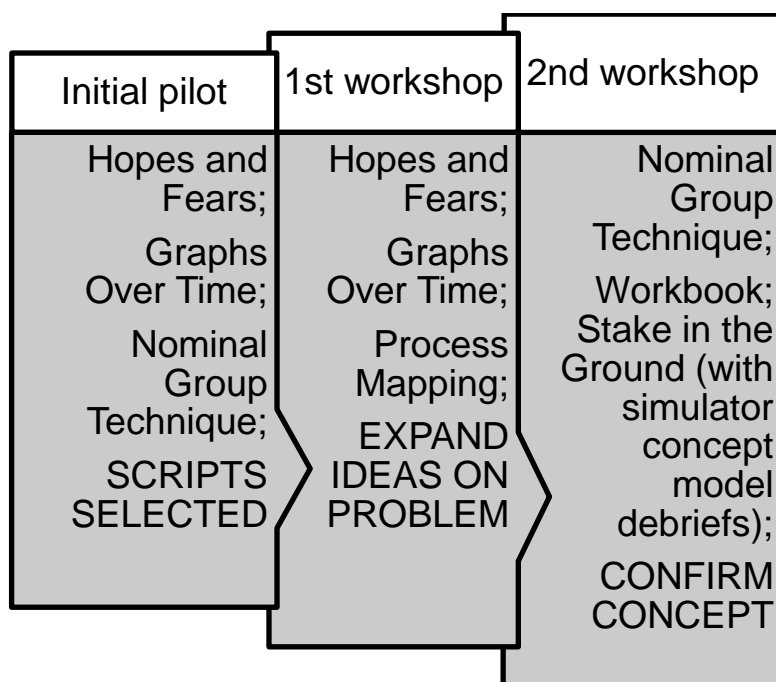
Figure 5.5. Sequencing trial and use in problem structuring workshops of Scriptapedia content.

Hopes and fears was the first script planned to follow team member introductions and explaining the purpose of each planned three-hour workshop. Taking only half an hour, it allowed people to write down their individual perceptions of what they hoped the workshop would give them and what they thought it might not be able to deliver.

The results could then be discussed and posted on the walls of the workshop for subsequent review during regular breaks. Any misconceptions could be quickly addressed by the facilitator before proceeding with the workshop.

The second planned script for expanding on ideas around the problem's dynamic behaviour was decided from piloting as Graphs Over Time. Here participant groups are asked to self-regulate what they perceive as the key indicator associated with the problems they encounter. With a gatekeeper already experienced during the script piloting stage, they are in a position to help lead workshop discussions about what parameters and how long each behaviour takes to unfold.

For the second, policy development workshop, a different set of scripts were used to provide ideas on how the problem behaviour might be solved. Particular agencies had strong views and these came out through piloting the Nominal Group Technique[36] script. Here individuals write down their top intervention policies for subsequent comment by the remaining members of the whole group. This is then seen by others in turn before being returned to the originator. Piloting this script allowed members to quickly judge how successful taking-action would be within a multi-agency context and offers great potential to select better, more acceptable policies that did not disadvantage any particular group.

Other piloted scripts that were also used but additionally, included workbook (Vennix and Gubbels, 1994) and stake in the ground scripts (Carter et al, 2014) to enable the output of workshops to be debriefed for individual participants who could raise further issues as necessary at this time. By verifying expert practitioner inputs as a collective workbook and validating simulation outputs from the resulting concept model demonstration, these additional scripts offered further insights into related problem behaviours.

Building models from a problem holder perspective offers considerable benefits for defining a problem. Thus, surveying the range of potential issues is important through the use of scripts capable of expanding views within the group. In order to decide, it is necessary to collapse the range of views towards the essential causal structure

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[36] Nominal Group Technique (NGT) involves individuals proposing suggestions relevant to the problem being considered that are recorded on paper before being passed to adjacent participants for commented reviews, eventually returning to the originator. A 365 variant means 3 suggestions for a group of up to 6 people each writing/commenting for 5 minutes can be processed in 30 minutes.

creating problem behaviours. Value approximations are all that is necessary to test potential relationships between important variables in a stock flow diagram concept model for understanding behaviour performance of key indicators. Wellbeing for individuals is important in describing family behaviour when deciding between schools and preparing to transfer. Rather than anxiety expressing a degree of mental ill health in children for treatment following diagnosis, wellbeing more closely relates to the CAMHS referral indicator where not everyone seeking help are suffering from problems requiring intervention. Referrals become likely when student wellbeing has reduced enough to warn concerned parents and sometimes, the children themselves.

5.1.3. Scripted elicitation workshops.

A total of two workshops were run with participants drawn into the multi-agency group that included representatives from council advisory services, secondary schools and the community hospital in Plymouth. Over the course of workshops, a total of seven practicing experts participated with a further six contributions from a group of retired experts from Plymouth, who assisted the piloting activity (Carter et al, 2014). Figure 5.6 shows a typical scripted exercise between group members where results are posted onto a wall for review and comment during break periods.

Figure 5.6. Piloting elicitation scripts for determining optimum data collection and review techniques.

Combination pairs of scripts were employed to obtain relevant problem structuring information. Based on expanding the range of ideas on a subject with the first of a script-pair before condensing the issues back to an agreed summing up using the second (Hovmand et al, 2012), facets of the somewhat, hidden system structure were revealed using oversupplied suggestions before the selection of key concepts accepted by all. The technique helps provide all participant with rapid insights into the range of issues around family dynamics and their important relationships when selecting secondary schools in Plymouth.

Structuring the problem dynamics from expert practitioner perspectives, for example by plotting behavioural graphs over time, supports system interpretation. Such understanding helps to develop a concept model based on stock flow diagrams that begins to explain specific characteristics. Once structured, seeking new opportunities

to intervene and solve the problem is possible by suggesting policies that are popular with other expert practitioners in the group. While only an implied study objective, demanding sufficient confidence in model performance is essential to progress. Derived through a rigorous test process, confidence in predictive capability of the model starts with a workbook explanation and individual debriefings, subsequent to workshops, that involve a concept model simulation of stocks and flows. Further confidence in system dynamics, model capability can then be created by selected modelling tests and checks through a process of experimentation performing simulated 'what-if' policy checks on the behaviour of key variables.

Figure 5.7 shows how script-selection relates the research objectives. Results from piloting suggest three types model-based elicitation aimed at new policy, observable repetitive behaviour and reduction of variables to what causes specific characteristics are valuable in this study.
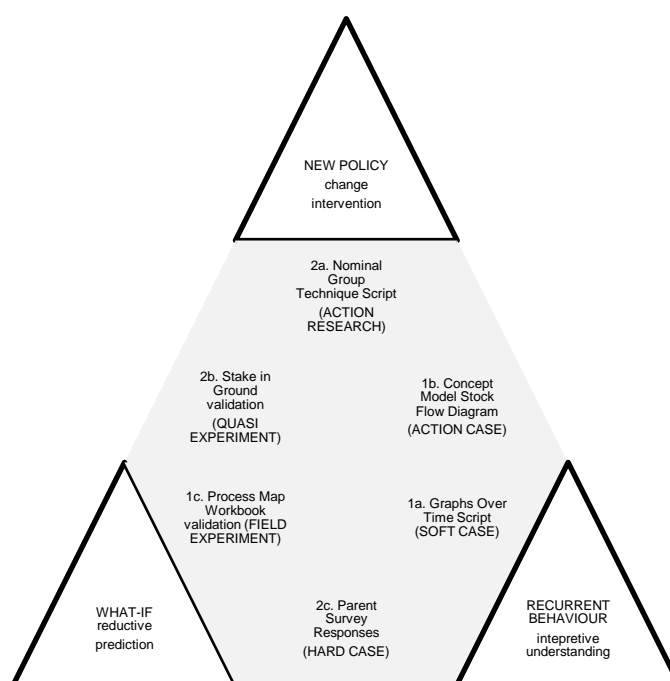
Figure 5.7. Triangle of objectives positioning different Group Model Building scripts published in Scriptapedia (Hovmand et al, 2012).

Commencing with participant observations of how the problem behaves over time is important for understanding structures that may create such underperformance.

Figure 5.8 shows the Graphs Over Time script-piloting exercise illustrating an inverse linear relationship between less choice and numbers of students needing support each year from an earlier workshop held in 2014. Whereas only piloting to help decide scripts, this initial result suggests a mechanism whereby rising competition as class sizes increase, serves to reduce opportunities for students over five years, may lead to the deterioration of children's emotional wellbeing.
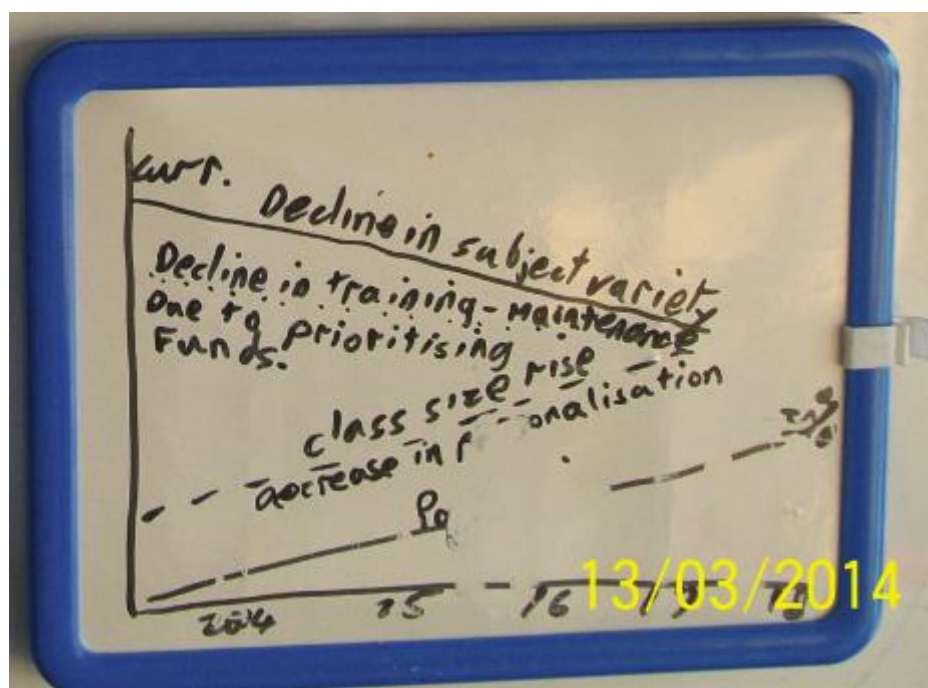
Figure 5.8. Some initial pilot views on future referral rises to Plymouth CAMHS

However, raised referral patterns between 2010-2015, could not be explained by such a causal mechanism since rising secondary cohorts only restart from 2015 in Plymouth. By contrast, numbers admitted into state secondary schools were falling during 2010-2015. However, the idea does offer a useful expert practitioner insight onto potential cause and effect around the problem behaviour. A steady decline in wellbeing reflected in rising referral numbers would therefore appear to have systemic causes that an expert practitioner (even those piloting scripts who had recently retired) can isolate and capture within a sketched plot of key variables.

The first workshop with current experts used a key pair of scripts to explore and bound the problem. The first script for expanding the issues is called Graphs Over

Time, where tables of participant pairings were asked to plot their combined view of how anxiety and wellbeing levels would change for children over the transfer preparation period. Here one group sketched views expressing aa negative wellbeing trend over time at the same time as anxiety followed a positive trend for the child being considered. The second team produced a more detailed plot of anxiety within family members over a period of two years while preparing and transferring into secondary school. This team revealed two types of family relationship that reflected differing breadths of empathy between parent and child. Whereas the anxieties commonly experienced by the student preparing to transfer schools, with associated tests and additional homework demands, were considered to deepen over the period (lowering child wellbeing) with peaks corresponding to specific challenges, parent levels were also plotted for comparison purposes. Two pairs of curves were produced, explaining either highly expressed (where parental emotional states closely lag those of the child due to "the belief, attitude and response" of them as caregivers towards children's mental ill health – Yang et al, 1999) or standard parent-child relationships where parents responses were more subdued..

Under such stressful conditions, selecting schools could be prone to misunderstanding and arguments within family groups. Family relationships were therefore considered to be significant in how well-suited schools could be selected or otherwise. The second script collapsed the views on timeline variation back towards the standard admissions process for Plymouth state secondary schools. The process-mapped result was employed as the starting point for the second workshop to develop policy and workbook descriptions.

In anticipation of the second workshop, the understood stock-flow diagramming notation was used to create and agree a process structure comprising pipes and reservoirs representing the flow of children through Plymouth secondary admissions. This was then printed onto a Nominal Group Technique sheet alongside a policy grid to provide a common set of terms for each stage in the process that could be referenced and drawn-upon to aid rapid communications. In this way, the results of the first workshop informed the starting script for the second.

The second workshop employed a further script pair to expand on potential policy options that support agencies could apply unilaterally or by coordinating in a multi-

lateral manner to achieve a change in rising demands from primary age referrals to mental health services. The initial script, called Nominal Group Technique (NGT), therefore established potential agency support interventions and the degree of inter-agency agreement on practicalities of implementing each proposed policy. The second script condensed views around potential interventions by seeking to find how such influences might work when involving parent and child or between parent and knowledge of schools. A summary of causal loops was produced and refined to offer insights on the structure of the concept model derived from this workshop.

Script-pairs were also adapted where an original script was reset against the time-limits available for retaining high quality inputs from the participant group. Given several rest periods for refreshments and corresponding review of other's work, the time remaining had to be carefully controlled for obtaining the best results. For example, the Nominal Group Technique (NGT) for eliciting policy options was adapted for the time available by asking everyone in the group to contribute three policy options in the first row of an A3 paper table within the first five minutes allocated. After passing the completed row in the table to their neighbour for adding further commentary on each policy the cycle would repeat until all had been able to comment on everyone else's policy proposals within the 30 minutes allocated to their task. By careful time management using scripts, workshops were designed to last not more than 3 hours in total.

The author facilitated the script-based group elicitation within workshops as well as model-based, result interpretation skills outside of each workshop. Modelling results were collected on paper and whiteboards as well as an audio record that was used for specific quotes. Minimising group time spent in workshops, the results were explained to individual participants using workshop outputs collated into a debriefing workbook alongside the resultant conceptual model that was represented by a schematic Stock Flow Diagram (SFD) shows in Figure 5.9. Having already introduced the idea of SFD (see Glossary xxii-xxviii) process models for describing secondary school admissions and intervention opportunities on the NGT paper-based forms, the conceptual model is derived from views collected through scripted workshops that was created to initially reflect burnout in students preparing for tests. The diagram shows how a parent-child reinforcing loop works in the school choice problem alongside the balancing effect of better knowledge of schools to maintain a status

quo during the transfer from primary to secondary school. While qualitative CLDs (see Glossary xxii-xxviii) offer some insights on dynamic behaviours within a system, SFDs clearly define the system boundaries, clarify what stocks are conserved and identify dominant gains or losses for changing levels of stock in the system. SFDs also offer the opportunity to interrogate 'what-if' policy changes on existing problem behaviours to understand favourable system responses. Further workbook details are available within Appendix 5 which explain what was summarised from the GMB workshops and represented to participants as part of their personal debriefings.
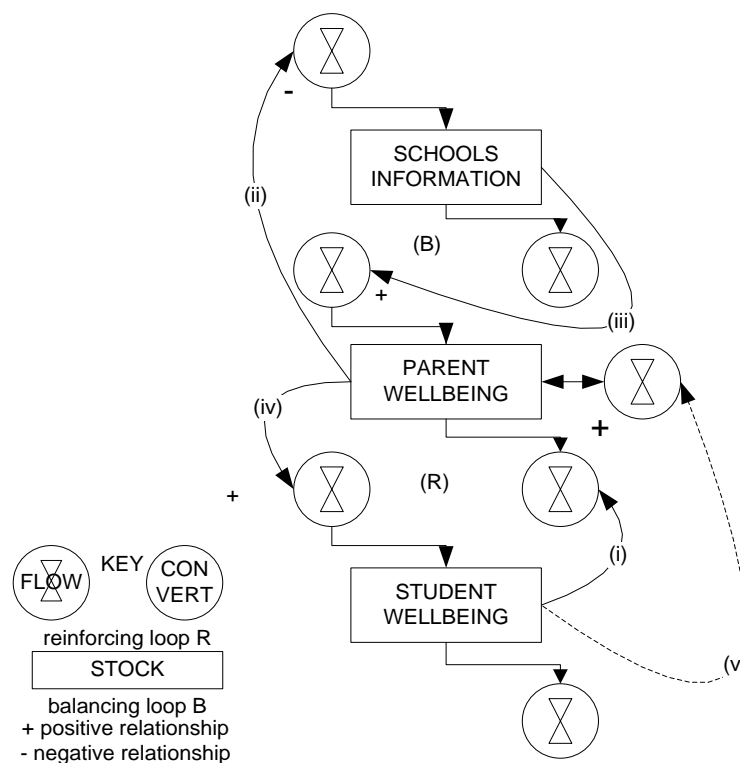
Figure 5.9. Schematic Stock-Flow Diagram concept model

The stock-flow diagram comprises three stocks representing family socio-emotional variables associated with deciding and transferring between primary and secondary schools within a concept model. Emotional stocks of wellbeing combine with a stock of knowledge of needs met by different secondary school options. The latter represents social views of parent and sometimes child, on what schools can offer prospective families. Two loops dominate at different times where parent and child generally reinforce (R comprising i and iv on the chart) each other to the extent that when child loses confidence, the parent responds quickly by also reducing their own

wellbeing. However, as parent wellbeing reduces, largely due to school competition and the impact on their child, this can be compensated by researching suitable secondary schools that add to knowledge of needs met and therefore confidence of parent. Such a balancing (B comprising ii and ii on the chart) effect then helps raise not only parent but influence child wellbeing recovery.

5.2   Use of GMB Scripting for qualitative stock-flow diagram

Scriptapedia is the source for GMB scripts, used on participative modelling which were piloted using a group of available expert practitioners from Plymouth who had mostly retired. A total of six, practicing special needs teachers, educational psychologists and mental health practitioners were balanced with recently retired head teachers to provide instant feedback on the various group model building scripts that were tested during the workshop based on a primary school incapacity problem in Plymouth appearing in secondary school intakes. Several scripts were facilitated by the researcher to understand how the group responded to prompts and a set of effective scripts chosen to minimise time while maximising group outputs and learning. Feedback was based on participants using hand-held terminals to answer a series of PowerPoint questions at the end of the day's events. This approach to GMB offered benefits of automatic debriefing of the group at the completion of piloting combined with data on how knowledge and learning had increased on the pilot topic by comparing pre-and post-workshop scores (Carter et al, 2014).

Results from the script piloting workshop suggested some scripts were more powerful for this target audience than others. The results ruled out the possibility of participative model building with parents without prior script testing as these would likely vary between groups. However, the scripted technique was appropriate for expert practitioners in Plymouth and the following selections were made to elicit their group model building data in two workshops. An agenda for a half-day, piloting workshop is provided in Figure 5.10.

Agenda – Group Model Building

- Introductions and problem 10:30 (slide)
- Hopes and Fears 10:45 (paper forms onto wall)
- Graphs Over Time 11:00 (miniboards onto wall)
- Sketched Model 11:45 (camera & folder inserts)
- Debriefing Survey 12:15 (clicker responses)

Parking, refreshments and lunch available

Figure 5.10. Typical Group Model Building agenda

5.2.1 Hopes and Fears Script (clicker voting)

This script allowed uncertainties within the modelling group to be surfaced and dealt with, either by confirming that the risk had not occurred through the facilitation process, or by updating the data collection tables to reflect pertinent issues for further consideration. The value from the script is that less pertinent concerns held by individuals are exposed and tested within the group setting before testing areas that need careful consideration during group model building, given the context of secondary school choice in Plymouth. Clicker voting enables pre-formatting of some of the common, piloted issues to be presented so that the changing picture of participant views, before and after the workshop, can be established. This script is only required for the first workshop.

5.2.2 Graphs over Time Script (problem over shorter and longer periods)

The dynamic trends of problem-related behaviours are plotted in pairs or triplet groups using a shared whiteboard and marker pen, by selecting display variables to plot against a time axis of their choosing. The initial problem was reduced wellbeing of children throughout their secondary education. As the graph over time axis is

specified by team participants, this can result in differences between team-held views of the fundamental problem. Time allocated for completing the script is also specified in order to ensure the facilitator attends discussions within each group before debriefing the participant beliefs generating each curve (variables, assumptions and mental models associated with the problem behaviour).

Following introductions, teams then formed and were asked to sketch key parameters they observe changing that represent the problem behaviour in according with the Graphs over Time script. The two teams of participants produced not only the steady decline in wellbeing over an extended period, starting from the year of transferring school but also another unexpected pattern. Two plots were sketched by the first team. The right-hand plot in Figure 5.11 clearly demonstrated the linear negative relationship between levels of wellbeing and anxiety over an extended period with slowly changing levels following transfer (but not during primary school years). In the left-hand plot, the abbreviations Ch refers to child and Ad indicates adult with MH indicating mental health. By contrast, for the second plot the term MA refers to mental assurance which also illustrates a second highly expressed relationship with shorter-term fluctuations in a "saw-tooth" pattern.

Where children were expressive in providing their views, parents would themselves track the emotional state of their child with little delay. Still, for standard parent-child relationships, only the peak levels of student apprehension would be attenuated into the parent response, with other variations falling outside of their threshold value.
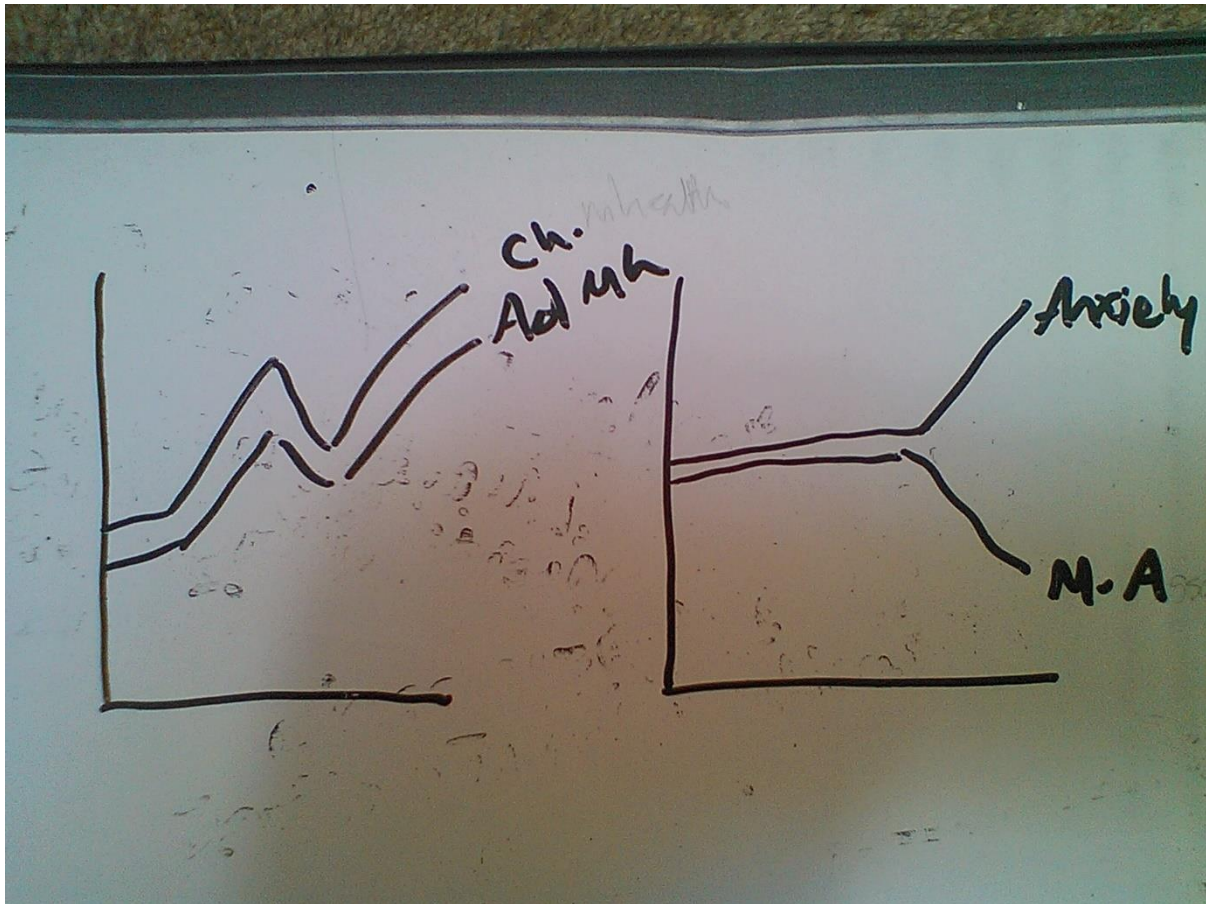
Figure 5.11. First graph over time group plot of longer term anxiety and wellbeing for student from transfer

The second team's behavioural plot of the enrolment period (Figure 5.12) suggested two types of families and these were either calm or challenged in the personal emotional responses of parent and child. In the emotionally calm case, children would see reductions in wellbeing (rises in anxiety levels) but not breach the CAMHS threshold for anxiety diagnoses (a treatable, medical ill-health condition) from referrals. In this case, the parent remained unaffected apart from small interrupts which quickly recovered. Here adults are considered to be better equipped to cope with stress and resulting anxiety.

In the emotionally challenged case for transferring schools, the behaviour was not the same as the child remained regularly above the CAMHS anxiety threshold where treatment might be necessary followed in close succession by the parent. Such 'peak and trough' emotional responses suggest regular behavioural challenges, or stressors, can apply to the school choice problem. Whereas reduced parental ability

to decide important issues is likely in wellbeing troughs, anxiety levels would vary and peak (corresponding to wellbeing troughs) on a semi-regular basis suggesting some regular occurrence over the two years around transfer for this behavioural group. This behaviour was markedly different to a slow decline in student wellbeing over their time spent in secondary education. This was therefore considered a short-term causal effect related to the period before and during transfer to secondary school as shown in the chart.
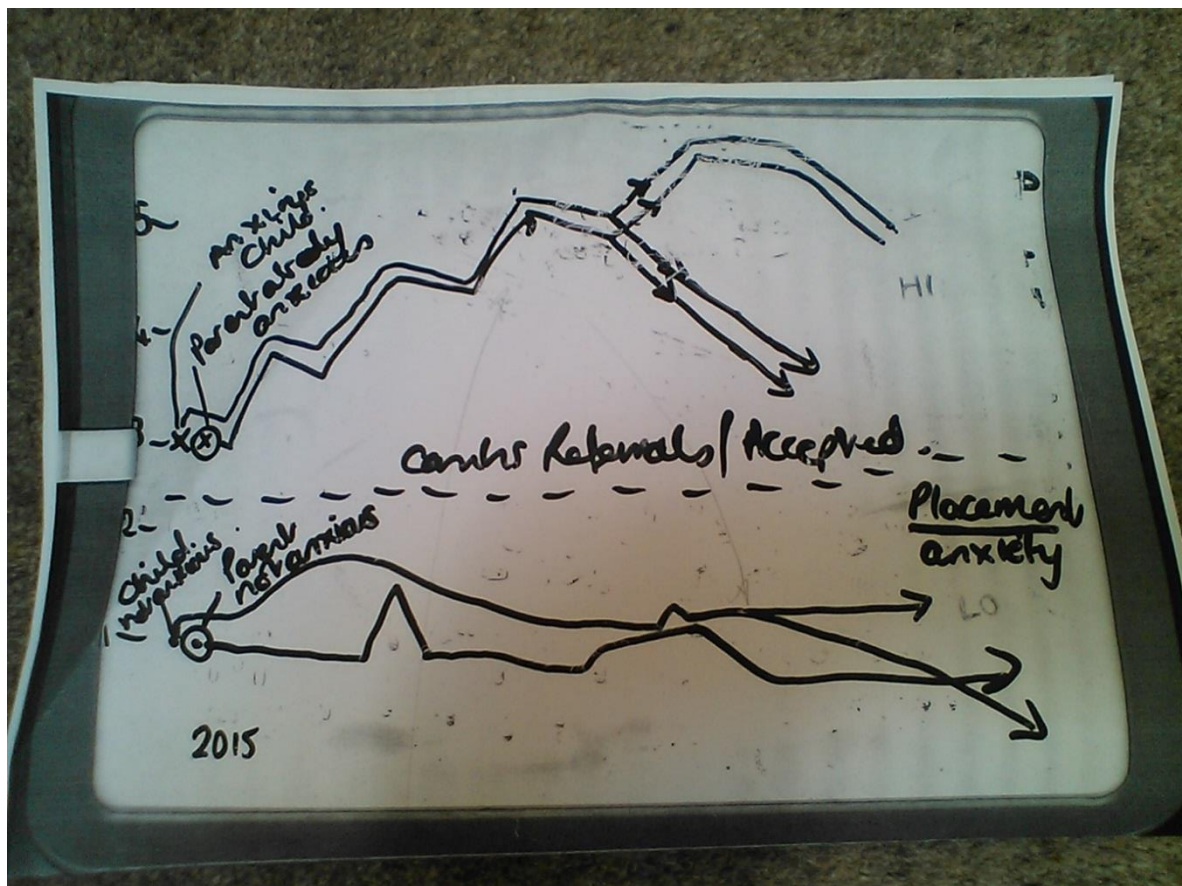
Figure 5.12. Second graph over time plot of anxiety for parent and child relationships up to and including transfer

Initially, similar scripted workshops were also considered useful to collect parent data however this was quickly proved infeasible after targeting some amenable parents, due to the complexity of arranging convenient times for all involved. This had the effect of changing the original research design from system dynamics mono-methodology in favour of a modelling multi-methodology, involving survey responses

from hard-to-reach parent groups as well as data collected in group model building workshops with expert practitioners.

5.2.3 Concept Model (using iThink TM software)

Given the sole facilitator-modeller role, a modified concept model script was devised for proposing a structure of three stocks as a simplified concept model of the secondary school fit problem following workshops. To each of the stocks, both inlet and outlet valves controlling flow-rates are included. Whereas initial values can be specified for the level of stock held, it is explained to those participating that only flow rate controls can be used to adjust subsequent levels of stock that are held in the structure of the simplified system. The model is sketched in full as a stock-flow diagram along with associated connectors passing information to control flow rates in each valve as a visual aid for participants. The discussion of potential improvements is provided through personally demonstrating how structure adjusts behaviour between taking a decisive course of action and obtaining subsequent results. A workbook script is circulated to all contributors in advance of a personal debrief for each of the participants for validating group model building results.

5.2.4 Workbook (behavioural verification of effect)

A workbook is presented in Appendix 5 that summarises the process for validating concept models from the Vennix description of group modelling in Morecroft and Sterman publication (1994). The resulting workbook comprises descriptions of individual content from scripts used within specific workshops to elicit and collect data supporting the conceptualisation of problem behaviour. A workbook explains how the resulting document can be used to circulate to individuals within the validating team of group modellers when short of workshop time and access to contributors. Workbooks offer a viable alternative to more complex Delphi techniques involving survey rounds. Finally, a series of questions in the workbook seek answers to understand how valid the concept model is and what else would improve the concept model's representational qualities.

5.2.5 Stake in Ground (behavioural validation of half-term burnout effect)

Stake in the ground is a script capable of supporting personal and group debriefings where concept model modes of behaviour can be induced and explained using stock-

flow models that plot variable behaviours over time. The published script (Carter et al, 2014) was first developed by Rouwette based on the work of Richmond, as a method for demonstrating what individuals may perceive about system behaviour before demonstrating what mathematical calculations infer. By debriefing the difference between what is expected and what is actually simulated, it becomes possible for individually held mental models to be challenged before modifying personal understanding of the situation aligned to the model. Where the model remains deficient, group model building participants are free to challenge the concept and suggest potential improvements for testing. This iterative process involving one or many changes then leads to a validation of the modes of behaviour exhibited by the adjusted model. The title refers to outlining key variable behaviour over time as a predictive 'stake in the ground' before running the corresponding model settings to explain how complex dynamics of a system actually unfold.

5.2.6 Referral data refinement

The second plot in Figure 5.13 represents considerable short-term variation in child wellbeing. Reflected in breaches of low-wellbeing thresholds set by the student or the family, CAMHS referrals in Plymouth differ between older (secondary) and younger (primary) groups when the latter are subtracted from the former. As overall wellbeing levels for children are related to CAMHS referral numbers (as one increases the other decreases), then it was useful to reassess whether the same effect was present in the Plymouth Community Healthcare (PCH) referral data. The graph analyses the referral data by age cohorts (each spanning 5 years) where 10-14 is considered secondary education and 5-9 primary school for this research based on the predominant nature of test preparation work undertaken in year 6. The plot shows development of Plymouth CAMHS referral number differences between cohorts on a monthly basis over a period of six years. While both vary considerably over time, the secondary referrals regularly exceed those from primary school aged children by between 20 and 40 referrals (a factor of 2). However, there are also reductions in this offset (shown by the arrows on the plot) where primary numbers come close to equal those referred from secondary around each summer period. Indeed, in September 2012 primary referrals exceed those from secondary schools across Plymouth. This repeat appears to be approximately annual but is not always on the same month (sometimes at the end of the summer break, this referral levelling effect can equally

occur as early as June suggesting that it is not driven by an effect of the summer holidays for example).
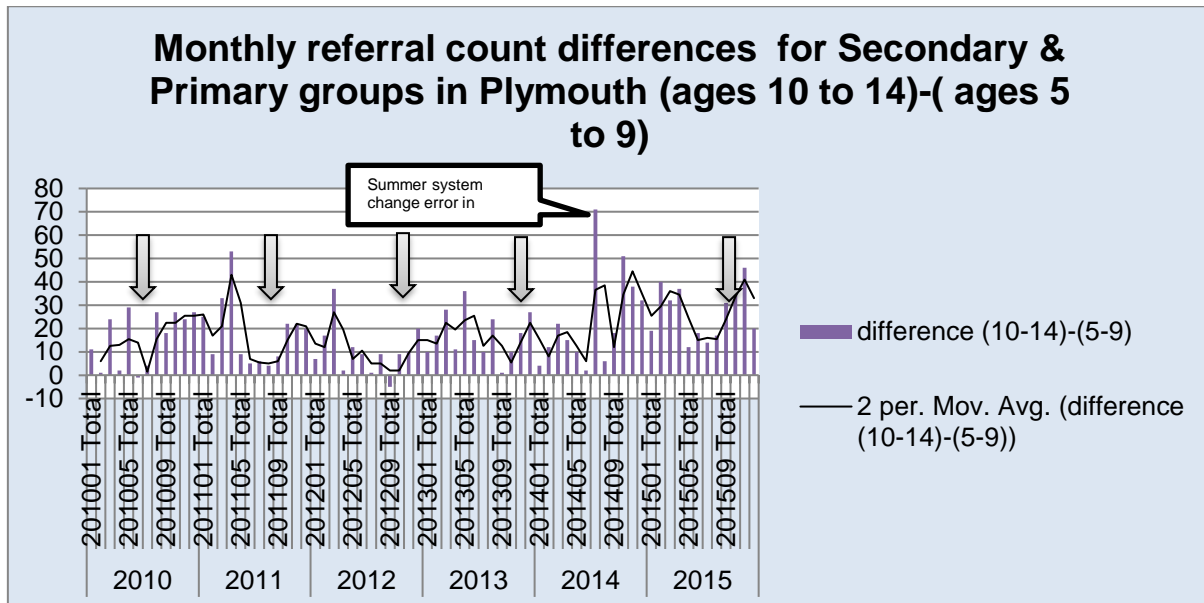
Figure 5.13. Summer difference reductions between secondary and primary school aged children referring to Plymouth CAMHS (source Plymouth CAMHS: IAPT).

Subsequent analysis shows the rise taking place in the third quarter of each year up to September. It was suggested that prescribing anti-psychotic treatments prior to restarting secondary school could artificially depress the actual numbers being reported. However, this was questioned as the General Medical Council (2013) had issued strong warnings against their general practitioners prescribing anti-psychotic drugs to adolescents attending secondary school (especially those drugs only licenced only for adults known as grey prescriptions untested on children). On balance, this could reflect a primary school trend of rising numbers of students referring to CAMHS over the past few years for at least one month each summer and has potentially serious implications, whatever the cause if referral rises continue to spread from secondary into primary education.

5.2.7 Process Mapping

This script was adopted when another script did not produce the desired structure during the first workshop. The process map was explained in some detail and the facilitator created the map as the description increased in detail and content. The

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replacement script produced a structure from which subsequent dictionary references could be made and the resulting process chart was added to Nominal Group Technique sheets to help navigate subsequent changes around the system in the next workshop.

The stages involved with parents selecting secondary schools for their children employs a process modelling script to understand the sequence and interconnections between parts of the system as seen by parents navigating the Plymouth admissions system. The script uses a blank "swim-lane" template to identify tracks for individual system actors against a sequential timeline (actors include parents, children, council, schools, etc.). Actions are illustrated in boxes joined together with arrows. Rather than concentrating on designing modelling workshops (the original purpose in Scriptapedia), defining the decision-making process for parents enables the inputs and outputs for each necessary action to be understood by the whole group for developing a shared dictionary of terms around the problem of school choice in Plymouth. This covers health, admissions and school related terminology.

5.2.8 Nominal Group Technique

The second workshop was designed to investigate prospective interventions and vote on their potential for success if applied by the multiple agents from council, health and education across the city. The Nominal Group Technique script was used to elicit data and was adjusted to ensure that proposals and feedbacks were rapid from within the peer group. Longer alternatives of this script exist and can be combined with "dot" voting for example (Scriptapedia version 2.0.6), but this variant ensured that up to three ranked interventions were proposed by each of the participants in the second workshop within a five-minute window before passing to the adjacent agency for them to offer commented feedback (and seek handwriting clarifications). In this way, there were multiple completed A3 tables of proposals fully commented with feedback from the other participants. From this the two most popular policies from all suggestions were extracted to help define the final scope of the quantified system dynamics model. Figure 5.14 gives an example of the scripted outputs indicating where agreement was reached (further details are available in Appendix 8).

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Nominal Group Technique for potential policy interventions

	Policy A	Policy B	Policy C	Policy D
Originator 1	A Gifted + talented – 1st choice B CAMHS representation at open evenings C Poor attendace at Primary D Flexible start + finish times	– Joint working Health /Social Care /education /CAF	– school viewings	
Reviewer 2	Agree with Policy A	Agree CAMHS rep at open evenings is important	Agree with Policy C	Agree with Policy D.
Reviewer 3	3u what do we mean BY definite 6. T? are agreed	Is this going to lead to real support or just a stall?	3u do fees make any real difference to poor attendance?	Practicalities? @ missed sessions?
Reviewer 4				
Review update				
Best policy	Y/N	Y/N	Y/N	

Figure 5.14. Nominal Group Technique example output with process map navigation dictionary

Once group model building ideas have been expanded around cause and effect in the structures of school choice for Plymouth, participants can condense their individual ideas on which interventions to apply to help solve the problem behaviours being observed. This is achieved using the Nominal Group Technique script that is modified to limit available time and suggested interventions for the size of group considered. Therefore, A3 size tables are handed to individuals who are asked to complete short descriptions of up to three interventions that could help address the problem behaviours being observed. With six in the group, each intervention proposer spends five minutes completing their row of interventions before passing the A3 sheet to their adjacent participant for commenting on each proposed intervention the subsequent row in further five-minute time slot. Thus, for a group of six workshop participants, the whole script should take half an hour to conclude in this "365" variant.

Two group recommended policies involved addressing both system stressors where knowledge was being outdated (and therefore lost by families) by government policy and local competition but also the demands of additional test preparations placed on primary school children. By raising knowledge of emotional support services available to schools at parent and child open evenings, decision maker knowledge could be restored to ensure that future needs could also be met. Such a policy would correspond to raising the inflow of family knowledge on how future student needs could be met by schools in the locality to help counter competition outdating effects on the knowledge outflow of the stock-flow concept model for example. An alternative policy to end grammar school testing and the home tutoring build-up as early as year 5 in primary school, was also endorsed for dealing with the question of low child wellbeing which could also be directly addressed by policy. Such a policy would introduce a delay before the onset of test preparations for year 6 SATs, where year 5 elective tutoring associated with 11 plus examinations would cease.

Studies in System Dynamics have already looked at many aspects of education (Kennedy, 2011) but few have yet developed causal theory around enrolment issues for children transferring between primary and secondary schools. In his taxonomy, Kennedy reviews system dynamic contributions around enrolment, albeit at governmental plus higher education levels of aggregation, and concludes some key trends from these studies.

> "SD can help identify the areas where policy or management changes have the potential of being most effective in producing desired results."

> "…counter-intuitive patterns are frequently discovered. Multiple sub-systems interact over time to generate results that are often beyond the causal observers' ability to project."

> "…sensitivity analysis (reveals) that when wrong decisions are made and, for instance, the financial situation of an institution deteriorates, reversing the decisions does not immediately restore the previous financial conditions. "

Enrolment systems are large and can be slow-moving, disallowing the opportunity to test new theories on live systems even when made available. Getting enrolment

policy decisions wrong can have long-term and serious consequences for those actors within a competitive marketplace.

5.3 Purpose of concept model

A concept model enables potential theories to be assembled that could offer explanations of complex problem behaviours. The problem behaviour requiring explanation surrounds the issue of secondary school choice in Plymouth and why children are getting referred for support from psychological health services across the city, generally in proportion to their age group cohort in secondary school.

The importance of decision making on school selection varies between families, parents and children where rational choice may not always apply for the best fit of school where utility is maximised. For example, one behavioural choice model that explains how individuals may select between complex alternatives is given by Image Theory (see p.37). Derived from psychological research on the behaviour of groups of students, this decision-making psychology behind making a reasoned selection relies on removing risks before sequencing the remaining, satisficing answers for profit, according to Beach (1990). This alternative to normative decisions based on utility measures against criteria, widens the range of decisions to not only consider profit from chance but also quantify cost from potential risk of selecting an unsuitable alternative. Thus, behavioural decisions appear to offer improvements over rational choice in the context of school choice.

Based on workshop outputs described in the final workbook, combining concepts of motivations for different approaches to personal decision making along with how children maintain emotional stability as they change workplace, while losing friends as they enrol in new schools, offers insight on the Plymouth school choice problem.

5.3.1. Concept model representation as a Stock Flow Diagram

The concept models script allows early testing for dynamic response from conceivable systems. Here the modeller builds key aspects of the system and seeks answers to what is wrong or still missing from participants. Concept model Stock Flow Diagrams represent the working artefacts of a system that can be simulated. The diagramming convention is defined by three elements known as stocks, flows

and converters all of which can vary over time as necessary to reflect detail of the problem being modelled. The level accumulated within a stock is quantified in specific units of which some can also be measured. Flows are directional and add or remove stock over time, depending upon the track of the arrow head away from or into the accumulation of a stock (wellbeing or knowledge as examples in school choice). Converters defined in iThink software, represent all other types of variable and use informational links, termed connectors, to control rates based on values calculated in other parts of the system.

It is noted that converters are auxiliary variables assembled to help the system dynamicist explain the conversion process between stock and flow (Yuan et al, 2011). The concept model is detailed in the workbook script output produced for case study (see Appendix 5) but a software simulator representing the concept model was also prepared to test participant views on student burnout and knowledge outdating effects observed from competition between schools. While needing further detailing of converters between stocks and flows, the electronic version of the concept model can then be used in conjunction with the stake in the ground script (Carter et al, 2014) to show the relative effects of different types of suggested policy intervention derived from Nominal Group Technique for comments by contributors.

5.3.2   Relationship modelling analysis.

As the group determined that the level of stock-flow modelling required to reflect different types of relationships was focused on family units deciding schools, the approach could help explain which social changes, initiated by support agencies, might offer policy rules that cold address structural problems in competed, English secondary school enrolment. Hirsch et al (2007) faced a similar challenge when modelling to understand and influence social change in schools. By using psychology to understand how to motivate schools on curricula, a school-level model was constructed of how different actors would respond emotionally to strengthen or abandon new curriculum developments in the teacher-student system. Policy suggestions on teacher turnover and student learning suggested more responsive teacher hiring controls resolving resource shortfalls, balancing student special and additional learning needs with suitably skilled teaching resources or mentoring

inexperienced teachers could all be tested for effectiveness in remedying these issues.

Within the family setting facing the school choice problem, emotional resilience of parent and child are important factors in achieving the best fit of school to needs for long term success. Knowledge of needs to that can be met by different schools helps decision makers. The concept of parent-child reinforcing social and emotional wellbeings, where low child wellbeing would create a similar response in parent wellbeing levels, was suggested. However, as decision makers, parents typically balance sudden emotional loss of wellbeing through researching the source of concern for the child, namely the enrolment process of changing schools. The concept therefore reflects important loops in the school choice problem for all families. Two loop frequencies were initially determined by answering the question about how quickly children update parents with the issues that matter to them (the converse also applies as discussion incidence is bi-directional between parties) and how often questions about schools can be answered satisfactorily for parents. The latter was set at a working week (5 days) based on support agency views around how long it might take to respond to an initial enquiry between council, secondary schools and health service information.

Coordinated responses take longer, especially if involving children with complex vulnerabilities and therefore needs, such as those described in a Common Assessment Framework process used between multiple agencies, but this is less usual than single service enquiries by concerned parents and others (In 2015, Ofsted inspectors for children in care note the difficulties of getting medical doctors and police to attend multi-agency, safeguarding case reviews, even when children are at risk in Plymouth). When asking parents, national data was available (The Children's Society 2013, p39 and 2015, p48) that indicated a discussion of importance on things that matter to the child every week (time management for example) even though talking together happened daily for 68% sampled (a period of 7 days but extending to 10 days when unhurried by worries for this non-linear effect). It is noted that self-reported low wellbeing for children preparing to transfer schools more than doubles from 3.9% in year 4 to 8.4% in year 7 (The Children's Society, 2012, p11 and p19) and it is stated that "The link between family well-being and overall (child) well-being is hardly surprising but the strength of this link and the weight it carries is striking".

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5.3.3 Concept Model Implications: group views, interpretation and model integration.

The group suggested several interacting factors that could explain both the erratic behaviour of student wellbeing, profiled through years 5, 6 and 7 along with the recurring surge of primary children referrals compared to those from secondary age cohorts during a month in the summer each year. As the annual recurrence of strong demand in primary school ages almost equals and sometimes exceeds that from secondary school age groups, then it was proposed that this may be demand from children with an autistic spectrum disorder who are sensitive to strategic challenges such as transferring schools which interrupt familiar patterns. This would correspond with the notable summer surge from primary children observed in CAMHS records but greater detail on the source is less conclusive, even though this group of children is now encouraged to join mainstream schools wherever possible if their condition does not warrant a special school. Here the children compete with others looking for popular and supportive schools, given the additional medical priority over most other children to appeal against an adverse result (children in care get first refusal for available school places).

As competitive pressures rise once more in Plymouth secondary schools over the next decade and beyond from 2015, those children experiencing social and emotional difficulties are likely to suffer additional demands on their wellbeing as they prepare for and then achieve transfer to a new school in forthcoming years. Such a cause may create extra demand in the future (special school statementing for such children has only recently changed) but it would occur just prior to transfer rather than spread across months, as and when Autistic Spectrum Disordered children are told about changes to their workplace. As early as 2014, joint commissioners for Plymouth City Council noted that "…this (referral demand upon CAMHS) has impacted on the waiting times as all of the referrals have required an assessment due to the high levels of risk. This is consistent with the increased levels of need we are seeing elsewhere in the system, and the service reports that they are mainly due to self-harm and children with neurodevelopmental issues who present with co-morbid mental health need." This is reflected in total demand across all three age groupings for Plymouth CAMHS referrals each month between 2010 and 2015 in Figure 5.15 (a recording error is attributed to the spike in numbers for July 2014).

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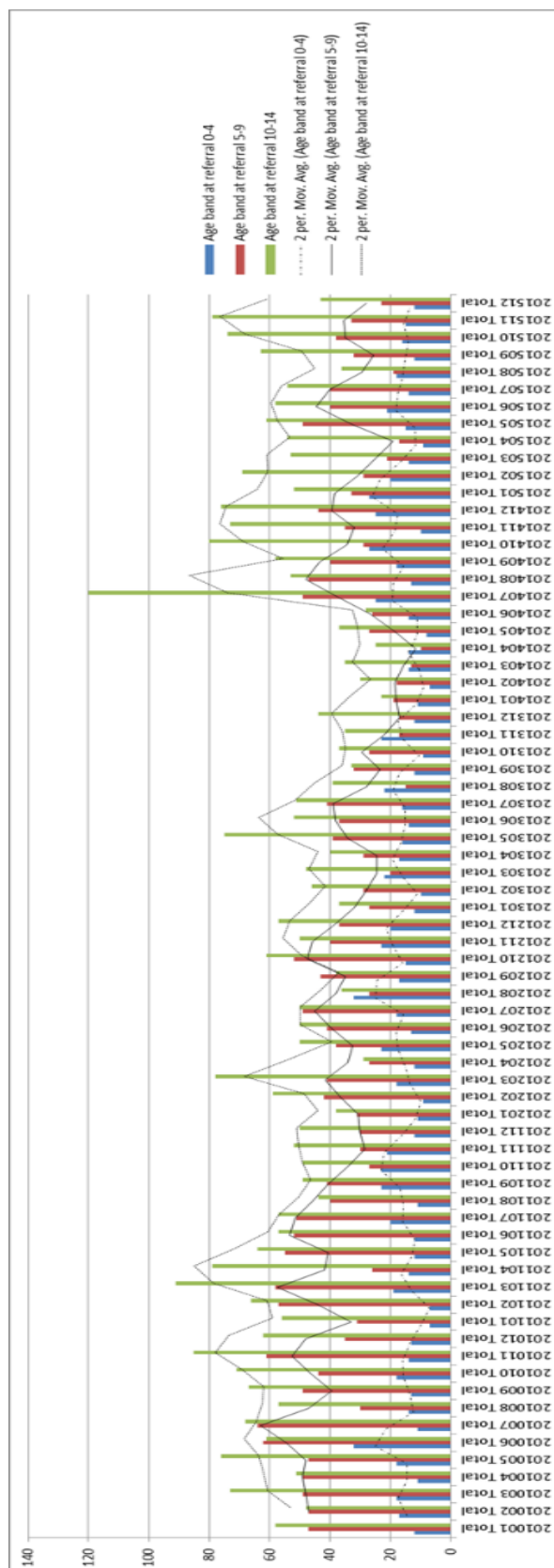
Figure 5.15. Monthly CAMHS referrals in Plymouth by school age (nursery, primary and secondary in tranches each spanning 5 years). Source CAMHS: IAPT.

The workshop group involved in building models suggested relationships between how families interact when facing the challenge of secondary school choice and the knowledge parents might seek to allay their concerns. Using a basic concept model to explain how worried children under pressure from their preparations to transfer would reduce levels of parent confidence, even when parents might be endowed with resilient reserves of wellbeing. Such a rapid loss of student wellbeing would be noticed and when challenged, a compensating, emotional homeostasis[37] (Formolo *et al*, 2016) would attempt rebalancing family emotional losses by collecting relevant knowledge on establishments and choices to help inform secondary school selection with confidence, no matter what results.

Armed with perceived problem knowledge from multiple sources, parents would be able to reassert their composure over time by acquiring an inflow of wellbeing and this improvement would be noticed by other members of the family including the student transferring schools. As parent wellbeing increased then so would student wellbeing after a delay for most families. Figure 5.16 gives summarising details of the concept model behaviours that were accepted by participants who had been individually debriefed using the stock-flow concept model.

The model was demonstrated by seeking individual contributor views on how different emotional levels of parent and child wellbeing, plus knowledge resources on the school choice problem might respond under different conditions using the graphical user interface shown in the top left central panel of the chart for managing detail in the remaining council, school and health quadrant sectors. The base response (1) was generated for the concept model demonstration using a burnout model (Skok et al, 2013) associated with students working additional hours above the normal 5-hour day to reflect test preparation pressures. With regular half-term recovery time set at 6-week intervals alongside a similar summer holiday period, the concept model shows a typical capacity to work overshoot and collapse associated with burnout and recovery. Subsequent response times were then adjusted (short and long) after asking participants how they thought emotional levels would respond

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[37] Wiener (1961) introduced the concept of transdisciplinary approaches to animal regulatory systems such as emotional homeostasis in his book on Cybernetics.

to such changes. Plots were then explained to show that competing helps to improve responsivity.
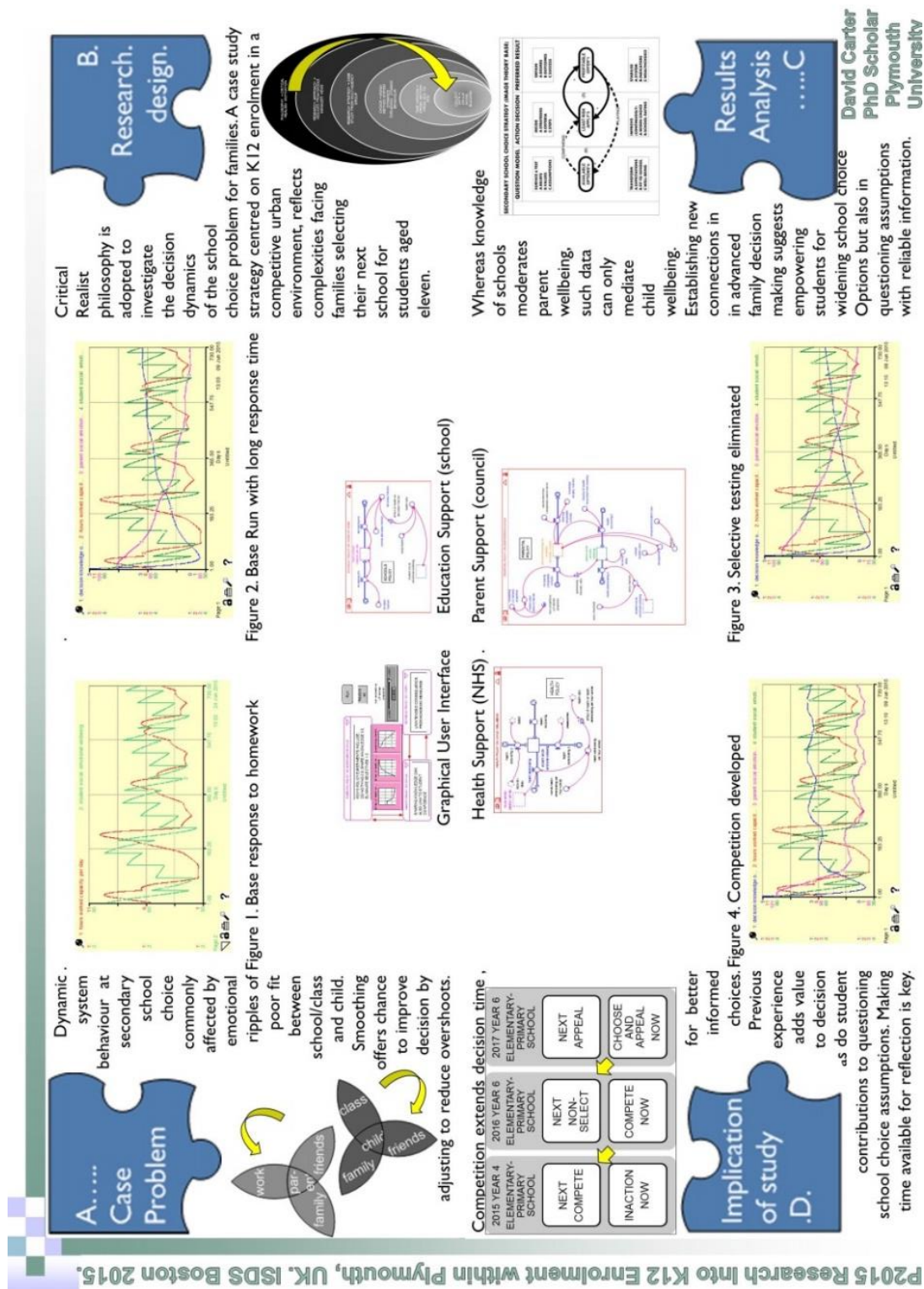
Figure 5.16. Concept Model for emotional demands of transferring from primary to secondary school.

As illustrated in this diagram, the concept model concentrates on three main stocks to describe emotionally-driven behaviours around secondary school decision making. Whereas a further stock (hours worked capacity per day) is needed to explain the student burnout effects of homework, this is not an area of policy development being considered in this case study, even if it offered potential for better supporting a child's emotional development towards adulthood. This is because all children experience tests and associated preparations during year 6 (primary school SATs) and year 7 (secondary school subject ability streaming), while others elect for their children to commence in year 5 with tutoring for selective entrance examinations taken in year 6 in the shorter term only. The model does however define important variables that affect the choices and preferences required to solve the family puzzle of accurately selecting between competing, state schools that were accepted when presented to participants.

Accuracy is essential for obtaining the right fit between child need and school provision to avoid subsequent emotional shocks or even potential dropping-out from secondary school. In American high schools for example (Darling-Hammond, 2006), dropouts are characterised with 'push-outs' for those students unable to meet expected grades and 'fade-outs' for other children lacking interest in academic activity (often reflecting children with unmet language needs from ethnic groups for example), whereas life events and failing to succeed are linked to socio-emotional traumas and unmet needs for flexibility. Sufficient precision is achievable through a process of clarifying individual needs against what competing schools are able to provide within commuting distance. In responding to fluctuating wellbeing of their child during the period of extended transition, parents commonly cope by first stabilizing their own feelings, before communicating their re-established confidence on the problem of selecting suitable schools to the student in question. The parental boost in personal confidence (and reflected in levels of wellbeing) is largely established by collating perceived knowledge upon which school decisions can be based. Specifically, understanding the fit between all needs (including those of the student) and provision ensures that the preferred school offers a sustainable solution to the puzzle while representing the outcome of considerable deliberation.

Once the behavioural relationships are understood by all, the conceptual model is therefore ready to be developed into a quantified model of longer term effects beyond transition. By estimating parameters associated with the different decision-making styles adopted, it becomes possible to investigate how parent perceptions of knowledge on school choice compare to knowledge established under ideal conditions of perfect information. This comparison then reveals the gap between what is theoretically possible and what different styles of decision making might achieve when adopted by parents. The concept model also enables new informational structures that involve children in decision making to be trialled to understand how children might benefit from being better integrated within the family process of determining schools. Where some indication of potential burnout demand may be suggested by referral rates to CAMHS in Plymouth from primary school aged children, debriefing experts using the concept model suggested that this effect was less prevalent based on their experience. For this reason, rather than burnout effects alone on children being demonstrated, the System Dynamics model was quantified to reflect the wider, emotional impacts of competition. Here the unmet needs as some students as they pass through secondary education represents a further system stressor where school selection is inexact.

The inclusion of children in complex decision making offers the potential for parents to consider adapting their decision-making styles with positive effect on narrowing the gap between expectations and actual outcome by improving the fit for their child transferring between schools. Since the change in decision making behaviours could take some time, delays are introduced where parents and children regain their wellbeing composures through improving confidence and certainty. These are personal settings for individuals participating in school choice where values have been estimated through asking expert practitioners and parents on either side of the demand and supply equation for the case study setting in Plymouth.

The concept model is focused towards how frequently matters of importance are discussed by children with their parents during periods leading up to and beyond transferring school, as this determines information flows rates that influence parents as their children experience unfamiliar challenges from competing for themselves and with others. In a different way, concerned parents seeking answers to school-choice related questions increase rates for generating perceived knowledge around

their own school choice problem. Having acquired sufficient resources to inform choice and preference decisions, parents may then be able to make sense of the competition whether overt (selective entrance) or hidden (population pressures). Parents communicate their newly found confidence to other family members once established. Initial parameterization is therefore performed at the individual level once decision-making styles are adopted by parents, which then provide test cases for understanding policy change impacts over time.

5.4. Model validation testing for confidence

Workbook validation from the group model builders was commented on, and adjustments were made. Equally at the same debriefing sessions, the concept model behaviour around student burnout was also verified by seeking their own views on how policy responses would play out on the simulation to either removing selective schools from the competition or sharing information more effectively with parents before explaining how the simulated behaviour to policy varies from personal predictions.

The stake-in-ground script (Carter et al, 2014) was then used in conjunction with a simulation model that was based on the stock-flow diagram. In particular, the simulation model was not accurately calibrated but did demonstrate the additional burnout effect experienced by children preparing for tests when transferring schools after carefully interpreting plotted results. Here each participant was asked to indicate how any burnout effect might impact student wellbeing before the effect was simulated using computer software. All those debriefed using the computerised concept model were surprised that the highly expressed "saw-tooth" behaviour in child wellbeing could be reproduced over a period of two years in-line with original graph over time behaviours. This suggested that underlying causal structure could explain such variable behaviour through the mechanism of a simulated concept model.

Resulting from debriefing using the published workbook results with individual participants at their place of work, the following thoughts were commented by different agents[38] participating in the modelling effort.

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[38] Health, Education and Local Government agencies included CAMHS/MAST, year 7 head/SENCO and PIAS from Plymouth

"Model demonstrated to work by varying levels of competitive activity between very little time to decide (2mo) and much more (12mo plus) for the assumed settings. Modelled relationships help explain observed behaviours for majority of parents with children transferring to secondary school over extended periods. Need to develop specific behaviour examples for those families less influenced by risk of inadequate information." Health.

"Summary diagram of relationships aids understanding by simplifying loops still further in a complex field." Health.

"Sharing information policy 'lever' needs considering for parent and child to understand impacts." Health.

"Personal experience of Plymouth school choice problem suggests that home-school proximity may rank highly in the decision but may not suit every child as needs differ." Health.

"Summary 'double-loop' lesson explains potential benefits of pre-experiencing decision factors that challenge to eliminate risk and win profit during Y5 preparing them for responsive sequencing for most profit in Y6." Council.

"Potential of game for updates to reflect latest position facing decision makers in Plymouth (Y4, 5 and 6) for testing with live and control groups through the council." Council.

"Misinformed parents often have set views on most preferred school unsupported by reliable information. Higher quality information would be useful for balancing parents by comparing Plymouth school options." Education.

"Parent concerns tend to increase questions about secondary school options for their child as they seek comparison but school marketing of specific 'brand' benefits concentrates on answers only from year 6 of primary school. A lot of low quality, incomparable data is currently provided about schools from which the wrong conclusions can be drawn." Education.

"School marketing investment may be saved if schools cooperate on targeting quality information towards the earlier stages of any decision-making process such as year 5, but all competing schools would need to cooperate." Education.

In conclusion, having tested potential burnout effects from preparation to change schools in a competitive setting, the emphasis from shorter-term preparation and transfer-related system shocks now switches towards a fully quantified system dynamics model of longer term socio-emotional decline for many children passing through secondary education resulting from potential unmet needs from preferred schools. As demonstrated in Figure 5.17, the pattern of lower wellbeing thresholds being repeatedly transgressed rises with age in secondary school over successive years. The pattern of rising, age-related referrals remains relatively constant in Plymouth with 15 and 14-year olds studying for GCSE outstripping earlier secondary years (15 and 14-year old referrals reversing in 2012).
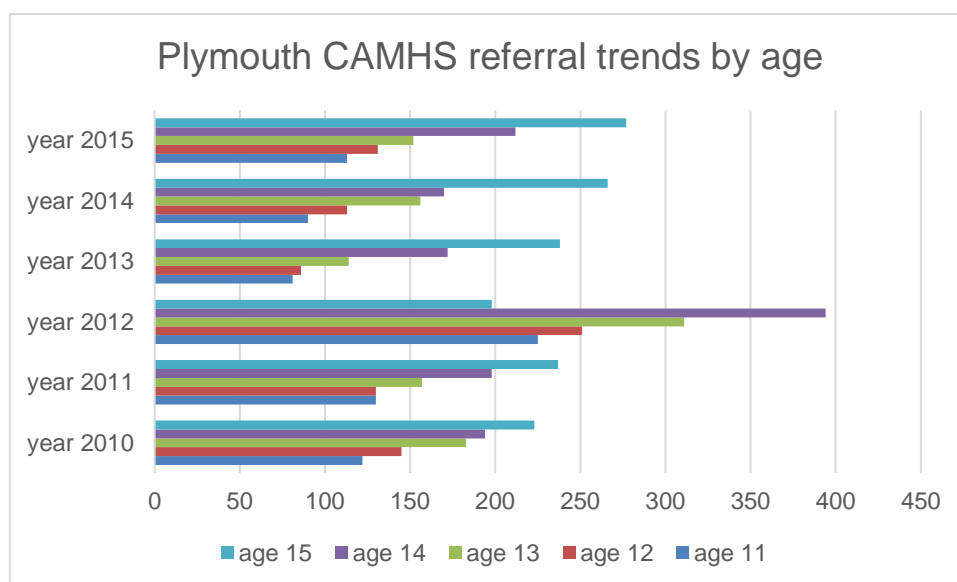
Figure 5.17 Pattern of rising CAMHS referrals with age in Plymouth between 2010 to 2015 (source CAMHS: IAPT).

The rising referrals with age problem relates to adolescence and a competition-intensified, GCSE curriculum colliding at around the same time. Such emotional collisions can be avoided by ensuring that schools remain flexible to evolving student needs, even when under pressure to produce league table results.

The Plymouth data for rising referrals covering the period 2010-2015 allocated to age groups can be compared with English trends for corresponding rises in those children reporting low levels of happiness as they move through secondary school and begin to stabilise and reduce only after leaving. Figure 5.18 plots the correspondence

between Plymouth and English data, the former peaking at age 15 when referrals are at their highest over the five-year sample period. This suggests that while mean happiness reduces gradually during secondary school education, faster rises in low wellbeing are noted over the same time as referrals to Plymouth CAMHS reach a maximum. Reducing the peak in referrals should make more treatment time available for those in dire need and potentially shorten queues.
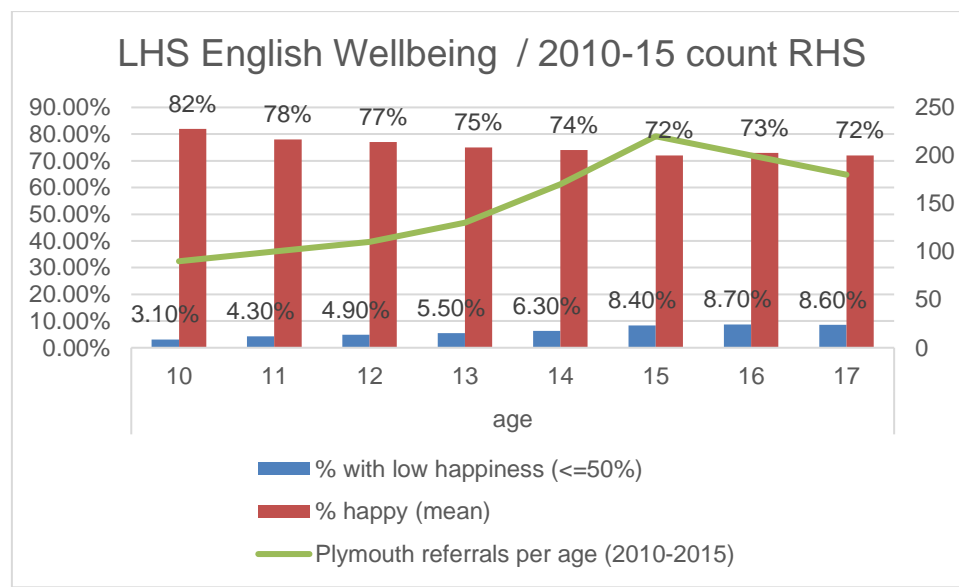
Figure 5.18. Plots of English wellbeing and Plymouth referrals to CAMHS

5.5. Summarising dynamic systems models.

Causal loop diagrams are typically used to provide a summary of the dynamic dialogue between cause and effect in a system. Figure 5.19 shows a causal loop diagram summary of the qualitative research undertaken with senior expert practitioners providing their middle-out views of how transferring schools may affect parent and child alike as they rely on their family dynamic to counter imbalances for students changing work and peer groups at the age of eleven. Causal loop diagrams summarise relationships between key factors by means of a linking arrow and a directional symbol suggesting either positive or negative relationship between the connected factors. When signed positively, either increases or decreases of input cause produce corresponding increases or decreases in output effect. Conversely, a negative symbol reflects that an increase in the cause produces a decrease in the effect or a cause reduction generates an effect gain. When such causal loops are

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linked together into a loop then either balancing or reinforcing loops can be summed by counting the numbers of each sign present (an odd number reflecting a balance).
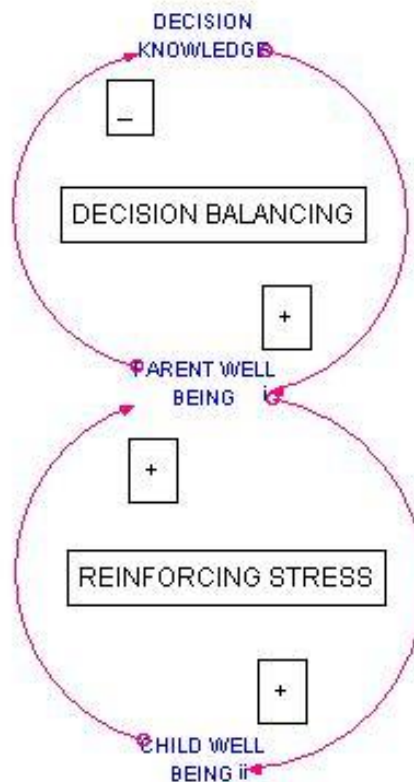
Figure 5.19 Causal Loop Diagram of stable family system summarising qualified concept model (see page 139)

Rather than suffering from Lane's suggestion of "mental blinkering" that can result from Causal Loop Diagrams[39] (2008), the expositive approach favouring Anderson and Richardson's "visual consistency" (1997) of Stock Flow Diagramming is used throughout the model-based research to shorten learning and acceptance of the final simulation model based on group model building principles. A summary of the key feedbacks is presented as a resultant causal loop diagram. The causal loop diagram also shows (as summarised from group modelling), parent wellbeing is used to buffer the impact of change on child wellbeing levels. Subjected not only to the stress of losing social and work-based networks before re-establishing new connections at the

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[39] Mental blinkering refers to CLDs being used to visualise group assumptions to identify relationships within a system at the expense of making important SFD distinctions between how rates control levels.

next school, children also need to prepare for transfer by taking tests before, during and after transfer, whether optional or not.

The reinforcing loop linking parent and child is critical at this time. Worries sensed by the child are understood by parents observing changes in their offspring's behaviour when facing the stress of change. Reductions in child wellbeing also cause a corresponding reduction in parent wellbeing. As parent wellbeing reduces, a corresponding reaction in child wellbeing reduction is generally observed leading to a spiralling decline in family relations. However, parents can generally counter such reductions in their own state of social-emotional health by seeking knowledge to inform their school choice problem. Here as parent wellbeing reduces, a corresponding increase in decision making knowledge helps the child compensate for worries and self-doubt over future schools. Once adequately informed, decision making knowledge gains help increase parent confidence and this wellbeing increase can then reverse the spiralling decline in social-emotional health, previously experienced between parent and child.

5.6. Chapter review

The chapter describes the selection of multiple Group Model Building scripts designed to induce problem structures from those working with children in Plymouth. The workshop outputs not only contribute to model structure, they also confirm acceptable policies upon multiple agencies that could affect problem behaviours over time. Two notable policies result that address reducing early academic demands upon children in year 5 or countering the outdating effects of market competition on knowledge of needs met by schools in the area.

Expert practitioners from within an urban setting such as Plymouth, offer a wide variety of views on cause and effect observed within Plymouth secondary school admissions when year 5 and 6 children apply to be considered for places in state secondary education, both within the city limits and others accessible beyond. The 'middle-out' perspectives offered by such a group can rapidly explain the balance between demand pressures from implementing management policy and meeting the needs of individual families at this strategic decision-making juncture when transferring between smaller primary and larger secondary schools. In this context, the GMB process offered benefits when scripting reduced time commitments and

debriefing using a validated workbook and simulated concept model produced further insights onto the problem of rising referrals with age, having considered the structures for emotional burnout and knowledge outdating induced from competition.

The stock flow diagram describing the concept model has been demonstrated to expert practitioners by producing counterintuitive, but explainable, behaviours when implementing suggested policy. In this way, the concept model offers confidence to participants that a quantified system dynamics model can explain patterns of demand. Based on the burnout model, the six-week half-term behaviour was validated by experts during their individual debriefing sessions as accurately reflecting what had been drawn during Graphs Over Time script for adult and child levels of wellbeing. In this case, the initial problem relates to Key Stage 2 plus other test preparations and potential confusion between school performance and personal performance for first-time examinees. Without parental guidance, overworking to provide the primary school with the best results may disadvantage the student and this needs parent intervention to ensure that their child does not overstress the importance of their own result at such an early stage.

Assembling a simulation model using parameters derived from primary and secondary data can lead to tests. Such tests confirm expected behaviour from system where varying assumptions can be demonstrated not to significantly affect responses. As CAMHS referral events are associated with low levels of wellbeing (which occur periodically under burnout conditions but establish longer-term decline that eventually exceed lower wellbeing thresholds during secondary education) the SD model is built to understand the impact of changing family dynamics on secondary school choice. Target groups identified from survey returns then provide data for each of the base runs (see Glossary xxii-xxviii), from which policy testing can proceed. Policy testing can then help confirm or deny policies (considering raised information availability to counter unmet student needs or ceasing selective school entrance testing for year 5 children to reverse test preparation burnout for example following Group Model Building). A blended approach can also be tested for effectiveness at smoothing emotional flows for families facing secondary school admissions in Plymouth with bespoke or generic knowledge inputs.

Concluding the issue of what problem structures underpin the rise in CAMHS referrals with secondary school age in Plymouth, this exploration suggests that a psycho-emotional system reflecting family members and their knowledge of needs met by secondary schools offers benefits that not only explain short-term burnout phenomena observed by expert practitioners helping those who experience problems, but also support adaption for a wider range of problems and potential intervening solutions, as children progress through their education in Plymouth.

6. Decision making with parents

6.0 Introducing parent decision-making deductions

Now the problem structure has been established through consulting with those who encounter the empirical issues first hand, attention now shifts towards understanding the ways in which parents select schools and why some preferences may be less accurate than others for meeting children's needs as they progress through their secondary education.
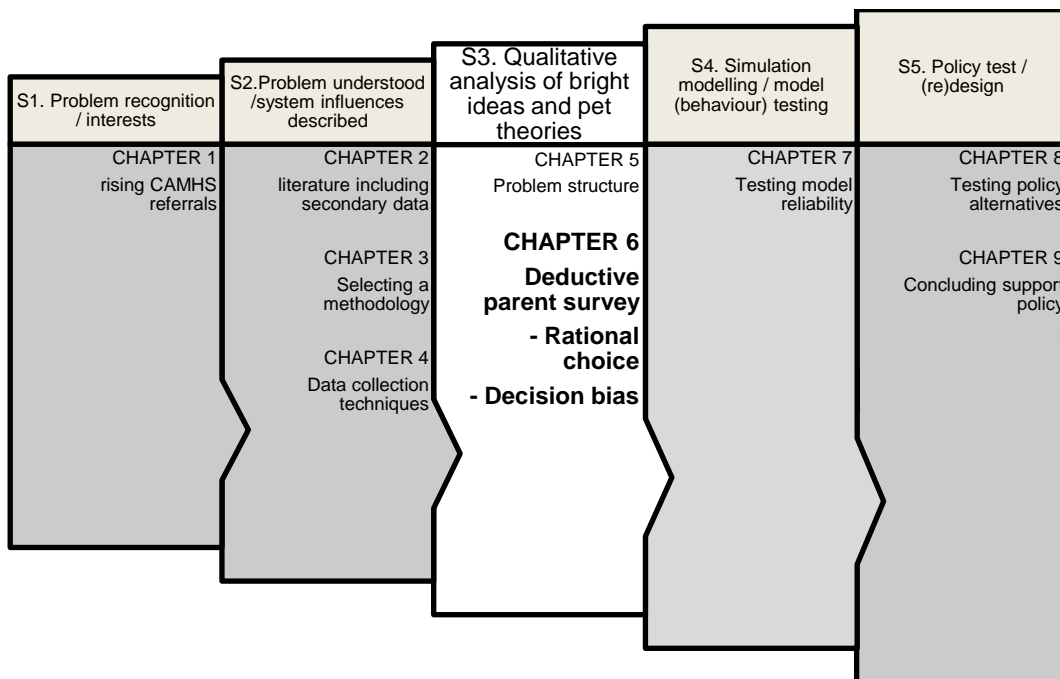
Figure 6.1 System Dynamics process look-up table (adapted from Coyle, 1996:p.11)

As indicated in Figure 6.1, previous development stages of the causal theory have established rising CAMHS referrals following transfer to secondary schools in Plymouth, UK from PCH-Livewell case data showing rises/fluctuations. This chapter explores parent views (those with children in the last, year 6 of primary schools in the locality of Plymouth) for deducing decision-making trends by answering the question about whether there are flaws in the way in which school selection decisions are made.

In addition to children and parents, various other interested parties benefit from an improvement in this system. Groups beyond health who support the transfer of students from primary to secondary also benefit from reducing demands on their

time. For example, education gains attentive students engaged with their work and the council quickly identify parents who need supporting with additional needs from their selection of a school. Secondary data from annual Good Childhood Reports (The Children's Society, 2011-2017) and the DCFS parental secondary school selection study (Coldron etal, 2007) confirm the benefits for families selecting schools at this important juncture.

Constructing models using expert practitioners has provided insight into the secondary school admission structures for Plymouth. The agencies represented in the group model building workshops have also suggested two policy areas that could help reduce problems for families navigating up to seventeen potential, but complex, school options for selecting three choices and the most preferred. Whereas the known influences on maintaining healthy mental balance are independent of the time spent in secondary education (withdrawal of support by friends, teachers or family is commonly referenced in different forms of power imbalance or bullying and can affect children at any stage of development), other stimuli do relate to time spent in education. For example, children emotionally troubled by the enrolment process when transferring between schools could become susceptible to further stressor-provoked, emotional crises in subsequent years based on family double-stressor, ABCX theory from McCubbin and Patterson, 1983 (refer to pp. 57-66). Here subsequent annual testing could represent crises piling-up for some children alongside other disadvantages that their family might be experiencing. Those affected would need to cope and adapt within their family setting to retain their levels of emotional health and wellbeing. Thus, selecting schools, while stressful for families, should not become a stressor for students when expectations may not be met. By contrast, ensuring children's needs continue to be met remains a stressor for parents throughout schooling.

Addressing the extended decline in emotional health from changing schools is now quantified for behavioural decision making in Plymouth based on survey returns from parents involved in selecting schools for children. When combined with participative modelling results, decision-biases from such surveys have the potential to explain CAMHS referral patterns relating to children experiencing emotional crises. Exploring the problem from a parent perspective in this chapter helps position model data in context of secondary school choice in Plymouth.

The problem of choosing a secondary school involves many factors that have varying degrees of reliable comparison information from which to make quality decision choices affecting the future of not only students but also their families. Decision making techniques vary depending upon the nature of the choices involved (DeScioli et al, 2015). Rigorous methods ideally support trade-offs between the gains and losses for courses of action from a decision maker's perspective to back a judgement for a successful outcome. As the mix of data required to inform decision making depends on individual case by case requirements, techniques that enable wide views to be reflected are important for this study within a framework of competition dynamics as it plays out in primary and secondary education.

The chapter scope therefore covers definitions of the terms associated with state education and wellbeing for children, trends in mental health referrals for children, anticipated rises in students enrolling and the provision of support services. Recent changes in English legislation are also covered for their impact on the provision of services to vulnerable children. The survey process involves respondent selection for answering survey questions concerning imminent school choice, trials of delivery mechanisms and removal of potential bias before deducing relationships. Survey mechanism development, to include flashcards and flyers for parents lacking time but willing to contribute answers, is also considered. The influence of other connected factors is taken into consideration in determining relationships identified using cross-impact analysis with statistical significance from data collected from parents in Plymouth.

6.1 Survey selection

Longitudinal secondary data on child wellbeing and related educational and family factors provides a substantial resource capable of estimating time-based changes in emotional resilience for English populations. Combined with cross sectional views from parents of children across England, the simulation model can be configured to represent different family types that may be at risk from potential inconsistencies when selecting schools. Therefore, decision makers (usually parents, sometimes guardians) need to be surveyed just prior to selecting secondary schools to appreciate local trends.

The survey design was therefore proposed that involved a targeting pilot to acquire potential respondents before asking them to complete an online survey. This enabled a flexible approach to supply the survey combined with an online ability to process respondent trends in the statistical analysis software provided by Qualtrics™.

Parent data was required to be able to parameterize a configurable, System Dynamics model that represented the trends of decision makers and their families from around the city. The situation leadership model on normative decisions (Vroom and Jago, 1988) previously explained in the context of policy decision making in groups (pp.33-43), can also help to represent school choice within the family unit as shown in Figure 6.2. Specifically, by separating more autocratic decisions about needs met from those obtained through democratic consultation, the model is useful for demonstrating the knowledge of needs met by schools for families. With a parent (frequently the mother) and child (changing schools) pair deciding which school best needs their combined needs, it is clear that a parent adopting an autocratic style can only ever represent their own needs at the expense of the 50% that the student could have contributed given a more open, democratic group-based style. Based on the Normative Decision Model for situational leaders, the chart indicates that decision maker styles can influence number of family needs to be met when selection schools, based on taking extreme positions for democracy or autocracy to understand impacts.
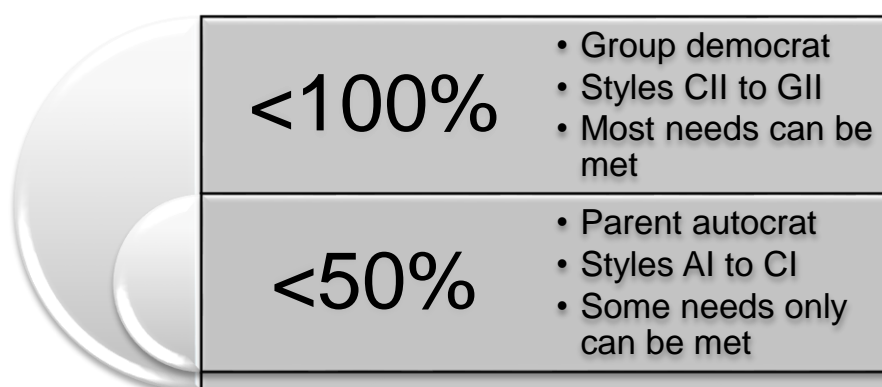
Figure 6.2. Categories of decision in Normative Decision Model (adapted from Vroom and Jago, 1986)

Different types of numerical data could be generated from decision makers around their school requirements that could be used to parameterize the resulting model. The eventual selection of survey questions involved not only behavioural decision making around situational leadership but also economic prospects and supporting questions to helps sort and filter respondents. After a convenience sampling targeting survey in 2014 identified some participants for the main survey (parents who qualified would be seeking Plymouth secondary schools in the near future, when applications for school places were being received), it was accepted that multi-access survey contributions should be used to be able to widen the types of parent responding beyond higher education in the target responses. Thus, the timing for surveys was proposed.

1. Target survey 2014;
2. Multi-access survey 2015.

6.1.1 Intended respondents

Given that target survey responses suggested academic biases from parents who responded about their experience of selecting local secondary schools for children, a wider ranging survey was developed that could be deployed through various media including flashcards and QR codes for smart phones alongside already established, internet access.

The final survey (see page 114) was aimed towards those about to decide schools through purposive sampling after the convenience of the online target survey was dismissed. This widening process helped minimise sample biases from the target group of parents about to select schools and instead of an intranet news article, a press release was prepared for use on the internet website at the University of Plymouth. The final flash cards used for asking survey questions in person when meeting parents are presented in Appendix 4.

6.1.2 Surveying parents using convenience and purposive sampling

A series of parents with recent experience of selecting Plymouth schools were invited to discuss their approach using a target survey distributed through an intranet survey at Plymouth University. A large proportion of university staff responding to the request favoured academic selection for their child, suggesting a bias in favour of

grammar schools that could not allow such results to be generalised as it was unrepresentative of the overall population due to the high proportion of parents electing for selective, grammar school admission. The sequencing of surveys conducted for the research are detailed in Figure 6.3.

Target survey	Multi-access survey 2015	Multi-access survey 2016
Electronic questionnaire pilot via university intranet for convenience sampling of parents	Introduction of flash cards for purposive sampling at city sports venues and from conference stand	A further question added Additional respondent views collected for deductive analysis
QUALIFY FOR SAMPLING VIEWS	TALK TO PARENTS WITH WIDER VIEWS	EXTEND RESULTS FOR ANALYSIS

Figure 6.3. Parent survey development stages

Moving on from convenience sampling using a target survey to determine interest from university members of staff in Plymouth, a purposive sampling approach was adopted employing the same electronic survey hosting service from Qualtrics but widened to accommodate more parent views on secondary school choice. The survey was broadened beyond electronic access by internet or mobile phone to include paper returns from flash card surveys conducted in public venues that were susbequently transposed by the researcher to enable cross impact analysis (see Glossary xxii-xxviii) through the platform.

Initially introduced through a research news article explaining the need to collect wider parent views that was published on the external Plymouth University website (Williams, 2015), this survey was designed (see page 115) to capture different aspects of theory relating to school choice prior to changing schools. Piloted using

QR code, tear-off tabs for mobile phone completion at the school notice board or public library, the survey request was also circulated to all primary headteachers in Plymouth by post and distributed to all local libraries. This attempt was unsuccessful in attracting a response and so a set of flashcards were created for face to face dialogues with parents as described on page 118.

6.1.3 Eliminating potential bias from sample

A further bias was noted when distributing surveys electronically. Here flyers were produced and sent to all primary school head teachers in the city as well as passed to all Plymouth libraries. As both communities were asked to display a website address for computer-based responses and QR code for smartphone survey answers, it was believed that this would widen access, potentially leading to snowball sampling. No survey answers were however generated through this route suggesting parents were not using smartphones to answer such questions. .

6.1.4 Special needs conference additions

Following the success of the flash card approach with parents in Plymouth, the same technique was deployed to collect parent views at a Special Needs Conference when invited to support a stand at the event. This resulted in additional useful views on reliable ways to select schools over an extended period of more than 12 months compared with shorter timescales of less than a quarter for those with standard needs.

6.1.5 Survey data collection.

The 2015 multi-access survey contained some filtering and sorting questions to assure quality of response whether answered online or in person. This is a potential weakness as there are fewer controls online to determine if respondents were parents when compared to asking parents by stopping them at a facility. However, feedback from peers suggested the questionnaire was understood and therefore this became less of a risk to the survey.

The 2015 questions were successful but with only 24 responses in total, it was decided a 2016 survey was needed for deploying in the two-month admissions window when families were deciding secondary schools. This was prepared and

extended to include an extra question in the area of child relaxation preferences. The new survey was completed by 13 respondents leaving a combined total of 37 valid responses.

6.2 Survey content

The final multi-access survey distributed with all questions in 2016 comprised 11 question areas where an extra question concerned how parents observed their children relaxing with friends and family. The areas covered by survey questions included (Appendix 4 gives further details):

- Primary school details;
- Half postcode catchment confirmation;
- Connections with secondary schools;
- Situational leadership styles;
- School information inputs;
- Economic prospects from education;
- Acceptable types of school criteria;
- Time taken deciding;
- School outcome expectations;
- Qualifications on family factors and additionally in 2016;
- Balancing school work and rest.

6.3 Final multi-access survey views confirmed in 2016

Due to low initial 2015 returns, a further round of surveys was conducted in 2016 using the forms and flashcard technique. Returns proved consistent and gave confidence in the sampling method. By repeating the sampling activities over two years rather than only one, greater confidence in the results from the single case study is achieved. This technique even proved successful for a special needs conference that the author attended (Figure 6.4)

Figure 6.4. Author's conference stand surveying parents of children with Special Educational Needs (PIAS Conference, November 2015)

6.4 Parent survey bias checks

As previously explained in the data collection method, Fisher Exact Testing (FET) offers the potential to understand small samples and deduce significant differences, typically between two independent and two hypothesised dependent variables. In this case, several potential parent biases based on behavioural decision making were explored using the test on survey data. Using cross-tabulation, results were processed to determine whether biases were present in the sample of 37 families (Appendix 6 gives an example of cross-tabulated results that were then shrunk by combining answers into 2x2 grids for statistical testing of potential decision biases).

6.4.1 Decision making based on future prospects

Using Fisher Exact Testing, there was no observable decision maker bias, as indicated by the numerical test, when considering four-fold patterns of approach to risk of loss and gain from future economic (job-related) prospects from leaving secondary education encouraged by teachers (Thomson *et al*, 2012). This may relate to the concept of continuous professional development requiring a university degree to obtain a desirable job in today's competitive workplace in England, making secondary education an intermediate stage along the way rather than an end-state for the majority of parents.

Thus, parental behavioural decision-making biases from future job prospects do not significantly influence which schools are chosen by parents. If unrelated to potential future outcome, then testing for decision making process bias may suggest predispositions for other types of behavioural choice. While Image Theory (Beach, 1990) had been considered (see p. 37) and eliminated in pilot parent surveys, Normative Decision Model (NDM) offered a range of potential explanations from situational leadership research.

6.4.2 Risk seeking bias when living within or beyond Plymouth

A rising population, inexperienced (see Glossary xxii-xxviii) in secondary school choice in Plymouth and lacking recent knowledge (and potential for selection inaccuracy due to pace of change) of what successful secondary education should comprise, leads to taking unnecessary risk. In order to test the theory, parents living outside of Plymouth were asked about risk taking with their choices of school in Plymouth. All respondents beyond Plymouth considered themselves to be risk adverse, even when their considered, alternative schools spanned more than one admission authority. By contrast more risks were accepted by parents living within the Plymouth area.

(EXPECTED COUNT)	HOME LOCATED	
	In Plymouth	Outside city
Avoid risk	19 (21.1)	7 (4.9)
Take risk	11 (8.9)	0 (2.1)
	30	7

26

11

37 total sample

Null hypothesis (no difference in the proportion of parents in or beyond Plymouth taking or avoiding risks when selecting schools) is disproven on a two tailed P test significant at 0.1 (Fisher Exact Test statistic value is calculated at 0.079675). In this situation, the evidence suggests that those taking or avoiding risk are not equally likely to live in Plymouth or beyond (those living outside of Plymouth biasing towards risk aversion as there is a cost to commute for example). Table 6.1 demonstrates a propensity for Plymouth parents to take significantly more risks deciding schools in Plymouth than others outside of Plymouth who all avoid potential risk.

6.4.3 Bias for faster autocratic decisions

Resulting from competition data overload from providers, parents deciding in a timeframe of less than three months largely limits inputs to league tables and visits (visiting two or fewer schools informs only 1 preference not 3 choices for example). Faster input filtering techniques are consistently ignored by most parents questioned: such evaluations include comparisons by website (catchment geography, parent feedback, etc.) or composite council guide (postcodes, oversubscription results, etc.) for example.

(EXPECTED COUNT)	DECISION SPEED		
	Less than 3 months	More than 3 months	
Autocratic parent decision AI-CI	8 (5.4)	2 (4.6)	10
Democratic family decision CII-GII	12 (14.6)	15 (12.4)	27
	20	17	37 total sample

Null hypothesis (no difference in the proportion of fast and slow decisions made among autocrats and democrats) is disproven on a two tailed P test significant at 0.1 (Fisher Exact Test statistic value is calculated at 0.072622). In this situation, the evidence suggests that autocrats and democrats are not equally likely to decide schools within 3 months (autocrats biasing towards faster decisions as they need satisfy fewer requirements when selecting schools for example). Table 6.2 demonstrates that a significant proportion of parents considering schools in the city are biased towards autocratic-rapidity when deciding their child's secondary school.

6.4.4 Biases lacking recent experience of decision making

Satisfying a limited subset of autocratic needs may satisfy parents based on longer term prospects derived from education, rather than more democratic decisions that also help meet the student's networking needs short-term or medium-term flexibility requirements should plans diverge from reality. This is demonstrated by parents who buy secondary education from private schools who are also spending money to acquire a network of privileged family contacts for their children. However other types of behavioural decision can also contain bias.

(EXPECTED COUNT)	SCHOOLS EXPERIENCE		
	1st child	Siblings	
Autocratic parent decision AI-CI	14 (11.5)	3 (5.5)	17
Democratic family decision AII-GII	11 (13.5)	9 (6.5)	20
	25	12	

37 total sample

Null hypothesis (no difference in the proportion of families with and without sibling experience of Plymouth secondary schools among autocrats and democrats) is disproven on a two tailed P test significant at 0.1 (Fisher Exact Test statistic value is calculated at 0.093919). In this situation, the evidence suggests that autocrats and democrats are not equally likely to have previous sibling experience of schools (democrats biasing towards families with sibling experience of Plymouth secondary schools as they learn from recent enrolment experience for example). Table 6.3 demonstrates a propensity for inexperienced parents seeking Plymouth secondary schools for their first child who disproportionally favour autocratic styles of decision making in marked contrast to those with recent experience who value democracy when selecting schools. This is significant for the Plymouth sample and can be developed as a target group for policies given just under half the sample had this potential bias.

6.4.5 Autocratic bias avoiding Word of Mouth recommendations

As anticipated, the more autocratic school choice decisions made in Plymouth families are biased away from Word of Mouth (WoM) recommendations when compared to more democratic styles.

Table 6.4 Independent column variable relatedness to dependent row variable between style & WoM.

(EXPECTED COUNT)	DECISION STYLE		
	Autocratic	Democratic	
WoM influenced	11 (13.8)	19 (16.2)	30
WoM ignored	6 (3.2)	1 (3.8)	7
	17	20	

37 total sample

Null hypothesis (no difference in the proportion of families influenced or ignoring Word of Mouth secondary school recommendations among autocrats and democrats) is disproven on a two tailed P test significant at 0.05 (Fisher Exact Test statistic value is calculated at 0.03346). In this situation, the evidence suggests that autocrats and democrats are not equally likely to accept Word of Mouth recommendations (democrats biasing towards being influenced by Word of Mouth as they consider others point of view for example). Table 6.4 demonstrates that a significant proportion of Plymouth parents considering schools in the city are biased away from WoM when deciding secondary schools using an autocratic approach.

6.4.6 Unhealthy bias for autocratic families

Plymouth parents adopting autocratic decision-making styles have lower levels of family health than their democratic counterparts. Whereas lower wealth notable diminishes decision making capacity for affected parents, the impact of lower family health on parental capacity to make rational decisions can also be anticipated from these results where their immediate concerns may be focussed elsewhere in the family.

(EXPECTED COUNT)	DECISION STYLE		
	Autocratic	Democratic	
Low-medium family health	12 (6.9)	3 (8.1)	15
High family health	5 (10.1)	17 (11.9)	22
	17	20	

37 total sample

Null hypothesis (no difference in the proportion of healthy families among autocrats and democrats) is disproven on a two tailed P test significant at 0.01 (Fisher Exact Test statistic value is calculated at 0.000875). In this situation, the evidence suggests that autocrats and democrats are not equally likely to live in healthy families (autocrats associated with families who only enjoy low to medium health as they may regularly disagree for example). Table 6.5 demonstrates that a significant proportion of Plymouth parents adopting autocratic decision-making styles also face lower family health when deciding their secondary schools. This can be attributed to having less time for decision making with reduced capacity for school choice associated with attentions being devoted to maintaining family health.

6.5 Validation of data model concerning autocratic decisions

Parent contributions suggest certain behavioural decision making styles are present in the Plymouth sample and that these contribute towards evolving student needs remaining unmet in secondary school selections. Several risk factors are present in families deciding schools:

6.5.1 Reduced family health

Lower family health leading to autocracy as a convenience to divert less attention from caring for family members who are ill.

6.5.2 Inexperience of school choice

Inexperience of personal school choice without siblings, relying instead upon other resources as a convenience to replace personal knowledge of how secondary schools compare and perform.

6.5.3 Decisions made quickly

Reducing time spent deciding requires less information to research alternative choices from the available school options making selection fit within the two-month window allocated by the admissions system for school selection.

6.5.4 Requirements for dynamic testbed

Timing of decision is limited to less than three months in the model for 17/37 of the survey sample in Plymouth who exhibit decision bias favouring autocracy. Alongside this the same proportion is satisfied with lower levels of knowledge on how schools meet needs, associated with inexperience and reduced initial levels of wellbeing allied to family health. No significance was associated with testing for economic prospects in the sample from Plymouth.

6.6 **Vroom Jago Contingency model of situational leadership**

Whereas prospect theory (p.40) offers a behavioural explanation for decision-making biases that over-value certain or unlikely outcomes based on job prospects for example, the contingency model of situational leadership suggests decision makers adapt their styles of decision making based on the specific situation they face (five categories are identified). For school choice, the family leader or parent may face deciding on school choice where any result would be acceptable to the child (autocratic) through to none at all (group).

Typically, situational leadership models have been applied to schools using cross sectional approaches (Goff and Finch, 2014) for deducing relationships between dependent and independent variables. Often applied to head teachers and

sometimes to students (Chandler, 2015), situational leadership adapts decision making behaviours to the specific problem to solve. The school choice problem is one such application to parents as situational leaders within the family unit. Autocratic style suitability to the prevailing or contingent situation can therefore be defined for those families lacking sufficient information for a high-quality decision i.e. inexperienced parents in further detail using the logic network. If the problem structure of the needs to be met is clear and the student would commit to a parent-selected school, then without aligned goal aspirations an Aii style would be justified. If, however the child does not commit but goal aspirations are aligned between parent and child then the same Aii style applies without sibling conflicts. Where siblings dispute selection then a Cii style would apply instead. It is notable that parents furnished with adequate information and highly likely commitment probability to their selected school by the affected child are only those who should use the autocratic Ai style. This style came to light through extended discussions with a parent who had taught at their intended secondary school for example.

By contrast more consultative or democratic Cii and Gii styles would always be more suitable for secondary school choice in cities where previously described conditions do not apply. These branches through the decision tree reflect the majority of applicants for urban enrolment, whether or not experienced (20 of the 37-strong sample exhibited democratic trends when facing the secondary school choice situation).

Commonly, inexperienced parents without high quality leader's information in the unstructured competition environment (between city-based secondary schools for example) with probable commitment of child to their decision use the Cii style. Without such probable commitment, parents of students who do not share goal aspirations would use the same Cii style. However, furnished with common goal congruence of aspirations the same Cii style applies only if the student has insufficient information to make their own high-quality decision. With adequate information then a Gii democratic style is the most appropriate for the situation. In summary, very few inexperienced parents should adopt autocratic styles (none for Ai and only limited numbers for Aii or Ci as highlighted in the chart). This is not what the survey statistical test suggests happens in practice where most of parents lacking experience adopt more autocratic rather than democratic styles in Plymouth.

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Only certain types of situational leadership style apply using the developed, contingency theory decision tree (Figure 6.5). By asking key questions at successive stages, the branching paths to making a final selection can be plotted.

1. Leaders Information (LI)? Adequate-yes, inadequate-no;
2. problem STructure (ST)? Clear-yes, unclear-no;
3. Commitment Probability (CP)? Supports decision-yes, unsupportive-no;
4. Goal Congruence (GC)? Shares objectives-yes, disagreement-no;
5. subordinate COflict (CO)? Conflicted choice-yes, unconflicted choice-no;
6. Subordinate Information (SI)? Sufficient-yes, insufficient-no.
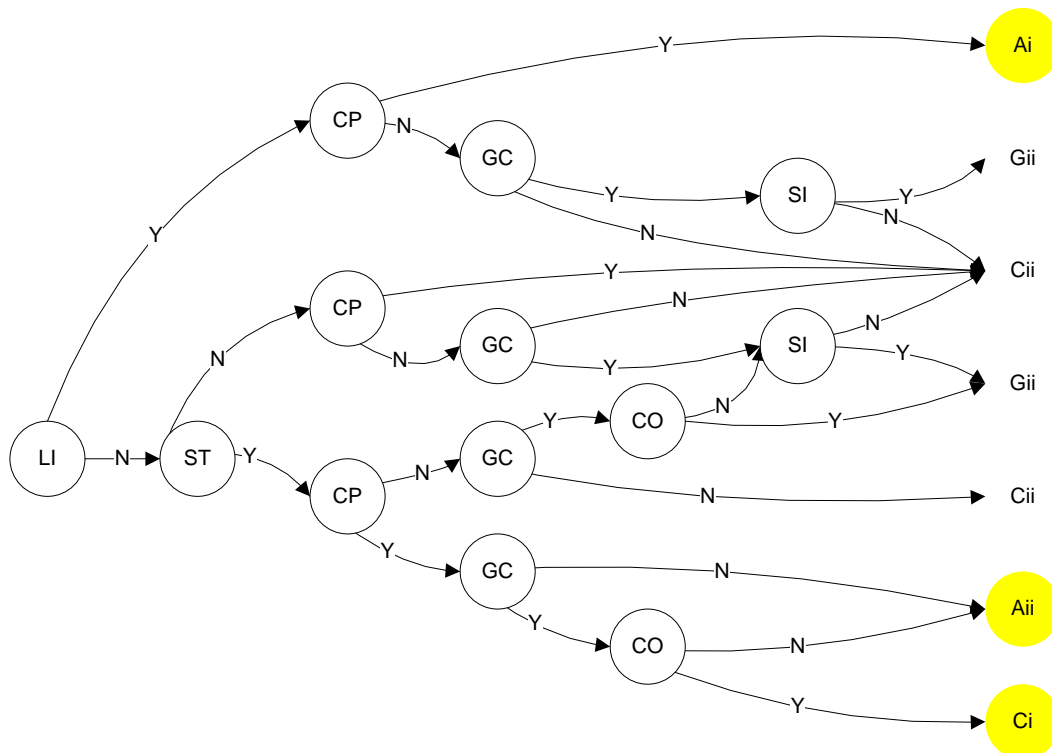
KEY TO SCHOOL CHOICE DECISION LOGIC FROM A SITUATIONAL LEADERSHIP PERSPECTIVE
Assuming secondary school choice problem requires high Quality Requirement (QR – importance of technical quality of decision for meeting needs) plus high Commitment Requirement (CR – importance of student commitment to selected school) then Vroom and Jago's 1988 network subset applies to the family decision.
Y = Yes
N = No
LI = Leader's Information. Sufficient school choice information for high quality decision Y/N?
ST = Problem STructure. Is secondary school choice problem well structured in cities Y/N?
CP = Commitment Probability. Would the student commit to a school that parent unilaterally selects Y/N?
GC = Goal Congruence. Does student share parent goal aspirations attained in selecting a school Y/N?
CO = Subordinate COnflict. Is conflict among siblings over preferred schools likely Y/N?
SI = Subordinate Information. Does student have sufficient information to make a high quality decision Y/N?
Note that the only autocratic paths recommended result in decision styles Ai, Aii and Ci are highlighted where
Ai = Parent solves decision problem alone using information available at the time;
Aii = Parent solves decision problem alone after obtaining necessary information from others;
Ci = Parent solves decision problem after obtaining ideas and suggestions from others: reflective or not;
Cii = Parent solves decision problem after obtaining ideas and suggestions from others as a group: reflective or not;
Gii = The group analyses the problem, identifies/evaluates alternatives and makes a parent-facilitated decision.

Outcomes highlighted reflect paths that lead to more autocratic style outcomes (three Ai, Aii and Ci) whereas other end states demonstrate decision making paths that reflect more democratic style outcomes (four Cii and Gii) based around the family group. It is notable that the four potential paths to autocratic decision styles are more than doubled (nine in total) should more democratic styles be adopted.

An example of autocratic path ending in Ai involves the parent leading the decision to have sufficient high-quality information to make a choice at node LI. With a student willing to commit to a unilateral decision on schools taken by the parent at node CP, a parent is able to solve the school choice problem alone using only the information available to them at that time to arrive at node Ai reflecting the autocratic decision. Other routes for autocratic styles Aii and Ci can be followed in the same way using the available key to explain the logic paths. The bias of parents responding to the question of their decision-making styles demonstrates that a significant proportion of respondents do not recognise the value of facilitating or even consulting the student on their school choice problem. Of the 37 answers, nineteen indicated decision style categories Ai, Aii and Ci which involve no round-table meetings (at most only ad-hoc, one to one discussions), whether for consideration of family member views prior to deciding or even facilitating a suitable decision style for selection based on chart logic. Favouring such autocratic styles of decision making is significant and has the potential to mask the best fit of school provision to student need.

Similar evidence of bias in decision-making is not deduced from prospective economic outcomes (Kanheman and Tversky, 1979; Tversky and Kanheman, 1992) and links to school choice experienced by previous generations in Plymouth where grand-parents influence choice of schools as much as parents themselves. For example, paying for public school access to a red-brick university to become a respected professional, paying for grammar school tutoring to have a reliable trade, or paying for preparatory school for better peer networks are ways in which prospects

may subconsciously influence choices in education but not feature in deductive responses to relevant questions where investment have already been made but are not relevant when answering questions.

The Normative Decision Model bias towards autocratically inexperienced decision makers suggests a key mechanism where student needs may get ignored during urban secondary school selection. This can now be reflected in the system dynamics data by not only using relevant timing information by different parent categories but also testing two types of Plymouth family, those without previous, personal experience of school choice from older siblings where target needs are limited to 50% (compared to others who can access the whole range of needs to be met by secondary schools and are effectively unlimited at 100%). By concentrating on simulation runs on autocratic decision makers, it is therefore possible to assess the impact of potential policies on this substantial, target group.

6.7 Chapter review

The chapter scope has covered respondents for answering survey questions concerning imminent school choice, trials of delivery mechanism and removal of potential bias. Survey mechanism development to include flashcards and flyers for parents lacking time but willing to contribute answers before analysing results for signs of bias within subsets of the sample are also described. The influence of other connected factors is also taken into consideration in the cross-impact analysis of data collected from parents in Plymouth

Additional validation of modelling group suggestions supports testing parents for behavioural decision biases (downplaying future student needs in favour of parental requirements that have to be met) and potential inattention to home-based overtime spent by children preparing for tests (preparing for tests or enjoying peers online can appear similar to parents if based on being alone). Assembling a simulation model using parameters derived from primary and secondary data can lead to tests confirming expected system behaviour. Here varying assumptions can be demonstrated not to significantly affect responses. Target groups identified from survey returns then provide data for the simulated base run of wellbeing and knowledge responses from the family decision making system. Once a behavioural decline is established that is capable of breaching low wellbeing referral levels,

support for alleviating biasing effects can be devised through detailed policy testing and blending based on system senstitivities.

Limited tests of the quantified system dynamics model (based on a qualified stock flow diagram) have revealed that the model is responsive to proposed change from a normal position of equilibrium (see Glossary xxii-xxviii) where socio-emotional effects balance each other. The simulation model therefore needs to be capable of representing specific aspects of the problem by employing different data sources, calculated soft variables and other relational structures suitable for demonstrating how proposed policy developments might work over time for families exhibiting different decision-making behaviours.

Parent views have demonstrated several important biases within decisions made when facing the complex variety from urban school choice. Compared to those parents considering Plymouth schools who live beyond the unitary authority boundary, decision makers in the city accept more risks when deciding secondary schools. Autocratic decision-making styles are regularly adopted by parents who appear to need or be willing to spend less time in making their selection of schools. Equally this significant group of decision makers have less healthy families overall and often lack experience from other siblings having already traversed secondary school enrolment processes in the city. Such a group is therefore one to model for potential unmet needs of children where autocracy offers little or no recognition of needs changing with school as their children face the extended demands that competition now places on students throughout their compulsory education, alongside adolescence.

Regarding effects observed in referral data reflecting the onset of emotional crisis, burnout causal theory relates to sustained academic pressures to prepare for achieving results for the individual and primary school (Saeki et al, 2015). Such disadvantages can divert student attention away from ensuring their needs can be met by the new school.

Standard Assessment Testing (SATS) results reflect upon primary school performance for those leaving. SATS results to inform others about to join in first (reception) year whose parent's may only consider schools with higher grades as a realistic option for their child. Without adequate parental support downplaying the

personal importance of the results for the student, the issue of preparing for such Key Stage 2 tests at the end of year 6 in primary school or streaming tests commencing year 7 in secondary school can dominate other social rebalancing systems offered by friends and family.

A qualitative model is now required for reliability testing before evaluating the impact of diverse policies on parents who may have standard or additional needs to consider for children transferring schools suggested by two types of family (SEN and STD) requirements. Thus, a valid system dynamics model structure is developed to support the evaluation of alternative policies, aimed at alleviating low levels of wellbeing in some children and adding to the body of causal theories while supporting enrolment into secondary schools across England (underpinned by statistical studies comparing relative influence between the stocks and flows involved).

Concluding on the question of which behavioural decision making attitudes require least knowledge of secondary schools, explanatory study results suggest that adopting autocratic styles of decision making offers fewer benefits across a wide range of children in Plymouth that could lead to the selection of unsuitable schools and consequent unmet needs as the curriculum narrows towards GCSE years following on from adolescence.

7. Decision analysis for families

7.0 Introducing abductive simulation model testing

Having established the concept model problem structure from expert practitioners and the decision biasing of parents in Plymouth, a system dynamics model needs developing on which different support policies can be tested. As the vulnerable group of first-born children or recently arrived families who lack direct experience is now clear (those who lack knowledge of which schools were able to meet ongoing needs from the city) the family response to alternative policies needs to be evaluated using a reliable simulation model.

Before evaluating policy alternatives however, confidence in how the parameterised model performs is needed. As demonstrated in the previous chapter (see page 174) families of standard and SEND children differ in the decision time either group takes from survey returns, then the system needs testing for both family situations to provide confidence. Tests are selected to ensure adequate model responses at both extreme values (those that are unlikely to occur under normal circumstances) but also for small variations from either family type's dynamic equilibrium or steady state position. Figure 7.1 illustrates the importance of describing real-world values with recognised dimensions. Thus, details of model structural components are described before explaining the behaviours of important feedbacks controlling inflows and outflows within the developed System Dynamics model. The chart also shows that structures for implementing both suggested and alternative policies are also tested before they can be used.

Having confirmed decision making biases in Plymouth that closely relate occurrences of autocratic, decision making styles and inexperience of the school choice problem in the sampled parent population, the potential for refining a causal theory is at hand. Based on a concept model, using system dynamics development techniques allows a fully parametrized model to be tested before trialing proposed, and designed policy alternatives aimed at alleviating low child wellbeing across the city. This chapter explores the family system for abducing system sensitivities to imposed change, once parameterized model confidence is established, for helping answer the question

about which types of support could help reduce referral trends with age.

S1. Problem recognition / interests	S2. Problem understood /system influences described	S3. Qualitative analysis of bright ideas and pet theories quantified	S4. Simulation modelling / model (behaviour) testing	S5. Policy test / (re)design
CHAPTER 1 rising CAMHS referrals	CHAPTER 2 literature including secondary data CHAPTER 3 Selecting a methodology CHAPTER 4 Data collection techniques	CHAPTER 5 Problem structure CHAPTER 6 Decision biasing	**CHAPTER 7** **Testing model reliability** **- Dimensions and real world values** **- Testing assumption sensitivity** **- Structures tested for assessing policy**	CHAPTER 8 Testing policy alternatives CHAPTER 9 Concludingsupport policy .

Figure 7.1. System Dynamics process look-up table (adapted from Coyle, 1996:p.11)

By establishing confidence in both model configuration and performance, there is an important opportunity to compare the dynamic impacts of different policies on the low levels of wellbeing encountered by children traversing secondary school, policies that could help stabilise and improve student emotional prospects where their individual needs continue to be met and exceeded by education providers.

The chapter scope therefore covers developments from the concept model by replacing emotional stressors of test preparation burnout for children by adding exogenous losses associated with longer-term trends of continuous testing regimes. A further exogenous, system stressor constantly outdates (see Glossary xxii-xxviii) knowledge of needs met by placing family knowledge under stress from competitive market choice in the urban setting. Relevant values are then added to produce the parameterized model before a selection of system dynamics tests are deployed to assess the validity of the simulated model configuration and simulated responses. As sensitivity testing could reveal other potential levers affecting problem behaviour, different types of family situation also need to be assessed to assure no harm is done to either standard or SEND children when adopting a policy. Finally, additional policy

test structures are established to ensure a consistent approach to policy testing that can be replicated by others.

7.1 System Dynamic Model structural and sensitivity checks

Multiple tests are used to confer reliability of model performance when subjected to assessment under specific conditions. Both structural validity and dynamic response can be assessed by testing the parameterized stock flow diagram. While the concept model has demonstrated the potential for explaining short term burnout effects on child wellbeing to expert practitioners during enrolment into secondary schools in urban environments, demonstrating the effect of exogenous, family stressors in the English competitive education environment is now required for the period leading up to and time spent in secondary school.

Simulating problem behaviours that families experience helps to understand when lower wellbeing warning limits might be breached (referral action is sought). Based on indicators that parents may miss, a concerted media campaign to highlight awareness and reduce stigma for children is important for gaining awareness and well-timed and targeted interventions. Announced in May 2017, Heads Together is one such example programme, lead in the UK by members of the Royal Family and aimed at increasing discussion on mental health issues (Booth, 2017).

7.2 Loop descriptions from concept model development

Emotional change happens within families, often from personal, but also occasionally from systemic, risk factors. Many categories of influential family change are recognised with common change examples that include, according to Charles et al (2008):

Internal – happens within group including marriage, divorce, birth, adoption, changing address, etc.

External – takes place in wider community including economic shocks, changed legislation, social acceptance, technological change, population demographics, environmental changes, etc.

Planned – with prior knowledge such as retirement, adult child returners, aged parents move-in, re-partnering, etc.

Unplanned – unexpected event such as death, injury/illness, homelessness, unplanned pregnancy, unemployment, disasters, etc.

Temporary – change of limited duration including treatable condition or jury service, etc.

Permanent – longer-lasting change including becoming a parent, serious injury, etc.

A planned change that most English children experience relates to changing from primary to secondary school aged 11. Emotionally draining for some families, selecting suitable schools capable of meeting everyone's needs is now an extended process, thanks mostly to competition. English academic competition between schools requires test results to reflect provider performance in both primary and secondary schools as children leave.

Test results from Key Stage 4 (KS4) called GCSEs are promoted to reflect current secondary school performances and offer comparisons for parents selecting their preferred schools during the admissions window in year 6. In the urban Plymouth environment, this offers girls the possibility of 15 options with one fewer number of options for boys that parents can choose from. Equally test results from Key Stage 2 (KS2) are aimed at supporting parents to select between primary school providers. Both test regimes represent significant preparation times for children where academic focus is strongly encouraged over other curriculum activities.

To cope with such demands for change in their work environment at school (moving from normal lessons to extended tutoring to pass examinations), children generally rely upon their family and their available networks to cope with transformation in work regime and potential loss of friends upon transferring schools. Thus, family relationships are key to continued emotional stability when moving from primary to secondary school as potentially at least two other stablising elements are removed from the child's emotional microsystem (Bronfenbrenner, 1992) previously described (see pp.57-66). When competition between schools places the child's microsystem under further pressure from the double family stressors of preparing for tests (student burnout) and losing knowledge of local school provision (parent outdates) then socio-emotional impacts can be considerable.

Based on scripted workshop discussions with a multi-agency group comprising council, health and education producing concept model results, a structure describing the emotional state of family members is proposed that represents stability through loop-based influences on individuals that experience feedbacks through psycho-social systems. The feedbacks can either reinforce the observed behaviour by making the indicator variable more vertical over time or balance the observed behaviour by making the indicator variable more horizontal over time (Hayward, 2017).

The following descriptions of the main loop components helps explain the influence of wellbeing in behavioural decision making for the majority of children transferring to secondary school. Table 7.1 provides further details of the SD model development by describing key structural components.

Table 7.1. Key model structure components

#	Name	Description	SD Model Representation (only components in black)
1	Pressure to research schools	P1/D1 calculates the rate of school options research.	 (pressure to research schools 2)
2	Pressure to select schools	P2/D2 calculates the rate of school choice research.	 (pressure to select schools 2)

3	Obligation to talk on things that matter to child	P3/D3 calculates the rate of parent answers provided for concerned children.	 (obligation to talks on things that matter to child 2)
4	Obligation to discuss family needs around dinner table	P4/D4 calculates the rate of student answers provided for concerned parents.	 (obligation to discuss family needs around the dinner table 2)
E1	Exogenous loss of knowledge	Stable stressor derived from external market competition changing services provided.	 (SERVICE PROVISION CHANGE RATE 2)
E2	Exogenous loss of wellbeing	Stable hybrid-stressor reflecting extra student	

		preparation time for competitive testing and adolescent unmet need	(stable rate across three consecutive periods described by TEST PREP BURNOUT RATE y567 2 then EARLY UNMET NEEDS RATE Y891011 2 and finally LATER UNMET NEEDS RATE Y891011 2)

Both important balancing (B1) and reinforcing (R1) loops are identifiable once all described components are assembled into the simulation model that connects wellbeings of both child and parent to the knowledge of how different schools could meet family needs. Emotional balancing between parent wellbeing loss is achieved for many through a raised knowledge of needs that different secondary school alternatives can meet for the family. The balancing loop (B1) is supported by two converter or soft variables (1 and 2 from table) that can explain how long the gathering of relevant knowledge takes different parent types and how delays in visiting schools influence wellbeing recovery for parents deciding between secondary schools.

The reinforcing loop (R1) is defined by a further two, soft variable converters (3 and 4 from table). Here the delays and proportions are associated with family communications where parents are obliged to talk about things that matter to children as are children when answering questions when families regularly gather together. Two exogenous losses (E1 and E2) are also defined within the decision balance that are beyond the control of many families. E1 reflects the outdating effects of secondary schools competing on family-held knowledge of needs that can be met whereas competition also causes children to lose wellbeing from preparing to take examinations (E2). Various stressor rates can be employed over different periods of time in school for testing purposes but a constant rate is assumed for simulating the move towards continuous testing of children studying new curricula.

Figure 7.2 shows the overall causal structure associated with selecting secondary schools in a competitive urban environment such as Plymouth comprising two exogenous outflow stressors from competition, four interacting flows (three in and

another out) and a three-stock system with the key state variable of child wellbeing or CWB (see Glossary xxii-xxviii).
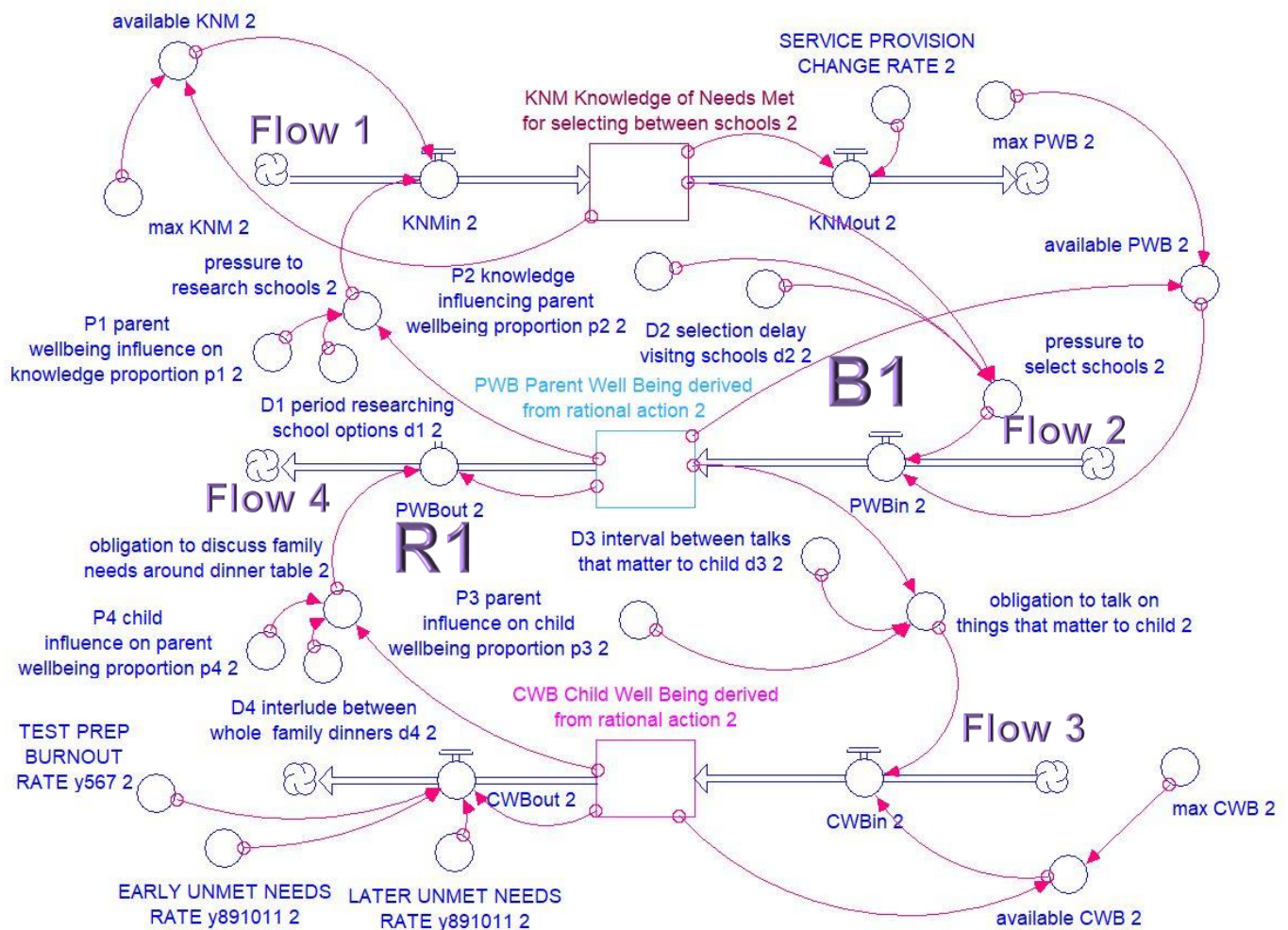
Figure 7.2. Calibrated behavioural model of secondary school choice in Plymouth

Two principal loops (R1 reinforces whereas B1 balances) are shown in the stock flow diagram that develop the ideas presented in the dynamic concept model demonstrated when debriefing expert practitioners on group model building results in Chapter 5 (see p.139 and p.160). The two loops connect three stocks that comprise the family system for behavioural decision making through inflows (1-3) and outflow (4) aligned with earlier concept model developments. Rather than based on bounded, rational decision stocks for maximizing most preferred benefits for those involved in the decision, parent behaviours around school choice are based on their emotional

response to child wellbeing which in-turn influences the knowledge of how schools satisfy family needs.

A simple, three-stock system is used to represent family emotional dynamics before selecting and after attending secondary schools over a total period of 7 years comprising years 5 and 6 (primary education) and 7-11 (secondary education). As the model is reported in days with a quarter of a day for calculating each new increment to avoid integration errors. This corresponds to timescales noted in Chapter 2 for studies of student dropout in Nicaragua (Guavara *et al*, 2005).

From top to bottom, the first stock reflects ongoing knowledge of how education providers meet family needs and is normalized as a percentage (non-dimensional units as numbers of needs to be met will vary between families) to reflect the combined needs of student and parent. In the context of a family group deciding schools, 50% of the needs to be met are allocated to either parent or student. The stock is stressed by exogenous losses from active competition between secondary education providers which serves to erode knowledge stocks in an urban setting, where one percent of the marketplace is assumed to change every four days in an urban setting such as Plymouth (DMK outdated rate per day is based on local secondary schools reflecting government initiatives and instructions for standards provided within the same quarter). This is not an unreasonable assumption for constant loss as both the government make changes at the same time as individual schools respond to governance signals in different ways. Knowledge of needs met continues throughout secondary school to consider alternatives should needs no longer be met and a change in providers required. Knowledge of needs met once again rises from selecting sixth form colleges.

As parents require a knowledge of needs met throughout secondary education (as well as preceding school selection) to ensure a good fit to student needs, the stock continues to be calculated throughout the simulation run in anticipation of further school change issues. However, the loops reflecting choice of further education are not reproduced in the chart as these would also connect to student wellbeing stocks as they begin to take more responsibility for ongoing education paths at this stage rather than just relying upon parent views of the market place alone.

Parent wellbeing is also normalized and represented by a percentage (non-dimensional units are chosen for the same reasons as those selected for CWB). By only studying school choice concerns and family behavioural responses within the model, gains and losses to the system are controlled by what knowledge is established for schools able to meet developing needs and satisfy their child's wellbeing demands while transferring schools and beyond. First order controls (where zero stock would terminate an outflow) are applied to the stock to avoid negative stock of wellbeing which has no meaning in the real-world.

In a similar way to that of their parent, child wellbeing is organized but with one important difference. Here a further exogenous loss is calculated to represent a further schools' competition stressor based on children preparing for tests over ever-extending periods. Again, set to a value where a quarter percent is lost each day (CWB burntout rate per day represents the loss of wellbeing between daily family interactions and those held most days – The Children's Society, 2013: Figure 31, p.39 refers), as a cumulative stressor rather than having an overshoot and collapse behaviour associated with home-based, overtime burnout in the shorter term. This would seem reasonable as both government and schools place competition demands on children, not only at the end of each period of education based in a school but also within it (streaming and other regular tests plus the emotional drain of adolescence).

All stocks were initialised in a steady state for either a STD (see Glossary xxii-xxviii) or SEND family situations (reflected in timing variations being applied) prior to setting proportional influences - called diverters - to reduce effect at successive calculations based on a proportion of a half. However, the proportion of an eighth better signifies a disadvantaged family in the target group where many diverters (see Glossary xxii-xxviii) apply rather than only two represented in the balanced, steady state. As the target group at risk has been deduced as autocratic, the final setting to achieve a base run requires maximum knowledge of needs met to be set to 50%. This stock configuration represents the point from which different policy tests can be applied as the family psycho-social system responds to the challenge of selecting schools within autocratic families.

Both loop dynamics are described in detail next. Starting at inflow 1 (DMKin percentage rate per day), the influence from parent wellbeing is calculated by the soft variable entitled pressure to research schools. This variable calculation subtracts the value of PWB (see Glossary xxii-xxviii) from 100 percent before multiplying the result by the influence proportion P1 before dividing by the delay interval D1 set in days. This calculation produces a negative influence so that when parent wellbeing reduces the inflow rate for knowledge on needs met by schools increases (DMKin) resulting in gathering more knowledge. Moving onto inflow 2 (PWBin rate per day), the influence from knowledge of needs met by schools is calculated by the soft variable entitled pressure to select schools. This variable calculation takes the value of KNM (see Glossary xxii-xxviii) and multiplies it by the influence proportion P2 before dividing the result by the delay interval D2, once again set in days. Hence as knowledge stocks rise, so does the inflow rate of parent wellbeing for regaining a degree of perceived control over school choice. This pair of stocks forms the balancing loop B1.

The social balancing loop is supported by a further psychological loop between the family members participating. Thus, a reinforcing psychological loop supports both parent and child as they transfer into secondary education where uncertainties of changing workplace and friends can be compensated through family relationships.

A further trio of first order controls represented by balancing loops are now introduced that work on the inflows to each of the stocks performing the same function of controlling levels to a preset value. Available stock results from subtracting actual stock from maximum stock values to indicate a difference target which when zeroed ends further flows. These are all initialized at 100 percent to ensure that stocks do not overflow with meaningless values. However as mentioned earlier, for autocratic parents this variable is modified to represent the denial of child needs when deciding schools by the parent where only half the needs are met (some of which may help the child as well as the parent and other family members).

7.2.1 Knowledge exploration of balancing loop B1

A strong balancing loop helps moderate emotional uncertainties for parents while offering the potential to mediate the worries of children involved in secondary school choice as a 'second order' effect. Specific needs are prioritised by families in

selecting schools to ensure the best fit of school to personal requirements. Whereas secondary schools are no different in this respect to primary schools, they are larger in size and thus fewer in number, where subjects are taught by specialists. Thus, family needs of secondary schools are unlikely to reflect those used to select primary schools: ensuring access to local friends can dominate parental decision making for example. Once a working knowledge of needs met by secondary school providers has been gathered by parents then the recovery of their own wellbeing helps balance the need for further research.

Once more, competition creates a further exogenous loss from the system that represents another stressor for wellbeing within the family unit. As indicated on page 27, outdating of knowledge from competitive secondary provision across England occurs on a regular basis at national government, local authority and school provider levels for all generations. Such eroding forces require additional, personalised research each year to ensure that school reputations are deserved, for example to compensate for the estimated quarter percent loss each day corresponding to an whole percentage point change in the secondary school landscape every 4 days. Figure 7.3 illustrates how knowledge of needs being met balances parental concerns during school selection.

A soft variable established for inflow 1 is given the title 'pressure to research schools'. Face validity from initial inspection confirms correspondence to something that most parents perform in the real world (Loundsbury and Gambardarella, 2015) while predicting a knowledge of needs met response behaviour as comparisons between providers establish family requirements. Under such circumstances, additional knowledge can be imparted to the parent selecting schools where a proportional influence - lying within the normalised range - is used to reflect common diversionary factors within the family unit. The value of proportional infleunce exerted on the variable is initially set to a half. A halving proportion reflects an idealised position for families with time and resources to cope with the demands of school choice (a parent at home running the household and choosing schools for example). What is also perceptible is the period between such research-based acitivities. This was set to the two month window allowed by the enrolment process plus the preceding summer holiday period. Following conversations with parents of children with special needs (PIAS, 2015), it was apparent that up to a year was more usual due to the complexity of needs to be met. Given a complex range of needs to be met, several parents mentioned they were seeking to understand SEN secondary school support for their children currently in year 5 of primary school.

A final soft variable for inflow 2 is given the title 'pressure to select schools'. Face validity confirms correspondence to something that most parents perform on behalf of their children in the real world (Loundsbury and Gambardarella, 2015) while predicting parent wellbeing response behaviour as confidence is recovered (or not). Under such circumstances, additional parent wellbeing can be imparted to the parent with sufficient knowledge of school providers options by adopting the same proportion of a half where one other diverter is present that takes their attention away from selecting between competing schools. What is tangible is reflected by the period between such decision events, where standard families take less than a month based on survey returns whereas families deciding SEND requirements were allocated the whole enrolment window of two months for example.

The B1 balancing loop ensures that stock behaviours over time become more horizontal (Hayward, 2017) reflecting the fact that lower parent wellbeing raises knowledge gains for how needs can be met by schools as parents gather knowledge concerning their personal, school selection problem. Lower parent wellbeing serves to increase the acquisition of knowledge on schools able to meet key needs which then help satisfy parent concerns leading to a cycle in psychological balance.

7.2.2 Family relationships reinforcement loop R1

Strong family reinforcing can work to fulfill student wellbeing or deplete this key resource (Gaynor, 2015). As suggested in an article by famed rugby players (Jones, 2017), mental ill health issues regularly stem from adolescence and issues of communication. "When I was twelve if I didn't play well or missed a few tackles, my father would not speak to me for the rest of the day. The way I saw it was that just a few mistakes in a game affected how he viewed and loved me. So I decided that was the way everyone was, and that I had to be perfect to keep people loving me…For the next six or seven years, I was anxious all the time about everything in my life…At the age of nineteen, my brain was in a place where I couldn't cope with the stress…It just snapped…yet I am very close to my family…Dad was devastated when I spoke to him (saying) he was terrified that if I played poorly he would say something too emotional that would hurt my feelings. So we both stayed silent."

Such accounts from highly-driven professionals suggest that communication is key to constructive family relationships that are capable of adding to student wellbeing. In this regard, secondary data (The Children's Society produces longitudinal surveys each year entitled the Good Childhood Report or GCR – that show student wellbeing declines throughout periods of secondary education for all children but recovers again with sixth form and college choices) suggests that meaningful discussions on 'things that matter' need to take place on a regular basis between parents and their children to avoid such long-lasting and detrimental misunderstandings. The Children's Society (2013: p.39) suggest that weekly discussions with parents on things that matter to the child are important with a positive linear relationship between frequency and child wellbeing that adds to their feeling of support.

However a more likely interval for children to talk on things that matter is 7.5 days of which one in four (Ecological Systems Theory suggests at least four influential

elements in microsystem stabilising influences for a child: Brofenbrenner, 1992) concerns their needs met by secondary schools (future teaching stability) rather than completing homework (current teaching stability), peer communications (neighbouring friend stabilising factors) or family activities outside of school (The Children's Society, 2013: p.31). This extends the interval on discussions around needs met by secondary schools to 30 days. 'Children who more frequently talk to family about things that matter and see extended family tend to have higher subjective well-being. There was no significant association for frequency of chatting with friends' (The Children's Society, 2015). Schrodt and Ledbetter (2007) note the value of regular positive communications on wellbeing within family units, irrespective of family make-up i.e. whether original or rebuilt marriages are involved.

The resulting soft variable for inflow 3 is therefore given the title 'obligation to talk on things that matter to child'. Face validity confirms correspondence to something that most families feel for their children in the real world (Loundsbury and Gambardarella, 2015) while predicting child wellbeing response behaviour as confidence is imparted or otherwise. Under such circumstances, additional parent wellbeing can be imparted to the student changing schools, subject to other diversionary factors reflected in the normalised range (0-1). At equilibrium, the halving ratio is again set to describe the proportion of attention ascribed by parents to answering concerns of the student during transfer to a new school. What remains most tangible is reflected by the period between such discursive events, as described. Such a configuration reflects how a family copes with exogenous losses while negotiating the relational tensions of selecting new schools.

Equally the opportunity for children and siblings to share experience and needs with parents at the dinner table is becoming less frequent according to recent surveys across England (The Children's Society, 2017). In a deductive study on the influence of mealtime frequency on adolesent perceptions of family communications (Fulkerson etal, 2010), positive associations are noted between frequency of shared dining within families and constructive perceptions of parent-child communications by adolescents and pre-pubescent children in years 6 and 8. Whereas Canadian children in the study dine with parents most days, discussions concerning family needs met when comparing secondary (or Canadian high) schools are assumed to take place less frequently, even during year 6 when decisions have to made.

In this case a more likely interval for whole family dinners across England is again 7.5 days (Sunday lunch is a tradition) of which one in four might concern their needs met by secondary schools rather than parent enquiries concerning housework tasks, transport arrangements or social events which also feature at such gatherings of family members for their reinforcing influence on child wellbeing (The Children's Society, 2013.p.31) This extends the interval on discussions around needs met by secondary schools to every fourth meal or an interval equaivalent to 30 days.

Regular dining together is considered a factor for promoting healthy development in children as they become adolescents in part, due to children recognising that adults are willing and able to allocate time to family-based activity on a regular basis. Such allocation of scarce time is seen as a potential protective factor for children in year 6 over subsequent years. Fostering strong social exchanges over other meals may also be possible but whereas breakfast is generally time-constrained, evening dinners are not under the same time pressures that face modern family living in the UK today. Elgar etal (2012) even note that not only positive wellbeing can result from frequency of sharing meals, so can prosocial behaviour and life satisfaction while reductions in internalising and externalising problems associated with mental ill health for adolescents occurs for a wide range of gender, age and affluence.

The resulting soft variable for outflow 4 is therefore given the title 'obligation to discuss family needs around dinner table'. Face validity confirms correspondence to something that most children feel for their families in the real world (Loundsbury and Gambardarella, 2015) while predicting parent wellbeing response behaviour as confidence is imparted (or not). Under such circumstances, additional child wellbeing can be imparted to the parent selecting schools where another halving proportional influence is configured that relates to shared family diverters for establishing an equalibrium i.e. lying within the normalised range. What is tangible is reflected by the period between such discursive events, as previously mentioned.

The communication mechanism in family relationships is therefore clear where students seek parent views on things that matter to them and parents explain family needs during regular interactions around the evening dinner table. This reinforcing family action to support child wellbeing also operates in reverse to rapidy deplete the wellbeing of students when miscommunicated (see earlier rugby playing example).

When meanings are misunderstood by parties, then lack of discussion with parents rapidly causes confusion for children that slows the inflow of wellbeing to students (apparent emotional upset associated with failure to win the match in the case cited) which serves to raise the outflow from parent wellbeing that the repeats the cycle by further slowing child wellbeing when not being discussed in regular family gatherings.

A further exogenous loss resulting from primary schools competing for league table positions, is also described by emotional burnout experienced by children preparing to be formally tested during enrolment for the first time (government proposals for even earlier reception class testing were proposed but eventually rejected based on parent and primary school objections DofE, 2017). Effectively a constant rate of loss at quarter of a percent each day is assumed. It comprises a reducing burnout factor (earlier and later loss contributions from unmet needs at the selected secondary school based on relevant timings from years 8 and then 9, prior to CGSE courses commencing). No attempt to reflect burnout detailed variation is provided as the model purpose differs from that of the original concept that illustrated shorter-term effects. Figure 7.4 illustrates how familial relationships reinforce school selection.
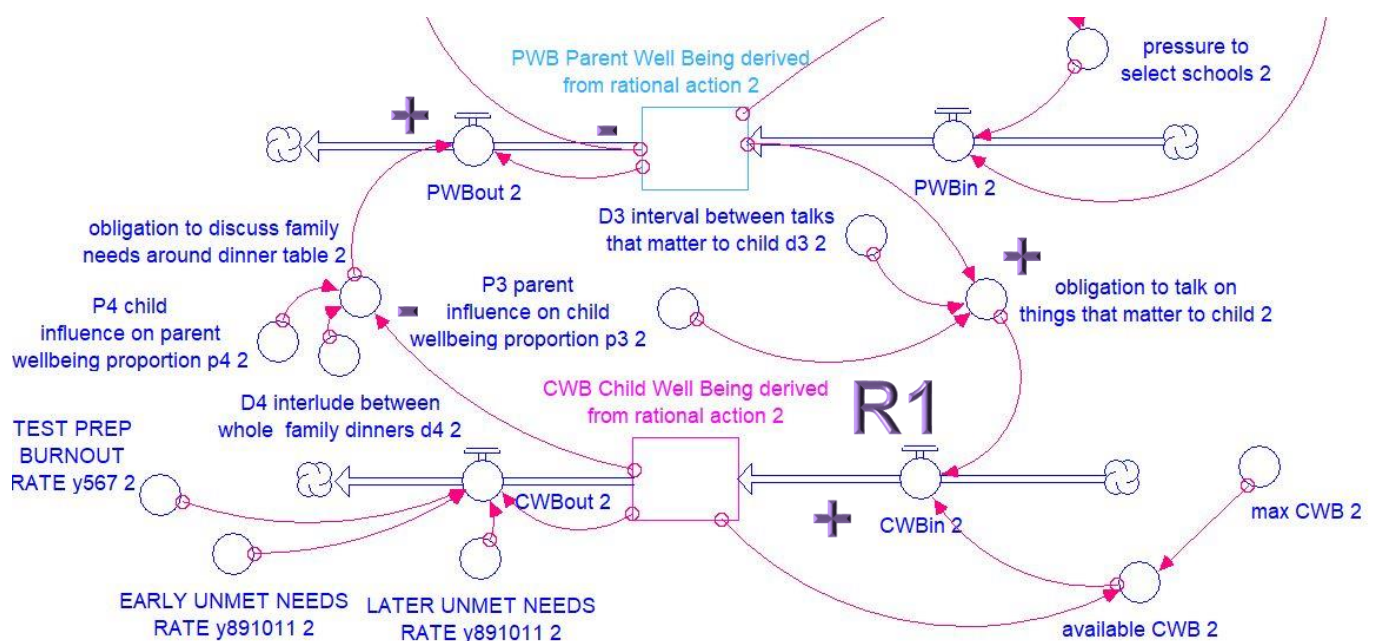
Figure 7.4. Family relationship reinforcement during secondary school selection (R1)

For a description of the reinforcing loop R1, we commence with inflow 3 (CWBin rate per day), the influence from parent wellbeing is calculated by the soft variable entitled

obligation to talk on things that matter to child reflecting the willingness of parents to engage in the school choice debate. This variable calculation takes the value of PWB and multiplies it by the influence proportion P3 before dividing the result by the delay interval D3, set in days. Hence with rising stocks of parent wellbeing there is a corresponding rise in emotional gains for the child. Ending with outflow 4 (PWBout rate per day), the influence from child wellbeing is calculated by the soft variable obligation to discuss family needs at dinner. This variable calculation takes the value of CWB away from 100 percent before multiplying by the influence proportion P4 and dividing the result by the delay interval D4, set in days, to produce a negative influence on the outflow rate of parent wellbeing so that when child wellbeing increases so does the stock of parent wellbeing as losses are stemmed. This pair of stocks concludes the reinforcing loop R1.

When achieving an emotional balance within the unit family deciding between secondary schools, the R1 reinforcing loop ensures that stock behaviours over time become more vertical (Hayward, 2016) reflecting the fact that lower child wellbeing drives down retained parent wellbeing as they observe and respond to each other. Lower parent wellbeing further slows the recovery of child wellbeing leading to a vicious (or virtuous after a tipping point is encountered within the loop) cycle of reinforcement. Two soft variables (Loundsbury and Gambardarella, 2015) representing family obligations are described in the reinforcing loop R1.

Parents are obligated to discuss family needs at common gatherings. The evening dinner table is one such gathering that is becoming less frequent as time pressures mount on individual family members. Here, parents and other siblings can air their own views for comparison with those of the student changing schools to offer some challenge of needs. By contrast children changing schools are obligated to ensure that they seek parent views on what matters to themselves when preparing to transfer to ensure that they can recover from reduced levels of wellbeing. The Children's Society provide further details of longitudinal surveys results annually (The Children's Society, 2011-2017) that include current states of self-reported student wellbeing across England.

7.3 Parametrization of structure with real world values

Group Model Building has provided concept model validity of the structure employed through a debriefing script known as Workbooks[40]. Parameterisation of the System Dynamics model further enhances the structural validity by reflecting values obtained from other primary and secondary data sources on the topic of secondary school choice complexity and student wellbeing fluctuation. The data used within the structures therefore relates to real world values derived from various sources. The details of the completed Workbook script are provided in Appendix 5 alongside full model equations in Appendix 7. Results from the Workbook agreed by group model builders confirm the suitability of stock flow structures around a family school choice system for Plymouth.

7.3.1 SEND and standard child emotional balances

Both extremes of student wellbeing need to be considered in modelling policy impacts based on the needs of standard mainstream students and the extra requirements from SEND children. It is essential to check proposed policy changes by testing for minimising adverse impacts from unforeseen and unintended consequences to either group of students at different ends of the learning spectrum to have confidence in policy projections for a population. Thus, balances for stocks are established for each situation (STD or SEND) based on the same system configuration but with different initial stock values that remain in equilibrium throughout the simulation run. For example, the configured system achieves a dynamic balance at lower levels of child wellbeing in the case of SEND families when facing the issues of transferring between schools.

7.3.2 Autocratic to democratic knowledge of needs met by schools

As surveys indicate that inexperienced parents are more numerous (almost half the sample compared to far smaller numbers reporting family health problems for example) and favour deciding for, rather than with, their children. It is therefore reasonable to believe that autocrats may represent a significant group within

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[40] A workbook is a scripting technique for gathering results from GMB workshops together for review by participants who attend all or only part of the sessions.

Plymouth that may not accurately select secondary schools, based on all family needs being met by the most suitable provider.

Modelling this subset of families within Plymouth, where the knowledge of needs met by potential school options may be limited, is therefore important. The two extremes within the autocratic subset of parents (standard and SEND), have specific system timings that maintain different emotional balances under normal conditions alongside knowledge of how schools could meet their needs. Given values established based on parent views and secondary data, it is possible to determine initial stock values that support a dynamic equilibrium state for each family type. The ability of system dynamics modelling to reflect social systems in a balanced, steady-state is a key strength of the system technique.

Based on seeking answers from Plymouth parents about to decide secondary schools in their perceived window for making decisions, five styles were considered as previously discussed based on Table 7.2. Using the definitions provided in the table, Ai, Aii and Ci have little chance of considering the future needs of a student changing from primary to secondary: for example, Ci may seek other family member views but this could include grandparents with potentially far greater influence on the final outcome with outdated knowledge from two generations ago.

Table 7.2. Classifying the decision-making styles of parents in Plymouth (based on Vroom and Jago, 1988)

AUTOCRATIC RESPONSES FROM SURVEY
Ai= use information already available to make your own (school selection) decision;
Aii=ask family members for specific information (knowledge of needs met by school) but not explain why before making a personal decision;
Ci=gather information (on schools) from individual family members and others before deciding yourself;
DEMOCRATIC RESPONSES FROM SURVEY
Cii= gather family for discussion (school selection) to gather perspectives and suggestions before deciding in private;

Gii=facilitate family discussion by helping them arrive at final decision based on consensus (choose between options before agreeing most preferred school).

At the other extremity of situational leadership, Gii in the table suggests all needs would be considered and the majority met when selecting a most preferred school. Whereas Cii is decided by the parent, it also offers group-based views on what would meet future needs for flexibility that children can encounter around adolescence, where a restrictive GCSE driven schedule may not allow the student to cope. The two extremes of family decision model are therefore represented for testing purposes by reducing from a maximum of 100% of knowledge around family needs (parent and child) to 50% where only parents decide schools. As the at-risk family group, autocratic styles of school decision making are now the group to test policy changes against to seek improved performance through targeted intervention.

7.3.3 Time scales for test preparation and subsequent dropout

Adopting a time scale of seven years or 2555 days reflects the period covering competition in academic years 5 and 6 (primary school) plus years 7, 8, 9 ,10 and 11 (secondary school). In the case of those children not preparing for grammar school during year 5, this would shorten their preparations and studying for secondary school to only six years or 2190 days. Test preparations commence with tutoring for selective entrance tests to Plymouth grammar schools for some students in year 5. Selective testing is followed by primary school coaching for all students who are obliged to take KS2 SATS at the end of year 6. Frequently Plymouth secondary schools must also stream-test year 7 entrants to reduce large cohort intakes to manageable class sizes of similarly matched capabilities. Final year GCSE testing requires the last two years in secondary school. Largely devoted to tutoring children to pass their examinations, children are constrained by a fixed curriculum throughout this period to achieve academic results, during or just after experiencing puberty.

7.3.4 Surveyed timings from pilot interviews and responses

All parents who responded to the survey answered questions regarding the time taken to decide schools. Whereas the majority did not suggest their child had Special Educational Needs and Disabilities (SEND), at a 2015 Plymouth Information, Advice

and Support for SEND conference, all parents who responded suggested that they took more than a year (365 days minimum) to decide schools as they had their child's complex needs to consider and finding the best school to meet these demanding requirements commenced in year 5. This was acceptable since secondary schools adopted the policy to routinely extend an invitation for open evenings to parents in Plymouth requiring a place for their child two years hence. Peters *et.al.* (2008) even note that 'parents of a child with a Statement of SEND were all more likely than average to feel very involved' based on their study of parental participation in children's education.

In contrast to this extended period of researching needs met by schools, parents not suggesting any special or additional needs took less time as per survey results. As the mean time to research was biased towards 3 months based on response count, a mean of 90 days was selected to represent the standard period of research. When deciding preferences from those schools chosen, less than a month (20 days estimated based on time between open events starting and ending) was standard but the whole period was necessary for SEND families (60 days).

7.3.5 Local child wellbeing

As noted in the report investigating commuting to work (ONS, 2014), researchers also connected reduced wellbeing with raised anxiety in a similar way to views expressed by expert practitioners in Plymouth. When consulted on child anxiety and associated wellbeing at key life transitions, plots of key state parameters overtime were sketched as previously described by expert practitioners (see pp.143 -144). It is noted that chronic stress represents a prolonged state of tension, both from internal and external stressors, sometimes resulting in physical indicators for the child. Chronic stress is not the same as acute stress which helps maintain an individual's stress response system to remain effective on a daily basis in a similar way where a deep discharge helps maintain cell charge capacity performance in a battery.

7.3.6 Knowledge of needs are met by providers

Parental wellbeing levels also reflect perceived risks to their children (Barnett and Gareis, 2008). Significant risk factors perceived by parents for their children include changing schools and associated preparations. The noted difficulty with regression

model testing is the inability to distinguish cause and effect, in this case between parent and child within family units. Under these circumstances, considering a fundamental family unit is better supported by using a System Dynamics modelling approach. Here feedback exists between the actors in the psycho-social dynamic system that can be modified by behavioural factors were required to demonstrate which causal change has what effect over time on system artifacts.

Whereas Sterman (2000) explains system dynamics modelling at an aggregate level for creating specific behaviours, a psycho-social dynamic model offers a smaller scope as it refers to relationships between individuals within the family unit that can be tested as a system when tasked with decision making. For example, aggregated morale of a family can be explained by how individuals interact to reinforce values held in common rather than apply a set of family rules that ensure a family remain motivated through interventions that minimize losses to morale. Using a psycho-social dynamic approach therefore enables the study of family reactions to challenges including external stressors associated with school choice and subsequent transfer.

Family type determines initial levels of knowledge plus child and parent wellbeing. Here decision-system intervals are estimated from primary and secondary data sources before adjusting the initial stock values to define unique, system balance points representing separate steady state equilibria for key family types. As a percentage, parent wellbeing is based on satisfaction derived from the rational actions taken when facing the challenge of secondary school choice amongst other factors. Full details of rationalized choices that parents use deciding schools across England are reported, including factors affecting secondary school admissions, by Coldron et al (2007). Ellison and Aloe (2018) report how similar school choice decisions are made by parents in the USA. Notable shortfalls in English secondary schools from a survey of 187 parents responding about year 7 experiences for their child (Evangelou etal, 2008) include several unmet student needs (ones that could have been determined by suitable research/visit questions), leading to student disaffection and even potential dropout (ticks listed below) shows needs that could be determined prior to selection:

- ✓ Arrange more induction, open, taster days and other visits (61parents or 32.3% of sample);
- • Increase communication with parent (16 parents or 8.5% of sample);
- ✓ Offer more explanation about school routines (15 parents or 7.9% of sample);
- ✓ Help them cope with more homework (15 parents or 7.9% of sample);
- • Give more help and be more lenient during initial period (15 parents or 7.9% of sample);
- ✓ Deal better with children's individual needs (14 parents or 7.4% of sample);
- ✓ Provide more help with travel to school (11 parents or 5.8% of sample);
- ✓ Place children together with more of their primary school friends (8 parents or 4.2% of sample);
- • Better links between primary and secondary school (8 parents or 4.2% of sample);
- ✓ Protect child more effectively from bullies (7 parents or 3.7% of sample);
- ✓ Give them a peer mentor (7 parents or 3.7% of sample);
- ✓ Help them with meeting other children and making new friends (6 parents or 3.2% of sample);
- ✓ Boost child's confidence and social skills to mix with others (6 parents or 3.2% of sample).

It is noted that potential student disaffection with secondary schools could be associated with a lack of school comparisons where almost a third of parents believed greater access was needed to schools compared to less than a tenth of those believing school routines might need further explanation.

7.3.7 Stock balance point adjustment process

Based on timing associated with standard and SEND family types, the process used for determining different psycho-social dynamic family steady states comprises four elements.

A - family system double stressor assumption where knowledge is regularly outdated by competition from other providers, local authority admission changes and English government departmental policy change such as the re-introduction of national grammar schools. Additionally, children (those preparing to compete in tests) can

experience psychological burnout without adequate time management support based on initial concept model behaviours demonstrated to expert practitioners;

B – such double stressors cause confusion and less clear communication within family resulting in inexperienced parent bias towards autocracy and selection of most preferred school unable to meet child needs for adolescent flexibility amongst others;

C - standard and special needs timing for different types of family mean that testing must consider both groups to effectively avoid policies that could adversely affect either family category that span the whole range of emotions;

D - family residual stock adjustments can then offer single equilibrium points to reflect either group once timing is configured based on double stressor at least halving attention in all families.

Results from this process indicate that different balances were achieved for stock levels for standard (STD) and Special Educational Needs and Disabilities (SEND) as indicated in table 7.3.

Table 7.3 Balancing stock levels for STD and SEND cases

Initial stocks balance points for unperturbed system			
Knowledge of Needs Met (KNM) %	Parent Wellbeing (PWB) %	Child Wellbeing (CWB) %	Case
35	76.4	83.6	STANDARD
28	29	66	SEND

It is notable that low levels of the stock of needs met provide initial emotional balances for both types of family i.e. not an overriding consideration for the majority within the subset of families considered to be vulnerable.

7.3.8 Pilot interview data

Certain anecdotal data was obtained through initial parent interviews associated with testing for rational choice (tested using multi-criteria decision analysis techniques). The data not only informed charaterisation of timing for different types of family

including those with standard (STD) and Special Educational Needs and Disabilities (SEND) children, it also ensured a degree of realism in explaining the questions to parents and seeking follow-up answers where responses required further investigation. Several confidence buildings tests were needed including taking values to extremes to demonstrate benign and reliable model behaviours (extreme values test), ascertaining dimensional consistency of the units employed (dimensional consistency check) and lever sensitivity checks for limited variations from the normal state (sensitivity assessment).

7.4 Extreme value testing

Once balance points have been achieved that describe the family's steady emotional state on needs met by schools, it is then possible to check the effect of large and sudden deviations. For example, by initiating stock values at extreme values (either unrealistically high or low for example), the system response can be observed for the degree of realism exhibited. Key variables are individually given extreme values to ensure behavioural consistency of the model's dynamic response even though such conditions are unlikely to ever be encountered in practice.

For example, Figure 7.5 illustrates the initial impact of zero knowledge where a corresponding worry is registered by the significant reduction of parent wellbeing prior to recovery and slight dip in child wellbeing in the standard case. The chart is divided into tables giving final values, influence assumptions and system timing variables alongside any policy lever factors being applied (here the value one indicates business as usual whereas a fraction suggests leverage is applied: details of which can be found in the next chapter). By contrast, the lower half of the chart shows the graphical response of key stocks in the model based on initial conditions. The response indicated is consistent with a system under control where parents become more concerned initially with reductions in their own wellbeing that then seeks knowledge after a delay to recover composure by rebalancing the system to a steady state, once knowledge recovers after only a year. The system response to the extreme value test is therefore acceptable but does not represent reality as there are few scenarios where all needs met knowledge is lost at the outset, possibly with the exception of Plymouth immigration from beyond the city.
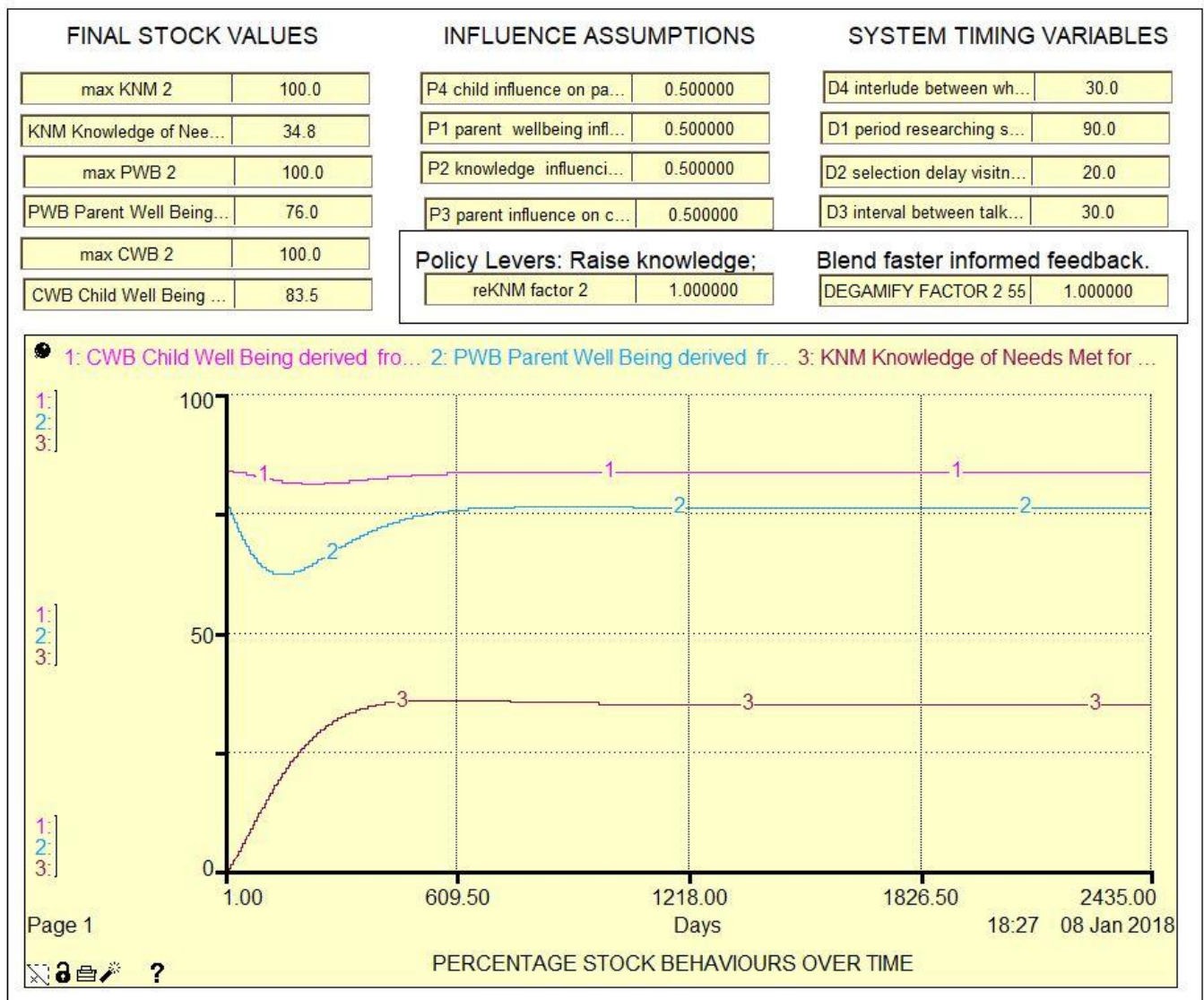
Figure 7.5. Chart of simulated response to recovering from initial loss of knowledge (standard case) building confidence in system damping controls for balance.

As both standard and SEND cases have different sensitivities, the test is repeated to ensure that the modified system responds in a manner that can also restore emotional balance to such family groups. Figure 7.6 again demonstrates that by removing initial knowledge from the system a response can also be explained for SEND families that tests extreme values. Whereas knowledge recovers after only a year, the response from parent and child is far slower as they attempt to rebalance their individual levels of wellbeing. Again, within the SEND family parent wellbeing reductions enable knowledge of needs met by secondary schools to be recovered

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but rather than a year taken by a standard family, the SEND family system takes over two years for parent regaining their steady state balance and up to three years for the child. Such a response suggests that the SEND family are more impacted by change as they take far longer to recover their initial composure and this is consistent with practice.

FINAL STOCK VALUES		INFLUENCE ASSUMPTIONS		SYSTEM TIMING VARIABLES	
max KNM 2	100.0	P4 child influence on pa...	0.500000	D4 interlude between wh...	30.0
KNM Knowledge of Nee...	28.0	P1 parent wellbeing infl...	0.500000	D1 period researching s...	365.0
max PWB 2	100.0	P2 knowledge influenci...	0.500000	D2 selection delay visitn...	60.0
PWB Parent Well Being...	29.2	P3 parent influence on c...	0.500000	D3 interval between talk...	30.0
max CWB 2	100.0	**Policy Levers: Raise knowledge;**		**Blend faster informed feedback.**	
CWB Child Well Being ...	66.0	reKNM factor 2	1.000000	DEGAMIFY FACTOR 2 55	1.000000

Figure 7.6. Chart of simulated response to recovering from initial loss of knowledge (SEND case) demonstrating longer return to balanced, steady-state conditions.

Thus, the system response to zero knowledge varies between standard (STD) and SEND system balances but both have common characteristics that recover equilibrium after a period of change lasting longer than a year. Both system responses are explainable therefore promoting confidence in the ability of the system

to predict trends from different policies affecting different types of family system. Equally, utmost knowledge of how schools meet needs with comparable examples offers an unrealistic but extreme test for STD and SEND family systems.

7.5 Dimensional consistency checks

Dimensions employed within the parameterized model are required to be consistent to ensure that the equations describing dynamic flow behaviours are sound. Coyle (1996) describes a mass balancing technique that infers confidence in model units. A further description of dimensional consistency checking for system dynamics modelling is provided by Qudrat-Ullah and Seong (2010) which is applied here.

Units of measure for defined stocks include:

- UoK - Units of knowledge (0-100% NDU)
- UoW - Units of wellbeing (0-100% NDU)
- Time taken (days - T)

Rate equations used in the model for stock inflows and outflows can be tested to confirm consistency of units on both sides of equations i.e. from the model using primitive dimensions of Current I, Temperature K, Mass M, Length L and Time T to relevant powers.

Rate equations take primitive dimensions of [I][K][M][L][T-1] where I is current, K is temperature, M is mass, L is length and T-1 represents inverse time. Therefore, looking at variable/rate equations individually reveals primitive structures that are accounted for in Table 7.4 with percentage or proportions represented by Non Dimensional Units (NDU).

Table 7.4. Dimensional consistency checks on rate equations in family system

Rate-related equations within model	Prim- itive units
PWBout_2 = PWB_Parent_Well_Being_derived__from_rational_action_2*obligation_to_discuss_family_needs_around_dinner_table_2/100	NDU [T-1] = NDU

	NDU [T-1] / NDU
obligation_to_discuss_family_needs_around_dinner_table_2 = (100- child_Well_Being_derived__from_rational_action_2) *proportion_of_child_influence_on_parent__wellbeing_p4_2 /interlude_between_whole__family_meals_d4_2	NDU [T-1] = NDU NDU [T-1]
CWBin_2 = available_CWB_2*obligation_to_talk_on_things_that_matter_to_child _2/100	NDU [T-1] = NDU [T-1] / NDU
obligation_to_talk_on_things_that_matter_to_child_2 = Parent_Well_Being_derived__from_rational_action_2 *proportion_of_parent_wellbeing_influence__on_child_wellbeing_p3_ 2 /(interval_between_talks_that_matter_to_child_d3_2*DEGAMIFY_FA CTOR_2)	NDU [T-1] = NDU NDU [T-1]
KNMin_2 = available_KNM_2*(pressure_to__research_schools_2)*knowledge_of _whole_family__needs_2*crisis_of__confidence_2/(100*reKNM_facto r_2)	NDU [T-1] = NDU NDU [T-1] / NDU
pressure_to__research_schools_2 = (100- Parent_Well_Being_derived__from_rational_action_2) *proportion_of_parent__wellbeing_influence__on_knowledge_p1_2 /school_options_research_delay_d1_2	NDU [T-1] = NDU NDU

	[T-1]
PWBin_2 = available_PWB_2*pressure_to__select_schools_2/100	NDU [T-1] = NDU [T-1] / NDU
pressure_to__select_schools_2 = Knowledge_of_Needs_Met_for_selecting_between_schools_2 *proportion_of_knowledge__influencing_parent__wellbeing_p2_2 /(school_visits_selection_delay_d2_2*DEGAMIFY_FACTOR_2)	NDU [T-1] = NDU NDU [T-1]
KNMout_2 = KNM_Knowledge_of_Needs_Met_for_selecting_between_schools_2* SERVICE_PROVISION_CHANGE_RATE_2*crisis_of__confidence_2 /100	NDU [T-1] = NDU [T-1] NDU/ NDU
CWBout_2= CWB_Child_Well_Being_derived__from_rational_action_2*(TEST_P REP_BURNOUT_RATE_y567_2+EARLY_UNMET_NEEDS_RATE_y 891011_2+LATER_UNMET_NEEDS_RATE_y891011_2)/100	NDU [T-1] = NDU [T-1] / NDU

Dimensional checking therefore confirms the consistency of equations used in system dynamics model (where NDU = Non-Dimensional Unit and T-1 = per unit of time).

7.6 Sensitivity analysis of potential levers

Smaller variations in individual variables can be tested to understand where potential levers to counter problem behaviours may exist. In steps of 5%, separate variations

in all key input variables (those values not calculated by soft variables for example) are observed for impact across the system. The range of +-15% was selected based on typical STD and SEND family system behaviours to give the results for increasing child wellbeing highlighted in Tables 7.4 and 7.5 respectively. Only those factors responding to the state parameter of child wellbeing (CWB) are noted.

The percentage range spans a 30% total variation in each model variable which gives six points either side of the steady state value that can help interpolate overall impacts of change. Six points are considered adequate to ensure that significant sensitivity to change can be detected across different family systems (both STD and SEND) as this does not need to test extreme change but merely model-based sensitivity to change. The modelling could extend to determine other balanced family emotional states that characterise alternative family types but two are sufficient to ensure that helpful policies applied to one group, have no adverse consequences for the other. Equally potential sensitivities of one group (such as the more sensitive SEND case where CWB is lower from the outset) can lead to better outcomes for the majority (STD in this example).

The tables show percentage adjustment of variable inputs in the columns (+ indicates up whereas – describes down) against the calculated variables that could be affected by such a change elsewhere across the model. All three stocks are present and child wellbeing (CWB) is highlighted for only those inputs factors in columns that positively increase levels of CWB i.e. observed after simulating the input variable change. The first case considered in Table 7.5 is that of the standard family where relatively short research durations are featured when considering the transfer of children between primary and secondary schools. The initial results suggest a largely insensitive model where little change takes place.

Table 7.5 Sensitivity test results for inflow 3 proportion and duration increments and decrements (STD case)

Name	p3	p3+5	p3+10	p3+15	d3-15	d3-10	d3-5	d3
available CWB	100%	95%	91%	87%	85%	90%	95%	100%
available KNM	100%	101%	102%	102%	103%	102%	101%	100%
available PWB	100%	98%	95%	93%	92%	95%	98%	100%
CWB	100%	101%	102%	103%	103%	102%	101%	100%
CWBout (burnt)	100%	101%	101%	102%	103%	102%	101%	100%
CWBin	100%	101%	101%	102%	103%	102%	101%	100%
KNM	100%	98%	97%	96%	95%	97%	98%	100%
KNMin	100%	99%	97%	95%	94%	97%	99%	100%
KNMout (dated)	100%	99%	97%	95%	94%	97%	99%	100%
whole family needs	100%	100%	100%	100%	100%	100%	100%	100%
obligation to discuss family	100%	95%	91%	87%	85%	90%	95%	100%
obligation to talk student matters	100%	106%	112%	117%	121%	113%	106%	100%
PWB	100%	101%	101%	102%	102%	102%	101%	100%
pressure to research	100%	98%	95%	93%	92%	95%	98%	100%
pressure to select	100%	98%	97%	96%	95%	97%	98%	100%
PWBin	100%	96%	92%	89%	88%	92%	96%	100%
PWBout	100%	96%	92%	89%	88%	92%	96%	100%

To gain more STD child wellbeing (CWB) both timing and influence levers are available based on parent wellbeing and the soft variable obligation of child to discuss things that matter to them in order to regain confidence (inflow 3). As proportional influence levels (P) are difficult to adjust upward based on these sensitivity tests, decreasing days spent between discussions (D) is a more realistic lever for most standard families. Therefore, encouraging children to regularly discuss things that matter to them suggest a degree of recovery in the problem variable of reduced child wellbeing. The significant positive variations are highlighted in the table.

By contrast families with SEND children transferring schools are more sensitive to change based on the analysis shown in Table 7.6.

Table 7.6 Sensitivity test results flows 1,2,3,4 proportion and duration increments and decrements (SEND case)

Name	p1+5	p1+10	p1+15	q1-15	q1-10	q1-5	p2+5	p2+10	p2+15	q2-15	q2-10	q2-5	p3+5	p3+10	p3+15	q3-15	q3-10	q3-5	p4+15	p4+10	p4+5	q4+5	q4+10	q4+15
available CWB	98%	96%	94%	93%	95%	98%	97%	94%	92%	91%	94%	97%	95%	90%	85%	83%	89%	95%	91%	94%	97%	97%	94%	92%
available KNM	99%	98%	97%	97%	98%	99%	101%	101%	102%	102%	101%	101%	100%	101%	101%	101%	101%	100%	102%	101%	101%	101%	101%	102%
available PWB	99%	97%	96%	95%	97%	99%	98%	96%	94%	94%	96%	98%	99%	97%	96%	95%	97%	99%	94%	96%	98%	98%	96%	94%
CWB	101%	102%	103%	104%	102%	101%	102%	103%	104%	105%	103%	102%	103%	105%	107%	109%	106%	103%	105%	103%	102%	102%	103%	104%
CWBout (burnt)	101%	102%	103%	104%	102%	101%	102%	103%	104%	105%	103%	102%	102%	105%	107%	108%	105%	103%	105%	103%	102%	102%	103%	104%
CWBin	101%	102%	103%	104%	102%	101%	102%	103%	104%	105%	103%	102%	102%	105%	107%	108%	105%	103%	105%	103%	102%	102%	103%	104%
KNM	103%	105%	107%	109%	105%	103%	99%	97%	96%	95%	97%	98%	99%	99%	97%	97%	98%	99%	95%	97%	99%	99%	97%	96%
KNMin	103%	104%	107%	109%	106%	103%	99%	97%	96%	96%	97%	99%	99%	99%	97%	97%	97%	99%	96%	97%	99%	99%	97%	96%
KNMout (dated)	103%	104%	107%	109%	106%	103%	99%	97%	96%	96%	97%	99%	99%	99%	97%	97%	97%	99%	96%	97%	99%	99%	97%	96%
whole family needs	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
obligation to discuss family	98%	96%	94%	93%	95%	98%	97%	94%	92%	91%	94%	97%	95%	90%	86%	83%	89%	95%	77%	84%	92%	92%	86%	80%
obligation to talk student matters	103%	107%	110%	111%	107%	103%	105%	109%	114%	116%	110%	105%	108%	117%	126%	130%	119%	109%	116%	110%	105%	105%	109%	114%
PWB	103%	107%	110%	111%	107%	104%	105%	109%	113%	116%	110%	105%	103%	106%	109%	111%	107%	103%	116%	110%	105%	105%	109%	113%
pressure to research	103%	107%	110%	112%	108%	104%	98%	96%	95%	94%	96%	98%	99%	98%	96%	96%	97%	99%	94%	96%	98%	98%	96%	95%
pressure to select	103%	105%	107%	109%	106%	103%	103%	107%	110%	112%	107%	104%	99%	98%	97%	97%	98%	99%	95%	97%	99%	99%	97%	96%
PWBin	101%	102%	103%	104%	102%	101%	102%	103%	104%	105%	103%	102%	98%	96%	93%	92%	95%	98%	89%	93%	96%	96%	93%	91%
PWBout	101%	102%	103%	104%	102%	101%	102%	103%	104%	105%	103%	102%	98%	96%	93%	92%	95%	98%	89%	93%	96%	96%	93%	91%

Families can exhibit a wider range of sensitivity when dealing with SEND children based on the model tests. In addition to inflow 3, adjusting proportional influences and days at inflows 2 and 4 or outflow 1 may also offer some effective ways to reflate child wellbeing. After reducing days at inflow 3 (a 15% reduction in time amounts to 9% increase in child wellbeing) then next most effective lever is reducing days at inflow 2 (a 15% reduction in time here amounts to 5% increase in child wellbeing). This suggests that families with SEND children transferring to secondary school would be sensitive to initiatives such as gamification, that were capable of speeding feedbacks in both loops through common system structures (school visits delay d2 2 equaling interval between talks that matter to child d3 2) and that such a policy blend might also benefit other family types. Such a policy may even counter effects from exogenous competition losses experienced by children, but also of knowledge reserve losses, that act as stressors for the family behavioural decision making system.

7.7 Policy test structures

Additional structures are represented in the system dynamics model to ensure that tests can be performed that represent the impact of suggested policies under consideration on the family system. Figure 7.7 shows the model with additional structures that enable policy interventions to be tested.

Policy 1 reduces demands on children in primary school from test preparation burnout and other external stressor effects by ending selective testing and associated tutoring of students in year 5 (2190 days run on policy commencing from year 6 for KS2 SATS rather than year 5 when tutoring for the 11+ examination would take place for elective students).

Policy 2 increases the flow of information to those who visit schools seeking advice on pastoral care for students (reKNM factor 2 is changed on model to increase the influence over knowledge of needs met at school open events).

Policy 3 reduces delays in the system between knowledge, parent and child wellbeing using the DEGAMIFY FACTOR 2 to reflect 7 days between updates for inflows 2 and 3 based model on sensitivity checks for STD and SEND)

Policy 4 adds to policy 3 by suggesting a gain in local knowledge of how schools may meet needs (knowledge of whole family needs 2 is changed on the model to reflect gains from gamification reflecting local Plymouth problems around secondary school choice).
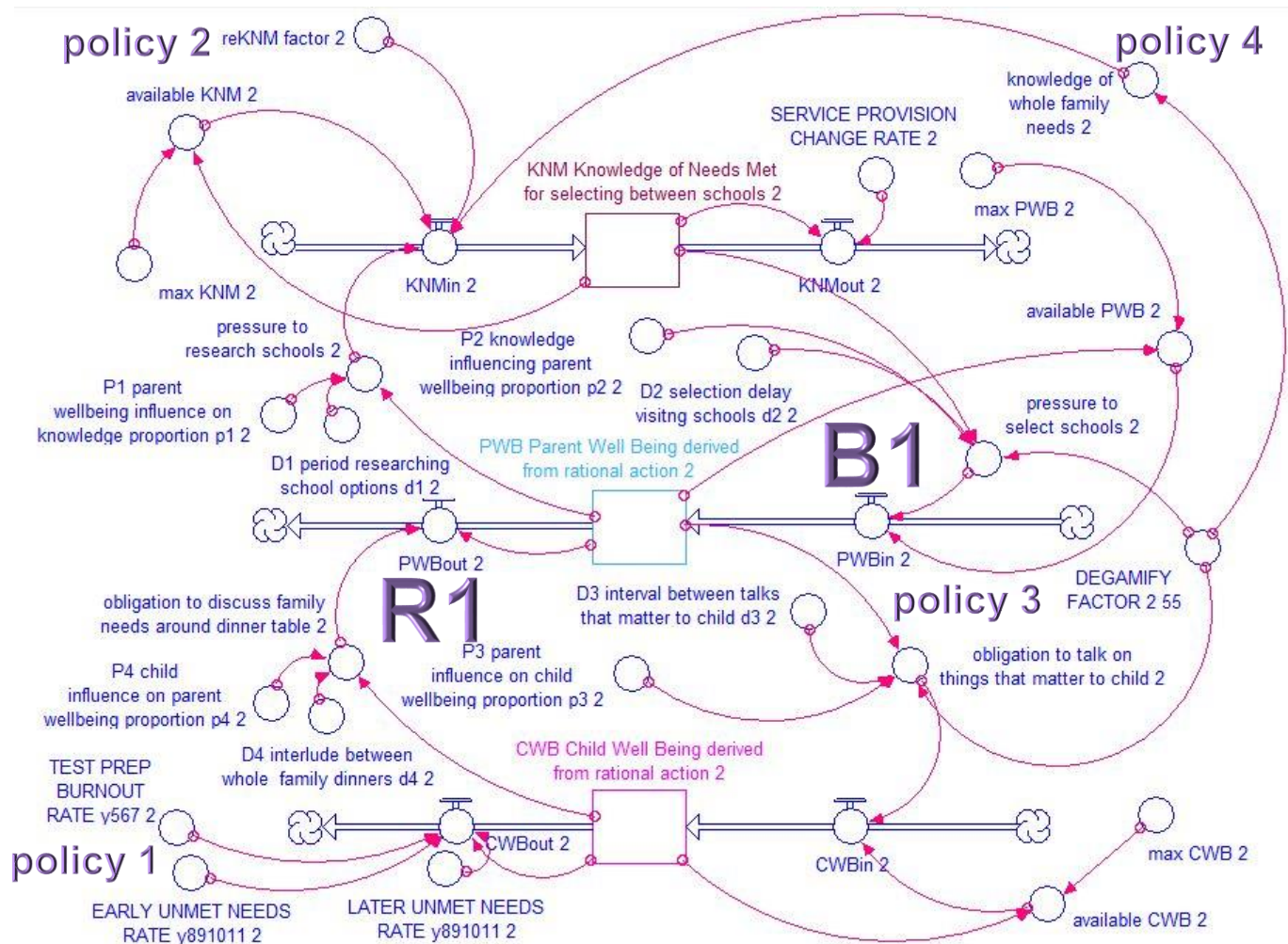
Figure 7.7. Policy intervention test structures within main loops

7.7.1 Eliminate grammar school tutoring from year 5 – policy #1 or LESS T

The purpose of this initiative was to remove the external stressor associated with year 5 test burn-out that some parents cause by tutoring their children for selective entrance tests known as the eleven plus examination into grammar schools. This cannot be tested in real-life as the current government supports developing selective

schooling opportunities across England. However, it is possible to test such decision rules using a simulation model to understand whether burnout and other effects are reduced for children preparing to change schools and progress through secondary education. In effect, the policy requires no additional structure but only reduces timescales to six years (2190 rather than 2555 days) by eliminating year 5 influences of selective competition.

7.7.2 Counter outdating knowledge loss of needs met by schools – policy #2 or MORE K

Whereas countering the loss of knowledge around needs met by different schools is the interned aim, this is unlikely to be achieved at national or local levels where knowledge outdate rates are set by introducing fewer education provision changes thus aim to slow down the pace of change. More realistically, offering parents greater opportunities to understand how different schools may meet existing (plus evolving) student needs may address a wider range of family requirements from education providers across Plymouth. Here the suggestion was to provide multi-agency support for transferring schools at their open events each autumn during the secondary applications window opening between September and October each year. Kidger *et al* (2009) also note that when improving the psychosocial English secondary school environment "such changes require greater clarity at policy level in terms of what schools, in collaboration with external agencies, should provide in this area".

This policy is not without cost implications for multiple agencies supporting open evenings for children in Plymouth and remains unlikely to make informed comparisons between school choices more accurate, even when education is supported by health and the council in providing useful information on softer decision factors, beyond the domain of league table statistics. This results in an additional model adjustment factor for gaining knowledge (deKNM factor means smaller normalised values reflect an increase in the flow of knowledge of needs met by different schools so doubling the rate is achieved by reducing this factor to 0.5).

7.7.3 Sensitive system levers to blend another policy based on system sensitivities (#3) or GAMIFY 7

The alternative way is to address the problem behaviour with a blended policy aimed to speed-up feedbacks between knowledge and wellbeing. Informed by sensitivity testing for SEND children, the potential to recover parent wellbeing by offering comparable knowledge of all needs met by different providers and from this, the recovery of child wellbeing through frequent and informative updates between family members is paramount. This results in a coordinated pair of timing levers (D2 and D3 on the model) speeding the flow into the recovery of wellbeing for both parent and child regularly playing a problem-structuring, board game of enrolment together for fun. The estimated gamification period is weekly having tested the game with families including younger siblings already at primary school.

7.7.4 Sensitive system levers to combine effective blend with gamified knowledge increase policy (#4) or GAMIFY F

The blended policy aimed to speeding feedbacks between knowledge and wellbeing now has the addition of a factor that also increases knowledge of needs that could be met through repeat gamification (degamify factor means smaller normalized values reflect an increase in the flow of knowledge of needs met by different schools so increasing the rate is achieved by reducing this factor to 0.255). The game would have to be adapted to reflect local conditions on a regular basis given that learning should be based on quality data. Again, the coordinated timing was reduced to weekly to reflect the same frequency as policy #3, but this time rates of knowledge gain about the local situation were also reflected through a customized board.

7.8 Considering standard and special family results

Based on the balancing process for each family case type (STD to SEND cases allow a range to be explored) using timing effects to characterise steady state stocks in the family unit, including knowledge of needs met, different steady states can be characterised. Resulting stocks of low knowledge and parent wellbeing apply to retain high levels of child wellbeing at all costs in the SEND family when preparing to transfer between schools. This may also be over an extended period when Transition

Plus[41] protracted introductions for SEND students have been arranged with a specific secondary school in question.

In a similar way, STD family child wellbeing is similarly retained with the additional benefit of higher parent wellbeing. There is little demand for knowledge of which family needs can be met from available secondary schools in this case. This steady state represents the diametrically opposite to a SEND family as shorter research periods allow faster response times as new needs are identified and solutions sought subject to any sharing constraints of those deciding.

Now that two cases of STD and SEND families (those who may be vulnerable to less effective secondary school selections) are used to describe the range of potential impacts from adopting different policies, a total of four policy interventions can be tested for impact against either case that has been characterised for families in Plymouth. This enables a total of eight impacts to be analysed for understanding the most influential approach to interceding around secondary school selection across both family cases for retaining child wellbeing longer-term. Such iteration then helps to identify optimal resilience gains for countering low levels of wellbeing (and the potential for exceeding self-determined lower wellbeing thresholds that are often a basis for referrals to CAMHS).

7.9 Loading system for disadvantage factors predicting threshold transgression base run

To represent what happens in some families, the impacts of multiple issues need representing to cause divergence from the steady emotional states already described for test purposes in STD and SEND equilibria. Whereas real world values for timing have already been applied and balanced through stock level adjustments, the proportional influence between knowledge and emotions is less likely to be characterized by halving as this suggests only one other attention diverting factor is involved in reducing impact. As discussed in secondary data (The Children's Society, 2017), recent information suggests a strong connection between multiple family disadvantaging factors and low child wellbeing. Of the 27 factors studied, only 3

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[41] Transition Plus is a scheme enabling children with additional needs to be introduced to their new mainstream school over an extended period of one or two years through bespoke induction arrangements.

related to parent child relationships. Of the remaining 24 relating to other family matters, if 7 were present for adults to resolve in the family setting then child wellbeing would also be likely to decline.

Modern life dictates that not only do children have many personal (or independent) influences on wellbeing retention but so do parents facing the stressors of daily life across and beyond English cities. Equally knowledge of needs met may be influenced by neighbours, school friends and other contacts rather than personal comparisons from reliable data sources. Rather than the steady-state halving assumption common to all soft variables defined for family equilibria (whether STD or SEND), the ratio of competing factors drawing or diverting attention away from school choice represents a common factor reflected by further quartering levels to an eighth. With this value configured as the proportion of influence at each soft variable for families, the focus on accurately selecting secondary schools reduces at this transition period due to other diverters that take higher priority.

On reflection, the value is more likely to be divided by eight for those inexperienced who may lack such focus such as monitoring, inductive reasoning and problem solving behaviours (Hurd *et al*, 2013) at this critical transition, as other independent issues divert attention from the school selection problem at hand. It is also notable that with three or more stressful, life events present, children experience a higher risk of the onset of mental ill health conditions including emotional (more common for girls) and conduct (more common for boys) disorders (Parry-Langdon et al, 2008). Potentially more children may interpret constrained periods preparing for significant tests as stressful life events as well as any subsequent unmet needs from their school education, given today's competitive education market in England.

Once loaded with more realistic factors (see from page 208), the policy test model structure also needs the impact of autocracy assessing where maximum values of family knowledge are limited to only 50% of the total needs to be met i.e. those of the autocratic parent alone who may not consider current and future student needs. In these configurations, the base runs for STD and SEND cases are established showing gradual declines in wellbeing.

7.10 Chapter review

The quantified stock flow model changes understanding from the concept model. Rather than CWB burnout stress leading to overshoot and collapse in the lead up to examinations, a longer view can be taken of emotional decline on the family. By assuming constant external stressors on knowledge of needs met being outdated by urban market competition combined with burnout effects before transferring to secondary, during adolescent years and then while preparing for GCSE examinations, the long-term impacts of school choice can be demonstrated. The model is calibrated using data from parents (autocracy reducing the number of needs that must be met for example in the target group). Validation testing involves both structure and dynamic response to ensure that the model is reliable and offers confidence in predicting the impacts of school selection. Sensitivity testing has also revealed more effective levers for influencing problem behaviour: involving the increase in frequency of feedbacks between knowledge, parent and child.

Model testing is an important factor in building confidence about how the quantified model operates and why it produces results that can be trusted, especially by making assumptions explicit and testing for variance using System Dynamics using a 'white-box' approach (Barlas, 1996). Two types of family exist that reflect different parts of the educational spectrum of needs and both archetypal families enable the exploration of model sensitivity through a range of tests. The outcome of such testing not only indicates how the model is parameterized with real-world values but also where systemic interventions could contribute more than the obvious but expensive, first-order, alternative control loops that pass through only a single stock (Hayward, 2017).

Now the model sensitivity testing is complete with a parameterized and valid simulation model, attentions are turned to the evaluation of alternative policies that could help alleviate low child wellbeing during secondary school. The possibility of avoiding the lower threshold breaches, those at which CAMHS referrals often take place, offers realistic goal. Suitable structures, previously described, have been incorporated to enable new policy tests to be performed to understand their impact on families who are emotionally stressed by transferring schools. Policy testing can now be used to confirm or deny considering raised information availability to counter unmet student needs or ceasing selective school entrance testing for year 5 children

to reverse test preparation burnout. A blended approach can also be demonstrated for effectiveness, as suggested from sensitivity checks, that stabilises emotional flows within families facing secondary school admissions in Plymouth.

Concluding on the question of where more sensitive levers exist to influence problem behaviours associated with the family decision making system, this explanation of emerging causal theory suggests that increasing feedback frequencies from knowledge of needs met to parent, then from parent to child at least once a week could offer benefits for coordination between support agencies as a new policy helping families find the right school for their child. In summary, model testing has suggested alternative intervention strategies that could offer more influence on the problem behaviour. Absolute system responses now need to be established to ensure that both STD and SEND families benefit alike from whichever policies offer improved outcomes for vulnerable families who subject to autocratic decision bias. By contrast, while democratic families may need less support, a targeted solution would also benefit them in ensuring needs continue to be met by schools.

8. Dynamics of wellbeing in families

8.0 Introducing wellbeing enhancement policy assessment

Now the model testing is complete, attentions are turned to testing alternative policies (shared decision rules) that could help alleviate low child wellbeing during secondary school, thereby avoiding the lower threshold breaches at which CAMHS referrals take place. This chapter explores intervention policies by abducing system responses to potential change by answering the question about which might be more effective at quelling emotional turbulence when transferring into new secondary schools for the best fit of school to needs.

Policy testing is based on having established confidence in the model being able to determine key emotional trends associated with selecting secondary schools for families affected by ongoing competing demands. Of the four policies considered, two were suggested and agreed through participative modelling with expert practitioners for having the potential to improve accuracy of secondary school selection, or reducing the test preparation demands on children in year 5 of primary education. The third policy was defined following system tests where SEND families were notably more sensitive to change in system timings concerning feedbacks from knowledge to wellbeing and parent to child. By shortening both to a seven-day interval through encouraging families to pre-experience the problems of local secondary school selection, not only is communication strengthened but so are levels of CWB leading to a psyche that has more resilience to withstand emotional shocks.

Figure 8.1 outlines the policies for which the additional model structures have been developed in the last stage of supporting, multi-agency derived, decision-rule design and test.
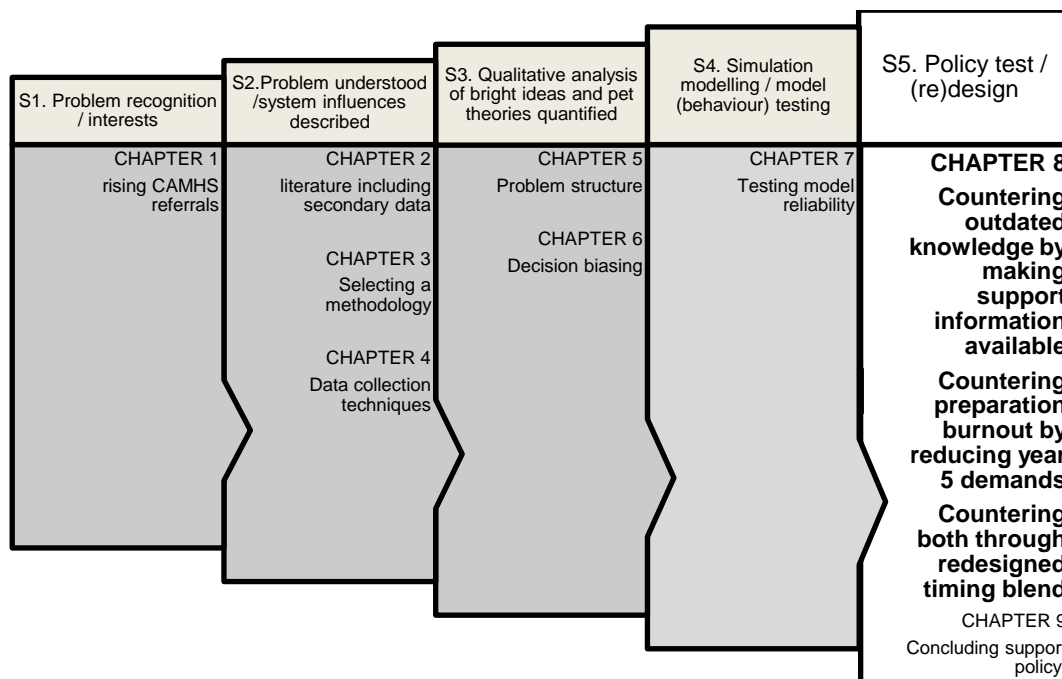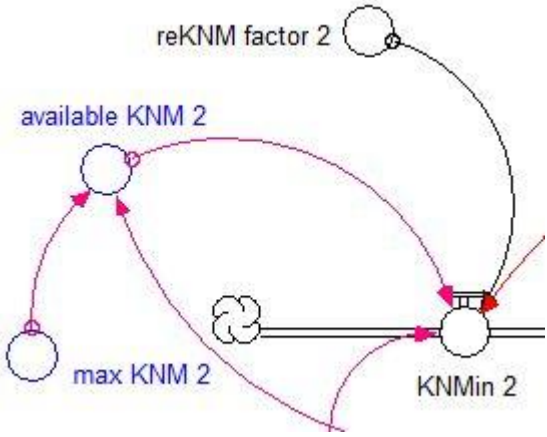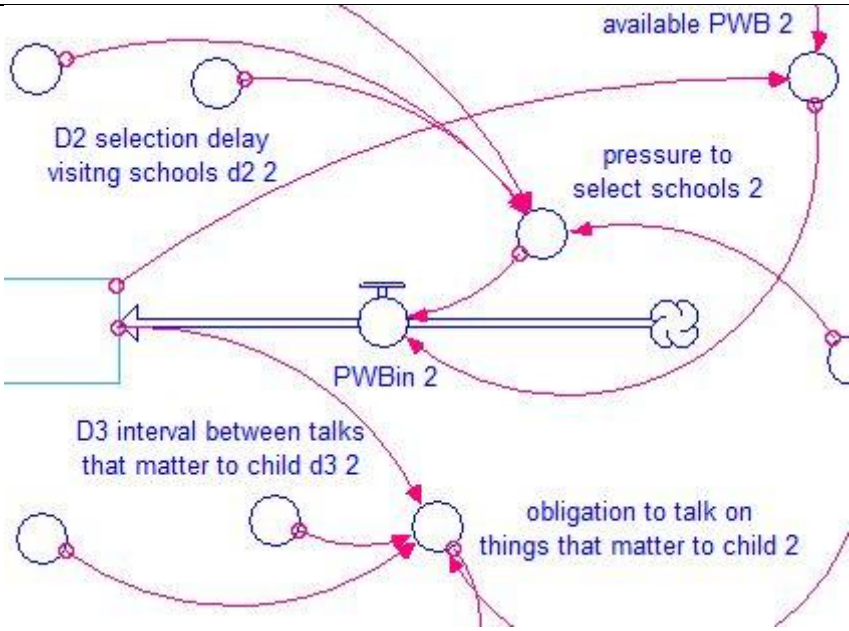
Figure 8.1. System Dynamics process look-up table (adapted from Coyle, 1996:p.11)

In order to explain how policies are determined, Table 8.1 identifies the additional structure required for each policy being tested (A-D) alongside the extremes of autocratic and democratic decision-making styles (i) that are required to ensure no adverse policy impacts are experienced by the wide spectrum of parent decision makers in the sample.

Table 8.1. Policy structure addition summary

#	Name	Description	SD Model Representation (policy additions in black)
A	SHORTER policy	Removing extra year5 preparation for elective 11+ exam shortening baserun from 2435	No additional model structure required to test the policy, only changing baserun timing for initial model settings.

		to 2190 days.	
B	MOREK policy	Raising input rate of knowledge of needs met to counter competition impact.	(reKNM factor 2)
C	GAMIFY 7 policy	Raising the frequency of family debate on schools (for example, by playing a standard board game).	(D2 selection delay visiting schools d2 2 and D3 interval between talks that matter to child d3 2)

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D	GAMIFY F policy	Raising the frequency of family debate on schools (for example, by playing a location-specific board game with up-to-date information – DEGAMIFY FACTOR 255).	
i	Decision style	Spectrum of decision making styles checked. Autocratic style limits knowledge of needs: democratic does not.	 (max KNM2 = 50% reflecting only those of parent at autocratic extreme. Democratic remains unlimited by recognising max KNM2 = 100% reflecting all family needs at other extreme).

Whereas removing a year from the initial simulation reflects the need to avoid tutoring children for selective examinations in year 5 of primary school (SHORTER), a policy increasing knowledge of needs met to redress the exogenous competition stressor requires a multiplier to the inflow called reKNM factor2 (MOREK). An

alternative to addressing either exogenous stressor of competition on family members is to adjust timing within either loop. The GAMIFY 7 policy (C) does that by coordinating delay reductions in principal balance and reinforcing loops B1 and R1 to every seven days reflecting frequent, weekly updates. The GAMIFY F policy (D) not only coordinates to a weekly update frequency but also reflects game customization to impart local knowledge of needs met by schools as well as national characteristics. However, all policies affect families in different ways and to avoid adverse impacts on psychosocial health, the impact of different types of decision making style must be tested. To this end, autocratic decisions can only reflect 50% of the maximum knowledge of needs to be met when parents consider only one secondary school whereas more democratic approaches widen this cutoff target for knowledge of needs met to 100%.

Suitable structures, have thus been incorporated to enable new policy tests to be performed, along with parameter settings previously defined in policy tables. Assessing policy impact on families that are emotionally stressed by transferring schools and subsequent unintended consequences (those that had not been considered at the point of school selection) is enabled by simulation modelling. The two types of family model considered to represent the spectrum of Plymouth families include STandarD (STD) and Special Educational Needs and Disability (SEND). Both family types are tested to demonstrate not only the potential for improvements but also that there are no harmful side effects resulting from policies designed for urban environments such as Plymouth.

Based on the original steady states for either family type, each baseline model (STD and SEND cases) is loaded first with modern family diversions (those that divide attention for establishing common, proportional influence assumptions throughout the system). While assuming standard exogenous loss rates (constant knowledge outdating and student burnout rates), each system has autocratic decision-making settings applied that are associated with parents who lack experience in secondary school selection as the key group vulnerable to inaccurate identification of secondary school choices and the school that is preferred.

It is noted from model testing with empirical evidence (pp.222-223) that family decision making is sensitive to exogenous losses from schools' competition and the

outlined assumptions (refer to chart descriptions on page 197) represent a coherent starting point for comparing potential intervention policies. Once the balancing family types are loaded in this way, family baseruns can be checked for potential breaches of low wellbeing thresholds under stress. The ability of different policies to raise levels of child wellbeing are measured by final values achieved after completing each simulation run so that potential lower wellbeing threshold breaches (as set by parents or the students themselves) can be avoided over time for the spectral range of family-types tested.

The chapter scope therefore covers the characterisation of family relationships in England from steady state individual balances for wellbeing where half the relationship is spent considering school choice towards a declining state where attention becomes diverted away from school choice before limiting maximum value of knowledge to 50% for the target group of inexperienced, autocratic decision makers. The various policies are then tested for their influence throughout the preparation for and period spent in secondary school before concluding which offers most impact on the problem.

8.1 Initial system loading with risk factors applied to steady state

Base runs for STD and SEND cases were generated next. The base run adjusts the steady state for each family group by reducing the proportion of influence exerted between input and output from each of the four soft variables within the model. For the steady state, balances were established when the proportions were halved, representing only one other factor distracting attention from the school choice problem. This could reflect considering and comparing the needs met by only one additional school for example which is typical of rural secondary selections. The urban reality of secondary school choice is however quite different and so the steady state proportions were further quartered to better represent the additional complexity that choice provides. The system responses were measured using the principal stocks of knowledge and wellbeings of parent and child.

Such background distractors can sometimes enhance performance according to Cornblatt (1988), whereas additional stressors serve only to pose additional demands on limited family resources around the time of selecting secondary schools as predicted by family stress theories. This translates into the two, systemic family

stressors initially identified involving exogenous knowledge loss around secondary schools for meeting most needs from provider complexity as well as emotional burnout from test preparations over an extended period determined by competition. These losses load further concerns onto families when work and friends change for the student when transferring schools aged 11. In order to characterise the higher risk group associated with inexperience of selecting secondary schools, the autocratic maximum level of knowledge was set at 50% as this reflects only one set of needs being satisfied when selecting schools in a family system.

8.1.1 Standard family base run response to stress over time

Four policy tests covering both extremes of family decision making (STD and SEND) are now tested using the structures provided. The tests comprise reducing the impact of burnout on year 5 students (ending selective school examinations for example), increasing the knowledge of how needs could be met in secondary schools to offset competition outdating effects (pastoral care and support services at open events for example), speeding family debate on school selection through gamification, either with or without customization to reflect local matters.

As previously described, a chart with three sections is used to show how structure (top section summarising a record causality for families by relating stocks together with information flows) relates to parameter settings (middle section indicating constants and variables that are collectively referred to as levers of change) that creates complex, dynamic behaviours over the timescales of interest (lower section graphing stock percentages called behaviour over time plots). It is noted that the central section shows final values achieved after completing each simulation run for the variables chosen to represent the spectrum for types of family.

Colours are used to identify each of the three stocks within the model. Cerise pink is employed for Child Wellbeing (CWB), a sky-blue describes for Parent Wellbeing (PWB) and finally a brown represents Knowledge of Needs Met (KNM). All stocks are measured as a percentage of what is possible for those involved where knowledge of needs can be restricted to only the half recognized by an autocratic parent deciding secondary schools in the family for example (a target behaviour to address for first born and those new to the city). For the behaviour over time plots, numbers are also used that correspond to the key given at the top of each graph (1-3). Where the key

does not provide the whole parameter description, further detail can be found on other model structure charts already described.

The simulation model calculates in steps of a quarter day over seven years in for most simulation test runs (one policy deliberately shortens this to six years when testing either type of family response to dual stressors). The seven-year period as the timescale for simulated behaviour over time plots. A flow diagram representing the two principal loops (R1 reinforcing and B1 balancing) within the model and the information flows that connect together stocks of child and parent wellbeing plus knowledge of needs met is also provided. The vertical graph axes reflect percentage and span from 0 to 100% and the horizontal axis is given in days.
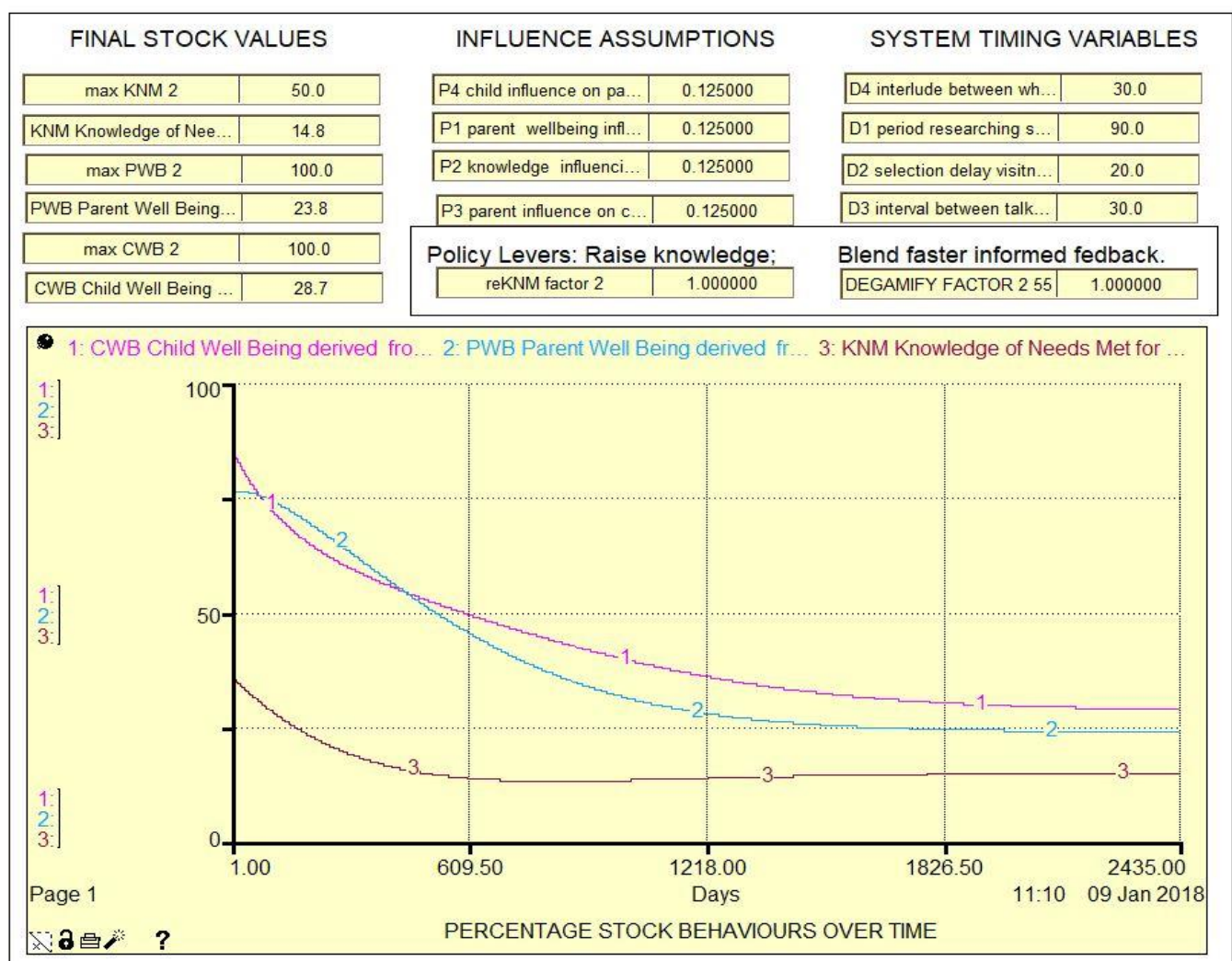
Figure 8.2. Base run response to competition stressors for standard family

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Under normal conditions, the standard base run in Figure 8.2 shows rapid decline in knowledge and wellbeing of family members as loading sends the balanced steady state into disequilibrium for standard families. Under such circumstances, stressors can overwhelm most family compensating mechanisms that have been developed as an accessible resource (the wellbeing of others or knowledge for example). Parent wellbeing goes through a point of inflection where it becomes more vertical than horizontal suggesting the dominance of a reinforcing loop up to and including this point in time. Following the inflection point the plot becomes more horizontal demonstrating a balancing loop behaviour establishing dominance. By contrast, CWB is continuously affected by a balancing loop as it becomes more horizontal which makes predicting a horizontal lower wellbeing threshold transgression event or referral, less accurate. The final value for standard child wellbeing is relatively low, being predicted at 28.7% in the base run under load from competition stressors and diverters.

8.1.2 SEND family base run response to stress over time

An even greater decline is observed in the case of a SEND family over a longer period for similar reasons to those previously discussed in Figure 8.3 (see standard family base run description). The lower final values indicated in the table relate to lower initial stock values for SEND over standard family balance points for steady-state equilibria established during sensitivity testing. In the case of SEND families, it is also likely that experience will have set low wellbeing, referral thresholds for children at levels higher than those for standard families to enable earlier warning for parents and opportunities to intervene from suitable support groups.

FINAL STOCK VALUES		INFLUENCE ASSUMPTIONS		SYSTEM TIMING VARIABLES	
max KNM 2	50.0	P4 child influence on pa...	0.125000	D4 interlude between wh...	30.0
KNM Knowledge of Nee...	5.9	P1 parent wellbeing infl...	0.125000	D1 period researching s...	365.0
max PWB 2	100.0	P2 knowledge influenci...	0.125000	D2 selection delay visitn...	60.0
PWB Parent Well Being...	3.1	P3 parent influence on c...	0.125000	D3 interval between talk...	30.0
max CWB 2	100.0	**Policy Levers: Raise knowledge;**		**Blend faster informed fedback.**	
CWB Child Well Being ...	5.5	reKNM factor 2	1.000000	DEGAMIFY FACTOR 2 55	1.000000

Figure 8.3. Base run response to competition stressors for SEND family

The final value for SEND child wellbeing is lower, being predicted at 5.5% in the base run under load from competition stressors. Such behaviour likely to breach lower wellbeing thresholds for the child and potentially the parent over the period spent in secondary school, especially where SEND sensitivities may set them higher than STD thresholds.

8.2 Countering the Child Wellbeing chronic stressor commencing with tutoring in year 5: wellbeing retention policy

In order to retain resilient stocks of child wellbeing, it is proposed to use a policy of ending selective entrance tests thereby reducing demands on children for tutored preparations during year 5 of primary (Appendix 8 provides initial policy suggestions).

8.2.1 Configuring to reduce local outflow volume by shortening overall duration

The policy involves reducing timescales from 7 to 6 years commencing from SATS in year 6 rather than year 5 test preparations (2190 days only as selective examination tutoring has removed year 5 under this tentative policy aimed at reducing first order child stress from preparing for selective examinations in year 5). The policy is achieved by ending grammar school selection in Plymouth that at present, motivates parents to coach their own year 5 children or more commonly, have them tutored for passing the selective tests known as the Eleven Plus common entrance examination for Plymouth grammar schools. The implementation of such a policy within the model, is achieved by reducing timescales from 7 to 6 years and recording the end values achieved for standard and SEND family situations to ensure no harm is done at either end of the learning spectrum.

It is noted that first order interventions often cost more to deal with the problem behaviour, in this case student wellbeing depletion from burnout derived from preparing for tests followed by the stress or shorter and longer term unmet needs. In the case of grammar schools, a closure policy would be counter to current government recommendations however and would also have to be tested with the local population where objections are likely to result. Given the current political context with the government pushing for greater choice of secondary education with grammar school opening for competitive entry within commuting distance for all families, such a policy is unlikely to be implemented for some time, if at all.

8.2.2 Wellbeing retention policy improvement over standard base run

Whereas a year less of preparing for tests at home (tutoring for eleven plus examinations is a private matter for families of children in year 5 where tests are taken early in year 6) should benefit children longer term, the reality of being coached throughout year 6 in primary school before taking SATS examinations at the end of year may still have emotional consequences for all students rather than an elective minority seeking entrance to selective schools.

In fact, testing continues when even entering larger secondary schools in year 7 as the ability of students must be matched in key subjects such as English and Mathematics through streaming tests to avoid disappointment and future disruption.

This cycle is further repeated in later years of secondary school which concludes with GCSE examinations.

FINAL STOCK VALUES		INFLUENCE ASSUMPTIONS		SYSTEM TIMING VARIABLES	
max KNM 2	50.0	P4 child influence on pa...	0.125000	D4 interlude between wh...	30.0
KNM Knowledge of Nee...	14.8	P1 parent wellbeing infl...	0.125000	D1 period researching s...	90.0
max PWB 2	100.0	P2 knowledge influenci...	0.125000	D2 selection delay visitn...	20.0
PWB Parent Well Being...	23.9	P3 parent influence on c...	0.125000	D3 interval between talk...	30.0
max CWB 2	100.0	Policy Levers: Raise knowledge;		Blend faster informed fedback.	
CWB Child Well Being ...	29.1	reKNM factor 2	1.000000	DEGAMIFY FACTOR 2 55	1.000000

1: CWB Child Well Being derived fro... 2: PWB Parent Well Being derived fr... 3: KNM Knowledge of Needs Met for ...

PERCENTAGE STOCK BEHAVIOURS OVER TIME

Page 1   Days   11:34   09 Jan 2018

Figure 8.4. Wellbeing retention policy response for standard family

In Figure 8.4, final stock outcomes remain unchanged over the six-year timescale based on starting in year 6 when compared to the seven-year period originally considered for competition in Plymouth under this shortening policy for standard families. This is reasonable as the system finds a new equilibrium for all family members over a shorter period than the timescale reduction from seven to six years proposed by the policy. The final value for standard child wellbeing is only slightly higher than the base run, being predicted at 29.1% in under this policy test. Compared with the 28.7% STD base run final value recorded for CWB, this suggests

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that the additional wellbeing derived from adopting such a policy has been politically and monetarily expensive for those attempting to improve child outcomes.

8.2.3 Wellbeing retention policy improvement over SEND base run

Neither does the shortening policy affect the final values of child wellbeing over those observed in the base run for SEND families. Figure 8.5 plots key stocks over time for SEND families for the shorter six-year period giving final values for each that do not significantly differ from seven-year outcomes for this family group. Compared with the recorded 5.5% SEND base run final value for CWB, the final value achieved from this intervention is only marginally higher than the base run, predicting a value of 6.1% in under this policy test. This result confirms that a costly policy (see shorT policy settings) of shutting grammar schools has some socio-emotional resilience benefits for families.
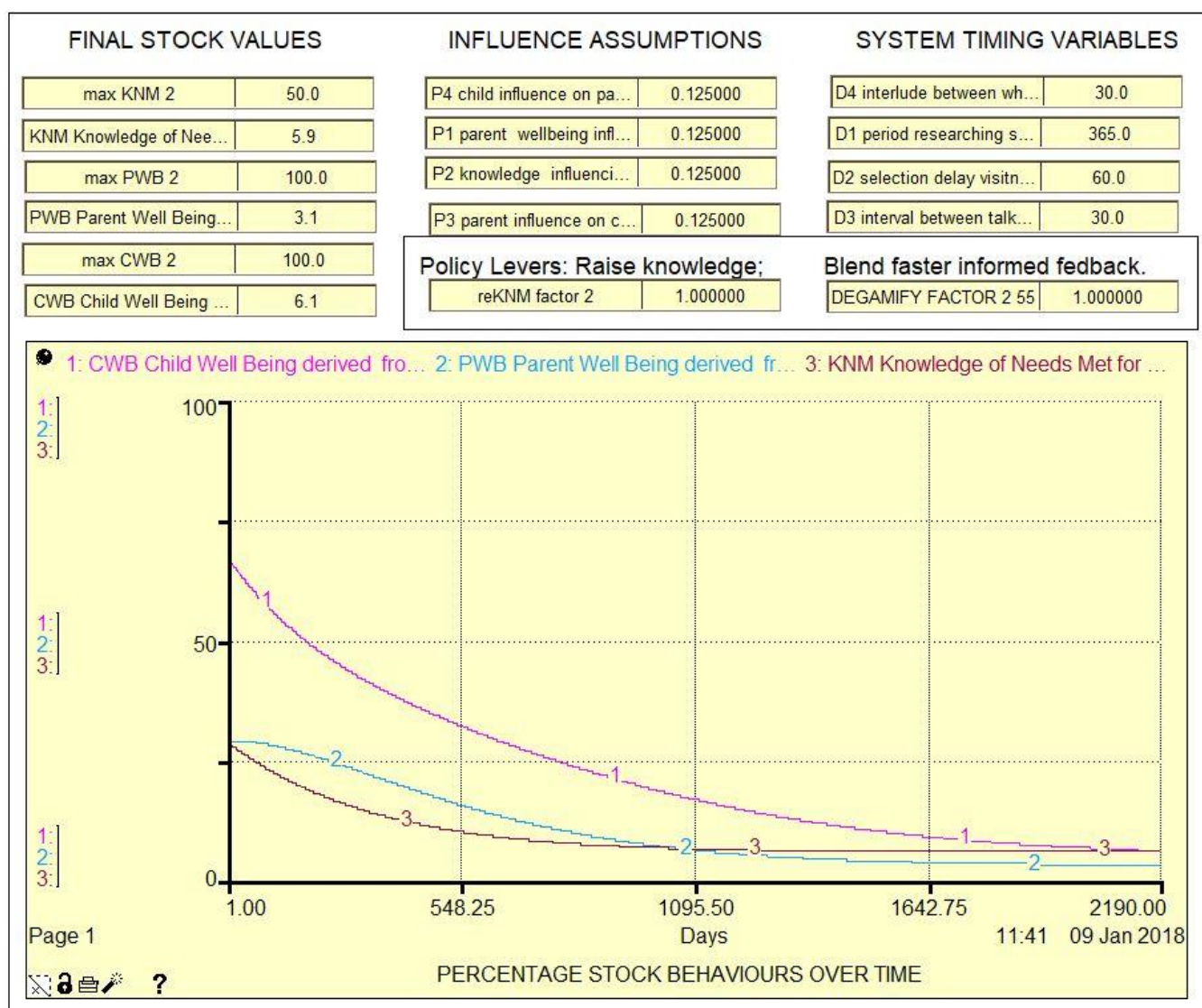
Figure 8.5. Wellbeing retention policy response for SEND family

8.2.4 Other system responses to wellbeing retention policy

The English private school system is also experiencing competition where the best regarded secondary schools are now assessing candidates as early as 11 years old for transfers at the age of 13. The rise in mental health issues for private primary school students is attributed to competition causing earlier academic demands on unprepared children. Their recent study for private schools (AQR, 2017) shows both girls and boys recording sharp drops in commitment (setting and achieving goals) and challenge (learning from taking risk whatever the outcome) on Mental Toughness Questionnaire scales (the MTQ48 survey is detailed by Clough et al,

2007) for 2,520 students as they approach GCSEs during year 9s through 11. Counselling resources have already been deployed in the absence of parents at private boarding schools to help children negotiate these changes. This has implications for proposals to test children arriving in primary school that were recently suspended for all state funded schools in England.

8.3 Countering the Knowledge of Needs Met outdating stressor: knowledge raise policy

This policy aims to compensate for the overall attrition of knowledge of schools able to meet needs as competition mutates what is now available to families. It does so by making knowledge accessible to parents and children at open school events. Information on softer factors, those that are less easily measured for comparison purposes, can be provided in the manner which can persuade families of the potential for one school to meet their specific needs when compared to others (Appendix 8 provides initial policy suggestions).

8.3.1 Configuring to speed local inflow (not slow nationally driven outdate outflow)

Rather than countering government policy aimed at increasing education provider choice to families through developing competition such as free schools, a policy that considers raising inflow to knowledge of needs met by a factor of two, offers a suitable, compensating alternative (see 'moreK' policy settings). Even though unlikely to double knowledge inflow, given the "pull" nature of a CAMHS stand at open events (it may not be of immediate interest to most families visiting schools during the open event, seasonal window each autumn but could attract questions leading to needs being met), increasing knowledge imparted to parents alongside student who also visit at such open events, can offer some benefits.

8.3.2 Knowledge raise policy improvement over standard base run

The knowledge raise policy has greater potential gains that result in higher levels of final stock values of CWB after seven years than the potential improvements from closing grammar schools. However, the rise in final value of CWB is again inadequate to warrant significant investment of time and money as suggested by the final stock value recorded in Figure 8.6. A standard family policy lever that has the effect of doubling the knowledge inflow rate is achieved by halving the reKNM factor

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on the model. The final value for standard CWB was greater than for the base run. Predicted at 35.7% in under this policy test compared with 28.7% for the STD base run final value of CWB.

This reflects other knowledge management policies around secondary admissions where access to ask questions about specific needs and draw comparisons is provided at open events and from online resources. Another comparison example are national league tables of GCSE school academic performances from the previous year. These are presented online to support inter-school comparisons by parents. While accessible to all, not all parents familiarise themselves with league table information or once obtained, ask schools specific questions about the data they present.
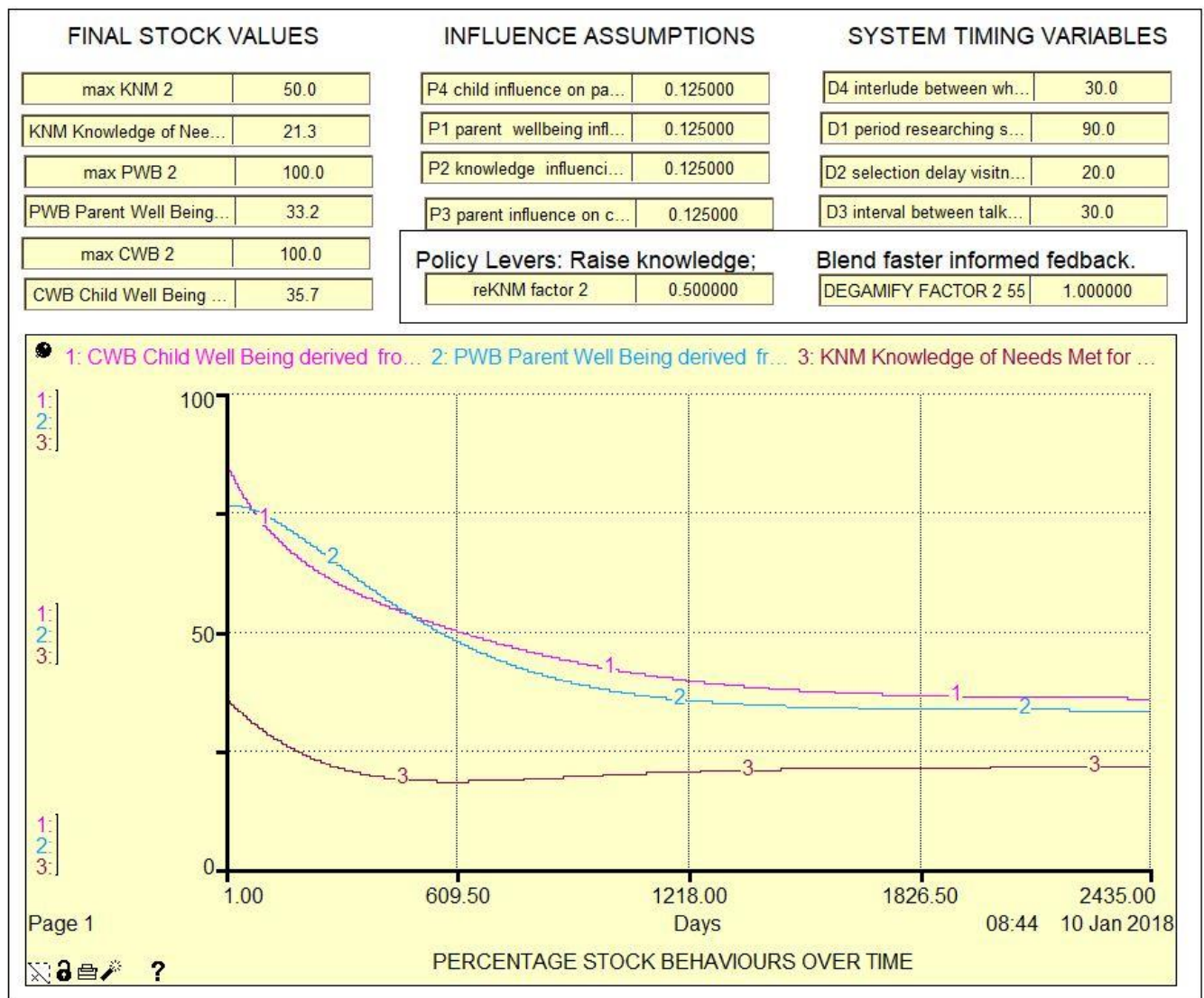
Figure 8.6. Knowledge raise policy response for standard family

8.3.3 Knowledge raise policy improvement over SEND base run

A similar level of gain is shown in Figure 8.7 for the SEND family case over the loaded base run. When the policy is applied to SEND families, there are slight improvements in retained stock levels after seven years but once again, insufficient gains to warrant significant investment of time and money. The final value for SEND CWB is only marginally higher than the base run, being predicted at 8.7% in under this policy test compared with 5.5% in the SEND base run.

FINAL STOCK VALUES

max KNM 2	50.0
KNM Knowledge of Nee...	10.3
max PWB 2	100.0
PWB Parent Well Being...	5.4
max CWB 2	100.0
CWB Child Well Being ...	8.7

INFLUENCE ASSUMPTIONS

P4 child influence on pa...	0.125000
P1 parent wellbeing infl...	0.125000
P2 knowledge influenci...	0.125000
P3 parent influence on c...	0.125000

Policy Levers: Raise knowledge;

reKNM factor 2	0.500000

SYSTEM TIMING VARIABLES

D4 interlude between wh...	30.0
D1 period researching s...	365.0
D2 selection delay visitn...	60.0
D3 interval between talk...	30.0

Blend faster informed fedback.

DEGAMIFY FACTOR 2 55	1.000000

Figure 8.7. Knowledge raise policy response for SEND family

8.3.4 Other system responses to knowledge raise policy

Raising knowledge of how schools can meet specific, family needs is unlikely to be established in practice. Comparable schools' data presented in softer league tables is one potential solution to acquainting more parents with what is currently available but the costs are likely to be excessive and take teachers away from their primary role.

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8.4 Reducing family communication delays on secondary school selection: faster feedback blending policy

The next policy takes a systemic approach as neither of the former policies address relationships within the family unit but rather individual actors within it (more knowledge for parents or less demand on child wellbeing has been simulated with disappointing results). Having validation-tested the simulation model previously, timing variables were identified as sensitive change levers (p.222 and p.224) that could be adjusted by encouraging regular discussion on secondary admission issues of concern to both parent and child.

8.4.1 Configuring families to minimise delays between knowledge and wellbeing: faster feedback blending policy

The policy reduces delays for parent and child feedbacks to a week (7 days) by gamifying the school selection process with basic knowledge before targeting this communications mechanism towards inexperienced decision makers (either first child or first time use of a secondary school) to redress potential impacts of autocratic behavioural decision making biases (see G7 policy settings).

By contrast to other policies, a coordinated systemic intervention maintains final stock levels of retained wellbeing very effectively, thereby offering good emotional resilience buffering.

8.4.2 Faster feedback blending policy improvement over standard base run

In-line with sensitivity testing from previous chapters, Figure 8.8 shows considerable final value wellbeing improvements for family members. By speeding-up the information fed back between knowledge and parent then from parent to child based on 7 days between such events for a standard family, final values of wellbeing remain elevated at 82.5% for children in year11 and 62.8% for parents at this time. Rather than previous declines throughout the seven-year timescale, child wellbeing is largely maintained despite shocks to the system of changing friends and workplaces upon transferring schools. This is because coordinated timing is more effective as a systems intervention than addressing proportions associated with more direct (first order) losses that are associated with national policy rather than local decision rules.

The reason for coordinating seven days between updates is based on doing things together as a family at least once a week even with other family commitments (parents working shifts for example). Gamification of the problem facing a family is less likely to succeed if the time between updates is set at less than a week for families. Under such circumstances, the mass diffusion for establishing individual family needs by enjoying a regular board game together throughout Plymouth would be at risk (see G7+f policy settings). Whereas the scoring mechanism (dice offer stochastic chances for winning that can be adjusted by different players commencing the game either in year 5 or 6) for snakes and ladders may offer some competitive incentives for playing the board game together (the gamification of school choice), the knowledge inferred by the game when encountering advantages (ladders) or disadvantages (snakes) along with enrolment timings is more valuable to understanding the dynamics of choice and what has to be completed by which date for example.

The final value for standard child wellbeing is significantly higher than the base run, being predicted at 82.5% in under this policy test compared to 28.7% on the STD base run.

FINAL STOCK VALUES		INFLUENCE ASSUMPTIONS		SYSTEM TIMING VARIABLES	
max KNM 2	50.0	P4 child influence on pa...	0.125000	D4 interlude between wh...	30.0
KNM Knowledge of Nee...	7.9	P1 parent wellbeing infl...	0.125000	D1 period researching s...	90.0
max PWB 2	100.0	P2 knowledge influenci...	0.125000	D2 selection delay visitn...	7.0
PWB Parent Well Being...	65.8	P3 parent influence on c...	0.125000	D3 interval between talk...	7.0
max CWB 2	100.0	Policy Levers: Raise knowledge;		Blend faster informed fedback.	
CWB Child Well Being ...	82.5	reKNM factor 2	1.000000	DEGAMIFY FACTOR 2 55	1.000000

Figure 8.8. Faster feedback blending policy response for standard family

8.4.3 Faster feedback blending policy improvement over SEND base run

More frequent feedbacks also benefit the SEND family where some wellbeing loss is experienced over the period of seven years but with little risk of breaching lower wellbeing thresholds, even when set above those within a standard family. This reduces the risk of having to refer to CAMHS and other support agencies across Plymouth including GP practices.

For SEND children, lower wellbeing thresholds are likely to be set higher by parents and student than for standard families as early warning of change is required but even with such a constraint, breaches followed by referral to CAMHS should be less

common based on this policy. Most importantly the simulation run predicts no specific

harm for those involved in operating this policy as indicated in Figure 8.9. The final

value for SEND CWB is far higher than the base run, being predicted at 75.1% in

under this policy test. Compared to the original outcome of 5.5% for the SEND

baserun final value for CWB, the rise 69.6% offers significant potential to help even

those raised thresholds for low child wellbeing referrals.

FINAL STOCK VALUES		INFLUENCE ASSUMPTIONS		SYSTEM TIMING VARIABLES	
max KNM 2	50.0	P4 child influence on pa...	0.125000	D4 interlude between wh...	30.0
KNM Knowledge of Nee...	3.5	P1 parent wellbeing infl...	0.125000	D1 period researching s...	365.0
max PWB 2	100.0	P2 knowledge influenci...	0.125000	D2 selection delay visitn...	7.0
PWB Parent Well Being...	41.5	P3 parent influence on c...	0.125000	D3 interval between talk...	7.0
max CWB 2	100.0	Policy Levers: Raise knowledge;		Blend faster informed fedback.	
CWB Child Well Being ...	75.1	reKNM factor 2	1.000000	DEGAMIFY FACTOR 2 55	1.000000

Figure 8.9. Faster feedback blending policy response for SEND family

8.4.4 Other system responses to faster feedback blending policy

It is anticipated that not only could feedback delays be shortened through

gamification, but also the inflow of knowledge on needs met could be proportionally

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affected by the same process if adapted to the specific locality of competing secondary schools for example. Thus, a de-gamification factor reducing from unity (when the factor reduces from 1 then more gamification occurs) serves to increase knowledge inflow rate while reducing delays between feedbacks.

8.5 Location-specific gamification using YOU SCHOOL (gamify factor)

Assuming a contribution of the gamification towards knowledge of schools that are able to meet needs as well as proportionally shortening typical days between play events for families, the de-gamification factor can be used to provide answers to the customisation of knowledge concerning the local education market.

8.5.1 Gamification over base run performance improvements for standard family

Like the previous policy, the final value for standard CWB is significantly higher than the base run, being predicted at 84.5% in under this policy test compared to 28.7% on the STD base run final value. Interestingly it is only slightly higher than the previous policy where no customisation was necessary. This result suggests that for only slight reductions in child wellbeing resilience levels (Figure 8.10), the gamification approach can be easily scaled-up across England if desired. However, it does not correct reductions in knowledge of needs that could be met by other schools in the city: something that may be important if particular problems develop with the secondary school provider at a later date for example.

FINAL STOCK VALUES

max KNM 2	50.0
KNM Knowledge of Nee...	13.3
max PWB 2	100.0
PWB Parent Well Being...	83.4
max CWB 2	100.0
CWB Child Well Being ...	84.5

INFLUENCE ASSUMPTIONS

P4 child influence on pa...	0.125000
P1 parent wellbeing infl...	0.125000
P2 knowledge influenci...	0.125000
P3 parent influence on c...	0.125000

Policy Levers: Raise knowledge;

reKNM factor 2	1.000000

SYSTEM TIMING VARIABLES

D4 interlude between wh...	30.0
D1 period researching s...	90.0
D2 selection delay visitn...	20.0
D3 interval between talk...	30.0

Blend faster informed fedback.

DEGAMIFY FACTOR 2 55	0.255000

1: CWB Child Well Being derived fro... 2: PWB Parent Well Being derived fr... 3: KNM Knowledge of Needs Met for ...

Page 1

PERCENTAGE STOCK BEHAVIOURS OVER TIME

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Figure 8.10. Gamification of knowledge and speed blended policy response for standard family

8.5.2 Gamification over base run performance improvements for SEND family

In Figure 8.11, the final value for standard CWB is again much higher than the base run, being predicted at 75.6% in under this policy test compared to 5.5% SEND base run final value. This is consistent with the previous conclusion on little loss from adopting a common standard of game across England for much less investment. It is noted that the SEND response from adopting this policy is less effective than the response to gamification without customization where local knowledge is incorporated (see page 253).

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FINAL STOCK VALUES

max KNM 2	50.0
KNM Knowledge of Nee...	11.0
max PWB 2	100.0
PWB Parent Well Being...	47.2
max CWB 2	100.0
CWB Child Well Being ...	75.6

INFLUENCE ASSUMPTIONS

P4 child influence on pa...	0.125000
P1 parent wellbeing infl...	0.125000
P2 knowledge influenci...	0.125000
P3 parent influence on c...	0.125000

SYSTEM TIMING VARIABLES

D4 interlude between wh...	30.0
D1 period researching s...	365.0
D2 selection delay visitn...	60.0
D3 interval between talk...	30.0

Policy Levers: Raise knowledge;		Blend faster informed fedback.	
reKNM factor 2	1.000000	DEGAMIFY FACTOR 2 55	0.255000

Figure 8.11. Gamification of knowledge and speed blended policy response for SEND family

8.5.3 Other system responses to gamification policy

With only relatively small gains in final levels of knowledge, it suggests that customization of the game is unnecessary for the English market as the intended wellbeing resilience improvements for families are apparent, whether adapted to reflect local market conditions or not.

8.6 Chapter review

The chapter has established that characterising of family relationships during school choice and beyond takes a functioning emotional family from a steady state where wellbeing remains balanced towards a declining state where attention becomes diverted away from school choice through other pressures compounded by autocrats lacking decision experience who also limit maximum value of knowledge of needs met (50% representing complete parental autocracy in school selection to reflect on policy impacts), in a group that requires support (process requirements are largely ignored by autocratic leaders with subsequent instability in governance systems: Van Vugt et al, 2004). Of the various policies tested, the most impact on the problem behaviour is derived from increasing the frequency of feedbacks between knowledge of needs to parent and again amongst parent and child. This is therefore a key finding from this study of enrolment decision dynamics within families.

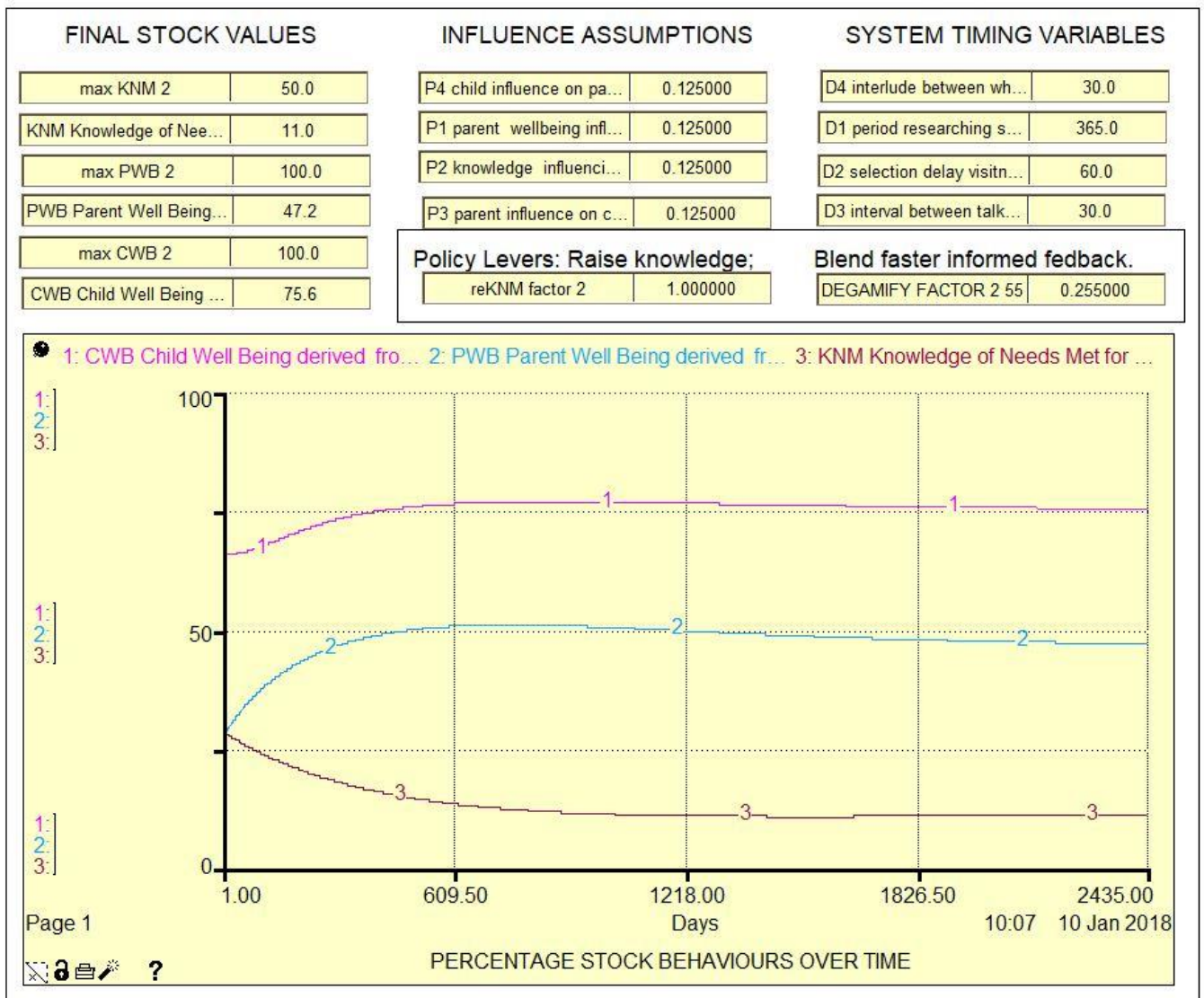The summary of simulator configuration for policy tests is given in the Table 8.2 below and reflects widely different types of intervention that could be considered for addressing the problems associated with schools competing and the impact on families selecting urban secondary schools (SHORTER; MOREK; GAMIFY 7; GAMIFY F). Two of four policies have not only proven ineffective, they also represent examples where influence is less easily exerted (SHORTER and MOREK). For example, not every school may want to be supported at open events by CAMHS and the costs for providing the service may be prohibitive for health. Equally closing grammar school academic selection countermands current government policy and even if possible, would be the most expensive option considered. By contrast the remaining two policies (GAMIFY 7 and GAMIFY F) are simple and easily implemented for little investment as they both involve board games for families to enjoy during primary school. Such techniques to gamify the problem of school choice offer real advantage in ensuring that the whole family need is expressed, discussed and understood before deciding secondary schools. Policy testing confirms that gamification offers emotional improvements for both standard and SEND cases where additional needs require greater consideration.

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Table 8.2. Simulator configuration summary of policy testing

EQUILIBRIUM STOCK INITIAL VALUES (%)	BASE RUN (CHRONIC DECLINE)		RECOVERY POLICY SUPPORT CONTRIBUTION	CASE
	DISADVANTAGE	AUTOCRAT		
KNM =35% P=76.4% CWB=83.6%	EIGHTHS APPLY	KNM MAX 50%	4th SHORT 3rd MOREK, 2nd GAMIFY 7, 1st GAMIFY F	**STD**
KNM=28% PWB=29%, CWB=66%	EIGHTHS APPLY	KNM MAX 50%	4th SHORT 3rd MOREK, 2nd GAMIFY F, 1st GAMIFY 7	**SEND**

For only slight improvements, a final gamification policy (Gamification for families or GAMIFY F) that adapts information to the local education market is tested but does not appear to warrant the additional local knowledge for gains in wellbeing and knowledge achieved. The approach was constrained to local education markets but even with similar frequency improvements facilitating family communications on needs around secondary school selection (7 days approximately), the extra wellbeing gained from customizing the game was unwarranted for the extra effort involved to cover England. Finally, comparing aims and objectives for developing a predictive causal theory around secondary school selection is now addressed alongside shortfalls in the research and potential developments.

Concluding on the question of which policy offers best return for correcting problem behaviours associated with autocratic decision-making styles adopted by those lacking experience, this exploration suggests that a standard board game enjoyed by family members once a week would offer almost the maximum benefit to the widest range of people. By raising the frequency of discussion in families, gamification offers advantages that other policies cannot emulate. As little additional gain in final stock

values is achieved by customising the board game, a standard game could be disseminated across England thereby scaling the impact of gamification to the widest audience in the shortest time. After delays associated with the Director of Research at Livewell South West attendance, the research results were presented to the executive board on 4 May 2017 and warmly received (Appendix 9 provides details of the final presentation and recommendations).

9. Conclusions, disclaimers and further work

In summary, referral demand for CAMHS support over coming years is set to rise in many centres of population such as Plymouth. This situation reflects a combination of an expanding population combined with raising referral demands from competing secondary schools. School choice under competition is a driving factor in obtaining a school capable of meeting family needs including those of the student. While parents may be confused over choice and children pressured to prepare for tests and exams, a poor school choice can result in test preparation burnout and eventual dropout for students when school demands exceed capacities available. Multi-agencies can work together to improve the situation for children and the most cost-effective approach involves problem gamification to raise issues on school choice and rates of discussion within families about which providers can best meet more needs, longer-term.

The research has revealed that some inexperienced families experience confusion over recent changes resulting from competitive choice between English state schools. All state-educated children experience less flexible school regimes over increasingly longer periods of time resulting from schools following a strict, national curriculum. Parents in urban areas have many more alternative secondary education providers to consider from which to find the best fit of provider to meet personal needs. These factors feature in a typical family psychosocial system under stress.

9.1 Addressing the objectives supporting the research aim

Several objectives were realised that support the research aim (see pp.18-19). The study has produced further knowledge, triangulated by the foci of complementary research methods that have been applied to English secondary school enrolment that help explain student referrals to CAMHS. The achievement of three research objectives to meet the overall aim are now described.

Concept Objective. Practicing experts drawn from local agencies who currently support families can establish common structures that describe the nature of psychosocial systems at play. One such psychosocial system is reflected by the family's emotional response to the challenge of competitive enrolment into English state secondary schools where children prepare to be tested and parents require knowledge to compare education providers. Here expert practitioners drawn from

council, education and health services suggest that the family feedback system between parent and child becomes stressed by competition. Competing urban secondary schools erode knowledge of education providers established over generations at the same time as requiring children to continuously prepare for being tested in support of academic comparison table production. The potential for student burnout is ever present as testing regimes deepen to enable comparisons between competing schools at key development stages. However long-term decline in child wellbeing replaces short-term fluctuations associated with test preparation burnout, when adolescent student needs can no longer be met by their selected secondary school. How families select secondary schools is therefore of considerable importance for ensuring that all future needs can be met so that low levels of child wellbeing are avoided (along with the potential need to refer for counselling as lower wellbeing thresholds are breached).

Behaviour Objective. Parents vary in their styles of decision making when challenged to select between competing secondary school providers in urban settings. The Plymouth urban case study identifies that some parents can become confused by competing providers of secondary education and may, under pressure, revert to autocratically decisive, decision-making styles that serve only to satisfy their own needs. This is most evident when the official period of choosing a secondary school by completing an enrolment application form is limited to two months each autumn in England. Under such perceived time pressures, parents with limited knowledge of providers and their own family's needs can select secondary schools that only satisfy their own criteria (not necessarily those of developing students). When questioned during the enrolment decision period, parents indicate behavioural decision-making biases. Whereas a two-stage decision is planned by the enrolment authority where comparisons screen out risk-laden school options to form a shortlist for visiting to compare education provider benefits, this is often not the style adopted by decisive parents. In such cases there is but one alternative to consider that satisfies only half of family needs: those of autocratic parental leadership. This is especially true when parents face other diversionary pressures on their decision making such as challenges from family health and/or wealth.

Policy Objective. The family psychosocial system involved in school choice can be represented as a dynamic simulation model that extends over several years. By

selecting families with either standard or special educational needs, a spectrum of responses can be tested by applying new support policy alternatives to understand which may sustain higher levels of wellbeing for all types of children (doing no harm is an important factor in setting policies when they apply to everyone). Baserun responses from the simulation model demonstrate that autocratic decision making can infer a decline in student wellbeing as needs remain unmet over time. Neither ending year 5 tutoring for selective school examinations (policy 1 for reducing examination stressor influence) or providing supportive, health related knowledge at open evening school events each autumn (policy 2 for countering knowledge stressor influence) offer sustained impact on wellbeing losses in such families. However encouraging families to regularly debate their school choice requirements (both policy 3 and 4 describe variants of increasing psychosocial system frequencies) offers significant gains as the whole needs of a family can be established early through playing informative games together. Agencies do have to cooperate, working together to achieve such an outcome for families at risk but the potential for fewer CAMHS referrals and the psychological damage that can last a lifetime maybe avoided for some facing these situations.

To conclude, within the research limitations, the aim of the study to model associated influences of secondary school choice on psycho-social wellbeing behaviours in families changing schools has been achieved by answering the supporting research question using a model-based multimethodology to examine this multi-faceted issue. It is noted that the Government also conclude that independent research is required to address the gap in knowledge on whether competition testing linked to narrowing the curriculum between KS1 and KS4 has an impact on student mental health (HOC, 2017) and that England is even more likely to fail this generation's mental health needs should they continue to ignore such relationships (HOC, 2018).

9.2 Research question answered

Which key factors might help explain the phenomenon of rising student referrals to CAMHS during secondary school for helping target support agency policy interventions?

Family decision making is key to attaining the best fit of school service provision to student need. When the needs of school to prepare for tests and examinations

exclude those interests of the child or adolescent young person then disengagement follows. Resultant emotional burnout through preparing for selective entrance examinations/ KS2 SATs/ streaming plus secondary dropout through KS4 GCSE curriculum-constrained years help to explain rising frustrations for some students. The family decision making system is also subjected to stress by competition. Here knowledge can rapidly erode while children are tested continually for indications of academic progress before and after changing schools. Therefore, reliable family relationships are essential for the child when others from workplace and friends can be disrupted in moving to larger secondary schools.

Parents (but also children) lacking older sibling experience of secondary school selection, within the urban environment such as Plymouth, exhibit tendencies adhering to Admission Authority guidance for deciding quickly. This takes place within the normal point of entry window for secondary school applications each September and October. Greater decision speed reduces the knowledge of needs that could be met by different providers and therefore the best fit of school for a student. This significant sub-group take decisions that tend to be autocratic and therefore miss-out other student needs around future flexibility for example[42]. This may also relate to the child's uncertainty around expressing needs but certainly the complexities of free choice within and outside of the unitary authority area.

Where SEND children have extra needs to be met, parents take much longer when selecting secondary schools and essential back-up plans should something go awry. For example, the move for children previously statemented to be educated in mainstream secondary schools may require those on the autistic spectrum to move from small primary school encompassing care to a much larger secondary system without such facilities. A poor school choice decision could quickly result in CAMHS referral with long waiting times. However, if an adjacent special school offers such a service and the student is unable to cope with the demands of mainstream secondary education, then reverting to a linked special school is a much easier problem to solve that may not even cause the loss of friends for the child concerned.

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[42] Schools with specialisms may help reduce these effects as they may remain flexible to certain demand (playing in sports teams and developing the performance arts are accommodated through local Plymouth maintained and free schools for example).

Multi-agency groups can establish common views on shared problems through the medium of system dynamics simulation. Their support policies may readily target first order losses (system stressors where competition drains child wellbeing while rapidly outdating knowledge of needs that schools can now meet) but these have less effect on preventing wellbeing losses in SEND and standard families. Far greater alleviation towards sustained, higher wellbeing levels is achieved through coordination and communication (see key finding on page 257). Low wellbeing threshold transgressions may be avoided along with the associated referral to CAMHS or social services, if frequency of children discussing their specific secondary school needs with adults can be increased.

9.3 Concluding the main aims

Answering the research question leads to a conclusion on the main aim of the study and the associated supporting objectives i.e.

'To model associated influences of secondary school choice on psycho-social wellbeing behaviours in families changing schools using System Dynamics to simulate the impact potential policy interventions for reducing CAMHS referrals.'

Eliminating elective, selective testing on children has little impact on breaching their low wellbeing thresholds when placed in the context of the largely stabilising, family-based, psycho-social systems supporting school choice. When tested with raising knowledge of new schools, children who may be facing academic and other pressures only receive limited wellbeing gains (see pp.242-245). Here any parental knowledge of needs met by schools is rapidly eroded (and other previous generation decision makers), as competition changes what schools can provide.

Actions that make a difference includes coordinating feedback within the family include a sound knowledge of needs met and parents happy to explain how schools could meet future student needs to their child. Above all else, the system is sensitive to timing of such feedbacks for both STD and SEND scenarios (see pp.250-253). Therefore raising the frequency of debate over secondary school selection has much greater impact for not only standard but also SEND needs being met. Not only are the wellbeing gains significant, they are also sustainable if the debate is encouraged to continue as students prepare to be tested again and where fit between need and provision remains reliable. The value of gaining local insight through the repetitive

process of playing bespoke board games is minimal (see pp.254-256) and therefore a common game covering English schools admission is entirely suitable and ready for use in primary schools (for example ELSAs [see Glossary xxii-xxviii] could lead the year 6 class in gamification with peers that would allow individual children to play and discuss with their parents at home).

The research has demonstrated some answers to the question that underpins the objectives for each line of investigation. In particular the simulation has illustrated how child emotions are affected as they prepare for changing schools and what policy designs may best help them cope with change. By asking parents in the locality how they select their preferred secondary schools, key relationships have been established for those vulnerable to incomplete decision-making that may not suit students as they progress through adolescent years in secondary education. Of those who see the results of low wellbeing in children and their diminishing potential over time, support policies aimed towards those who are vulnerable offer hope that the structure of family decision dynamics can be influenced to improve fit between student and school needs, thus avoiding future disappointment. The impact of school choice on CAMHS referrals implicates a wider group of families that may not have time to deal with school choice over other pressing matters. Policies that nudge them towards improved choices can therefore only help all types of family with whatever needs they may have.

As O'Donnell et al note in their report on wellbeing policy in the UK (2014) "…Pareto improving – that is they leave at least one person better off and no one worse off – it is essential that we work in a broad enough space, taking into account all consequences for well-being…".

This study clearly demonstrates that wellbeing surrounding school choice and getting the right fit between school and student is best achieved for all by talking together on the factors affecting selection. Far less effective for wellbeing retention are policy actions addressing outdated knowledge of which needs are now met by a school or burnout deriving from competition between state schools generating additional hours from students preparing for tests. Emotional health in all children is essential for ensuring strong, future societies.

9.4 Key contributions

This research represents a novel study design for generating a model capable of providing policy insights on an intractable issue. Building from a sound base of secondary data on how wellbeing changes for children traversing English state schools, the modelling effort identifies key problem structures (capable of explaining recurring behaviour according to expert practitioners) before determining the impacts of decision bias (beyond the bounds of rational choice) before inferring policy benefits through operating systemic levers capable of raising wellbeing inside lower threshold values, the point at which children and parents might refer to CAMHS or another service (GPs, social services, PIAS, etc.)

The multi-stage process for inducing views from practicing experts, deducing decision bias from parent groups and abducing lever sensitivities for increasing child wellbeing offers a significant contribution towards how policy modelling can be adapted to deal with real world problems in the future. Scientists employ various techniques to link cause and effect through establishing relationships called laws. When the law is unknown between cause and effect then inductive research designs are needed: in the matter of competing schools overlooking child/adolescent needs (with potential CAMHS referrals as lower, acceptable thresholds are breached), the concept model structure defines mathematical laws capable of reproducing behaviours. Should the effect be unknown then this can be deduced if the cause and law are established: here a vulnerable group of inexperienced parents shows that autocratically biased decision behaviours reduce the needs met for a child. Finally, if cause is unknown but law and effect are present then abducing results is needed: this allows sensitive policy lever combinations to be located that retain child wellbeing based on timing rather than slowing exogenous stressor effects.

Of lessons learnt, the research design describes the multimethodological techniques applied in modelling the case study problem, demonstrating that triangulated, scientific research can help investigate a single case study. New combinations of techniques are capable of uncovering sufficient information to be able to construct a useful and usable simulation tool (one capable of supporting a range of intervention tests in a reliable manner).

As illustrated in Figure 9.1, the process triangulates cause and effect through disclosing mathematical links that can be tested and confirmed for reliably reproducing behaviours observed from the urban case study. Factors for establishing all elements of the equations are listed in columns and the research inferences are described by each row. Identified by capitalised text, missing elements of the multi-faceted problem are indicated in each row for resolution by making induced/deduced/abduced inferences from the scientific, analytical techniques that triangulate data within the model-based multimethodology of the intrinsic case study. The contribution to knowledge is thus threefold. Firstly, a novel research design to address a multi-level and multi-agency, single case study problem using triangulation between deduced, induced and abduced sources of data contributing to social system research methodology. Secondly, a contribution to the research discipline of system dynamics with a causal exploration of school enrolment into secondary education and associated decision making. Finally, the practical contribution of a tested range of potential policy solutions to a problem rooted in schools competing for students that now affects families selecting and using secondary schools effectively contributes knowledge to health and social care practice.

FACTOR research inference	CAUSE (COMPETE) X	LAW (LINK) =Y*C	EFFECT (REFERRAL) Y
induced	2. adolescent unmet needs?	MISSING PROBLEM SRUCTURE	1. rising age referrals
deduced	2. wellbeings rebalance through knowledge of school choices.	1.FET autocracy via inexperience	MISSING DECISION BIAS
abduced	MISSING POLICY LEVERS	1. SD model timing sensitivity effective	2.not exogenous stressors of knowledge outdate or test prep. burnout

Figure 9.1 Research design contribution for triangulating causal links in single, intrinsic case studies

In rising order of policy impact on Plymouth CAMHS referrals rising throughout secondary schooling, the following can be concluded on decision rules proposed:

Fourth. On the matter of impact on the problem of rising referrals, SHORT policy 1 to end selective testing offers the least emotional benefit for families considering eleven plus examinations as the system settles after six years and therefore removing the seventh changes very little.

Third. MOREK Policy 2 that aims to increase the quality of information on needs met for families through school open events are also ineffective as families may not visit or get the chance to ask questions, unless already concerned.

Second. GAMIFY 7 Policy 3 seeks to exploit system sensitivities through a generic gamification approach where families enjoy playing school choice together. The benefits of not only enjoying the company but also sharing needs from secondary school selection cannot be overstated.

First. GAMIFY F Policy 4 offers the most child wellbeing resilience for STD families but at the cost of local customisation of the board game to match local school conditions and parent wellbeing. It is noted that families supporting SEND children fair less well under this policy than policy 3. The extra gains over policy 3 are therefore unwarranted given the level of complexity in rolling-out such a solution.

An example snakes and ladders customisation for a three-choice single preference enrolment system is shown in Figure 9.2 reflecting conversations with local parents.
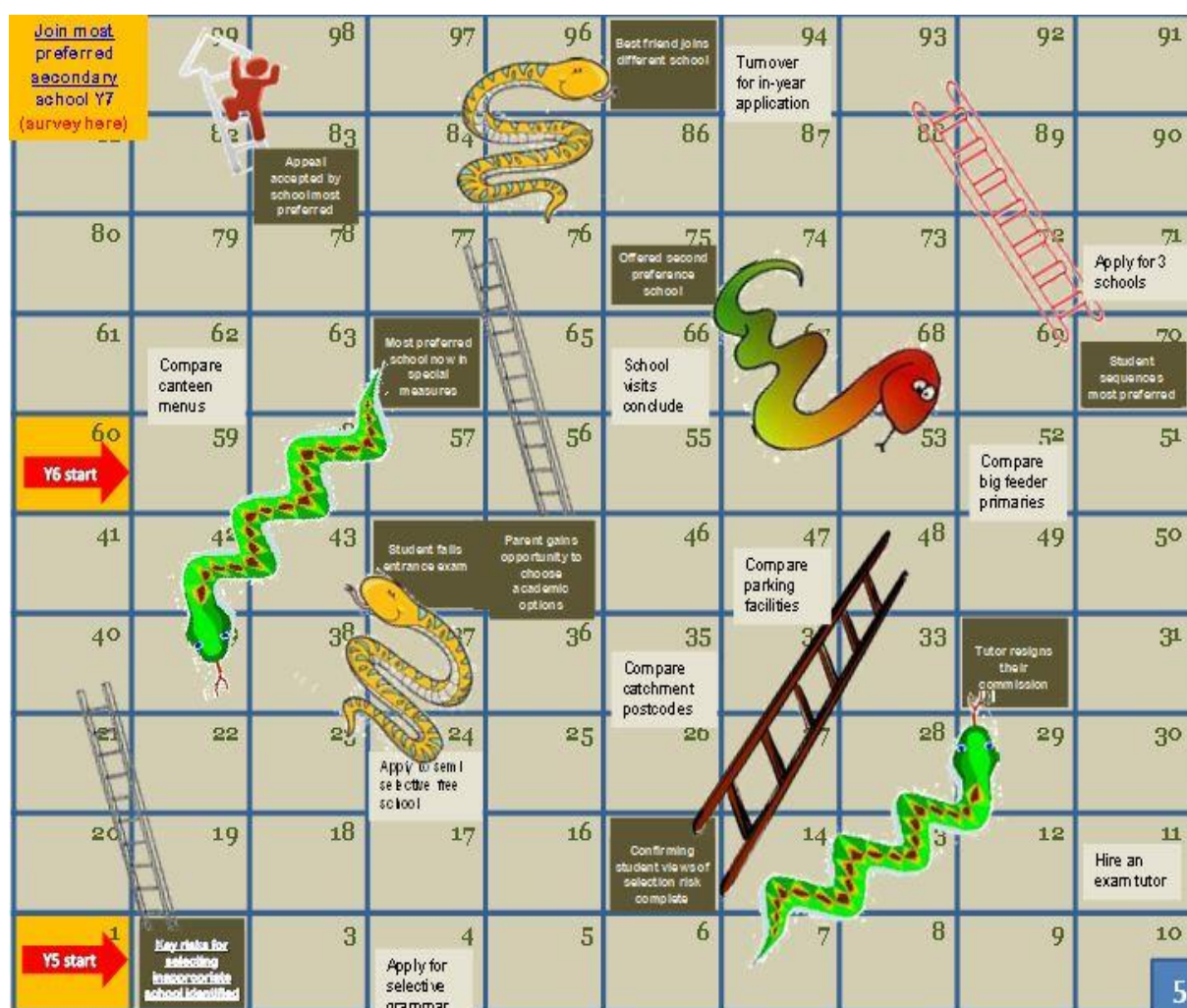
Figure 9.2. Example custom gamification of school choice problem: YOU SCHOOL board game (adapted from Northumbria University).

Whereas this game was based on software to enable the die (bottom right hand corner showing a number between 1 and 6) to generate numbers to enable players to move their counter forward a number of positions on the virtual board game using a PowerPoint presentation (for example, after school clubs showing children how to play the game in groups) this would not be the ideal way to encourage frequent conversations within a family unit. A physical board game would be a far better tool as it could be left out where players retain their own counter positions to encourage competition and debate between parent and child players at convenient intervals. Potentially a fridge-mounted board game could further raise debate frequency. Rather than the game content, it is the sharing of student needs with parents that

provides insight into the types of secondary school that could meet most family requirements.

9.5 Limitations of research

The methodological process contribution to knowledge is offered by the research that is capable of exploring why children might lose wellbeing as they negotiate entry into and use of new schools in the English mainstream secondary system. In particular, this research studies the impact of national competition directives on local choice of school in a competitive, urban environment. It represents a single, cross-sectional, case study and therefore applies at the time of publication but delays in affecting change may mean that results become outdated over time.

The model reflects a closed system where boundaries reflect assumptions for family decision making on secondary school selection that include:

Competition as an exogenous stressor draining Knowledge of Needs Met through an outdating process;

Competition as an exogenous stressor draining Child Wellbeing through continuous test preparation regimes that traverse adolescence;

Autocratic decisions reliant upon parental needs alone to demonstrate the impact of such leadership styles only family emotions from which to compare policy implications;

STD and SEND cases to show the range of possible family response types to policy change, thereby avoiding future harm;

Policies that extend the model boundary to test adding to knowledge and reducing the simulated time horizon (coordinating the frequency of communications remains entirely within the model limits and is reflected by variables rather than extra structure).

Equally certain policy testing can only be applied using simulation techniques as recommendations from the GMB teams of practicing experts countermand current government policy, thereby affording few opportunities to implement such policy in the real-world, even if the limited benefits of such a scheme were considered affordable. That said, the investment of effort appears to favour other policy

interventions based on the causal dynamics of a psycho-social system (one that describes social interactions with parents and schools plus psychological links between parent and child) demonstrating typical interactions between education and family units. The remaining limitation relates to joint-commissioning and agreement between health and social services that the development of a game could help reduce demands for both agencies.

9.6 Future developments

This explanatory study describes perceived connections between emotional health and competitive pressures from schools. It provides some insights that explain system related behaviour but that need confirming in scientific detail to extend the topic and produce greater insights. While initial relationships are clearly set out, these require testing in other urban situations across England to see if and how the relationships work elsewhere. While the value of a novel method has been demonstrated in this application (combining the induced views of experts supporting, the deduced thoughts of parents deciding, and the abduced results of system testing). Further use of simulation tools capable of abducing results (where inductive and deductive techniques may fall-short of the mark but offer valuable contributions towards reducing even more of the assumptions mentioned) is essential for developing new views on intransigent problems over time.

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APPENDIX 1. Prize paper on user engagement

Using scripts for the construction of management simulation models in the context of multi-agency engagement

(awarded best paper pm at ICSMR 2014)
David Carter, Jonathan Moizer and Shaofeng Liu

Abstract— **For a solo researcher barriers have existed in how group model building scripts can be easily facilitated for those participating from multiple agencies to engage in producing convincing models. Overcoming these barriers enables System Dynamics to reach prospective beneficiaries who may not have considered modelling as a means of addressing dynamically complex, multi-faceted issues that are widespread in community healthcare. This paper aims to improve script selection, achieving effective results for participants involved in validating multi-agent, policy alternatives. By studying targeted elicitation techniques from system dynamics and elsewhere, it is possible to shed light on how learning from scripts for modelling in system dynamics can inform other problem structuring methods for engaging management decision makers.**

Index Terms— **Group Model Building, Scripts Pilot, Multi-Agency engagement**

INTRODUCTION

Failure to agree suitable scripts from a filtered list of descriptions provided in versions of Scriptapedia [1] with gatekeepers spanning health and education agencies, indicated the need for an improved approach to multi-phased model construction for an emerging process. Lack of gatekeeper familiarity for selecting scripts, combined with script facilitation in practice by the modeler, were both contributing factors. Alongside such needs, the research faced elevated risk associated with combining modeller/ facilitator/ recorder roles within workshops and reducing this was considered paramount for research project success. The purpose of the case study is therefore to decide the best approach for synthesising sympathetic interventions in child and adolescent mental health through existing providers and managers located in a large, urban unitary authority of England. Specifically, the goals of modelling the case study

include capturing comprehensive decision drivers alongside those deciding resource allocations from contributing agencies and investigating the mechanisms by which policy ambitions can be realised. The gap in knowledge is then used to support negotiation and agreement on how to best intervene in the system to reduce anxiety for those aged 11 when transferring between primary (elementary) and secondary (high) schools in the UK.

The aim of this paper is to determine which Group Model building (GMB) scripts to employ and in what sequence to meet the constraints of minimum meeting time for maximum commitment from a multi-agency combine to effect improvements for the emerging system. Objectives for this research include a comprehensive description of a pilot-based GMB approach, decomposing results from piloting selected scripts and then formulating a compressed approach for audience-focused GMB workshops.

A good range of scripts have already been catalogued but only some would be suitable for GMB to inform construction of a fully quantified system dynamics model [2]. Not only is the GMB process shortened to the time constraints of those contributing, the researcher has to collate model data at the same time as facilitating participants and capturing results. Some scripts lend themselves to less facilitation and recording effort, for example when individuals write their own views on paper for comment by others or participants that self-cluster individual sticky-notes on a whiteboard under themes that can be captured as a photograph. Others require full facilitation though a shared model-capture process. Piloting script selections is therefore important to ensure maximum audience engagement before commencing model construction with a representative audience. This piloting approach is designed to gauge likelihood of model production success based on the response of professionals without prior knowledge of modelling but with a proven ability to reflect upon identified parts of the system.

The remaining of the paper is organised as follows. The next section reviews related literature in decision conferencing and group model building theories of modelling. The approach to script selection research is discussed in section III Methodology. Section IV presents and discusses some initial results resulting from the case study, followed by Conclusions and recommendations on what to use then follow in Section V.

LITERATURE REVIEW

There has been a growing number of publications in GMB and the utilization of scripts to facilitate GMB. A new multi-method survey tool [3] is adopted to evaluate participant views on specific GMB contributions to model construction. This enables scripts (including those beyond standard formatting offered through Scriptapedia) to be evaluated in the context of the case study and potential contributors views on the process and results achieved. Employing magnetic hexagons [4] is an example of a well-known but unformatted script that was tested in the GMB workshops. An example of a formatted script for adding numerical values to a simulation model by participants placing a 'stake in the ground' is shown in Table I. From the Table, it can be seen that a script can

provide a useful means of achieving shared understanding between GMB participants by clearly laying out the context, purposes, nature of tasks, time and steps etc. of the GMB process.

TABLE I: EXAMPLE SCRIPTAPEDIA TEMPLATE OF A SCRIPT (ROUWETTE, 2010)

Description	Participants are asked to predict the outcome of a modeling experiment. This script is an excellent way to generate lively and fruitful discussions and identify points for improvement of the model.
Context	This script can be used when a simulation model has been developed which is at least partially validated, so that there is a considerable degree of confidence in simulation results
Purpose(s)	• Making participants familiar with (assumptions in) a simulation model • Identifying points or further improvement of a simulation model
Nature of group task	• **Divergent**: participants' arguments for expecting a certain model output are made explicit • **Convergent**: the model is used to test participants' expectations on outcomes and in this way is expected to bring these closer together • **Evaluative**: testing participants' ideas involves identifies those ideas that are inconsistent with other knowledge on the system modeled
Time	Preparation time: for a more complex model it will take longer to set up the model simulation Time required to complete steps in script: eliciting comments, running the model and discussion afterwards will probably take around 20 – 30 minutes per simulation Follow up time: if changes in the model are required this may involve another session; if no changes in the model are required participants' confidence in the model is probably increased and no additional follow up (for this particular script) is needed
Materials needed to complete script	• Computer, projector and projection screen • Simulation model • Behavior over time graph to show baserun • Paper if expectations on simulation output are going to be written down, preferable behavior over time graphs showing baserun of variable(s) of interest
Inputs from other scripts	• Behavior over time graph to show baserun • Simulation model
Outputs from this script	• (Possibly) list of further improvements in model structure
Modeling team roles required and expertise needed	• Facilitator to guide group process • Modeler/ SD expert to interpret and explain model behavior in terms of structure
Who is in the room?	• All participants, facilitator and modeler
Steps	1. Briefly summarize main assumptions and parts of structure of the model (I assume that the audience has seen or worked with the model before, or at least is familiar with the model to some extent). 2. Present baserun of the variable(s) of interest. 3. Explain the variable to be changed and how it will be changed. At the start of the exercise, in each simulation only one variable will be changed. Later combinations of changes in variables may be used. 4. Invite participants to write down individually how the variables of interest will change. Ideally participants will draw the expected behavior in time graphs of baserun of variable(s) of interest.
	5. Identify differences between predictions and ask participants to discuss differences (before the model is run). 6. Simulate the model with the changes (explained in step 2). Present results in behavior over time graphs. Explain differences to baserun in terms of model structure. 7. Compare model output to predictions and ask participants to discuss differences. Does the output correspond to expectations and are the structural explanations similar? Then the conclusion is that the model has passed another test and probably 1. participants have gained insight into their problem (they changed some of their ideas on system structure) and 2. confidence in the model is increased. Does the model behave differently and participants do not think the structural explanation corresponds to their experiences of the issue to be captured in the model? Then a list of model improvements can be drawn up. Very probably a mix of both will be the case.
Evaluation criteria	• Participants' insight into the issue increases • Participants' confidence in the model increases
Author(s)	Barry Richmond [21]
History & Basis for Script	I saw this script first in two papers by Barry Richmond (see below). I am assuming similar processes have been used in modeling classes and projects for a long time, although I know of no other publications.
Revisions	Translated into 'script language' Etiënne Rouwette September 2010
References	Richmond, B. (1987). *The strategic forum: from vision to operating policies and back again.* Paper High Performance Systems. Richmond, B. (1997). The strategic forum aligning objectives, strategy and process. *System Dynamics Review* 13(2): 131 – 148.

Groups can be empowered by selecting appropriate scripts used to address issues involving dynamic complexity in socio-technical systems when building models together. First adopted for system dynamics by Vennix in his influential book [5], Group Model Building (GMB) is the common term used to describe group-based system dynamic model construction. GMB is used typically either for quantified simulations of the problem (and trialing resultant intervention opportunities) or qualified diagram structures. An example of the latter is a causal loop diagram that indicates relative influences between connected factors in a system involving feedback and is commonly used to structure complex dynamic problems.

Models constructed through GMB can be employed to help mediate disputes over complex issues between participants who might otherwise disagree [6]. GMB facilitation methods encourage problem owners or stakeholders to take part in model development and subsequently adopt future outcomes predicted by a simulation model through clear and transparent or 'white-box' construction processes [7]. GMB also seeks to overcome the heuristics inherent to "traditional" decision making through integrating and structuring available information [8]. The process of modelling can support capture of qualitative plus judgmental data within quantified model formulations [9], principally by employing descriptions of elicitation processes for sub-models known as scripts. A compendium of deployed and developing scripts has been published; the most recent version, Scriptapedia 3.05, indicates the primary nature of the group task as either

divergence or convergence of ideas. Typically convergent scripts help build models where divergent scripts expand ideas around the issue. For example eliciting hopes and fears of the group collects together divergent views on what success or failure might entail from the workshop for each participant before using a convergent script, debriefing those participating using a multi-method survey tool to ascertain views (electronic scoring on individual strength of beliefs across the group also offering instant feedback to debrief participants).

Facilitation is used to ensure that the outputs remain targeted at the issue being considered. Quantitative modelling combines diverse data sources to underpin simulations of the observed dynamic phenomena. Most scripts are designed to achieve consensus but both assumption reversal and review-update concepts also feature amongst the published techniques [1]. The Scriptapedia compendium of scripts supporting different aspects of GMB, is regularly updated to reflect growing body of practice. Such scripts can be applied to different cases of participatory model construction by first generating divergent insights on complex uncertainties followed by convergent views offering clarifications of the problematic behaviour and potential intervention opportunities. It is noted that scripts can compress traditional multi-phase build into only three workshops.

Scriptapedia offers a collection of accessible GMB scripts that have been described and categorised using standard templates to aid facilitation and modelling by helping to establish positive stakeholder dynamics [10]. Pertaining to the issue under investigation, facilitating individual mental models into memorable GMB charts for subsequent incorporation and testing of a fully dimensioned system dynamics model can be achieved using GMB. Thoroughly understanding individual stakeholder motivations is necessary before combining them into shared perspectives on the issue at hand and represents an essential aspect of managing stakeholder dynamics. Again the concept of widening mental models through the application of a wide set of group cues (rather than a potentially limited and therefore incomplete set of individual signals) is explored through model building scripts that support complex participant feedbacks [10]. The authors recommend starting elicitation using shared natural language before moving participants on towards those specific goals met by creating formal models. Finally, selecting important variables to reflect in an unquantified, stock-flow diagram structure helps to ensure that quality insights can be harvested from system dynamics simulations concerning alternative policy option decisions across a range of factors.

In order to shrink workshops into time-bounded yet effective group engagements, developing modelling debates beyond the workshop confines is another important avenue of exploration. Another complimentary approach [11] to GMB modeling employs the concept of Delphi questionnaires, termed workbooks, not only support data elicitation but also identify likely participants from hard to reach groups. By meeting defined requirements through careful question selection, the task of developing accountable, policy decision improvement initiatives can be established remotely.

However not all audiences are engaged and therefore committed to survey outcomes especially when remote and of little potential consequence. A process that involves the least investment of highly-prized participant time combined with the greatest clarity of communications to a receptive audience could offer better opportunities to engage. Here compressing workshop time through the use of scripts needs revisiting.

METHODOLOGY

The contribution that building shared models can make in translating messy issues into clearer problems through scripts, especially where participants have a rich stock of prior knowledge on the issues of concern, is recognised [12]. Such anecdotes and stories can be used to translate experience into examples that can be incorporated into a model. The importance of bringing the participants' different experiences and perspectives into the GMB process cannot be underestimated, particularly where participants may hold unique knowledge. Healthcare and education are two areas of public service within the UK where complexity abounds. Messy public sector topics addressed using GMB principles include a national shipping policy [13], emergency services management [14], criminal justice [15] and within this, even detailed policing themes [16].

Selecting scripts for building models may therefore offer considerable efficiencies across public sector providers, especially when combined with greater effectiveness for resulting policy, when compared to a traditional meeting agenda (typically used to address shared multi-agency issues in the UK public sector). Starting with traditional system dynamics model construction processes, we now consider how theory and associated technology may help to reduce participant time commitments from the public-sector to a community health study employing GMB scripts.

The need to first expand ideas on the topic of modelling being considered is important for group work and the process of useful data collection for quantified model building. Divergence supports exploring the range, variety and constitution of issues that could be considered from different points of view offered by those participating in the session. As scripted sessions last anywhere between thirty minutes and three hours, summary information usually in the form of charts and graphics, enables the detail to be recorded in a shortened format for subsequent recall and review.

The information generated through a divergent script now has to be focused using system concepts and ideas using another script that converges data towards a sub-model contribution that can be easily recalled and debriefed. The chosen scripts have to compliment the overall workshop purpose with the right output products and therefore pairing complementary scripts is important for engaging contributions with a consistent approach. Ideally not lasting more than four hours from start to finish, including breaks with refreshments on hand, helps to avoid discomfort and reversion to snap judgments (termed 'system one' [17] or impulsive decision making in management psychology). Greater confidence can be generated in script performance if the opportunity to pilot with a suitable group is available to

the modeller/facilitator. This helps reduce risk associated with combining GMB roles [18]. It may also be useful to have alternative or back-up scripts if running with a group for the first time.

By contrast a longer five-phase process [19], one where time constraints do not apply, is traditionally used when not collaborating on model construction comprising problem definition. The phases comprise conceptualizing model structure; eliciting feedback structure; equation writing and parameterization then; policy development. Each of the phases provides iterative detail on different parts of the model construction process. Modelling in this way is considered a more established route to system dynamics simulation but remains unsuited to working with groups that are unfamiliar with a modelling approach. It is noted that scripts have been used to help reduce all five phases into three workshops, given multiple roles and enough time. However this now needs revisiting if a combined role is to develop a system dynamics model within a relevant group of participants.

A representative group was selected for the pilot topic from education, local government and health. An agenda was agreed with the two gatekeeper roles that enabled a wide range of potential scripts to be tested for their ability to condense the data elicitation process by ensuring maximum contributions from all attending. A debriefing script, based on electronic survey technology, then supported view collection and script verification at the end of the workshops.

CASE STUDY RESULTS

GMB participants for the piloting workshops were selected for their wide ranging experience and expertise (half were current practitioners while the remainder were recently retired) in child education and health service provision. Represented in the group were primary and secondary teachers, head teachers, local council officers, teaching assistants, counsellors, psychologists and health managers.

The problem posed for piloting was the hypothesis that a bulge in student numbers now entering primary school reception classes in a city, could manifest itself as a reduction in success rates for children obtaining their first choice of secondary school in five years for an extended period. The reduction in first choice placements could then increase delay and frustrate those families and children needing places upon transferring schools aged 11. Parent and child stress induction may result, causing demand for statutory appeals to increase pressure on council provided services. This will again introduce further delays and uncertainty providing a vicious feedback loop in a short space of time. 95% first choice placements currently enjoyed across the city would reduce and dissatisfaction with the system would mount, over-spilling into community health provision for those individuals who are unable to cope.

It was suggested that Child and Adolescent Mental Health Services and health commissioning may need to prepare for significant increases in demand for child services over a period of time where rates may suddenly rise. By working as a multi agency combine, it may be possible to model such emergent effects and decide ways of intervening that would reduce overall impact from larger cohorts of year 6 students

planning their transfers into year 7.

Having decided to run a pilot in a realistic setting with experienced participants, key scripts forming the basis of individual workshops were chosen due to their adaptability. Table II provides further details of the workshops agenda.

TABLE II: THE AGENDA OF SCRIPTS FOR A WORKSHOP

Function	Group 1	Group 2	Group 3
Key divergent script elicitation	Hexagon clustering	Graphs over Time	Nominal Group Technique
Aim of script	Discover multiple factors	Reveal systemic behaviours	Establish viable intervention

It was found that the piloting approach to script selection provided gatekeepers with a degree of familiarity while testing whether the individual scripts would provide the detail necessary to establish a quantified model.

Piloting with a representative audience was also the preferred approach for the solo researcher where views could be tested using a standard questionnaire that also supported a debriefing process by using electronic voting on questions thereby providing instant feedback on group-held views while allowing a debriefing discussion to proceed at pace. Here specific scripts within the participative modelling process are tested to ensure that they produced adequate results and generate shared understanding that can be reflected in a common dictionary of acceptable terms. The piloting process enables differences and improvements to be assimilated before attempting to facilitate the scripts (now with the support of gatekeepers) on the selected problem for a live audience from those multi-agencies with a stake in the outcome. This helps reduce overall risk especially where one individual has to take responsibility for both modelling and facilitating. It is noted that recording has been previously established using live audio tapes and with contributor permission, this was the chosen solution for piloting GMB scripts with participants [20].

The initial results of the script selection aimed at achieving a rapid and constructive modelling intercession have also been reported to the research sponsor, thus extending the level of support across the client organisation to modellers, beyond those involved in piloting. The value of a planned approach to GMB over separate workshops and multiple sessions will assist those involved in researching the community health issues i.e. around anxiety in children changing schools when aged eleven. Should further workshop time reductions become necessary, then the opportunity to quantify more model detail outside of workshops and potentially with Delphi questionnaires may have to be re-evaluated [11] with attendant risks around accountability for responses and commitment to action outcomes.

Innovation is present in every workshop as long as the stories can be heard and facilitated. For example, during the Nominal Group Technique (a '365' process allows 3 policy

topics to be recorded for 6 individuals each spending 5 minutes writing on their form before passing it to the left for comments by five others), a healthcare manager identified a scripted process improvement when top unilateral policy rules were commented in turn by others in the group. Having read other policy suggestions the improvement was then identified and integrated into a further policy option not previously considered that suggested a multi-agency combined approach for testing on a simulator i.e. an example of multi-lateral policy development in action.

TABLE III. SCRIPT COMPRESSION FOR GMB IN COMPARISON TO OTHER APPROACHES

SD TRADITIONAL MODELING PHASES FOR SIMULATOR CONSTRUCTION (COYLE, 1996)	SIMULATOR CONSTRUCTION BY SURVEY AND WORKSHOP (VENNIX AND GUBBERS, 1994)	PILOTED SIMULATOR BUILD USING SCRIPT COMPRESSION IN THREE GMB SESSIONS
1. Defining problem presenting reference modes eliciting reference modes audience, purpose and policy options	1.Defining problem interviews with organisational leaders	1.Defining problem interviews with agency leaders to identify drivers*
2. Conceptualizing model structure sectors, a top down approach maintain sector overview while working within a sector stocks and flows by sector	2. Conceptualizing model structure 'stawman' modelling of stocks and flows by meeting with core modelling team reflecting participants	2 and 3. Conceptualizing model and eliciting feedback structures Graphs over Time script* for 'status quo' projections plus 'hoped-for' system responses based on developing emergent system structures
3. Eliciting feedback structure direct feedback elicitation capacity utilization script system archetype templates 'black box' means-ends script	3. Eliciting feedback structure survey questions based on simple flow chart	
4. Equation writing and parameterization data estimation script model refinement script 'parking lot' for unclear terms	4. Equation writing and parameterization detailed questionnaire based on detailed system diagrams	4. Equation writing and parameterization 'stake in the ground' estimating system response to varied inputs (unpublished script, 2010)
5. Policy development eliciting mental model-based policy stories create a matrix that links policy levers to key system flows 'complete the graph' policy script modeler/reflector feedback about policy implications formal policy evaluation using multi-attribute utility models scripts for 'ending with a bang'	5. Policy development meeting with engaged group to develop viable policy interventions	5. Policy development decisions informed by verifying results of inaction, unilateral and multilateral policy decision rules (modified Nominal Group Technique script)* presenting system behaviour summaries explained using causal loop diagramming for indicating sustainable improvement policy decisions

Table III indicates how compression through selecting scripts can be achieved moving from the left hand column explaining the traditional five phases [19] through Deplhi questionnaire meeting-time reductions [11] on the way to the final right hand column decided for P2015 involving piloting key scripts* with a representative audience verifying script performance. It is noted that not all script material or durations were assessed during the pilot due to the lack of a

developed system dynamics simulator for subsequent convergent scripts.

Based on results in Appendix A, script compression research looks promising to deliver a model based on only three workshops with high quality engagement within windows of only three hours. Some of the key benefits that our workshop participants agreed on about using scripts in GMB include:

- Assisting putting ideas forward
- Assisting multiple views on issues
- Assisting deciding options for tackling issues
- Help change views on what ought to be done
- Helps think more creatively on issues
- Informs about influences surrounding issues
- Helps understand how contributor values relate to their views
- Helps challenge previous thoughts on issues
- Helps focus on really important factors
- Helps with the clarity of thought on positive and possible changes
- Helps meet the purpose more clearly
- Helps people work well in a team
- Helps provide sufficient information to engage in debate

CONCLUSIONS

Healthcare and education specialists are major participants in the modelling study of the dynamic phenomenon of school transition anxiety in children. They are not modellers but frequently observe the effects of emergent systems not always operating effectively. Their views are key to successful modelling but specific gate-keeping roles have to be entrusted with script endorsement and accurate use of language to avoid wasting time for the majority of participants. The adopted process of piloting demonstrated the appropriateness of the scripts selected from those available for use with a community health related group of public servants. By using a filtering approach to selection, Scriptapedia formats enable reliable quantitative script choices prior to deciding relevant divergent-convergent pairs of scripts for data elicitation. The benefits of selecting suitable scripts for an audience include improved levels of engagement, more champions for a shared course of action and greater understanding of the consequences of particular policy interventions.

Quality communications are inferred from not only a common dictionary of terms used by the group but also through the clarity of elicitation processes supported by scripts. Certain qualitative scripts are also used to support process communication rather than data elicitation needs. For example, all workshops employ the qualitative debriefing script which does not extract data but instead clarifies workshop outcomes by reviewing sub-models collected throughout the workshop across individual scripted sessions. Survey results from the pilot day confirm that scripts were indeed suitable for generating relevant data and offered value to those participating in GMB from the target audience. New dictionary terms were also defined around the community heathcare problem during workshops.

Having reached our objectives of describing a pilot-based GMB approach, decomposing results from piloting selected scripts and re-formulating a compressed approach for audience-focussed GMB workshops, the aim of establishing which GMB scripts to use has helped further reduced face to face participant time while maximising the target group commitment (without the need to resort to questionnaire responses from specialists where necessary assurances for subsequent action could be lacking).

Appendix A. Examples of Electronic Survey Results

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Total
Assists putting ideas forward	50%	50%				100%
Assists multiple views on issues	66.67%	33.33%				100%
Assists deciding options for tackling issues	50%	50%				100%
Helps change views on what ought to be done	16.67%	66.67%	16.67%			100%
Helps think more creatively on issues		83.33%	16.67%			100%
Informs about influences surrounding issues		66.67%	16.67%		16.67%	100%
Helps understand how contributor values to their views	16.67%	83.33%				100%

Helps challenge previous thoughts on issues	16.67%	16.67%	66.67%			100%
Helps focus on really important factors	16.67%	66.67%	16.67%			100%
Helps with the clarity of thought on positive and possible changes	16.67%	50%	33.33%			100%
Helps people work well in a team		100%				100%
Helps provide sufficient information to engage in debate	16.67%	83.33%				100%
Helps express own cultural viewpoint		83.33%	16.67%			100%

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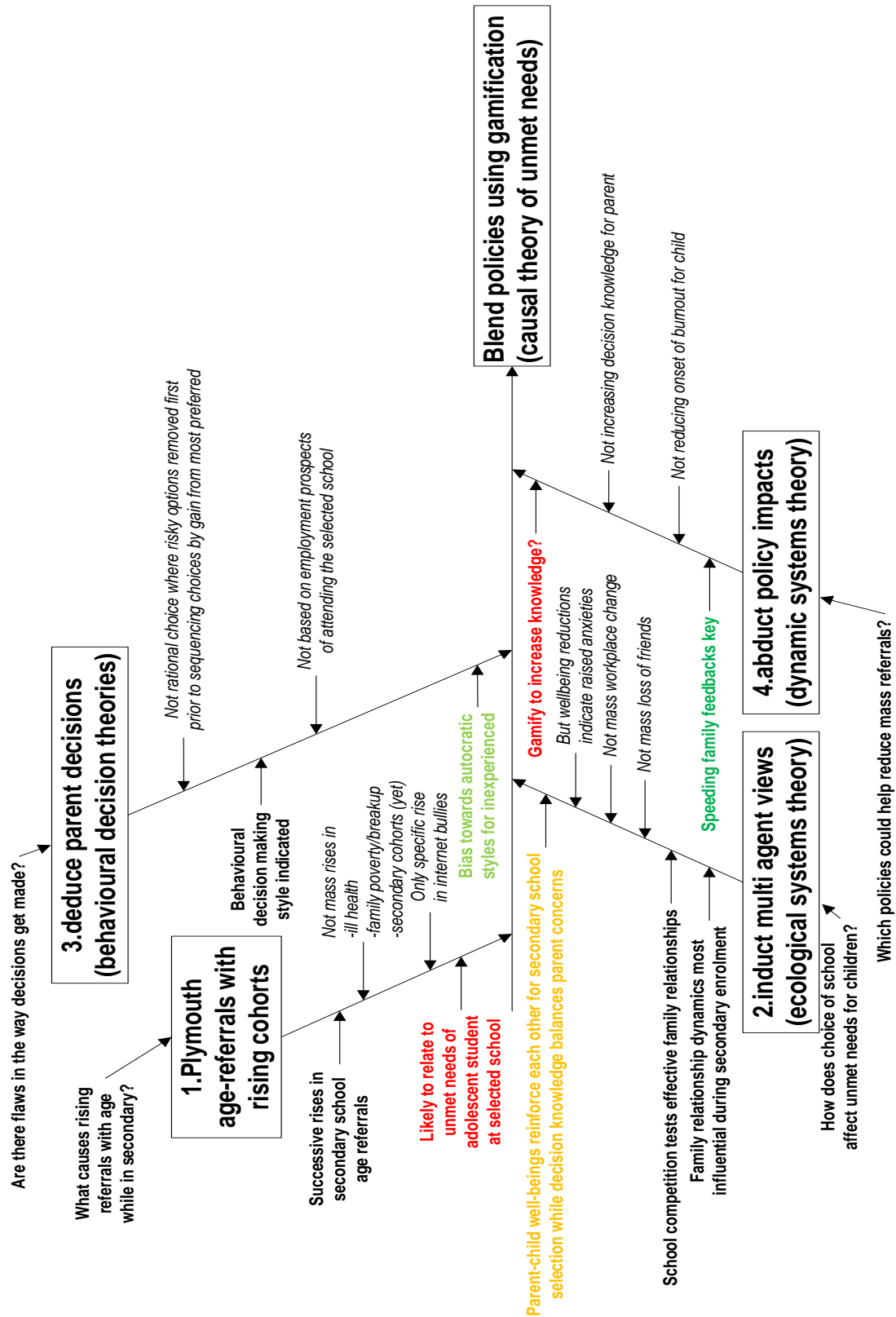
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Blend policies using gamification (causal theory of unmet needs)

Not increasing decision knowledge for parent

Not reducing onset of burnout for child

3.deduce parent decisions (behavioural decision theories)

Not rational choice where risky options removed first prior to sequencing choices by gain from most preferred

Not based on employment prospects of attending the selected school

4.abduct policy impacts (dynamic systems theory)

Are there flaws in the way decisions get made?

Behavioural decision making style indicated

Gamify to increase knowledge?

But wellbeing reductions indicate raised anxieties

Not mass workplace change

Not mass loss of friends

What causes rising referrals with age while in secondary?

Not mass rises in
-ill health
-family poverty/breakup
-secondary cohorts (yet)
Only specific rise in internet bullies

Bias towards autocratic styles for inexperienced

Speeding family feedbacks key

1.Plymouth age-referrals with rising cohorts

Parent-child well-beings reinforce each other for secondary school selection while decision knowledge balances parent concerns

School competition tests effective family relationships

Family relationship dynamics most influential during secondary enrolment

2.induct multi agent views (ecological systems theory)

Successive rises in secondary school age referrals

Likely to relate to unmet needs of adolescent student at selected school

Which policies could help reduce mass referrals?

How does choice of school affect unmet needs for children?

APPENDIX 3. Fisher Exact Test calculated example

Concerning differences between school GCSE results, parents may believe that grammar schools may offer better pass rates for GCSE Chemistry than their non-selective, secondary school counterparts in the city. Given small numbers are taking GCSE chemistry at a non-selective school whereas the course at grammar school is full, Fisher Exact Test can show whether the GCSE Chemistry pass/fail rates are grammar are significantly different from those at a non-selective even when numbers vary dramatically. The example of GCSE Chemistry results helps to explain the theory by presenting the school types in rows and the examination results in columns as a count of students in each cross-tabulated category as a 2x2 table. Bracketed figures suggest the proportions that would be expected based on numbers in either type of school taking the examination (a small sample size of 26 in total is tested in the example).

Table A.3 Fisher Exact Test on Two-by-Two example cross tabulation of GCSE school results.

	GCSE CHEMISTRY RESULTS		
(EXPECTED COUNT)	Pass	Fail	
Secondary Grammar School	8 (7.6)	14 (14.4)	22
Secondary Non-Selective School	1 (1.4)	3 (2.6)	4
	9	17	

26 total sample

Table A.3 shows the variation of recorded from statistically expected (shown in parentheses) results for grammar and non-selective state schools where sample sizes differ as fewer students take the examination in the latter. For an absence of biasing (the null hypothesis) proportional results are expected if there is no bias

favouring results in one school over the other e.g. quality of teaching, access to resources, etc. Proportional results are shown as being expected in the brackets of the matrix. Unbracketed actual scores are also recorded and then compared to establish if there is a statistically that can be deduced using Fisher Exact Test mathematical theory explained next i.e.

Does the data provide sufficient evidence to indicate that the proportions passing GCSE Chemistry differ for the two schools?

H_a: The proportions passing GCSE Chemistry differ for the two schools.

$(\pi_{Grammar} - \pi_{Nonselect} \neq 0)$

H_o: The proportions passing GCSE Chemistry do not differ for the two schools.

$(\pi_{Grammar} - \pi_{Nonselect} = 0)$

Assumptions: Two independent binomial experiments were done. Since the sample sizes are small, Fisher's Exact test is used.

Test Statistic: n_{11} = the number passing GCSE Chemistry at Grammar School.

$\alpha = 0.05$: P-value ≤ 0.05

Assuming the marginal totals are fixed, then all possible two-way tables which have those marginal totals should be determined using the smallest marginal total and create the table for each ordered pair of integers with that sum.

Since $n_2 = 4$ is the smallest marginal total, the following ordered pairs are then checked for

(n_{21}, n_{22}): (0, 4), (1, 3), (2, 2), (3, 1) and (4,0).

$$P\{nij\} = \frac{n1!\,n2!\,n1!\,n2!}{n!\,n11!\,n12!\,n21!\,n22!}$$

Equation A3.1 General calculation for Fisher Exact Test

9	13

0	4

$$P\{nij\} = \frac{22!4!9!17!}{26!9!13!0!4!} = 0.159197$$

Equation A3.2 First term calculation for Fisher Exact Test

8	14
1	3

$$P\{nij\} = \frac{22!4!9!17!}{26!8!14!1!3!} = 0.409365$$

Equation A3.3 Second term calculation for Fisher Exact Test

7	15
2	2

$$P\{nij\} = \frac{22!4!9!17!}{26!7!15!2!2!} = 0.327492$$

Equation A3.4 Third term calculation for Fisher Exact Test

6	16
3	1

$$P\{nij\} = \frac{22!4!9!17!}{26!6!16!3!1!} = 0.095518$$

Equation A3.5 Fourth term calculation for Fisher Exact Test

5	17
4	0

$$P\{nij\} = \frac{22!4!9!17!}{26!5!17!4!0!} = 0.008428$$

Equation A3.6 Fifth term calculation for Fisher Exact Test

And summarised as

n_{11}	$P\{n_{ij}\}$
9	0.159197
8	0.409365
7	0.327492
6	0.095518
5	0.008428

Since n_{11} = 8, the two-tailed P-value is the sum of all probabilities less than or equal to 0.409365. In this case the P-value equals 1. Hence there is not enough evidence to conclude that the proportions passing GCSE Chemistry differ for the two schools. For a one-tailed test the P-value is found by comparing n_{11} to its expected value. If n_{11} exceeds its expected value then the P-value is the sum of the probabilities for all n_{11} > to the expected value. If n_{11} is less than its expected value then the P-value is the sum of the probabilities for all n_{11} < to the expected value.

As the expected value is 7.6, the P-value is 0.159197 + 0.409365 = 0.568562. Hence there is not enough evidence to indicate that the probability of passing GCSE Chemistry is higher at Grammar than at Non-Selective.

APPENDIX 4. Flash card design for final survey

Survey of Year 5/6 Parent Views
on choice of Plymouth Secondary
Schools

David Carter
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OPTIONS, CHOICES AND PREFERENCE

OPTIONS

17

FILTERED

3 CHOICES ON APPLICATION
1 MOST PREFERRED
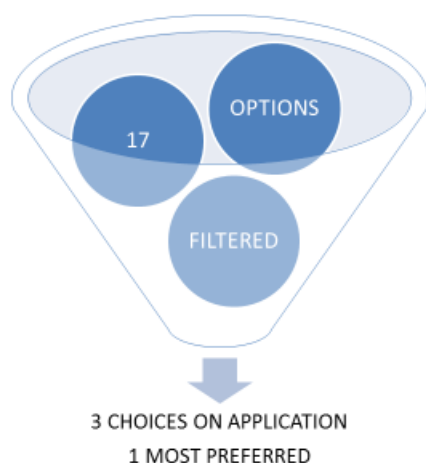
1. PRIMARY SCHOOL DETAILS

WHAT YEAR IS YOUR CHILD?   **ONE CATEGORY ONLY**

A. YEAR 5 PLYMOUTH
B. YEAR 6 PLYMOUTH
C. YEAR 5 BEYOND
   PLYMOUTH
D. YEAR 6 BEYOND
   PLYMOUTH

2. POSTCODE CONFIRMATION

**WHAT IS THE FIRST HALF OF
YOUR HOME POSTCODE?**

3. CONNECTIONS WITH SCHOOL

WHAT FAMILY ASSOCIATIONS?   **ONE CATEGORY ONLY**

A. NO PREVIOUS LINKS

B. SIBLINGS ATTEND(ED)

C. PARENTS LINKED

D. OTHER RELATIVES LINKED

E. MIX OF ABOVE

4. APPROACH TO SCHOOL CHOICE

WHICH BEST DESCRIBES YOU?   **ONE CATEGORY ONLY**

A. SOLVE USING AVAILABLE INFORMATION TO YOU (ai)

B. CONSULT BEFORE SOLVING PROBLEM YOURSELF (aii)

C. SHARE INFORMATION WITH INDIVIDUAL FAMILY MEMBERS FIRST (ci)

D. SHARE WITH WHOLE FAMILY BUT MAY NOT ACCOUNT FOR ALL VIEWS IN SOLUTION (cii)

E. NOT IMPOSE DECISION BUT DIRECT/FOCUS DEBATE (gi)

5. RELIABLE INFORMATION SOURCES

HOW DO YOU VALUE?

A. NEWS ARTICLES
B. WORD OF MOUTH
C. SCHOOL VISITS
D. SCHOOL WEBSITES
E. LEAGUE TABLES
F. COMPARISON WEBSITES
G. TELEPHONE HELPLINE
H. SCHOOL PROSPECTUS
I. COUNCIL GUIDE

SCORE OPTIONS

- HIGHLY INFLUENTIAL
- LITTLE OR NO INFLUENCE

6. OVERALL TACTICS FOR SCHOOL OFFER

WHICH BEST DESCRIBES YOU?

A. INSURE AGAINST OF MOST PREFERRED NOT OFFERING
B. LOCK-IN POTENTIAL GAINS TO AVOID LOSING A PLACE
C. TAKE A RISK BY CHOOSING BEST OF LIMITED OPTIONS
D. GAMBLE ON UNLIKELY FACTORS TO SECURE PLACE
E. COMBINATION OF THE ABOVE

ONE CATEGORY ONLY

7.KEY SCHOOL CHOICE FILTERS

WHICH BEST DESCRIBES YOU?   **ONE CATEGORY ONLY**

A. GRAMMAR

B. SINGLE FAITH

C. SINGLE SEX

D. CO-EDUCATION (BOTH)

E. SPECIAL NEEDS

F. FEE PAYING

G. NONE OF ABOVE

8. TIME TAKEN DECIDING SCHOOLS

GIVEN OTHER COMMITMENTS, HOW LONG TO INFORM YOUR DECISION?   **ONE CATEGORY ONLY**

A. WEEK OR LESS

B. 1-4 WEEKS

C. 1-3 MONTHS

D. 4-12 MONTHS

E. MORE THAN A YEAR

9. SCHOOL DECISION FACTORS

WHAT OUTCOMES WOULD YOU EXPECT?

A. SUBJECT VARIETY
B. ACADEMIC RESULTS
C. TEACHING QUALITY
D. SCHOOL ORGANISATION
E. PROGRESS UPDATES
F. FACILITIES
G. ADMISSION NUMBERS
H. COMMUNICATIONS
I. PREDICTED RESULT
J. ADAPTABILITY
K. COSTS OF ATTENDING
L. REGULAR WORK AT HOME

SCORE OPTIONS

- ALWAYS
- SOMETIMES
- SELDOM/NEVER

10. FEELINGS ABOUT SCHOOL CHOICE

HOW DO YOU RATE?

A. NUMBER OF FAMILY MEMBERS ACTIVELY DECIDING SCHOOL
B. OVERALL FAMILY WEALTH
C. OVERALL FAMILY HEALTH
D. FAMILY HAPPINESS WITH DECISION
E. YOUR OWN HAPPINESS
F. YOUR CHILD'S HAPPINESS
G. DISCUSSING THINGS THAT MATTER THE SAME DAY

SCORE OPTIONS

- HIGH
- MEDIUM
- LOW

11. BALANCING SCHOOL WORK

HOW DO YOU VALUE?

A. MORE TIME WITH FRIENDS
B. MORE TIME FOR INTERESTS
C. MORE TIME WITH FAMILY
D. LIMIT TIME SPENT WORKING AT HOME
E. SEEKING TEACHER ADVICE/SUPPORT

SCORE OPTIONS

- ALWAYS
- SOMETIMES
- SELDOM/NEVER

THANK YOU

For your time

PHOTOGRAPH AND TEXT THIS SURVEY
SYMBOL TO FRIENDS FOR THEIR VIEWS

APPENDIX 5. Typical workbook commented at concept model demonstration

P2015 Secondary School Choice Problem for Plymouth

Model-building Project

Dynamics of the Parent-Child Relationship Mediated by Information

VALIDATION WORKBOOK

Graduate School of Management,

Faculty of Business,

Plymouth University,

UK

Introduction

This document is the validation workbook in the participative model-building project known as P2015. A number of structured interviews have taken place with parents who have largely succeeded in obtaining preferred schools for their children in competitive state secondary education sector of Plymouth in the UK. This workbook reports on both workshops, held in June and November 2014, and also formulates a number of questions in preparation for final research presentations. Please bring the complete workbook questions prior to individual debriefings being arranged to demonstrate model capability so far.

In addition, three reports on aspects around transferring to secondary school are also provided;

- Burgess,S., Greaves, E., Vignoles, A. and Wilson, D.(2014). What Parents Want: School Preferences and School Choice. *The Economic Journal.* (online version published before inclusion in an issue)

- Carter, D., Moizer, J., & Liu, S. (2014). Using Scripts for the Construction of Management Simulation Models in the Context of Multi-Agency Engagement. *International Journal of Innovation, Management and Technology.* 5(4) pp. 273-279.

- Dalton, A. (2009). Aiding in the transition from primary to secondary school. *The Plymouth Student Educator,* 1(1), pp.1-9.

Please consider these articles in preparation for completing both validation questions at the end of the workbook prior to the debriefing interview.

Workshops and Interviews Report

The following people were present at workshops 1 & 2 (various attendance times): Martin Edmonds (Secondary School), Bob Burton (Council – Parent Partnership Advisor), Emma Corrigan (Council – Educational Psychologist), Lynda Vella (Health – CAMHS Clinical Team Leader) and Graham Carr (Health – former CAMHS Clinical Team Leader). The facilitator for both workshop sessions was David Carter, supported by Kirstie Spencer in a gate-keeping capacity as well as representing Child and Adolescent Mental Health Services in Plymouth. The aim of this project is to assess

factors and relationships between those deciding schools and information provided for helping students successfully navigate their transfer between Plymouth mainstream state schools when aged eleven to help understand competitive influences. The first workshop concentrated on plotting normal and highly expressed parent-child relationships as they evolved during the decision-making process. By contrast, the latter session concluded by mapping out certain influencing factors and consequences endorsed by the competitive urban admissions system for secondary education in Plymouth. In addition, a potential range of policy changes that were considered to alleviate the problems observed. A range of basic variables ultimately emerged from this process that was believed to influence reported dynamic behaviours over time.

anxiety (wellbeing loss leading to breach)

child

information

marketing

bullying

parent

student

wellbeing (social and emotional not physical)

Word of Mouth Recommendation (WoMR)

semi-selective (performing arts free school)

selective (1 male & 2 female grammar schools)

government policy

non-selective (remaining mainstream state secondary schools excluding special schools)

tests

Transition Plus

confidence (wellbeing gain leading to recovery)

cohort

open evening

choice

peers

competition

Planned Admission Number (PAN)

Information quality

risk	appeal
multi-agent	population bulge
result feedback	admission process
year n (where n = 6 primary or 7 secondary)	common application form
	normal point of entry
preference	decision maker knowledge

Next, the model was built step-by-step based on discussions about the causes of changes in the number of admission opportunities for children aged eleven. I describe these discussions on the following pages, and indicate the topics associating key script titles (sourced from Scriptapedia) in the margin reflecting discussions of each workshop group or parent interview.

Hopes and fears   The discussion began by identifying associated hopes and fears with the group model building activity. The participants proposed a number of their own individual hopes and fears and the common themes were brought together by the facilitator and displayed for review during regular comfort breaks. Before the workshop closed, the facilitator also conducted a live questionnaire about modelling multi-methodology. Simply reviewing whether participant hopes had been realised and their fears avoided, suggested that most were satisfied with the approach. Typical pilot views are discussed further in Carter et al, 2014.

Graphs over time   It was decided to distinguish between highly expressed and conventional parent-child relationships as the nature of how each behave over time differs significantly according to the group. Highly expressed relationships exhibit tracking behaviour where fluctuating levels of student concern at the prospect of changing schools is directly mirrored by those of the parent. Conventionally expressed parent-child relationships do not follow each other in this manner but instead offer buffering between anxious/confident student variations in terms of self-reported social and emotional wellbeing. For example, it was described that such parents understand day-to-day variance in their child's wellbeing but might only react with satisfaction or concern, to formal establishment requests for information about their decisions on choice of school, purchasing uniform, etc.

Admission processIn addition, it
was important to inform subsequent workshops and parent
interviews by having an up-to-date admissions process described for
Plymouth. This was captured as a simple series of stocks and flows
in a diagram that represented a process recognisable to parents.
Stocks included year 5 students competing for places (semi and
selective schools) year 6 student preferences and objections from
schools rejecting a student's application known as appeals, held
towards the end of year 6. Furnished with this simplified process, a
parent questionnaire was designed to understand individual
decision-making cases of parent-child relationships and the
supporting role of information, as detailed within the modelling group.

Parent-volunteer interviewing then focused on the question of what exactly was meant by secondary
school decision making and how the wellbeing of both child and parent were affected throughout the
secondary school admissions process, whether or not successful in achieving original aims.
Competition for desirable school places plays an important role in understanding secondary school
choice (Burgess at al, 2014). With the advent of free schools in Plymouth, academic-only selection
criteria have now been superceded to select some children based on other talents and abilities. A
recently established School of Performing Arts now offers year 6 children access to secondary school
based on audition test results for example. With secondary school application opportunities limited to
three, choice of schools has to consider new options and rank them accordingly; otherwise the
admissions authority would remain unaware when determining allocations of student to school.

Government policy distinguishes between different types of school by allowing semi and selective
schools to test children opting to compete for places to help inform their school choices and preference
sequencing. By contrast to semi and selective establishments, non-selective schools are more likely to
compete on general rather than specific skill-based reputations for excellence. For such schools
however, Word of Mouth Recommendation can influence decisions makers by answering questions
not represented in published results. Supplemented by school visits, parents and children are
encouraged to understand schools competing for their support and what they offer to the individuals
involved in the decision making process. It is therefore concluded that navigating admission into
secondary school represents a complex process for decision makers involving multiple information

sources of specific interest. By competing for selective places early (before completing the Common Application Form for example), it is necessary for decision makers to gain experience of the schools and develop admission strategies. Such pre-experience of the issues affecting choice between options and sequencing preferences, serves to encourage wellbeing gains for those deciding. In this situation the acquisition of new and reliable information such as test outcomes, greatly enhances decision maker confidence. Here the relationship between the parent and child wellbeing is especially important. This concerns the mediating effect of knowledge relating to secondary school options linked to the wellbeing of those making decisions and others affected by resulting outcomes. Both parent and child affect each others' levels of subjective wellbeing in most family settings.

competition value   The practical value of reliable information resources is enhanced with student results from competing for places. Parents deciding schools can begin to understand levels of risk when applying to certain schools based on previously published figures from the year before. Risk can encompass qualifying grades for semi and selective schools plus specifying the order in which choices are preferred. The information offers an important influence on decisions by helping moderate demand where a marginal score might prioritise a school as second or last preference and students would be less likely to receive an offer. Further value from competing is also derived from the pre-experience of understanding family drivers favouring schools, whether or not selective. Largely inflexible factors that relate to fairness and equality have to be considered first when deciding schools (answering questions of location for example may offer little to trade-off between schools as changing catchment areas can be expensive and therefore represent risk uncertainty to families). Social determinants are important when families consider what school options are within reach, warranting the extra investment required to obtain desirable benefits that may not be available elsewhere.

compare information According to the participating parents, whereas opportunities to compare schools using reliable information may be adequate for academic competition to enter selective schools, less supporting information exists for differentiating between non-selective schools with similar academic backgrounds. Visiting potential and preferred schools may help decision makers but this is often limited to a few weeks before finally deciding. While supporting strategic decision making, visits can offer few, reliable comparators. Council support for secondary school choice is also available but reduced funding has seen some services withdrawn. Whereas more flexible decision factors might be considered by children as they contemplate changing school, such criteria tend to be less strategic than the factors parents find

important for long-term success. Parents are often better equipped to trade-off competing criteria between schools in order to maximise profitable gains for the family as well as the child. In conclusion, the more practice available for making informed decisions, the better the overall fit of child to secondary school whether targeting semi, selective or non-selective establishments in the application. This implies that high-quality information across the range of school options available is an important mediator for decisions on the school choice problem, beyond published academic results from previous years and admitted numbers of first, second or last place preferences.

<u>stocks of wellbeing</u> Two important stocks of social and emotional wellbeing help explain highly-expressed relationships between parent and child and the role of anxiety and confidence associated with transferring school. The ability of parent levels of wellbeing to follow or track those that their child experiences suggest an exclusive connection where rate changes are communicated from child to parent with only minimal delays (limited smoothing of social and emotional wellbeing between actors in such relationships). In such cases, child wellbeing is closely tracked by parent levels to the exclusion of other influences. By contrast, for the majority of conventional parent-child relationships, the ability to track levels of wellbeing is suppressed by parents offering a buffer to children suffering fluctuating levels of wellbeing associated with multiple pressures of being a year 6 student (Dalton, 2009). When significant variations in student levels occur as workloads increase during year 6 for example, parents can offer reassurance to their child by not responding "like-for-like" but rather using their own knowledge of their school choice problem to offer advice based on reliable comparisons between schools to increase confidence and balance demands from their child.

The question of 'what determines numbers of options that families consider' now adds to the debate. Here the explanation offered by Image Theory (Beach et al, 1988) suggested two stages that first selected a choice set from options available (based on reducing risk) before considering maximising profit by sequencing choices set by preference order. Family risk and profit may take precedence over that of the student e.g. if siblings already attend a non-selective secondary school then increased certainty of being offered a place may persuade decision makers that "school gate" risks are reduced by an efficient 'school run', for example bullying/abuse outside of school jurisdiction. The latter stage of such complex decision making directly corresponds with the previously described admissions process requiring a choice of three schools in their order of preference. However evidence generated through structured comparisons of decision criteria and summary factors suggests that the former stage also exists, as all

competing parents could identify their least preferred school and a runner-up outside their eventual choice set. The most important risk reduction stage is often subconsciously performed by parents before engaging with students on comparing relative profit between those in the choice set. If risks are considered to be excessive, fewer schools are included in the choice set, narrowing to one in extreme cases.

The second workshop ran further hopes and fears script for new and previous contributors revealing similar concerns to those already dealt with in the first workshop for a different group of expert practitioners (some part-time attendance). The aim of the workshop was to determine a range of policy designs (unique to an agency or multilateral, shared by agencies) before exploring causal relationships to assess decision making among families facing the secondary school choice problem in Plymouth. In response, a series of influence maps were generated that were rearranged and involved three interacting, decision-specific stocks (wellbeing for parents and children plus accessible school information capable of reliably informing school choice decisions). Running designated scripts (Carter et al, 2014) generated specific insights while minimising participant time.

nominal group   Potential policy interventions were generated using nominal group technique adapted to ensure that time constraints were met. Individuals suggested a range of interventions but common support was expressed for implementing a decision rule on collaboration between schools. As a first step, simple form of collaboration could be achieved by sharing information more effectively to offer reliable comparisons to parents. More controversially, the unilateral intervention to remove selective school competition, by returning to comprehensive local schools, was also suggested rather than schools competing on specific competencies such as academic prowess. Both interventions were considered to be within the scope of the model and each was developed for testing against individual cases.

causal-maps   Besides the interactions between child and parent wellbeing and the information used to mediate, wellbeing loss through bullying is also an important concern for many children. The worries of year 6 students losing their peers are addressed by policies that enable nominated friends to attend the same year 7 form class. However this may not stop parents and other relatives coercing children into taking tests or attending specific schools according to expert practitioners. Only once the student is empowered to assist in school choice decision making is it possible to affect such behaviour. Over-reliance for decisions influenced by schools marketing themselves to students and parents at open evenings was also considered by the group. Whereas useful to compare respective profits from

prospective schools using such showcase events, making comparisons to reduce risk is unreliable and adds little to stocks of school information for selecting a choice set. Indeed there is little or no coordination of open evening dates between Plymouth schools to even make drawing physical comparisons feasible for families wishing to visit all required schools; suggesting once again value during second stage decision making involving relative profits to inform sequencing of up to three school preferences only. Pre-screening children prior to testing at age eleven is likely to be counter-productive as parents have said "the tests that tell us whether our child is going to get into a good school will happen aged 11, so we expect him to be doing weekly tests to prepare him from the age of 10" thereby raising anxiety rates over extended periods and potentially exacerbating the rates of social and emotional wellbeing loss for children.

As mentioned, these relationships are summarized by participants when drawing 'Graphs Over Time' of the associated problematic behaviours. Originally based on anxiety level estimates in parents and children encountered by expert practitioners, the plots have been inverted to represent wellbeing instead as practitioners indicated that when anxiety rates increase, corresponding levels of wellbeing are lost. O'Donnell et al (2014) suggest that measuring wellbeing has at least four components which are now routinely collected by the Office of National Statistics each year. Longer-term aspects of measuring wellbeing include satisfaction with life and feelings of worthwhileness (Maslow suggested deficiency and growth needs as early as 1955) whereas more rapid variations are captured by the responses to personal feelings of happiness or anxiety from only the previous day. Consistent with a longer-term view and the aims of this work, estimates for wellbeing integrate anxiety losses and happiness gains over time for those involved in decision making.

P2015 Figures. Causal Map Summary (above) Stock Flow Diagram Detail (below)
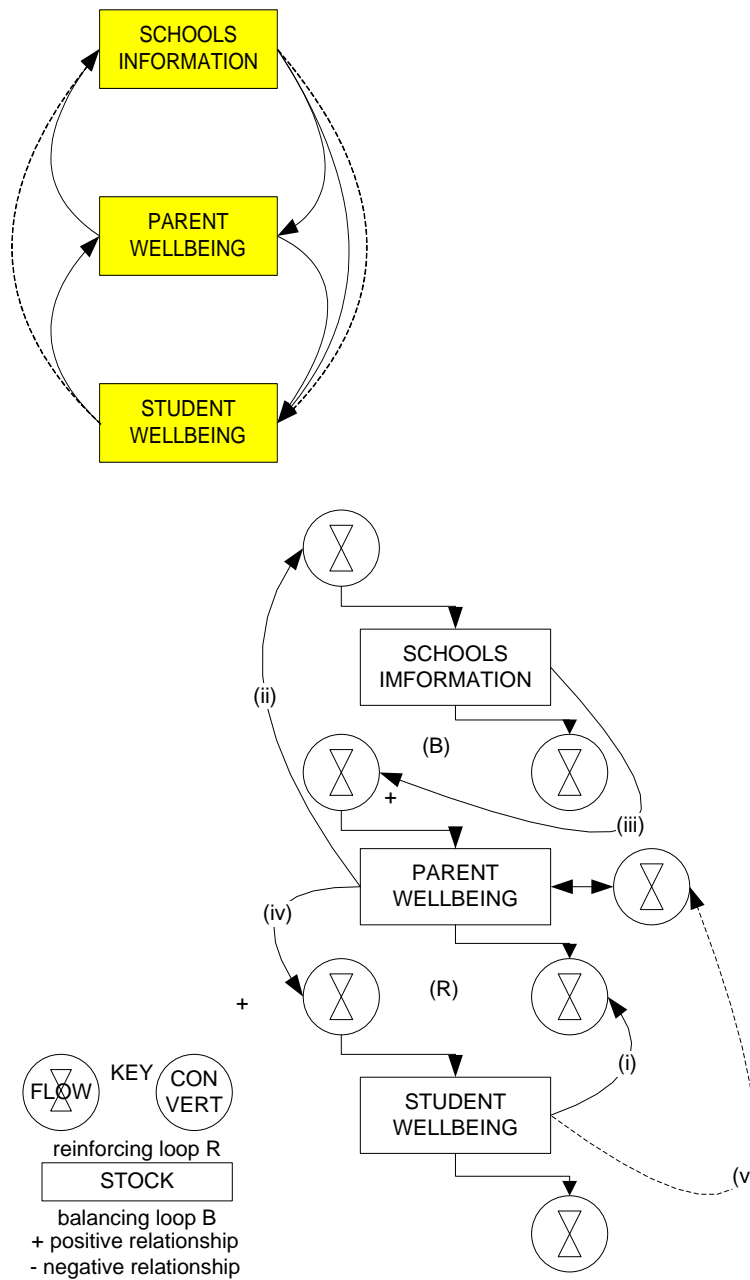
This completes the report on the first two workshops and interviews for research project P2015.

Preparation for the summary presentation

It was eventually decided to continue modelling to reflect three possible policy interventions for the majority:

- Comparison base-run where nothing is changed;
- Schools providing high quality information for making decisions based on sharing information;

- Demonstrating impacts of the city council removing competitive loop on knowledge acquisition.

Please complete the following questions before signing responses, prior to each interview.

1. Are the relationships in the model on page 9 correct? Are there other relationships with regard to standard information quality, eliminating competition or empowering children with student responsibilities in the school choice problem?

   (You can write your answers on the model or note them below.)

   _____

   _____

   _____

   _____

   _____

   _____

   _____

2. The aim of the model is to map out the causes and consequences of changes in use of information to better decide secondary schools based on school fit to family need. Are there other variables and relationships that you would like to include in the model on the preceding page and if so how? You can think about this in terms of the list with generated variables on page 3 and the important developments in the competitive education market that were previously mentioned.

   (You can write your answers on the model or note them below.)

   _____

   _____

   _____

   _____

   _____

   _____

   _____

   Signature_____ Date_____

End of the workbook. Thank you for your support in the P2015 modelling of wellbeing dynamics.

David Carter

Principal Researcher Project P2015

APPENDIX 6. Survey cross-tabulation of results versus degree of autocracy

		APPROACH TO SCHOOL CHOICE. What decision making style best describes how you would tackle choosing secondary schools					
		you solve problem using information already available AI (1)	you obtain others views before solving the problem AII (2)	you share information with individual family members CI (3)	you share information with all affected family members but their views may or may not reflect final decision CII (5)	you focus and direct the family discussion but do not impose your will but rather seek democratic participation on decision GI (6)	Total
PRIMARY SCHOOL DETAILS. Which year of primary school is your child attending in September,... .	Year 5 in Plymouth (1)	1	2	3	1	1	8
	Year 6 in Plymouth (2)	2	4	2	5	9	22
	Year 5 outside of Plymouth (3)	1	0	0	0	1	2
	Year 6 outside of Plymouth (4)	0	0	2	1	2	5
	Total	4	6	7	7	13	37
SECONDARY SCHOOL CONNECTIONS. Does your child have older siblings/relatives who attend/attended ...	Siblings attend/attended (1)	1	0	2	4	5	12
	Parent(s) attended (2)	1	1	0	0	3	5
	Other relatives attend/attended: please specify (3)	0	1	1	0	0	2
	No previous association with schools (4)	2	4	4	3	5	18
	Total	4	6	7	7	13	37
RELIABLE SOURCES. Which information sources do you find provide reliable knowledge for answering... - News articles (available as and when published)	Highly influential in supporting decisions (1)	0	1	1	1	3	6
	Little or no influence in supporting decisions (2)	4	5	6	6	10	31

	Total	4	6	7	7	13	37
RELIABLE SOURCES. Which information sources do you find provide reliable knowledge for answering... - Word of Mouth Recommendation (available as and when offered)	**Highly influential in supporting decisions (1)**	4	3	4	7	12	30
	Little or no influence in supporting decisions (2)	0	3	3	0	1	7
	Total	4	6	7	7	13	37
RELIABLE SOURCES. Which information sources do you find provide reliable knowledge for answering... - School visits (up to 17 often available during September and October)	**Highly influential in supporting decisions (1)**	4	5	6	6	13	34
	Little or no influence in supporting decisions (2)	0	1	1	1	0	3
	Total	4	6	7	7	13	37
RELIABLE SOURCES. Which information sources do you find provide reliable knowledge for answering... - School inter net sites (varied content available on-line)	**Highly influential in supporting decisions (1)**	2	3	4	1	5	15
	Little or no influence in supporting decisions (2)	2	3	3	6	8	22
	Total	4	6	7	7	13	37
RELIABLE SOURCES. Which information sources do you find provide reliable knowledge for answering... - League tables (previous GCSE records available on-line)	**Highly influential in supporting decisions (1)**	3	5	2	6	7	23
	Little or no influence in supporting decisions (2)	1	1	5	1	6	14
	Total	4	6	7	7	13	37
RELIABLE SOURCES. Which information sources do you find provide reliable knowledge for answering... - Comparison websites and search engines (available on-line)	**Highly influential in supporting decisions (1)**	0	2	0	1	0	3
	Little or no influence in supporting decisions (2)	4	4	7	6	13	34

	Total	4	6	7	7	13	37
RELIABLE SOURCES. Which information sources do you find provide reliable knowledge for answering... - Telephone helpline support (working hours only)	**Highly influential in supporting decisions (1)**	0	1	2	1	1	5
	Little or no influence in supporting decisions (2)	4	5	5	6	12	32
	Total	4	6	7	7	13	37
RELIABLE SOURCES. Which information sources do you find provide reliable knowledge for answering... - School prospectus (often available on-line)	**Highly influential in supporting decisions (1)**	3	4	4	4	5	20
	Little or no influence in supporting decisions (2)	1	2	3	3	8	17
	Total	4	6	7	7	13	37
RELIABLE SOURCES. Which information sources do you find provide reliable knowledge for answering... - Council admissions guide (previous secondary school competition ratios available on-line)	**Highly influential in supporting decisions (1)**	0	2	2	2	1	7
	Little or no influence in supporting decisions (2)	4	4	5	5	12	30
	Total	4	6	7	7	13	37
TACTICS FOR SECURING AN OFFER. What best describes your overall strategy for choosing between sec...	**II. avoid risk by locking-in gains from likely success to secure the secondary school place (2)**	2	2	1	2	4	11
	I. avoid risk by insuring against unlikely failure to secure the secondary school place (4)	2	1	3	3	2	11
	III. take a risk by making best of limited alternatives to secure the secondary school place (5)	0	2	1	1	5	9
	IV. take a risk by gambling on unlikely factors to secure the	0	1	0	1	0	2

	secondary school place (6)						
	Any combination of above options I-IV e.g. avoid risk by taking mock exams to check scores (II) before taking risk on student sequencing the order of schools they prefer (III). Please give your own combination below, explaining reasons. (7)	0	0	2	0	2	4
	Total	4	6	7	7	13	37
FILTERING SCHOOL OPTIONS. Would you only consider schools from the outset that could offer your child…	grammar education (1)	1	3	1	1	2	8
	one faith education (2)	0	0	0	0	0	0
	single sex education (4)	0	0	0	1	0	1
	co-education (male and female) (5)	2	1	3	2	4	12
	special education (6)	0	0	1	0	0	1
	fee paying education (7)	0	0	0	0	0	0
	none of the major filter criteria above (8)	1	2	2	3	7	15
	Total	4	6	7	7	13	37
TIME TAKEN DECIDING. Given your other commitments, how long on average would you need for locating suitable schools...	A week or less (1)	1	2	1	1	2	7
	1week-1month (2)	0	3	0	0	2	5
	1month-3months (3)	2	0	0	3	3	8
	3months-1year (4)	1	0	1	0	2	4
	More than a year (5)	0	1	5	3	4	13
	Total	4	6	7	7	13	37
DECISION FACTOR OUTCOMES. When	Needs that must be met always (1)	2	1	1	1	3	8

comparing schools to make a decision, how do you value the following... - Costs of attending	Needs that should be met sometimes (2)	2	2	2	4	3	13
	Needs that could be met seldom or never (3)	0	3	4	2	7	16
	Total	4	6	7	7	13	37
DECISION FACTOR OUTCOMES. When comparing schools to make a decision, how do you value the following... - Subject variety	Needs that must be met always (1)	3	4	5	6	11	29
	Needs that should be met sometimes (2)	1	1	2	1	2	7
	Needs that could be met seldom or never (3)	0	1	0	0	0	1
	Total	4	6	7	7	13	37
DECISION FACTOR OUTCOMES. When comparing schools to make a decision, how do you value the following... - Academic result outcomes	Needs that must be met always (1)	4	5	4	6	8	27
	Needs that should be met sometimes (2)	0	1	2	1	5	9
	Needs that could be met seldom or never (3)	0	0	1	0	0	1
	Total	4	6	7	7	13	37
DECISION FACTOR OUTCOMES. When comparing schools to make a decision, how do you value the following... - Teaching quality	Needs that must be met always (1)	4	5	6	7	12	34
	Needs that should be met sometimes (2)	0	1	0	0	1	2
	Needs that could be met seldom or never (3)	0	0	1	0	0	1
	Total	4	6	7	7	13	37
DECISION FACTOR OUTCOMES. When comparing schools to make a decision, how do you value the following... - Management & organisation	Needs that must be met always (1)	4	2	4	6	8	24
	Needs that should be met sometimes (2)	0	3	1	1	5	10
	Needs that could be met seldom or never (3)	0	1	2	0	0	3
	Total	4	6	7	7	13	37

		1	2	3	4	5	15
DECISION FACTOR OUTCOMES. When comparing schools to make a decision, how do you value the following... - Progress updates	**Needs that must be met always (1)**	1	2	3	4	5	15
	Needs that should be met sometimes (2)	3	3	4	3	7	20
	Needs that could be met seldom or never (3)	0	1	0	0	1	2
	Total	4	6	7	7	13	37
DECISION FACTOR OUTCOMES. When comparing schools to make a decision, how do you value the following... - Available facilities	**Needs that must be met always (1)**	3	5	4	3	8	23
	Needs that should be met sometimes (2)	1	1	0	4	3	9
	Needs that could be met seldom or never (3)	0	0	3	0	2	5
	Total	4	6	7	7	13	37
DECISION FACTOR OUTCOMES. When comparing schools to make a decision, how do you value the following... - Planned numbers admitted	**Needs that must be met always (1)**	2	2	4	1	4	13
	Needs that should be met sometimes (2)	2	3	1	4	6	16
	Needs that could be met seldom or never (3)	0	1	2	2	3	8
	Total	4	6	7	7	13	37
DECISION FACTOR OUTCOMES. When comparing schools to make a decision, how do you value the following... - Home-school communication	**Needs that must be met always (1)**	4	3	4	5	8	24
	Needs that should be met sometimes (2)	0	2	2	2	4	10
	Needs that could be met seldom or never (3)	0	1	1	0	1	3
	Total	4	6	7	7	13	37
DECISION FACTOR OUTCOMES. When comparing schools to make a decision, how do you value the following... - Accurate results prediction	**Needs that must be met always (1)**	2	2	1	3	3	11
	Needs that should be met sometimes (2)	2	2	4	4	6	18
	Needs that could be met seldom or never (3)	0	2	2	0	4	8

	Total	4	6	7	7	13	37
DECISION FACTOR OUTCOMES. When comparing schools to make a decision, how do you value the following... - Adapts to new needs	Needs that must be met always (1)	3	3	3	4	8	21
	Needs that should be met sometimes (2)	1	1	2	3	3	10
	Needs that could be met seldom or never (3)	0	2	2	0	2	6
	Total	4	6	7	7	13	37
DECISION FACTOR OUTCOMES. When comparing schools to make a decision, how do you value the following... - Regular work at home	Needs that must be met always (1)	0	1	0	3	1	5
	Needs that should be met sometimes (2)	1	0	0	0	4	5
	Needs that could be met seldom or never (3)	0	1	0	0	2	3
	Total	1	2	0	3	7	13
FEELINGS ON SCHOOL CHOICE. How would you rate your family's situation (an answer per item is need... - Number in family actively involved in decision (just a parent deciding could be low for example)	low (1)	1	2	0	0	0	3
	medium (2)	3	1	2	2	3	11
	high (3)	0	3	5	5	10	23
	Total	4	6	7	7	13	37
FEELINGS ON SCHOOL CHOICE. How would you rate your family's situation (an answer per item is need... - Overall family wealth relative to Plymouth (high relative wealth may afford private education for example)	low (1)	2	2	4	1	4	13
	medium (2)	2	1	3	5	8	19
	high (3)	0	3	0	1	1	5
	Total	4	6	7	7	13	37
	low (1)	1	1	0	1	1	4

FEELINGS ON SCHOOL CHOICE. How would you rate your family's situation (an answer per item is need... - Overall family health relative to Plymouth (for example a family member needing regular care could be low for example)	**medium (2)**	2	2	6	1	0	11
	high (3)	1	3	1	5	12	22
	Total	4	6	7	7	13	37
FEELINGS ON SCHOOL CHOICE. How would you rate your family's situation (an answer per item is need... - Degree of family happiness with school choice problem they face (parents and child all being content could be high for example)	**low (1)**	0	0	0	2	0	2
	medium (2)	1	1	2	0	4	8
	high (3)	3	5	5	5	9	27
	Total	4	6	7	7	13	37
FEELINGS ON SCHOOL CHOICE. How would you rate your family's situation (an answer per item is needed... - Your own level of overall happiness at present	**low (1)**	0	0	2	0	0	2
	medium (2)	0	2	1	2	6	11
	high (3)	4	4	4	5	7	24
	Total	4	6	7	7	13	37
FEELINGS ON SCHOOL CHOICE. How would you rate your family's situation (an answer per item is needed... - Your estimate of your child's level of happiness	**low (1)**	0	0	1	0	0	1
	medium (2)	0	1	0	2	4	7
	high (3)	4	5	6	5	9	29
	Total	4	6	7	7	13	37
	low (1)	0	0	0	1	0	1

FEELINGS ON SCHOOL CHOICE. How would you rate your family's situation (an answer per item is needed... - Importance of discussing things that matter to your child on the day	**medium (2)**	0	0	0	0	1	1
	high (3)	1	2	0	2	6	11
	Total	1	2	0	3	7	13
BALANCING SCHOOL WORK. When concerned about your child's work-life balance, which improvement ... - Spending more time together with friends	**Always (6)**	0	2	0	2	2	6
	Sometimes (7)	1	0	0	1	5	7
	Seldom/never (8)	0	0	0	0	0	0
	Total	1	2	0	3	7	13
BALANCING SCHOOL WORK. When concerned about your child's work-life balance, which improvement ... - Spending more time on an interest	**Always (6)**	0	0	0	2	3	5
	Sometimes (7)	1	1	0	1	4	7
	Seldom/never (8)	0	1	0	0	0	1
	Total	1	2	0	3	7	13
BALANCING SCHOOL WORK. When concerned about your child's work-life balance, which improvement ... - Spending more time with family members	**Always (6)**	1	1	0	3	3	8
	Sometimes (7)	0	0	0	0	4	4
	Seldom/never (8)	0	1	0	0	0	1
	Total	1	2	0	3	7	13
BALANCING SCHOOL WORK. When concerned about your child's work-life balance, which improvement ... - Limiting time spent working at home	**Always (6)**	0	0	0	1	1	2
	Sometimes (7)	1	2	0	2	6	11
	Seldom/never (8)	0	0	0	0	0	0
	Total	1	2	0	3	7	13
	Always (6)	0	1	0	1	1	3

BALANCING SCHOOL WORK. When concerned about your child's work-life balance, which improvement ... - Seeking advice and support from teacher(s)	**Sometimes (7)**	1	1	0	2	4	8
	Seldom/never (8)	0	0	0	0	2	2
	Total	1	2	0	3	7	13
Thank you for your contribution to my school choice survey. Would you be happy for me to contact you again...	**Yes (1)**	2	2	3	2	7	16
	No (2)	2	4	4	5	6	21
	Total	4	6	7	7	13	37

APPENDIX 7. System Dynamics model equations (SEND case example)

CWB_Child_Well_Being_derived__from_rational_action_2(t) =
CWB_Child_Well_Being_derived__from_rational_action_2(t - dt) + (CWBin_2 -
CWBout_2) * dt

INIT CWB_Child_Well_Being_derived__from_rational_action_2 = 66

INFLOWS:

CWBin_2 =
available_CWB_2*obligation_to_talk_on_things_that_matter_to_child_2/100

OUTFLOWS:

CWBout_2 =
CWB_Child_Well_Being_derived__from_rational_action_2*(TEST_PREP_BURNOU
T_RATE_y567_2+EARLY_UNMET_NEEDS_RATE_y891011_2+LATER_UNMET_N
EEDS_RATE_y891011_2)/100

KNM_Knowledge_of_Needs_Met_for_selecting_between_schools_2(t) =
KNM_Knowledge_of_Needs_Met_for_selecting_between_schools_2(t - dt) +
(KNMin_2 - KNMout_2) * dt

INIT KNM_Knowledge_of_Needs_Met_for_selecting_between_schools_2 = 28

INFLOWS:

KNMin_2 =
available_KNM_2*(pressure_to__research_schools_2)*knowledge_of_whole_family
__needs_2*crisis_of__confidence_2/(100*reKNM_factor_2)

OUTFLOWS:

KNMout_2 =
KNM_Knowledge_of_Needs_Met_for_selecting_between_schools_2*SERVICE_PR
OVISION_CHANGE_RATE_2*crisis_of__confidence_2/100

PWB_Parent_Well_Being_derived__from_rational_action_2(t) =
PWB_Parent_Well_Being_derived__from_rational_action_2(t - dt) + (PWBin_2 -
PWBout_2) * dt

INIT PWB_Parent_Well_Being_derived__from_rational_action_2 = 29

INFLOWS:

PWBin_2 = available_PWB_2*pressure_to__select_schools_2/100

OUTFLOWS:

PWBout_2 =
PWB_Parent_Well_Being_derived__from_rational_action_2*obligation_to_discuss_f
amily_needs_around_dinner_table_2/100

available_CWB_2 = max_CWB_2-
CWB_Child_Well_Being_derived__from_rational_action_2

available_KNM_2 = max_KNM_2-
KNM_Knowledge_of_Needs_Met_for_selecting_between_schools_2

available_PWB_2 = max_PWB_2-
PWB_Parent_Well_Being_derived__from_rational_action_2

crisis_of__confidence_2 = step(1,0)+step(0,1095)+step(0,1460)

D1_period_researching_school_options_d1_2 = 365

D2_selection_delay_visitng_schools_d2_2 = 60

D3_interval_between_talks_that_matter_to_child_d3_2 = 30

D4_interlude_between_whole__family_dinners_d4_2 = 30

DEGAMIFY_FACTOR_2_55 = 1

EARLY_UNMET_NEEDS_RATE_y891011_2 = step(0.125,1095)

knowledge_of_whole_family__needs_2 = 1/DEGAMIFY_FACTOR_2_55

LATER_UNMET_NEEDS_RATE_y891011_2 = step(0.125,1460)

max_CWB_2 = 100

max_KNM_2 = 50

max_PWB_2 = 100

obligation_to_discuss_family_needs_around_dinner_table_2 = (100-CWB_Child_Well_Being_derived__from_rational_action_2)*P4_child_influence_on_parent__wellbeing_proportion_p4_2/D4_interlude_between_whole__family_dinners_d4_2

obligation_to_talk_on_things_that_matter_to_child_2 = PWB_Parent_Well_Being_derived__from_rational_action_2*P3_parent_influence_on_child__wellbeing_proportion_p3_2/(D3_interval_between_talks_that_matter_to_child_d3_2*DEGAMIFY_FACTOR_2_55)

P1_parent__wellbeing_influence_on__knowledge_proportion_p1_2 = .125

P2_knowledge__influencing_parent__wellbeing_proportion_p2_2 = .125

P3_parent_influence_on_child__wellbeing_proportion_p3_2 = .125

P4_child_influence_on_parent__wellbeing_proportion_p4_2 = .125

pressure_to__research_schools_2 = (100-PWB_Parent_Well_Being_derived__from_rational_action_2)*P1_parent__wellbeing_influence_on__knowledge_proportion_p1_2/D1_period_researching_school_options_d1_2

pressure_to__select_schools_2 = KNM_Knowledge_of_Needs_Met_for_selecting_between_schools_2*P2_knowledge

__influencing_parent__wellbeing_proportion_p2_2/(D2_selection_delay_visitng_schools_d2_2*DEGAMIFY_FACTOR_2_55)

reKNM_factor_2 = 1

SERVICE_PROVISION_CHANGE_RATE_2 = .25

TEST_PREP_BURNOUT_RATE_y567_2 = step(0.25,0)+step(-0.125,1095)+step(-0.125,1460)

APPENDIX 8. Policy tests suggested and agreed by GMB participant groups in Nominal Group Technique (outlined)

Nominal Group Technique for potential policy interventions

	Policy A	Policy B	Policy C	Policy D
Originator 1	A Gifted + talented – 1st choice B CAMHS representation at open evenings C Poor attendees at Primary D Flexible start + finish	Joint working Health /social Care /education /CAF times	school viewings	
Reviewer 2	Agree with Policy A.	Agree CAMHS rep at open evening is important Is this going to lead to real support for just a stall?	Agree with Policy C. Agree with Policy D	
Reviewer 3	But what do we mean BY G + T? no agreed definition		But do boys die more any real difference to poor attendance?	Practice lines? missed session
Reviewer 4				
Review update				
Best policy	Y/N	Y/N	Y/N	

Nominal Group Technique for potential policy interventions

	Policy A	Policy B	Policy C	Policy D
Originator 1	National campaign a good for all local school-lift all children + away from colour of choice	Encourage collaboration rather than competition between local schools, so that they can improve together rather than one improving to the detriment of others.	Ensure enough number and accommodate students for catchment areas	Scrap Grammar Schools
Reviewer 2	Support this statement provision of equality			
Reviewer 3	I agree	I agree I agree! How	Agree.	Agree. How would we do this? leads back to Policy A
Reviewer 4				
Review update				
Best policy	Y/N	Y/N	Y/N	

APPENDIX 9. Extracts of dissemination talk for Livewell Southwest Executive Management Team by author on 4 May 2017

APPENDIX 9
Can competing for URBAN school places influence referrals TO CAMHS?

David Carter

PhD Scholar, Plymouth University

Plymouth Child Health Profile — March 2014

CHILD HEALTH in PLYMOUTH
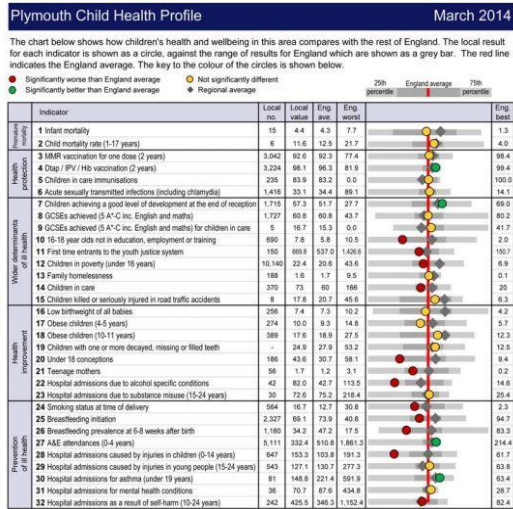
LOW WELLBEING RESULTS IN THE red for:

-self-harm;
-NEETS DROPPING OUT POST GCSE; AND
-unintended injuries (0-14).

5WH diagram:

- **Why?** Students need better chances than low wellbeing allows
- **What?** Intercede in systemic loss of well being (counter-bubble from primaries)
- **Who?** Referring secondary students, parents & support
- **Where?** Educationally competitive Plymouth
- **When?** Prior to primary bubble bursting on city from 2016
- **How?** Induct problem structure, deduct parent decisions, abduct supportive interventions

5WH SYNOPSIS

familial problem structure induced from experts with parental decision biasing deduced from parents competing in Plymouth within a rising secondary school population.

Questions of discovery

- I know nothing about mental health so everything is an opportunity to learn;
- Several key questions to answer for Plymouth CAMHS;
- Multi-agency views and parent perspectives key;
- Competing priorities as ex-school governor: observing effects of competition.

(I) CAN COMPETITION AFFECT REFERRALS ?
- LEARN ABOUT PROBLEM UPSHOT

(II) WHY LOW WELLBEING FOR UK AND IN CITIES?
- LEARN ABOUT PROBLEM STRUCTURE FOR FAMILIES

(III) WHY AFTER SELECTING SECONDARY SCHOOLS ?
- LEARN ABOUT DECISION MAKING

(IV) HOW TO QUANTIFY IMPACTS?
- LEARN ABOUT BEHAVIOURAL RESPONSES

LEARN ABOUT PROBLEM UPSHOT

- Started by thinking rising Plymouth cohorts was only referral problem.
- Data also showed additional age related rises through secondary school years.
- Interviewed some parents using a rational choice approach without success.
- Made me wonder what other decision making is used by parents...

(I) CAN COMPETITION AFFECT REFERRALS ?
- RISING REFERRALS WITH AGE IN PLYMOUTH SECONDARY SCHOOLS WITHOUT EARLY WARNING
- RISING ADMISSIONS FROM PRIMARIES FROM 2015 ONWARDS IN PLYMOUTH

LEARN ABOUT PROBLEM STRUCTURE FOR FAMILIES

- Your colleagues and others from MAST, council and secondary schools added structure of admissions from family perspective along with policy interventions.

- Admissions start early for some tutored in year 5 (11+) and all coached in year 6 (SATS) then streamed year 7.

- Competition between 17 secondary options in Plymouth and 3 more close-by but why confusion?

(I) CAN COMPETITION AFFECT REFERRALS ?

- PROBLEM UPSHOT: REFERRALS RISING WITH AGE ALONGSIDE RISING PLYMOUTH COHORTS

(II) WHY LOW WELLBEING FOR UK AND IN CITIES?

- ADMISSIONS START WITH CHILD PREPARING FOR TESTS
- YEAR 5 ELEVEN PLUS EXAM TUTORING, YEAR 6 COACHING FOR SATS, YEAR 7 STREAM TESTING
- MORE SCHOOLS COMPETING IN CITIES
- POTENTIAL ONSET OF BURNOUT FOR CHILD WIHOUT ENOUGH TIME MANAGEMENT SKILLS

LEARN ABOUT DECISION MAKING

- Asked parents about to decide how they proceed.

- Plymouth parent tests for rationalised choice was inconclusive.

- Behavioural decisions therefore subject to bias.

- Not bias of economic prospects from attending a school but rather parent inexperience related to autocratic style reducing needs met (first born and incomers at risk) but which family types to evaluate?

(I) CAN COMPETITION AFFECT REFERRALS ?

- PROBLEM UPSHOT ID REFERRALS RISING WITH AGE ALONGSIDE RISING PLYMOUTH COHORTS

(II) WHY LOW WELLBEING FOR UK AND IN CITIES?

- STUDENTS BURNOUT WELLBEING STOCKS WHILE PARENTAL KNOWLEDGE OUTDATED BY COMPETITIVE PROVIDERS AND GOVERNMENT CHANGE

(III) WHY AFTER SELECTING SECONDARY SCHOOLS ?

- NOT RATIONAL CHOICE FOR MANY
- NOT ECONOMIC PROSPECT BIAS RATHER BIAS FROM SITUATIONAL LEADERSHIP OF INEXPERIENCED AUTOCRAT
- ONLY HALF OF NEEDS MET

LEARN ABOUT BEHAVIOURAL RESPONSES

- Dropout and disaffection stems from unmet needs of student by school as well as lower acceptable wellbeing threshold breaches (referrals).

- Timings established for family spectrum defined by range of SEND and standard types.

- Considered systems in balance for simple halving proportion before applying realistic demands on English families to demonstrate breach potential over several years in secondary.

- Reversal by gamification timing gains not repeated by slowing exogenous losses including year 5 tutoring burnout and outdated decision information...

(I) CAN COMPETITION AFFECT REFERRALS?
- PROBLEM UPSHOT ID REFERRALS RISING WITH AGE ALONGSIDE RISING PLYMOUTH COHORTS

(II) WHY LOW WELLBEING FOR UK AND IN CITIES?
- STUDENTS BURNOUT WELLBEING STOCKS WHILE PARENTAL KNOWLEDGE OUTDATED BY COMPETITIVE PROVIDERS AND GOVERNMENT CHANGE

(III) WHY AFTER SELECTING SECONDARY SCHOOLS?
- BIAS FROM INEXPERIENCED AUTOCRATIC PARENTS UNABLE TO MEET CHILD NEEDS OF SCHOOL POST PUBERTY

(IV) HOW TO QUANTIFY IMPACTS?
- SEND AND STANDARD FAMILIES TESTED
- TIMING QUANTIFIED FROM SIMPLE CONCEPT MODEL DEVELOPMENT
- SYSTEMIC TIMING OF COMMUNICATIONS MORE EFFECTIVE THAN 1ST ORDER CHANGE SUGGESTIONS (EITHER STRESSOR)

DOES COMPETITION AFFECT REFERRALS?

- YES IT CAN. WHERE SCHOOLS COMPETITION IS INTENSE WITHIN CITIES FOR EXAMPLE BASED ON:
  - RISING REFERRALS WITH AGE THROUGH SECONDARY FROM LOW WELLBEING THROUGH UNMET NEEDS;
  - INEXPERIENCED AUTOCRATIC DECISION MAKING BIAS SUGGESTS RISK FACTOR;
  - BLEND INTERVENTION TO COUNTER RISING COHORT DEMANDS BY SELF-HELP

(I) CAN COMPETITION AFFECT REFERRALS?
- PROBLEM UPSHOT ID REFERRALS RISING WITH AGE ALONGSIDE RISING PLYMOUTH COHORTS

(II) WHY LOW WELLBEING FOR UK AND IN CITIES?
- STUDENTS BURNOUT WELLBEING STOCKS WHILE PARENTAL KNOWLEDGE OUTDATED BY COMPETITIVE PROVIDERS AND GOVERNMENT CHANGE

(III) WHY AFTER SELECTING SECONDARY SCHOOLS?
- BIAS FROM INEXPERIENCED AUTOCRATIC PARENTS UNABLE TO MEET CHILD NEEDS OF SCHOOL POST PUBERTY

(IV) HOW TO QUANTIFY IMPACTS?
- SEND FAMILY SENSITIVITY TO CHANGE HIGHLIGHTS CHEAP TIMING INTERVENTION THAT ALSO WORKS FOR STANDARD FAMILY NEEDS RATHER THAN STEMMING LOSSES

System structure
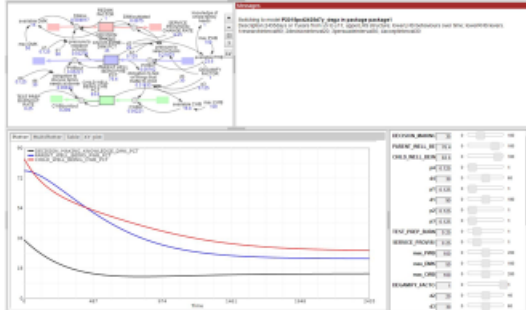
Behaviours (%) baserun y5-11 (d)

You School
(not wrong school)

L
E
V
E
R
S

Countering ineffective INTUITION. Retaining well being Within family system subjected to high competition losses, TESTS 3 POLICIES: A;B;C.

families by exploring views of parent and child on school NEEDS using snakes and ladders. White squares for timing whereas brown offer trials (snakes) but also PROGRESS (ladders).
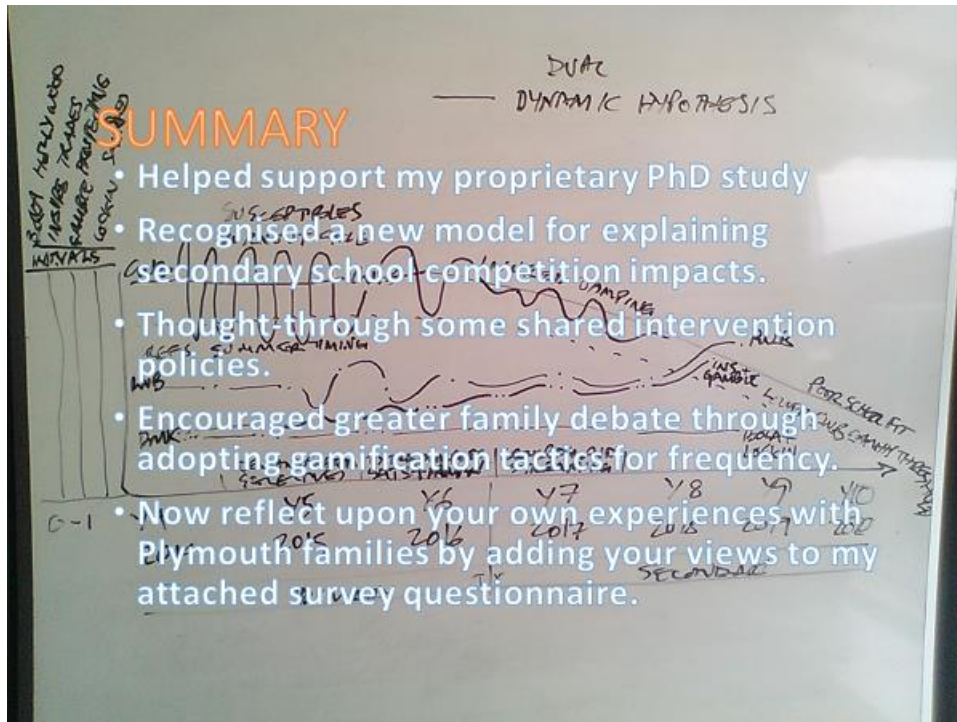
FURTHER
RESOURCES

- Carter, D., Moizer, J. and Liu, S. (2014). Using Scripts for the Construction of Management Simulation Models in the Context of Multi-Agency Engagement," *International Journal of Innovation, Management and Technology*. (5)4, pp. 273-279.

- Coldron, J., Tanner, E., Finch, S., Shipton, L., Wolstenholme, C., Willis, B., Demack, S. and Stiell, B. (2008). Secondary School Admissions. *Research Report No DCSF_RR020.*

- Parry-Langdon, N., Clements, A., Fletcher, D. and Goodman, R. (2008). Three years on: survey of the development and emotional well-being of children and young people. *Newport, UK: Office for National Statistics.*

- The Children's Society (2011-2016). Good Childhood Report.

APPENDIX 10. Research results presentation summary to Livewell Southwest Executive Team, 2017

CORPORATE REPORT SUMMARY FOR LIVEWELL SOUTHWEST

Name of meeting:	Research project presentation by David Carter
Date of meeting:	4 May 2017
Name of report:	P2015 research results and recommendations
Authors:	David Carter (Plymouth University)

Approved by:	Kirstie Spencer	**Presented by:**	David Carter

PURPOSE OF REPORT:

To update the Board on research activity within the Operations Directorate over recent years.

RECOMMENDATION(S):

For information on alleviating referrals following selection of secondary school.

APPROPRIATE LIVEWELL STRATEGIC AMBITION (please tick):

☒	Where experience exceeds expectation. (applies knowledge through game format)
☒	A recognised employee-led organisation. (multi-agent expert contributions)
☒	Based around local communities. (applies to secondary schools in Plymouth)
	Providing seamless system leadership.
	Sustainable, successful and admired.
☒	Supporting people to be safe, well and at home. (play game to pre-experience issue)
Please tick as appropriate:	

☒		This paper provides **assurance** for the above objectives (experts rate contribution)
		This paper presents **a risk** to achieving the above objective

IF ASSURANCE, WHAT IS THE NATURE? (please tick):				
	Progress Report	☒	Action Plan (family communications)
	Minutes/Notes of Meeting	☒	Strategy (ensure all needs are met)
☒	Protocols/Policy/Procedure (ID target)		Guidance

Summary of Financial and Legal Implications: The financial implications of production and distribution of gamified solution to the Plymouth secondary school choice problem can be managed unless multiple ethnic minority versions are required which may delay delivery and raise costs.

EQUALITY ISSUES & STAKEHOLDER INVOLVEMENT
Have you considered any equality issues and stakeholder involvement? Multi-agency involvement has enabled different stakeholder perspectives to be represented. The research has passed the ethical standards required of Plymouth University postgraduate researchers.

APPENDIX 11. Poster presentation of research results in 2018