Informing Secondary School Decision Making within a competitive market environment; gaming to widen choice and preference for smoothing flows.

Abstract

The study proposes a systemic view of state secondary (high) school choice by evaluating the impact of school comparison data (beyond performance statistics currently provided) on the wellbeing of child and parent experiencing a competitive urban admissions environment using system dynamics. The admissions process into year 7 when transferring from primary (elementary) to secondary education can be complex and sometimes convoluted when prospects of changing studies and friends can impact child wellbeing while subject to examinations for example. Add to this instability in family relationships and the three fundamental balancing loops for providing children with stability are all threatened leading to potential dynamic imbalance upon changing school. System Dynamics provides a broad and encompassing technique to evaluate such problems by considering feedbacks emanating from the social and emotional wellbeing of those involved. Feedback models are suitable to summarise an interconnected system for family decision making that incorporates views from council, health and school support systems. In order to balance the effects between variables, potential policy options considered include sharing schools comparison data for improving the focus, timing and frequency of the feedback for families compared against removing competitive enrolment from selective schools entirely, thereby avoiding stresses by eliminating choice.

199 word abstract

19 page paper excluding Annexes

Problem background for children transferring schools

Introduction to research

System Dynamics modelling offers groups the opportunity to construct either simple or complex models that are able to incorporate a variety of perspectives to represent a dynamic problem (Sterman, 2000). When adequately specified, such models allow potential intervention testing from contributing groups or agencies (Vennix, 1996). As pressures build within the context of primary and now secondary school enrolment demand, some children and their parents may encounter more difficulties obtaining the school of their choice[1]. The study of this dynamic problem elicits views of stakeholders already experienced in competing for places, specifically deciding between options but also from others supporting, decisions for the best fit of state school to individual need. Suggestions that could help relieve the problem situation are confirmed through simulation model testing of intervention policies according to the model verification plan. This enables policy makers across agencies to understand relative importance of their policies to support decision makers and help avoid unintended consequences inherent in social systems that span multiple agencies. This paper proposes a method for validating a system dynamics model using expert practitioner views drawn from multi-agency workshops alongside surveys of decision maker views. System dynamics workshops have now concluded and there remains some surveying of parent views to complete this research study.

Physical and psychological topography

In the UK, deciding a secondary school is a strategic milestone (both physical and psychological) for developing students and supporting families. Around the age of eleven, children commencing the last year in primary education (year 6) and guardians are required to specify up to three state secondary schools for which they wish to be considered. A further eleven months later (year 7), children transfer to the secondary school where they have accepted a place. The physical and developmental challenge of secondary education on new joiners is reasonably well understood by the time children enrol. For example, those children with special needs often access the special schools system rather than mainstream education. Even though a psychological shock, multiple classrooms and teachers, new subjects and a longer day, often involving travel across a city such as Plymouth are implicit in changing schools in England (Dalton, 2009). Less well determined is the important role of psychological demands on children and parents when navigating a successful path through the complex demands of enrolment dynamics according to expert practitioners.

At least two factors regularly combine to produce multifaceted demands for urban admission authorities. Firstly the number of secondary schools competing for students to enrol with them is greater than in less populated rural areas due to the higher density of urban providers reinforced by government policies that widen competition (for example education providers are paid by intake numbers for year 7 at a specific date each autumn as they start that assumes students stay for the whole academic year). Alongside encouraging wider competition between secondary education providers and the results used to measure success (Harrison et al, 2015), the impact of rising cohorts of children has to be considered from 2015 as the predicted bulge in Plymouth primary schools

[1] Primary schools take children between 5 and 11 years whereas secondary schools from 11 to 16 years. In England, mandatory education provided by the state now extends beyond these ages to include further education or training until aged 18 for those children born in 1997 or later.

transfers into secondary education. Most preferred place shortages have already been experienced by parents seeking reception class enrolments for their primary school children in Plymouth and this situation may well repeat as capacity is used-up in the local vicinity causing less palatable options to be considered, often further from home. The rising demand of mental health support commencing with children starting secondary school may also increase as cohorts rise again from 2015. The problem is not unique to Plymouth and is recognised across England as populations rise (Steer et al, 2014). Mental health interventions are capable of returning 98% of children to school afterwards: by contrast over 41% of children starting treatment for such conditions in the UK are not in education (Kyriakopoulos et al, 2015).

Plymouth is no exception having a population in excess of a quarter of a million people and being relatively isolated by surrounding rural areas in South West England. The city has a state secondary enrolment totalling some 2,500 applicants at the normal point of entry for year 7 in September each year. The city offers a full range of state secondary schools including selective and non-selective types (PCC, 2014). Whilst offering choice to parents and opportunities to students, the wide range of education provided can appear daunting to those without previous experience and therefore a considerable challenge to get the student-school fit correct.

Education policy stratification

Government policy since the banking crisis[2] in 2008 (Sapir, 2008) has attempted to redress the amount spent on public services year on year to help pay for banking debts that the government were forced to underwrite. Even so the loss of the UK's "triple-A" credit rating (Lugo et al, 2014) has increased pressure on reforming public services to become less of a burden on the state as the cost of borrowing increases to reflect financial risks emanating from the global crisis. The responsible coalition government has changed education policy over recent years by increasing fees structures for those attending higher education whilst ensuring that sixth-form college transport costs are recharged to families for students electing to continue their studies. Nor has secondary schooling between years 7 and 11 remained unscathed over recent years. Whereas much of the costs previously fell to local authorities for providing this education, liberalisation of school governance arrangements now means that more of the budget can be controlled locally. For example, recent free school entrepreneurial developments are managed direct from central government rather than through local authorities. This gives local flexibility to some school types for acquiring and releasing staff which helps balance books where the majority of spend is considered to be wages. Such flexibility is less helpful for strategic resource planning however when responding to rising demand city-wide as such investment decisions in new schools becomes less coordinated.

Equally local authority budgets for state secondary school provision have been under pressure during this period. Examples such as health advice from educational psychologists is now limited to providing training for school staff in recognising distressed children with specific social and emotional wellbeing needs. Likewise the provision of information and advice to parents choosing schools has also reduced to match available budgets. Such services enable parents to make more

[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 through mortgages in the US became contagious, affecting not only US but also UK banks. The reduction in income to the UK's exchequer resulted in austerity measures to reduce public spending.

informed choices based on current knowledge of all state school options through the Plymouth Parent Partnership (now retitled Plymouth Information and Support for Special Educational Needs and Disabilities to reflect a smaller, needier community where the larger majority move towards online information support).

Successive education policy has served to increase the diversity of state school options available to parents deciding secondary schools for their children. The dominant neo-liberal theme behind such education policy directives strive to increase competition between providers with the intention of driving-up education standards. Here market choice, as exercised by parents, ensures that successful schools are duly rewarded for their investment in raising standards by becoming more popular i.e. rising in parent priority to become most preferred of the three secondary schools chosen for the student application. Relative to rural school choices, competition within the urban is often far more intense and therefore needs quality support to get the right school for the child in question. Whereas the provision of special schools remains beyond the scope of this study, urban competition even for limited numbers of students often attracts interest from other candidates situated in surrounding rural authorities as the density of providers in a city such as Plymouth makes comparing education standards a powerful parent tool in school choice.

As the majority of state secondary education income is now determined by pupil numbers, competition for students between providers has intensified over several years. The Published Admissions Number (PAN) for new year 7 students is published per school and when combined across Plymouth, the sum represents the capacity limit for offering school places. With cohort numbers due to rise again for several years from 2015, Plymouth's secondary PAN capacity may be adequate now but the likelihood of logistical success for families being offered secondary schools reduces as capacity is used-up in meeting excess demand. This may mean that the advertised 95% (or thereabouts for Plymouth) chance of being offered your most preferred school choice could reduce as demand rises and this would have corresponding impacts on motivation and wellbeing where future parent and student expectations may need managing.

Logistical considerations

The logistics of transport has also been the subject of policy changes experienced by secondary schools. In rural situations this often means that the longer distances involved often have to be paid for by local authorities for children to attend specified secondary schools from feeder primary schools. Within the three kilometre urban centre of Plymouth, secondary school transport costs fall to families in most cases. This either requires parents who are willing and able to drive their children to and from school (known as the school run, the effect places extra demand on local road networks while adding to pollution levels at key times of the day) or, adequate footpath, cycling, bus and train links to make student commuting a viable proposition. Many of the secondary schools are positioned within the vicinity of major transport arteries. For example all three of the selective schools in Plymouth are located close to train stations.

School distribution may reflect historical centres of population rather than current localities. For example, new primary school capacity is planned for the Derriford area to the north of Plymouth. Not only reflecting new housing developments to the north of the city, the extra capacity echoes new work-related centres with council offices, retail and science parks all contributing to demand for state school provision beyond the nursery school private provision already in situ.

Modelling for health flows

Levels of social and emotional wellbeing are recognised stocks held by individuals (O'Donnell et al, 2014); students and parents alike. Often considered dimensionless, various measurement tools have been used with specific success by psychologists asking audience-specific questions concerning their state of wellbeing. However successful such static measurement tools, the properties of psychological wellbeing are dynamic and vary over time as gains and losses are experienced by individuals. The causes of wellbeing fluctuations are widespread and not easily determined, relating to the inner psyche and the degree of match (or not) to what is expressed publically by the individual. However the demands of choosing a secondary school are better understood for children and adults, connecting to net gains or losses of wellbeing. Levels of wellbeing in decision makers also influence decision making behaviours and can cause less-informed decisions and corresponding shocks.

Stocks of student wellbeing fluctuate widely during the last year (year 6) in primary school as self-existence, relatedness to others and competency growth deficiencies are satisfied or lost in Alderfer's hierarchy of motivational need (1972). Many children are challenged by the prospect of changing school that can be exacerbated by the onset of adolescence. One standard challenge facing all students involves additional homework for those preparing for tests such as those at the end of Key Stage 2 during year 6. The dynamic burnout model is well documented in system dynamics and psychology (Homer, 1985; Maslach and Goldberg, 1999) when applied to adults working overtime for extended periods. However it also offers one possible explanation of student social and emotional wellbeing as it evolves during the course of year 6. Here the capacity for a student to work at home (an equivalent to adult overtime performed in the place of work) is likely to vary depending upon the individual's stock of wellbeing. An understanding of parent wellbeing response to fluctuating levels exhibited by children when facing the strains of competing for school places based on reliable information resources.

Aim and objectives supporting research question

In seeking an answer to the research question of whether competition helps or hinders smooth flows of well children into state secondary schools it is important to establish suitable methods that involve multiple stakeholders for obtaining results. The aim of this paper is therefore to present a modelling multi-methodology to address the question and describe validation processes completed so far.

Several objectives result from the aim of the research and answering the key question of whether competition benefits outweigh family costs. Objectives for this paper therefore include;

Present a modelling multi-methodology involving system dynamics;

Describe application of a multi-method validation technique;

Suggest implications from potential modelling outcomes.

Organisation of document

The remaining document is organised as follows.

Section 2 seeks to provide theory-based research activity considered against the backdrop of multi-agency, policy review and the school choice problem facing families. The evidence base for model building in participative groups is also examined to assist in developing new causal theory alongside collating perspectives on decision analysis involving multiple factors. Psychological factors supporting dynamic decisions are also considered.

Section 3 aims to examine the selected model-based multimethodology tackling the issues of appreciating the dynamics of parent-child relationships during the admissions process while seeking to understand the competing factors in making such decisions through the lens of critical realism.

Section 4 discusses how theory compares multimethodology validation for structured interviewing techniques and participative modelling activities.

Section 5 concludes on the objectives supporting the research aim and reflects on whether the aim has been met and which outcomes remain to be confirmed.

Literature review

Model-based multimethodology with system dynamics and multi-criteria decisions

Quantitative operation research techniques first applied to management decision making have now developed with the addition of softer problem structuring methods. The range and variety of methods now means that combining them in different ways is a developing branch of operational research. Adding together parts or whole methods is recognised as multimethodology and is typically employed to address intractable problems where a single view may be insufficient (Munro and Mingers, 2002, Howick and Ackerman, 2011). For example, two or three types of combination recur with some frequency in the published research according to Munro and Mingers and simulation can be paired with both problem structuring techniques such as soft systems method as well as more numerical approaches such as statistical analysis. Softer qualitative technique combinations are often used in social science but mixed techniques involving quantified practices are almost as popular in these settings. Group-based contributions often reflect real-world complexity and therefore a variety of approaches can help reveal essential detail to assist understanding. For some groups switching between perspectives can be difficult (Kotiadis and Mingers, 2006) but when groups are separately addressed by single techniques this is less problematic.

Modelling using system dynamics also enables groups to understand and help develop representations of real world problems. In general, they combine insights generated from other methods often associated with problem structuring. *Journey Making* is a problem structuring technique that has been combined with system dynamics for informing policy making workshops (Ackermann at al, 2011). Various areas combine system dynamic techniques in multimethodological approaches such as law enforcement (Howick and Eden, 2011) and health (Santos et al, 2008). It is noted that the term hybrid modelling usually refers to more than one simulation technique being applied. Divorced from problem structuring, hybrid models are therefore closer to numerical modelling (Morgan, 2013).

When model building is facilitated with clients (Franco and Montibeller, 2010), whether quantified or qualified in nature, then benefits can be shared for the researcher discovering new values and the groups involved in sharing their information, often in a workshop setting. Group Model Building is one such approach applied to system dynamics as it enables open and transparent construction (Andersen and Richardson, 1997). Through rational description and reasoning, specific goals can be achieved using participative system dynamic modelling (Hoppenbrouwers and Rouwette, 2012). Ownership of model and problem combine in such group-based activities (Akkermans and Vennix, 1997), where scripts enable specific information capture for incorporation into the model (Luna-Reyes and Andersen, 2003). Model building in groups is a recognised approach for tackling messy issues that need clarifying before they can solve systemic puzzles at the centre of evolved and often repeating problematic behaviours (Rouwette et al, 2011), such as competing for secondary school during the K12 enrolment process.

Information supporting choice of secondary school

Local Admission Authorities[3] provide annual brochures explaining the latest state admissions process for both primary and secondary education (PCC, 2014). Contact details alongside Published Admission Number capacities are released per school. Also provided in the guide are placement results for students prioritising each school either first, second or last to indicate the level of risk associated with sequencing particular school choices. GCSE school league tables are also published online by the government for mostly supporting school academic comparisons (Ofsted, 2015).

By contrast, education policies are often embedded in various places such as key legislation, within council interpretations of government directives or even with a school policy deciding their specific admissions criteria. Codes of practice from government empower independent, council-based admission authorities to operate equal choice policies for example (School Standards and Framework Act in 1998 is modified by Education and Inspections Act in 2006). These codes appoint admission authorities to act as intermediaries between schools and parents deciding schools, thereby avoiding schools unfairly making offers to only those individuals placing them as their most preferred choice of the three available.

Parent decision making

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 often have to support trade-offs between the gains and losses for particular courses of action from a decision maker's perspective to back a judgement. As the mix of data required informing decision making depends on individual case by case requirements, techniques that enable these views to be captured are important for this study.

Multi-Criteria Decision Analysis (MCDA) according to Belton and Stewart (2002) offers a range of techniques that can test the value of different courses of action. It supports decision makers in structuring complex problems before weighing and valuing the possible outcomes. Structured interviewing around decision making can be performed with many tools within this category

[3] English Admission Authorities are part of the Local Authority (or municipality) providing local government services.

(generally using appropriate software to capture responses). Some software tools enable aspects of decision making to be answered remotely in survey style interfaces delivered across the internet however more complex structured interviews using such techniques demand individuals meetings with those providing data. A short and effective technique to weigh respective contributing factors with recourse to further information is called Analytical Hierarchy Process (AHP). Devised by Saaty in 1980, AHP enables an interviewer to obtain relative comparisons weighting importance of criteria for each option considered (Keeney, 1996). This feature of the AHP technique makes it more suited to individual structured interviews as it seeks parent perceptions of the weights they apply to different categories of criteria employed for selecting schools.

Competition and impact on social emotional wellbeing

Children face a number of challenges as they change schools in Plymouth (Dalton, 2009) and this affects and is affected by levels of social and emotional wellbeing. In the Ecological Systems Theory (1998), Bronfenbrenner and Morris establish a requirements hierarchy starting within the person-centric microsystems, supporting an individual by providing stability that included work (school life), family (home life) and friends (social life). Religion was also mentioned but faith only plays a limited role with diminishing numbers of families in England attending church regularly according to Hayward in 2005 and is therefore omitted.

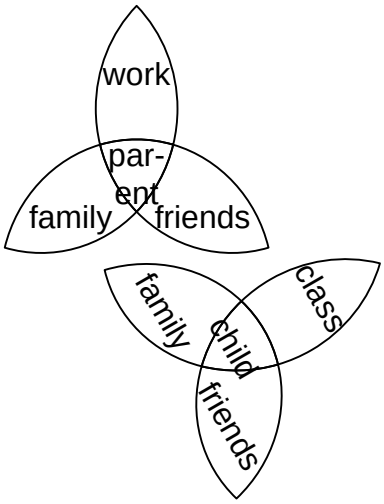

Figure 1. Microsystem stability factors supporting individuals (Bronfenbrenner and Morris 1998, adapted for parents and their children when transferring schools).

Figure 1 indicates two Microsystems that represent members in a family that offer an important source of stability for a child (but also parent) even when changing between schools and experiencing new classmates which can threaten hyper-stable normality (Garcia, 2006). The chart also helps explain why losing a parent through divorce or sickness, or parents suffering redundancy at work may well affect wellbeing for children in the family unit. Competing for school places also

adds to pressures on both parent and child who need a level of resilience or buffering to cope with K12 enrolment demands over extended periods.

Student enrolment and dynamics of school choice

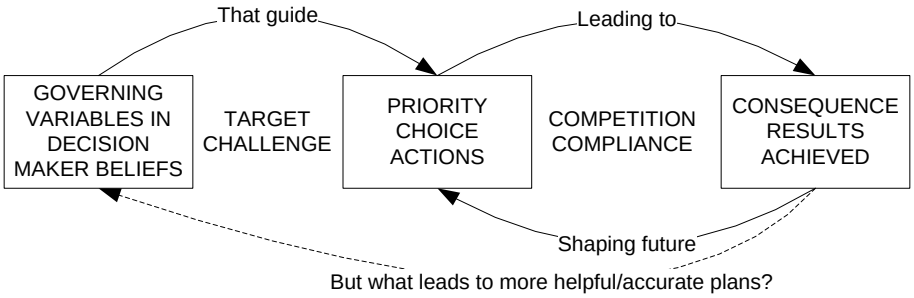

Figure 2. Double loop learning from competition towards challenge (adapted Argyris and Schön, 1978)

Challenging the metal models of parents deciding schools for the children aged eleven is difficult when much concentration is focussed towards competition and complying with complex admission system demands. Argyris and Schön (1978) developed their organisational model for learning involving two feedback loops that defined action and consequence in the first loop and a further loop linking to governing variables. The equivalent 'double-loop' learning concept for parents and children deciding schools is shown in figure 2. Simulation of the dynamic environment involving family relationships is one means by which challenge can be presented to persuade expert practitioners of the shared value in pursuing consistent policies. However simulation is not necessarily practical for families approaching the decision to learn about the choices and so simplification to a game incorporating others' experiences provides an alternative method to disseminate understanding. The focus reduces dominance of the first loop of compliance and pattern-based decision making by introducing the dashed line represented by a game of chance. In such cases, parents and children can experience and value alternatives together to create family mesosystem-based, learning organisations able to reflect upon others successes and mistakes against the enrolment process. By challenging assumptions and beliefs through sharing, it becomes possible to improve priorities attached to schools and sequence according to fit to family and child needs instead, leading to offers from schools.

In his call for education-based papers from the system dynamics community, Kennedy (2011) clearly identifies K12[4] enrolment as a gap in knowledge that needs answers. Since that time no new K12 based papers have been published that relate to this gap in knowledge even though other education examples have been published such as generally applicable education quality control by Hussein and El-Nasr (2013). Previous demands on the Nicaraguan education system for literacy have been considered from inconsistency associated with dropping-out based on system dynamics in 2004 (Altamirano and van Daalen). A further example in 2008 (Pedamallu et al) considers migrant primary school student performance in Turkey. However there remains considerable room for further development of causal theory in this area.

[4] K12 refers to Kindagarten or nursery schooling through to year 12 when GCSE examinations take place in the UK around the age of 15.

Methodology of modelling

Through the adopted lens of critical realism, the author aims to establish causal theory explaining dynamic behavioural variations in driven by the engine of social and emotional wellbeing relationships. The researcher employs this vantage point to objectively establish perceived family relationships and their influence on decision making processes involving choice of secondary school, independent from subjective views which can be interpreted and explained according to Bhaskar (1978). The reality test has to be "causally efficacious" to evidence such connections where there are three layers of reality in a model to traverse, similar to that which an iceberg might represent. The first or observable layer is empirical, the second being actual (time and space existence is more difficult to observe being under the water line). The deepest layer corresponds to a transfactual real layer from which social phenomena emanate from deepest underlying structures that are sometimes difficult to perceive being hidden well below the surface of the water. Rather than emanating from below like social phenomena, as humans our understanding traverses from the top of the iceberg down. Starting at the observable layer (statistics collected from data sets for example) through the actual layer (events and relationships for example) to end in understanding reality of structures involved in such causal relationships (mental models for example). This makes understanding social phenomena difficult but in such situations modelling methodologies can help.

Based on the Saunders et al "research onion" (2012) where concentric layers represent different aspects of methodological design, the following description traverses the onion "rings" to select a suitable investigative methodology for establishing the social reality of the school choice problem starting with the outer skin of critical realist philosophy and ending with analysed results of decision maker and expert practitioner perspectives in the centre of this research effort. The approach is inductive around decision maker views but becomes more deductive when considering social phenomena and deeper underlying structures represented by their mental models once sorted by their decision making styles. As parents offer individual views on school choice, a case study strategy is employed that can provide context for all relevant information supplied by expert practitioners. Mingers (2003) suggests that case studies used as part of a modelling multi-methodology, often combine interview and survey data as is the situation in this research where interviewing structure relies upon Analytical Hierarchy Process structured questions concerning relative contribution between factors. He continues by indicating that both case studies (such as structured interviews) can support interpretive and positivist paradigms whereas simulation is positivist by nature. Case studies can also combine data collection methods so that interviews and surveys also fit within this approach to research. As longitudinal appreciation of past behaviour and future response from systems is required, in addition to what individuals consider important in their school choice problem at present, it suggests that two types of model may be required for these tasks. A modelling multimethodology is therefore the preferred choice of method by enabling assessment of integrated results between different numerical techniques according to Morgan (2013).

The flow of a modelling multimethodology validation process is proposed in figure 3. The matrix indicates rows involving people who are able to validate different modelling assumptions alongside columns that represent sequential process steps in the specific method. Group Model Building (Vennix, 1996) is a key concept within this methodology where expert practitioners are asked to construct a model through a series of scripted interventions designed to draw out specific features needed by the modeller for inclusion within the system dynamics model. The scripts have been

contributed by the system dynamics community into a shared repository known as Scriptapedia (Hovmand et al, 2012) and piloted using a representative group of experts including educational psychologists, special school teachers, head teachers, local government officers and mental health professionals. (Carter et al, 2014). The process follows a sequence whereby an expert practitioner group from multiple agencies is asked to structure the systemic problem behaviour. Next parents are selected by their child's primary school year group to understand relevant decision making factors for rating schools and this is followed by an exit survey for parents estimating the impact of relevant factors in choice of school. A further workshop group is used to determine links between dynamic interactions and suggest a range of possible interventions before using decision making cases to indicate system levers and learning points for families. These assumptions are then tested with families and expert practitioners to validate the causal theory through participation.

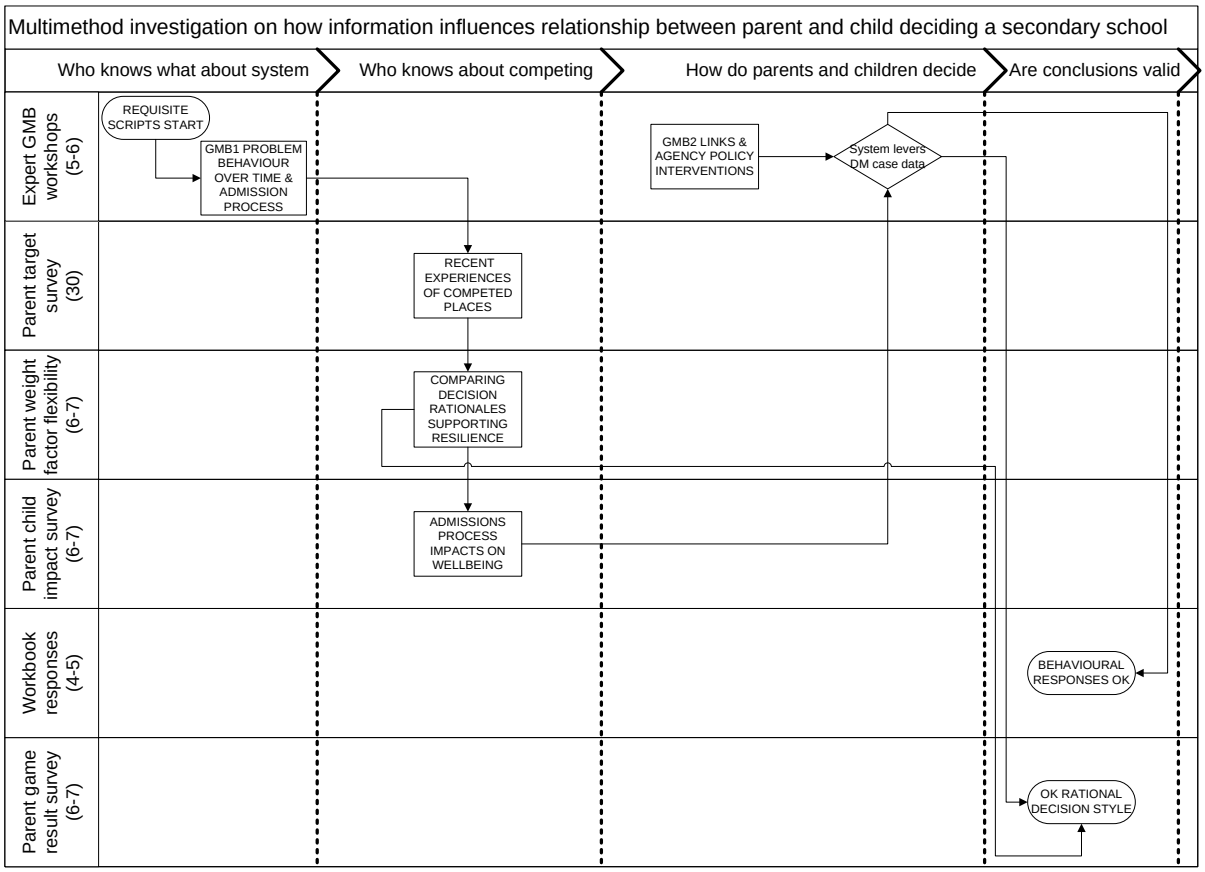

Figure 3 . Methodological flow for developing causal theory.

Participative models for consent

Identified by mental health experts who regularly encounter family relationship problems in Plymouth while making critical secondary school decisions, adequate buffering can provide family relationships with a degree of resilience that can be stripped away in highly expressed relationships. The ability of a child to negatively affect parent wellbeing is expressed by psychologists as well as captured during Group Model Building (GMB) workshops. By employing GMB elicitation scripts with multi-agency groups (Carter et al, 2014), participants are encouraged to plot such problem behaviours over time in terms of parameters with which they are familiar. This time-based collection of representative behaviours is defined by using the Graphs Over Time script to capture dynamic

effects within systems that contain structure and feedback. Annotations are encouraged to help describe specific effects within such plots over the period of Secondary School Decision Making (SSDM). As part of the script, two separate expert sub-groups were tasked to produce graphs of how wellbeing or anxiety might manifest themselves during this critical period of decision making. Independently derived, both plots showed tracking behaviour for highly expressed relationships between parent and child. A further plot described how lesser expressed (normalised) relationships might work when a degree resilience buffering was present. The final plot indicated that as anxiety levels rose with a person, their corresponding levels of social and emotional wellbeing reduced in response. Experts confirmed that this correspondence between raised anxiety and wellbeing loss rate affected children and adults equally. Anxieties increase when transferring school not only for children facing physical challenge and social upheaval but also for parents balancing difficult factors in their choices made between a myriad of secondary schooling options to arrive at the most preferred in the urban setting. The impacts of such decisions have repercussions over a minimum of the next five years of student development if not for much longer. This degree of agreement on the dynamic nature of the problem confirmed that system dynamics could offer potential insights onto this messy problem shared between agencies and the families involved.

Risks to children changing schools include perceived loss of physiological resources such as sources of food or drink combine with failure of peer support mechanisms from friends in primary school. By contrast parental risks might consider school-run logistics and siblings attending other schools. The experience of parents in knowing the needs of their child as well as those of the family is an important factor in choosing between competing secondary school options and selecting the most preferred school. Image Theory (Beach and Mitchell, 1987) helps by suggesting that faced with a complex array of options, or decision maker strategy may be applied over a period to improve chances of a successful fit between secondary school and student where shocks from changing school are minimised to assist smoother, more effective transitions.

Based on decision maker mental models, judgement criteria can be used first to filter-out risk associated with the options available. In the Plymouth cases, parents could look to the fourteen or more state school options in the unitary authority area first and apply criteria that would identify which options had inherent risk implications. If one or more criteria were violated then parents could deem the options to be too risky and would therefore exclude it from their specific choice set. Criteria thresholds could therefore allow a choice-set of up to three qualifying options to be specified on the Common Application Form (CAF). These same criteria are unlikely to be used in determining the order in which to sequence the choices made. Instead, a further stage in Image Theory decision making suggests that a new set of criteria are now applied to determine priorities. Rather than basing decision for most preferred again on risk, the new criteria sequence the choice-set by profit to the family and student concerned. The CAF requires that the choice set of up to three schools is sequenced in order of preference and this relates directly to the last stage of Image Theory. However detailed test cases are needed to determine if subconscious or other types of pre-filtering for risk is apparent in Secondary School Decision Making and here Analytical Hierarchy Process (AHP) can help structure interviews.

Structuring interviews for perspective on modelling

AHP asks comparison questions concerning the relative importance in making choices between criteria and assesses the answers for consistency. By selecting a decision making style based on

intuitive or system 1 and rational or system 2, it could be possible to demonstrate that parents may consider risk before sequencing for profit according to Image Theory.

Views from those who compete can provide an important source of reliable information for not only selective schools. Visits to schools at open events can also reveal hidden risks which can alter the chosen set of up to three schools. Sequencing choice-sets takes place after school visits conclude but open evening timetables are not de-conflicted city-wide to allow best fit of school to pupil as inherent risks and profits can still be missed when denied the opportunity to visit. Resourceful parents can attempt early school visits through personal contacts within the school structure as this can provide even more insight into how the school really works rather than what may be presented to them on an open evening.

Structured surveys with parents allow individual case studies of decision making for children to be studied in the context of changing school. This data can help establish the role comparative information plays in influencing decision makers. The level of parental social and emotional wellbeing determines when additional types of comparative information are sought. One well understood parental response to such family-based stressors seeks out useful information to support decisions on their individual school choice problems. While most information sources have a finite 'shelf-life' limiting their usefulness (for example Word of Mouth Recommendations or WOMR mostly apply to today's situation and would not be useful several months later). By contrast, certain types of information can be consistently compared year after year such as Key Stage test outcomes from SAT or GCSE scores.

While information resources degenerate over time, the techniques for stabilising them involve creating useful data sets over successive years in order to remove subjectivity from individual service providers of secondary education and other more ephemeral sources. However generating information is also possible by students competing with others in different types of test on or before year 6 in primary school. Students who can compare their academic skills in Eleven Plus entrance tests for academically selective grammar schools or their creative skills in audition situations (a semi-selective school in Plymouth) by generating results that give them confidence in their own abilities while adding to the parent's comparable information resources for use in decision making. In the case of grammar school tests for example, parents can appreciate levels of risk associated with including two or fewer such schools in the choice-set based on previously published, entrance cut-off scores for each selective Plymouth school.

Results discussion

Structured interviews and surveys

Decision theory underpins AHP by offering a reliable basis for demonstrating whether Image Theory applies for competitively successful parents using the UK's secondary state education system. Survey data can add to this by seeking social and emotional wellbeing impacts estimated for the child and parent. This information demonstrates that courses of action have potential consequences and that challenging the underlying assumptions may reveal better fit between student and school.

A source of data that parents can rely upon for making school comparisons is the academic record of students. Here consistent and comparable data is published by the government regarding the GCSE

achievements of year 12 secondary students for example (five years after entering secondary school in year 7). Regular quality improvements are applied to the data set, the most recent change of note being to only record the first attempt scores rather than re-test results, where scores tended to improve with repetition. Not only is such data used to reward secondary schools by demonstrating the academic value they are required to add for each student, it also reflects OFQUAL standards and how they might change over time in accordance with potential commercial interests of the examining boards.

However as a tool for deciding secondary schools, GCSE league tables offer a questionable level of predictive statistical reliability as not only are they last year's results (or earlier) reflecting the abilities of a cohort that joined five years ago, they bear little resemblance to what the new year 7 may achieve in another five years' time, given potential changes in government policy, school leadership, etc. that also have a bearing on the issue of school results.

Group model built simulations

Whereas academic league tables may influence parents, they often have less impact on how students decide and prioritise secondary education choices. Several schemes have been employed according to Expert Practitioners in the Plymouth context to help children acclimatise into their new secondary schools. Even though competition may increase the difficulty of applying such alleviating schemes in the future as resources dwindle, existing arrangements enable the vulnerable to attend secondary schools on a regular visitor basis from their primary schools to help resolve practical concerns associated with a specific planned secondary school. Called Transition Plus, the scheme adds to student information resources about a particular non-selective secondary school and can be invaluable when keeping school selection simple and worry-free for a minority of affected children.

Of equal importance are techniques to address bullying concerns for children considering the prospect of changing to a larger, perceptibly less-caring secondary school. Children who plan to transfer from feeder primary schools to associated, non-selective secondary schools may specify a year 6 class mate who would transfer with them into their new, year 7 class group. This provides students with some confidence in a friend to call on in the event of bullying behaviours within the secondary school setting. Feeder primaries often have established transport routes as they are usually close to home addresses and this helps reduce bus or train journeys and associated waiting for changes at bus stops or train stations where bullying can sometimes take place. It provides a form of information that directly supports student wellbeing before and during the process of transferring between schools but remains beyond the scope of model development described in this research study.

Negative consequences of school open evenings becoming marketing 'shows' targeted at children for demonstrating the best aspects of school performance to year 6 and younger children would appear to be balanced-out by the parent opportunities to inspect facilities, question staff and other students at such events. This allows parents to contextualise the various benefits that schools are able to supply on paper for example. The elicitation script descriptions employed in the second workshop provided in Annex A are based on Scriptapedia.

Conclusions on supporting change

If Image Theory offers a credible explanation of parental behaviour through different decision making styles verified in AHP surveys, then their activity in eliminating risk for their child and the family should mean a powerful and direct enabling mechanism is now at the disposal of others traversing the admissions process, given sufficient reliable comparative data. Placing circumstantial concerns aside, information gathered by families on each respective schools profit can similarly be applied on the risk-reduced choice set to sequence the preferred order of the schools listed on the application CAF. Rather than satisfying parent wellbeing deficit demands alone, children can get involved at this stage of decision making as evidenced by one of the case studies.

Such sequencing of schools preferences by the student is a powerful enabler as it offers rapid feedback to the child that their views are valued and trusted by parents who have already effectively contributed their insights on the choice of secondary schools. This may serve to bolster levels of child wellbeing and add to confidence that the most preferred option offers the best fit to need for parent and child alike. A designed policy test should determine whether this is the case and could therefore be recommended for example.

Modelling multi-methodology involving system dynamics

A viable multi-method approach has been explained that enables those involved in choosing their secondary schools and agencies from education, health and local authorities involved supporting their decision making process to understand what impact shared policies can have on reducing unwanted shocks in the system. System dynamics enables lessons from successful parent decision making examples to be incorporated alongside views from expert practitioners.

Applied multi-method validation technique

Case study validation and specifically AHP structured survey results relies upon accurately capturing parent perceptions and assessing consistency of weightings applied. This validation takes place at the individual level as different family needs for secondary education could show inconsistencies between different decision strategies for results being combined together. Importantly the technique specifically questions detailed numerical scores for alternative options including beyond the choice set at last place and fourth position.

Simulation model validation requires multiple agents to accept that the model exhibits behaviour that they would anticipate or if not, why the model might challenge their mental model assumptions surrounding. After conducting a range of confidence tests upon the model, asking participants to complete a workbook (one that summaries the research contributions before describing resulting simulation outcome) provides the ultimate form of simulator validation. Appendix B gives a validation workbook example for understanding the capability of the system modelled.

Implications for modelling outcomes

Feedback from anticipated dynamics system responses to policy change for each agency is important. However families being able to assimilate lessons learnt from their own decision weighting pre-experience is needed to allow them to challenge their own assumptions about which schools would offer real education potential for their child' development. Parent exit survey results are required to confirm or adjust the dynamic model of parent child relationships mediated by knowledge and the template is suggested in Annex C.

It is concluded that the aim of paper for validating approach to address gap in K12 enrolment dynamics is met through this approach.

Limitations of study

Feedback from parents involved in competitive admissions is important in making risk free school choices and profitable sequencing for most preferred school where the gaming approach is the suggested way forward to gain this confidence. This study is limited to the confines of the secondary education system in Plymouth for the range and variety of state school options available to families. Results are incomplete at this stage and may not demonstrate learning to reapply to those encountering the admissions system for the first time. Dynamic wellbeing relationships between parent and child may be generalised but this remains to be confirmed.

Double Loop Learning for organisations applies as much to competing Plymouth parents as it does to urban admissions into secondary schools. Here priority choices lead to resulting offers being achieved. Results then help shape future priority choices of schools in the first loop aimed at complying with competition rules. However when target setting; parents use decision maker beliefs to guide priority choices. Without a mechanism to feedback from resulting offers achieved, decision makers and families involved in deciding secondary schools have little opportunity to pre-experience the issue and modify their long-held beliefs or mental models. A mechanism for parent and child to pre-experience decision considerations is one way to close the target setting loop and provide double loop learning.

ANNEX A. Second Workshop Script

ANNEX B. Example Workbook Validation Tool

ANNEX C. Parent Survey

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