An economic method for formulating better policies for positive child development

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ABSTRACT

Social scientists and education, health and human service practitioners recognise the benefits of primary prevention and early intervention compared with remedial alternatives. A recent meta-analytic review of early childhood prevention programs conducted by the authors demonstrates good returns on investment well beyond the early years, into and beyond adolescence. There are two methodological deficiencies in the current prevention literature: (1) the limited tools available to assist when making choices on resource allocation and engaging in a structured decision-making process with respect to alternative policy options for early prevention; (2) the absence of a rigorous tool for measuring the economic impact of early prevention programs on salient aspects of non health-related quality of life. This paper examines traditional economic methods of evaluation used to assess early prevention programs, and outlines a new method, adapted from the Analytical Hierarchy Process, that can be used to address these deficiencies.

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Introduction

Economic analyses of early intervention and developmental prevention programs have provided compelling evidence for the long-term monetised savings to stakeholders such as the government or crime victims (Aos et al. 2004; Currie 2000; Heckman 2006). However, while useful in the formulation of public policy, at best this type of evidence can only account for a small proportion of the full benefits that may be generated when well-designed and well-implemented programs are delivered to at-risk groups or populations.

Missing from the economic toolbox are measures of direct improvements to the quality of life of individual participants, or their parents, teachers, and community members affected by school dropout, youth crime, substance abuse, and associated problems. The scientific evidence demonstrates that quality of life improvements can occur across an impressively wide range of life domains, including social and emotional development, cognitive development, social participation, health, and family wellbeing. Developmental prevention initiatives are, ultimately, directed at promoting these kinds of outcomes through the positive development of children and young people and their families, and as Nagin (2001) has observed, it is illogical to construct methods of cost-benefit analysis that ignore these immediate and longer term enhancements to wellbeing and human capital.

A second problem with current economic methods is that it has been impossible to compare program alternatives (for example, home visitation with preschool programs) due to the absence of a common metric for outcomes; that is, in the absence of a method for measuring benefits to participants across diverse life domains (education, family life, social interactions, and so on) using a common unit or 'currency' that is meaningful to stakeholders.

A final issue facing cost-benefit analysts and policy people is that when the evidence is available, making informed decisions about what programs to fund on the basis of complex information and multiple and extremely diverse criteria is difficult, given limited human cognitive capacity or bounded rationality (Saaty 2000).

This paper addresses all three problems. It describes a method that adapts Saaty's (1980) Analytical Hierarchy Process (AHP), which in turn is based on the Multi-Attribute Classification (MAC) system for the development of empirically well-grounded tools for the economic evaluation of developmental prevention initiatives as they operate on an ongoing basis in community settings. The MAC system provides a condensed, yet complete framework for describing quality of life status for use in the economic evaluation of developmental studies. A key advantage of the MAC system is that it simultaneously provides detail on an attribute-by-attribute basis and captures combinations of deficits among the attributes (Feeny et al. 1995). In addition, MAC systems are compatible with multi-attribute preference functions, which provide a method for computing a summary quality-of-life score for each outcome of interest (Manning 2008).

The approach proposed in this paper is an original formulation grounded in empirical research, extending methodological work already commenced (Manning

2008; Manning, Homel & Smith 2010). The method is designed to value the salient domains or attributes and their respective indicators with respect to improvements in quality of life emanating from early-in-life interventions and developmental prevention programs. By 'salient domains or attributes' we mean fundamental core attributes of quality of life and the capacity of individuals to function with respect to these attributes, including (as indicated earlier) educational performance, cognitive development, social-emotional development, deviance, social participation, criminal justice, and family functioning.

This research forms the foundation for future research that will: (1) compare methods of measuring utility values (for example, scalar versus standard gamble) to ensure the utility values derived are consistent across methods, and if not propose solutions and/or appropriate methods; and (2) create a multi-attribute classification (MAC) system that can be used in economic evaluations of social interventions.

The need for a new approach to economic analysis

The use of economic analysis in the evaluation of early development programs has become standard. However, as noted above, the methods have been limited to cost-savings (for example, savings to stakeholders such as reduced demand on the criminal justice system), cost-effectiveness (for example, reductions in the use of reading recovery programs) and cost-benefit (monetised long-term benefits to government stakeholders such as smaller criminal justice costs, reduced use of health services, and increased employment tax) (Welsh, Farrington & Sherman 2001).

Before explaining these approaches more fully, it will be useful to clarify what several commonly used terms mean. First, we should note that in this paper we use the terms 'primary prevention', 'early prevention', 'early development programs', 'early intervention', and 'developmental prevention programs' somewhat interchangeably. All these terms are used in the literature and encompass a broad array of program styles and target populations. What justifies treating them for present purposes as an undifferentiated whole is that they all aim to 'get in early' to prevent problems from occurring or to prevent them from becoming entrenched (Homel 2005).

Turning to terminology in economics, 'utility' refers to the satisfaction individuals derive from one or more outcomes (for example, improvements in educational performance and family wellbeing) (Gold et al. 1996). 'Value' expresses an individual's relative preference among the elements, the strength of the value being defined by using a set of real numbers (Isard & Smith 1982). 'Preference' is a concept that assumes a real or imagined choice between alternatives and the possibility of rank ordering alternatives, based on happiness, satisfaction, enjoyment, or the utility they provide (Saaty 2000). As we discuss later in this paper, 'utility' and 'preference' are very closely related terms, often used interchangeably.

Table 1. Approaches to economic analysis of crime prevention programs

Type of analysis	Measure of cost	Measure of outcomes	Strengths	Weaknesses
Cost-effectiveness	Monetary value of resources	Units of effectiveness (for example, improvement in academic test scores)	Easy to incorporate standard evaluations of effectiveness Good for alternatives with small number of objectives	Hard to interpret when there are multiple measures of effectiveness Only useful for comparing up to two alternatives; outcome measures must be comparable
Cost-benefit	Monetary value of resources	Monetary value of benefits	Can judge absolute worth of a project Can compare CB results across a variety of projects	Difficult to place monetary values on many salient life benefits
Cost-savings	Monetary value of resources	Monetary savings resulting from impact of intervention	Good for assessing the savings generated to stakeholders	Difficult to place monetary values on many salient life benefits
Cost-utility	Monetary value of resources	Units of utility	Incorporates individual preferences for units of effectiveness Incorporates multiple measures of effectiveness into a single measure of utility	Difficult to arrive at consistent and accurate measures of individual preferences Cannot judge overall worth of a single alternative, only useful for comparing two or more alternatives

Adapted from Levin, H. & McEwan, P. 2001, *Cost-effectiveness Analysis*, Sage Publications, London.

There are a number of established approaches in the economics literature (Boardman et al. 2006; Gold et al. 1996) to placing money values on the benefits and costs of early interventions. Table 1 provides a summary of these approaches and their respective strengths and weaknesses.

A small but growing number of scholars has recognised the importance of quantifying human capital development (that is, quantifying increased resources in individuals including knowledge, health, experience and skills), particularly for early in life interventions, to reveal the full economic benefits available to all stakeholders including program participants and their families across the life course (Doyle et al. 2007; Heckman 2006; Nagin 2001). Nagin proposed the development of a methodological tool that considers benefits across multiple domains, at different times, yet at the individual level. Rather than criticising the more technical matters of economic analysis (for example, choosing the right discount rate), Nagin focused on the broader conceptual issues concerning the structure of an analysis. Writing for a criminology audience, Nagin observed that economic analyses of prevention

programs generally focus on the crime control perspective, using this as the unit of analysis. He argued, however, that this perspective does not suit the prevention model whose natural unit of analysis is the individual. Economic analyses of early prevention programs have, in part, measured enhancements to human capital, but this has been limited and not holistic (Manning 2008; Nagin 2001).

Nagin proposed that economic studies should incorporate qualitative improvements in a child's and their family's quality of life. Moreover, he argued that cost-effectiveness analysis, which is usually based on a crimes averted metric, is an insufficient evaluation criterion. This approach rests on seemingly plausible, but still highly speculative estimates of the impact of early prevention on later criminality; see for example, the cost-effectiveness analyses of California's 'Three Strikes' law (Greenwood et al. 1996).

In summary, Nagin argued that the current structure of economic analysis does not account for all the salient effects produced by developmental prevention programs, such as increased public safety, or significant individual benefits, such as improved quality of life. Second, there seems to be a disjunction between the timing of the initial investment and the future realisation of benefits. In his words, '… it seems misguided to frame the argument for developmental prevention in narrow crime prevention terms when in fact developmental prevention is not directly competing for crime control resources' (p. 361). Cost-benefit analyses of the Perry Preschool program for example (for example, Barnett 1993, 1996; Schweinhart, Barnes & Weikart 1993; Schweinhart et al. 2005) failed, according to Nagin, to capture the full effects of developmental interventions. Karoly et al. (1998) observed that, overall, developmental programs provide '… gains in the emotional or cognitive development … improvements in educational process and outcomes … increased economic self sufficiency … reduced levels of criminal activity, and improvements in health-related outcomes' (p. xv). Some of the outcomes mentioned can be captured only through a non-monetised metric.

Our approach builds on Nagin's arguments, based on current evidence that early prevention programs have potentially far-reaching impacts that must be valued in holistic terms, rather than in terms of the traditional savings perspective. Simply broadening the sampling of outcomes in the calculation of benefits or savings to the government will be ineffective because such outcomes still would not capture some of the salient non-dollar outcomes that flow from social interventions. Nagin attributes the ineffectiveness of such a method (that is, cost-benefit analysis) to the expense of collecting such data in a way that would enable demonstration of discrete outcomes: '… many potential impacts such as improved performance in the labour market or lower criminality require years to follow-up and document' (p. 364). Moreover, the highly speculative nature of valuing discrete impacts, for example, placing monetary values on discrete events such as an arrest or a year of special education services, has not been adequately critiqued. Such cost estimates are highly imprecise and simply increasing the list of items valued only increases the speculative nature of the analysis.

The Analytical Hierarchy Process (AHP)

The Analytical Hierarchy Process (AHP) developed by Saaty (1980) is a systematic procedure for representing the elements of a decision, rationally disaggregating the elements into smaller constituent parts, and introducing simple pair-wise comparison judgments for use in developing a vector of weights for priority ranking alternatives. The method also provides relative utility weights for all the elements within the hierarchy that have undergone pair-wise comparison judgments by respondents.

Manning (2008) extended the method by adding an objective component. The extended process provides respondents with results from a meta-analytic review of the empirical literature specific to the nature of the issue (Manning et al. 2010). This step provides respondents with empirical evidence in the form of effects sizes to assist in deductive thinking. These effect sizes can be described in words in the scenarios presented to the various stakeholders. This is important given that policy-makers require multiple criteria to analyse complex problems, as well as accurate information about the likely real-world effects of different programs.

The AHP method has been applied to the analysis of real-world problems such as the allocation of resources (for example Cheng & Li 2001a, 2001b), planning (for example Crowe, Noble & Machimada 1997; Udo 2000; Yang & Lee 1997), impact of policy (for example Saaty 1980, 2001), and resolution of conflicts (for example Johannessen, Bandara & Smith 2004; Tarbell & Saaty 1980). AHP is also used to inform corporate planning, portfolio selection, and cost-benefit analysis by government agencies for the purposes of resource allocation (Saaty 2001). However, this method has never been applied to assessing the benefits of developmental prevention.

As noted earlier, the AHP method is a special case of MAC or the Multi-Attribute Classification system. Specifically, it is a special case of what has been labelled in the literature as Multi-Criteria Analysis (MCA) or Multi-Criteria Decision Support Systems (MCDSS) (Mendoza et al. 1999; Triantaphyllou 2000). The advantage of the AHP method compared with other alternatives in the MCA and MCDSS categories is: (1) it is a multi-level approach, which enables the problem to be disaggregated into component parts enabling more thorough analysis of each component; and (2) it produces summary results that can be interpreted as utility values (Saaty 2001).

Differentiating utility values

The AHP is an efficient technique for solving problems, such as priority rankings for alternative policies, and eliciting relative utility values. We use the term utility in this case to refer to the preference individuals have for a given set of criteria or outcomes. The term has often been synonymous with preference as the 'more preferable an outcome, the more utility associated with it' (Drummond et al. 2005, p. 140).

The term utility is commonly used when preferences are represented by assigning integers (whole numbers, including zero) to a scale. This process represents a cardinal preference function, or a cardinal utility function (Isard & Smith 1982). Cardinal utility is limited in that there is not an established scale for its measurement

except indirectly using other cardinal measures such as dollars. Outcomes that are aspects of non-health quality of life cannot be easily represented using cardinal utility functions. If, on the other hand, numbers can be used to reflect preferences, the numbers only represent whether an individual prefers one outcome to another, effectively creating a set of rankings. In these circumstances '… the ratios of these numbers have no meaning, nor do their absolute differences. Use of numbers in this way represents an ordinal preference function, often designated as an ordinal utility function' (Manning 2008, p. 204).

Between cardinal and ordinal utility is a concept known as relative utility. This is where the ratios of the numbers associated with outcomes are meaningful but the numbers themselves are not. For example, Isard and Smith (1982) state: '… a participant may be able to say that he values (prefers) one outcome twice as much as another but that it does not matter to him whether the first outcome has a number 200 and the second 100, or the first 150 and the second 75' (p. 19). The AHP process makes use of the concept of relative utility.

Obtaining relative utility values using the AHP method

In this section, we present a simplified account of the method. Assume we wish to determine preferences (to elicit relative utility values of outcomes) for three forms of early intervention (X, Y and Z) that most contribute to the goal of individual quality of life. The attributes or outcome domains found by Manning (2008) to be most relevant to policy-makers based on both empirical evidence and their own experiences and histories were: educational success (ES), cognitive development (CD), social-emotional development (SED), deviance (D), social participation (SP), and family wellbeing (FW). The three forms of early intervention possess all six attributes (that is, they all help bring about improvements in all six outcome domains), but at various levels of intensity or effectiveness: high (H), medium (M) and low (L). The resulting hierarchy is provided in Figure 1.

Figure 1. An illustrative hierarchy for determining preferences
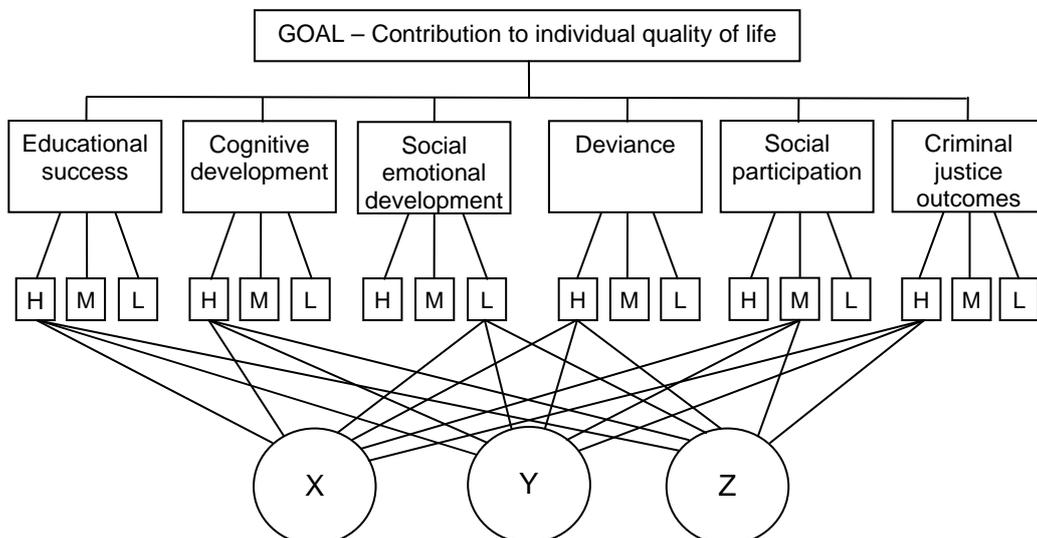
A ranking of early intervention alternatives (X, Y, and Z) and relative utility values for these interventions, the associated attributes (ES, CD, SED, D, SP and FW) and their levels of intensity (H, M and L) are derived through seven steps. A schematic representation of these steps is provided in Figure 2.

Figure 2. Application of AHP technique to the ranking of the X, Y, Z alternative interventions to achieving the goal
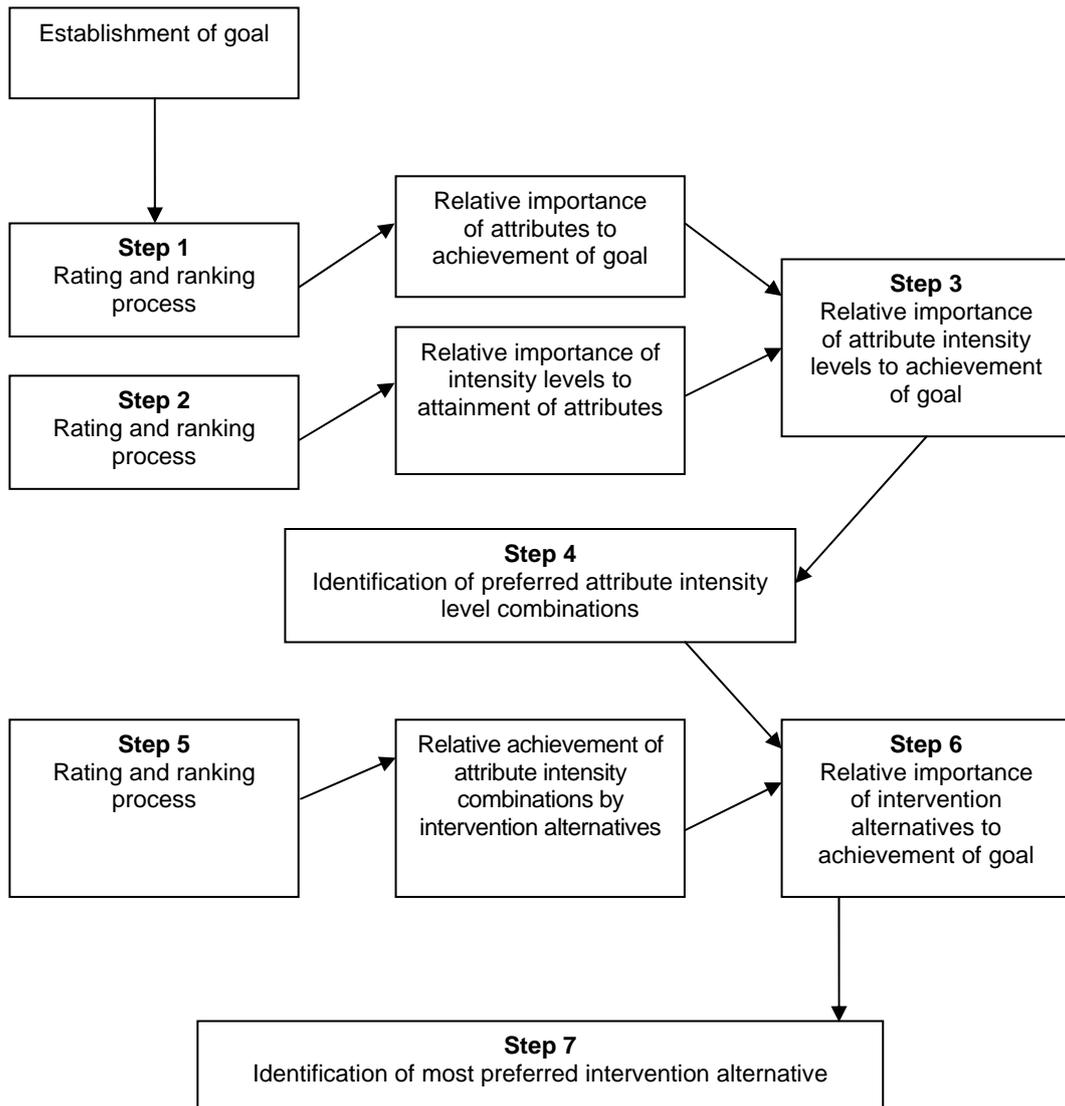
Step 1: Expert team provides individual judgments of relative importance of attributes (ES, CD, SED, D, SP and FW) to the goal of enhancement of individual quality of life using the scale depicted in Table 2.

Table 2. Saaty's Comparison scale

Intensity of Importance	Definition	Explanation
1	Equal importance	Two elements are of equal importance
3	Weak importance	Experience and judgment slightly favour one element over another
5	Essential or strong importance	Experience and judgment strongly favour one element over another
7	Demonstrated or very strong importance	An element is strongly favoured and its dominance is demonstrated in practice
9	Absolute importance	The evidence favouring one element over another is of the highest possible affirmation
2,4,6,8	Intermediate values	When compromise is needed

Adapted from Saaty, T. 1980, *The Analytic Hierarchy Process*, McGraw-Hill, New York.

The selection of experts used in this method is based on the multiple informant model, where members of the expert group are selected on the basis of their 'expert' knowledge of the problem, or because they are directly affected by the problem (Achenbach, McConaughy & Howell 1987; Manning 2008). The multiple informant model provides an accurate and reliable data set, particularly when data relates to behavioural and emotional problems of children.

The sample size should be representative of the groups selected, ensuring that no selection bias occurs (for example, selecting individuals who respond only in sympathy with the researcher). For example, Manning (2008) selected participants (n = 25) on the basis of '... (a) their ability to influence decisions regarding the implementation of program options available for early childhood intervention; and/or (b) their demonstrated expertise in the evaluation of the effectiveness of outcomes (both short- and long-term) associated with existing early childhood intervention programs adopted in the Queensland context' (pp. 239–240). This included a policy development group (for example, representatives of local government departments such as Queensland Department of Education, Training and the Arts), who were extremely eager to participate and saw the relevance of the method; a school level group (for example, teaching staff of primary schools, childcare centres, and kindergartens); a community agencies group (for example, management and staff of community organisations involved in the delivery of prevention programs); and an academic group (academic researchers contributing to the developmental prevention and early education literature).

From these judgments (provided by the expert group) a matrix that compares the six attributes in pairs with respect to the goal is developed. This matrix is used to determine preferences (or priorities) among the six attributes (Figure 3). The whole numbers in Figure 3 are derived from Table 2, noting that fractions are simply the reciprocal of another cell (for example, ES/CD = 4 and CD/ES = ¼). To arrive at the normalised vector, the numbers in each column are divided by the column sum

(for example, the score of 4 for the CD-ES cell is divided by 20.20), and the resulting scores added across rows and divided by the number of columns (which is 6). This yields the normalised vector of priorities, which is needed for Step 3. The elements in the normalised vector sum to 1.0. Each element represents the relative preference for the goal, in the sense that (for example) educational success (ES) at 0.06 is less than a quarter as attractive as criminal justice outcomes (CJO) at 0.26.

Figure 3. Matrix comparing six attributes with respect to the goal, using Saaty's scale

Goal	ES	CD	SED	D	SP	CJO	
ES	1	1/4	1/5	1/4	5	1/6	0.06
CD	4	1	1/3	3	6	1/2	0.17
SED	5	3	1	4	7	3	0.38
D	4	1/3	1/4	1	5	1/5	0.10
SP	1/5	1/6	1/7	1/5	1	1/7	0.03
CJO	6	2	1/3	5	7	1	0.26
	20.20	6.75	2.25	13.45	31	5.01	

Normalised vector of priorities for Level 1 of the hierarchy

Step 2: Develop six matrices that compare the three intensity levels (high, medium, low) in pairs with respect to each attribute. This comparison determines the preferences among the intensities of the attributes, whereby a normalised priority vector for each level of intensity is derived with respect to each attribute. Figure 4 provides an example of one of these matrices, for ES. The procedure here is the exact analogue for intensity levels of the procedure for the relative preferences of attributes shown in Figure 3.

Figure 4. Determining preferences among the intensities for the attribute educational success (ES)

ES	H	M	L	
H	1	5	8	0.73
M	1/5	1	5	0.21
L	1/8	1/5	1	0.06
	1.325	6.20	14.0	

Normalised priority vector

It is important to keep in mind that the expert judgments reflected in the preference scores in Figures 3 and 4 are informed by empirical evidence derived from a meta-analysis of past intervention projects for which detailed follow-up studies have been conducted (Manning, Homel & Smith 2010).

Step 3: The priorities of the intensities (H, M, and L) for each of the six attributes (ES, CD, SED, D, SP and CJO) are grouped in columns and the priorities of the attributes (derived from Step 1) are entered above the columns of intensity preferences for each attribute or outcome domain (Figure 5). For example, the numbers in the ES column are simply the normalised vector elements from Figure 4, while the 0.06 at the top is the relative preference of the ES attribute from the normalised vector in Figure 3.

Figure 5. Matrix displaying priorities of attributes and intensities of attributes

	(0.06) ES	(0.17) CD	(0.38) SED	(0.10) D	(0.03) SP	(0.26) CJO
H	0.73	0.76	0.05	0.63	0.18	0.76
M	0.21	0.19	0.19	0.28	0.71	0.19
L	0.06	0.05	0.76	0.09	0.11	0.05

We now need to combine the relative preferences for each attribute or outcome domain with the relative preferences for each intensity within that attribute. To do this we multiply the numbers in each cell of the matrix in Figure 4 by the number in brackets at the top of the column, yielding a weighted vector of priorities for the intensities (that is, weighted for the relative preference of each attribute) (see Figure 6).

Figure 6. Priorities for the six attribute-intensity combinations

	ES	CD	SED	D	SP	CJO
H	0.041	0.128	0.018	0.063	0.005	0.201
M	0.012	0.032	0.073	0.028	0.019	0.051
L	0.004	0.008	0.292	0.009	0.003	0.013

Step 4: The number in each column in Figure 6 with the highest priority is then selected to obtain a vector of desired attribute-intensity combinations (to reduce the size and complexity of the analysis in this example—although a legitimate procedure more generally) (Figure 7).

Figure 7. Vector of the most desired attribute-intensity combinations

$$\begin{bmatrix} H-ES & H-CD & L-SED & H-D & M-SP & H-CJO \\ 0.041 & 0.128 & 0.292 & 0.063 & 0.019 & 0.201 \end{bmatrix}$$

The matrix in Figure 7 is then normalised using the same procedure as in Steps 1 and 2 (Figure 8).

Figure 8. Normalising the vector of attribute (outcome domain) priorities

$$\begin{bmatrix} 0.041 \\ 0.128 \\ 0.292 \\ 0.065 \\ 0.019 \\ 0.201 \\ \hline 0.746 \end{bmatrix} \xrightarrow{\text{Normalise}} \begin{bmatrix} 0.056 \\ 0.172 \\ 0.393 \\ 0.084 \\ 0.025 \\ 0.270 \end{bmatrix}$$

Step 5: So far all we have explored is preferences for the outcome domains (attributes) and their respective levels of intensity, as judged by the expert group. Next, we develop six matrices that compare the three early intervention alternatives (X, Y, Z) in pairs with respect to the most desired attribute-intensity combinations in Figure 8, to determine the relative desirability of the available program alternatives. Expert judgment is once again used in determining these matrices and the results obtained from relevant meta-analysis are provided to the experts prior to their judgments being elicited. Figure 9 provides an example of one of these six matrices—namely that which relates to the desired high intensity with respect to the educational success attribute (H-ES). Using the hypothetical cell entries in Figure 9, Y is considered of 'strong importance' (score 5) compared with X (using Saaty's scale in Table 2), in terms of the judged relative intensities of importance of Y and X in producing a high level of educational success. The normalised vector of relative priorities for each program alternative is also computed and shown in Figure 9.

**Figure 9. Comparing preferences for program alternatives X, Y and Z
for desired attribute-intensity combination H-ES**

$H-ES$	X	Y	Z		Priority
X	1	5	8	→	0.715
Y	1/5	1	5		0.219
Z	1/8	1/5	1		0.067

← Normalised priority vector

Step 6: Priorities for the early prevention alternatives are then grouped in columns with respect to each attribute-intensity combination (derived from Figure 9) and the normalised priorities (derived from Figure 8) are entered above each corresponding attribute-intensity column. Each column is then multiplied by the normalised priority of the corresponding attribute-intensity combination. Figure 10 provides an example for H-ES, where for program X (for example) 0.039 = 0.056 X 0.715.

**Figure 10. Calculation of vector for attribute-intensity combination H-ES
with respect to program alternatives X, Y and Z**

	$H-ES$
	(0.056)
X	0.715
Y	0.219
Z	0.067

→

$$\begin{pmatrix} 0.039 \\ 0.012 \\ 0.004 \end{pmatrix}$$

Figure 11 is the matrix of weighted overall priorities for each of the alternatives (X, Y, and Z) created by repeating the above procedure for each attribute-intensity combination (H-ES, H-CD, L-SED and so on).

Step 7: The final step involves adding the rows in Figure 11 to obtain the overall priorities or relative utility values for the three early prevention alternatives (Figure 12). These relative utility values indicate that intervention X is most preferred, with a relative utility of 0.395, while intervention Y is the least preferred with a relative utility of 0.252.

Figure 11. Weighted attribute-intensity combinations for alternatives X, Y and Z

	$H-ES$	$H-CD$	$L-SED$	$H-D$	$M-SP$	$H-SR$
X	0.039	0.097	0.029	0.035	0.010	0.184
Y	0.012	0.064	0.080	0.022	0.009	0.064
Z	0.004	0.010	0.283	0.028	0.006	0.022

This method allows the researcher to observe, based on objectively informed subjective responses from participants, the relative value of each program alternative and the individual relative utility values for all levels of the hierarchy (Steps 1–6).

Figure 12. Vector of priorities for program alternatives based on pair-wise comparisons of all levels of the hierarchy

$$\begin{bmatrix} X & 0.395 \\ Y & 0.252 \\ Z & 0.353 \end{bmatrix}$$

This quick overview of the AHP method does not provide the reader with the essential tools (for example, matrix algebra, eigenvalue calculation, and transitivity) to conduct this form of analysis. A more complete account of the method is provided in Manning (2008) including discussion of (1) how the rating and ranking process used in Steps 1, 2 and 5 is checked for consistency and adjusted when judgments fall outside the acceptable range, and (2) how sensitivity analysis is employed during selected steps to ensure that the final relative utility values are meaningful and reliable.

Applying relative utility values in cost-utility analysis

The AHP method, as demonstrated, does allow the development of a common metric from which to compare outcomes for alternative early prevention programs. So how do we apply the results of this method (the relative utility values) to assess (from an economic perspective) the qualitative improvements (enhancements in human capital) in a child and his/her family's quality of life using the individual as the unit of analysis?

If we hypothetically compare the utility and costs of the three early intervention alternatives X, Y, Z using the individual as the unit of analysis we would first define the attributes (outcome domains) by which the success of alternatives would be judged, and identify sub-domains and indicators that represent the attributes of interest. Next, we would assign importance weights to the attributes of interest and generate relative utility scores using the AHP method. The economic analysis would then

involve collecting cost data for each alternative (Manning, Homel & Smith 2006) and combining cost estimates and overall utility values to create a cost-utility ratio (Table 3).

Table 3. Costs, utility and cost-utility ratio for three preschool program alternatives

	Program X Alternative 1	Program Y Alternative 2	Program Z Alternative 3
Average cost per student	$30,000.00	$28,000.00	$25,000.00
Overall utility	395	252	353
Cost-utility ratio	$75.94	$111.11	$70.82

Finally, we account for uncertainty by again conducting a sensitivity analysis. Given space restrictions, we have not included a description of this method. Drummond, O'Brien, Stoddart and Torrance (1997), Levin and McEwan (2001), Manning (Manning 2004, 2008) and Manning et al. (2006) provide a full account of cost utility analysis.

Conclusion

This paper has demonstrated that it is possible to combine the costs of a program and their respective utility scores to identify the program alternative with the lowest cost-utility ratio. Table 3 demonstrates (based on hypothetical data) that program Z provides the lowest cost-utility ratio. This effectively addresses Nagin's point, in that the method captures the salient qualitative improvements in a child's and his/her family's quality of life flowing from the intervention/program. Further, the individual replaces the societal savings perspective as the unit of analysis, and the method produces a common metric to allow comparison between program alternatives.

To derive utility values to use in cost-utility analysis, our technique enables objectively informed subjective valuation of preferences that do not rely on monetisation; that is, this valuation is informed by objective information from past research on the effectiveness of interventions. Finally, this valuation has been derived in such a way as to enable the complex nature of the interventions to be incorporated in a structured protocol of decision making through the use of a hierarchical approach.

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