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Green Space and Health Benefits:
a QALY and CEA of a mental health programme

Ken Willis
School of Architecture, Planning & Landscape
University of Newcastle upon Tyne

Bob Crabtree
CJC Consulting, Oxford

Liesl M. Osman
Research Services, University of Oxford

Kirsty Cathrine
Forestry Commission Scotland, Hamilton

Abstract
Green spaces are promoted as a means of improving the health related quality of life (HRQoL) for people with health problems. This paper evaluates the Branching Out program in Scotland, which provides patients, with mental health problems, social, physical and recreational activities in an outdoor 'community' setting. Patients carry out group-based woodland activities over a 12-week period. Health agencies in the Strathclyde region of Scotland offer patients the opportunity to participate if they consider that the patient will benefit from Branching Out activities.

The evaluation uses the SF-12 questionnaire to assess HRQoL of participants in the program. From the SF-12 scores quality adjusted life year (QALY) change is calculated. Cost per QALY is estimated in relation to economic costs of the program (staffing cost, facilities, and other costs e.g. travel).   Cost effectiveness analysis (CEA) reveals Branching Out is comparable to other programmes oriented to social recovery.   Its cost-effectiveness in terms of National Institute for Health & Care Excellence (NICE) guidelines for medical treatments depends on the duration of the health improvement.

Key words: QALYs, mental health, forests, cost-effectiveness analysis

JEL classification: I12, I18, H75

Introduction

Governments encourage active use of the outdoors to improve people's health and well-being. In the UK the Department of Health (2004a) has 'reducing obesity', 'increasing exercise' and 'improving mental health' as three of its six overarching priorities. Regular physical activity is effective in preventing illness and as a therapeutic intervention for existing illness, particularly for cardiovascular disease, musculo-skeletal diseases, stroke and cancer. Physical activity has not been shown to be *preventive* for all types of mental illness, but there is good evidence that it is *therapeutic* for clinical depression, and for general mental well-being[1]. The Department of Health (2004b) concentrates on the *preventative effects of physical activity* and concludes that 'for general health, a total of at least 30 minutes a day of at least moderate intensity physical activity on five or more days of the week reduces the risk of premature death from cardiovascular disease and some cancers, significantly reduces the risk of type 2 diabetes and it can also improve psychological well-being'. Psychological health benefits include improvements in psychological disorders such as depression, as well as more subtle vitality, general mental state, benefits and experience of social inclusion, as found by Kuo and Sullivan (2001a, 2001b) in their studies of housing projects in America. Kaplan & Kaplan (1989) also developed a theory of green space having 'restorative' psychological benefit for many people, explaining the preference many people express for access to nature.

This paper evaluates a green space programme run by Forestry Commission Scotland (FCS) which aims to improve then mental health of participants. The Forestry Commission (FC) generates a low rate on return on its investment in terms of marketed products, principally timber production (Crabtree *et al*, 2004). Many of the benefits produced by forestry are non-market benefits (e.g. open access recreation in forests, biodiversity benefits, carbon sequestration, and landscape benefits) (Willis et al, 2003). The FC is constantly seeking additional uses for its forests to further enhance market and non-market benefits of forests, to demonstrate the economic and social benefits of forests. A new initiative by FCS is the use of forests as an aid in the treatment of mental health patients. This project, called Branching Out, is a program which aims to improve the health related quality of life (HRQoL) of adults experiencing severe and enduring mental health problems. It is an adjunct treatment for those in secondary and tertiary care.

Green space and health

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[1] Extensive reviews of the medical evidence are given in Department of Health (2004b) and Pretty *et al*. (2005). English Nature (2003) has reviewed the positive impacts of nature on psychological well-being.

A number of studies have revealed an impact of green space physical exercise.   In Australia Giles-Corti and Donovan (2002) and Giles-Corti et al (2005) found that the likelihood of using Public Open Space (POS) for physical activity increases with increasing ease of access (short distance and lack of barriers such as major highways), and that use of the site is significantly affected by its attractiveness and size. A study by Ellaway *et al*. (2005) found that higher levels of greenery and lower levels of graffiti and litter in residential environments are associated with being physically active and not overweight and obese.   Residents in high 'greenery' environments were 3.3 times as likely to take frequent physical exercise as those in the lowest greenery category.

There is some literature on the benefits of green space and physical activity in relation to mental health. Fox (1999) reviewed the literature on the role of physical activity in mental health treatment and the improvement of mental well-being in general, and concluded that exercise was effective in the treatment of clinical depression.   Exercise can reduce state and trait anxiety and can improve physical self-perceptions and in some cases global self-esteem. Pretty et al (2007) measured the effects of green exercise (including walking, cycling, horse-riding, fishing, canal-boating and conservation activities) across 263 participants. Even though these participants were generally active and healthy, green exercise led to a significant improvement in self-esteem and total mood disturbance (with anger-hostility, confusion-bewilderment, depression-dejection and tension-anxiety all improving post-activity).   All the activities generated mental health benefits, indicating the potential for a wider health and well-being dividend from green exercise.   A Swedish study by Grahn and Stiggsdotter (2003) found access to small scale green-space (private gardens, allotments or a summer cottage) was associated with lower self-reported experiences of stress – independent of the informant's age, sex and socio-economic status. The more often a person spent time in an urban open green-space, the less often he or she reported stress-related illnesses.

Positive effects of physical activity have been shown for people with serious mental illness: in a review of the benefits of physical activity for schizophrenia Gorczynski and Faulkner (2010) concluded that there was evidence that regular exercise programmes had positive effects on physical and mental health and well-being. Merom et al. (2008) carried out a randomised trial of walking as an adjunct to group cognitive behavioural therapy for anxiety disorders and found that the addition of exercise to the cognitive therapy programme significantly increased improvement on scores measuring depression, anxiety and stress.

An important reason for designing physical activity activities for mental health service users is that they are less likely to reach population norms for physical

activity and more likely to have poor physical health. Dickerson et al. (2006) showed that the overall health of mental health patients falls below that of the general population. NHS Health Scotland (2011) concluded that those with severe and enduring mental health problems gain health improvement benefits from physical activity; and noted that for many it is the participation in a new activity with other people and the social self-confidence this brings that is of primary importance. The national clinical guidelines for Scotland (SIGN: Scottish Intercollegiate Guidelines Network) recommend physical activity as non-pharmaceutical treatment for mild to moderate depression (SIGN Guideline 115 Evidence level B) and obesity (SIGN Guideline 115, Evidence level A).

A longitudinal analysis by Alcocket al (2014) of over 5000 households from the British Household Panel Survey 1991 to 2008, revealed that, compared with pre-move mental health scores, individuals (*n*=594) who moved to greener areas had significantly better mental health in all 3 post-move years; whilst individuals who moved to less green areas (*n*=470) showed significantly worse mental health in the year preceding the move, but returned to baseline in the post-move years. The study standardised for area level covariates (e.g. employment, unemployment, school performance, crime levels, etc.), and for individual level control variables (e.g. age, education, marital status, children, employment, housing type and space, etc.). Unfortunately the authors were unable to examine the mechanisms that might explain how green space improved mental health e.g. by encouraging greater levels of physical activity.

Most studies report findings indicating green space has a beneficial health effect. However, Lee and Maheswaren (2011) in a review of the evidence suggest that the links between physical, mental health and well-being, and urban green space are weak. Many studies are limited by poor study design, failure to exclude confounding effects, bias or reverse causality and weak statistical associations. Environmental factors such as the quality and accessibility of green space affect its use for physical activity; whilst user determinants, such as age, gender, ethnicity and the perception of safety, are also important.

A study of the health benefits of green space ought to (1) assess whether increased access to green space increases physical activity and mental health over what it otherwise would have been; (2) that this has a health impact, i.e. it benefits people who would not otherwise engage in HRQoL activities;[2] (3) whilst the magnitude of the health improvement is estimated; and (4) the benefit or economic value of the health improvement is calculated; to (5) set against the costs of the green space

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[2] The analysis needs to assess the extent to which the green space HRQoL benefits are created rather than being diverted or autonomous.

health program; to (6) evaluate whether the benefits exceed the costs. Whilst there have been numerous studies of the health impact of green space, few studies have attempted to assess all these aspects. The study of the Branching Out program is one of a few studies that assess all these aspects. The aim of the paper is to assess the cost-effectiveness of Branching Out by evaluating the economic benefits of the Branching Out programme in relation to its costs.

Branching Out

The Branching Out program started in 2007 from discussions between FCS and UK National Health Service (NHS) in Greater Glasgow and Clyde. Since 2007 the programme has developed and expanded in terms of its partners, funders, and geographical coverage in Scotland.

Branching Out aims to improve the HRQoL of adults experiencing severe and enduring mental health problems. Agencies offer patients the opportunity to participate if they consider that the patient will benefit from Branching Out. Participation is voluntary. Patients typically include those with severe and enduring mental health problems in both low secure and in medium secure rehabilitative care, with one or more mental health conditions such as moderate to severe chronic psychotic disorders, or chronic depression. Others may have a range of issues for which Branching Out may be therapeutic, such as chaotic family lives, homelessness, addiction, abuse, extreme isolation and lack of support, obesity and obesity related health problems. Referral can be made by clinicians within seven National Health Service (NHS) board areas or agencies in Scotland[3]. Each patient is referred where the Branching Out program offers elements which fit within the treatment goals for that patient. Therapists aim to create a therapeutic group, mixing people with different needs and abilities, whom they judge are likely to benefit from working together (Cathrine, 2011).

The programme provides these patients with social, physical and recreational activities in an outdoor, 'community' setting in which therapists, service organisers and patients carry out group-based woodland activities for three hours each week, over a 12-week period. Branching Out activities give experience in outdoor skills, nature conservation, environmental art, green exercise and relaxation. The activities are tailored to the needs of local groups.

Therapeutic goals seek to improve physical health, providing activities which encourage daily structure and routine, developing social skills, broadening the transferable skills of clients, increasing confidence and self-esteem. Improving

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[3] Greater Glasgow and Clyde, Lothian, Forth Valley, Lanarkshire, Ayrshire and Arran, Borders, and Tayside

physical activity is part of the 'Good Lives' model for treatment in forensic psychology, relevant to many of the participants in the Branching Out program. This is one of the treatment models recommended in Scottish psychological health therapy guidelines (NHS Education for Scotland, 2011).

Economic methodology

Society values the benefits of health improvements by the amount of money it is willing to pay for particular health improvement programmes[4]. One organisation that makes decisions about whether it is worthwhile to spend public money for particular health improvements, in relation to the health improvement achieved as a result of the treatment, is the National Institute for Health & Care Excellence (NICE).[5] Over the years NICE has made decisions about whether particular drugs and treatments are economically beneficial in relation to the health improvement obtained and the length of time the health improvement is likely to last. Improvements in HRQoL are usually estimated in terms of quality adjusted life years (QALYs). There is some merit in valuing Branching Out in terms of NICE guidelines, since the benefits of other aspects of the patient's mental health treatment are determined by the NICE approach.

A quality adjusted life year (QALY) is a measure of both the quality and quantity of life improvement. It assesses health improvement, due to some treatment or intervention, by estimating the contribution of the treatment to the patient's quality of life. The QALY approach assigns to each period of time a weight, ranging from 0 to 1, corresponding to the HRQoL during that period, where a weight of 1 corresponds to optimal health and a weight of 0 corresponds to a health state judged to be equivalent to death (Weinstein and Stason, 1977). The QALY relating to a health outcome is the value assigned to a heath outcome multiplied by the length of time over which the outcome holds. QALYs are used to measure the benefits a HRQoL intervention, and to assess the cost-effectiveness (as cost per QALY) of an

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[4] Traditionally the economic value of outdoor recreation type activities has been measured using a revealed preference (RP) e.g. a travel cost method (TCM); or through a stated preference (SP) technique. There are a number of issues in any application of a TCM: accurately estimating the cost incurred of travel to the site, and the value of travel time to reach the site. Stated preference (SP) has been used to elicit how individuals value health improvements, by directly asking them. SP techniques comprise Contingent Valuation (CV), and Choice Experiments (CEs). Both have been used to value health improvements (see Alberini, 2012; Chanel and Luchini, 2014) and outdoor recreation. Although CV and CEs could be used to value Branching Out, by asking participants their willingness-to-pay (WTP) this could be a challenging task where mental health patients are concerned. Moreover asking participants would not reveal the benefit that society places on improving the health of mentally ill people.

[5] Prior to 1st April 2013 NICE was called the National Institute for Health and Clinical Excellence. In Scotland, it is the Scottish Medicines Consortium which advises on medicines. Their advice on cost-effectiveness of treatments is analogous to NICE advice in England.

intervention. QALYs can be aggregated across years and across people, if certain assumptions hold: utility independent, risk neutral, constant proportional trade-off behaviour (Pliskin et al, 1980).

QALYs have become the most widely used single measure of the benefits of health outcomes and a means of measuring the cost-effectiveness of health interventions. The NICE uses £20,000 to £30,000 per QALY as a threshold value for determining whether a medical intervention is value for money. Thus, an intervention that raises health state by 0.1 QALY per person could be considered to be economically cost effective if it costs less than £2,000 to £3000 per head.

NICE[6] uses cost-effectiveness analysis (CEA) to consider the effectiveness of each drug on a case-by-case basis. Generally if a treatment costs more than £20,000 to £30,000 per QALY, then NICE does not consider the drug or treatment to be cost effective, and hence the drug or treatment is not adopted by the National Health Service (NHS) for treating an illness.

This threshold of £30,000 has emerged following the establishment of NICE in 1999, although NICE does not have a clear and explicit cost-effectiveness threshold (Devlin and Parkin, 2003). Towse (2002) suggested a threshold cost per quality adjusted life year gained implicit in NICE decisions was between £20,000 and £30,000. Devlin and Parkin (2003) see the threshold as being probability based rather than a single number: the effect of uncertainty and the burden of disease explaining the rejection of some treatments with a relatively low cost-effectiveness ratio (CER) and the acceptance of others with a relatively high CER. The analysis by Devlin and Parkin (2003) suggested a cost-effectiveness threshold somewhat higher than the £20,000 to £30,000 which NICE has publicly identified. Rawlins and Culyer (2004) point out that NICE rejects the use of an absolute threshold on the grounds that (1) there is no empirical basis for deciding the value at which the threshold should be set; (2) there may be circumstances when NICE might want to ignore the threshold; (3) a threshold would imply that efficiency has absolute priority over other objectives e.g. fairness; and (4) since many technology supply industries are monopolies, a threshold would discourage price competition. So rather than apply an arbitrary threshold, NICE makes its decisions on a case-by-case basis (Rawlins and Culyer, 2004).

In making these recommendations about the adoption or otherwise of therapies, NICE is effectively placing a monetary value on health gains, and setting a maximum

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[6] In Scotland, the Scottish Medicines Consortium advises on medicines. Their advice on cost-effectiveness is not categorical although the same range of £20,000 to £30,000 per QALY is indicated as a guideline.
http://www.scottishmedicines.org.uk/About_SMC/Policy_Statements/A_Guide_to_Quality_Adjusted_Life_Years

price on the marginal QALY gained. Baker et al (2011) argued the "value" generated by such a supply side approach may be less than that indicated by a demand side approach based on society's (individuals) preferences and willingness-to-pay (WTP). However, both suffer from informational deficiencies and optimal decision making in health care provision may require reconciling the two approaches (Baker et al., 2011).

Assessing the economic benefits of Branching Out involves two issues: (1) do Branching Out activities improve mental health? and (2) what is the economic value of this improvement?

Results

The most rigorous and scientific method to assess the effectiveness of a medical treatment is a randomised clinical trial (RCT). In RCT patients are randomly allocated to receive a treatment or a placebo group. The "*with* treatment" group can then be compared to the "*without* treatment" group. The advantage of randomization is that it minimizes self-selection bias, allocation bias, and balances both known and unknown prognostic factors, in the assignment of treatments. It eliminates bias in treatment assignment; masks the identity of treatments from participants, investigators and assessors; and permits the use of probability theory to estimate the likelihood that any difference in outcome between treatment groups could have arisen by chance.

Unfortunately it was not possible adopt such a rigorous approach in the Branching Out study. There is no obvious "placebo" to Branching Out (where participants thought they were receiving Branching Out treatment, but did not in fact do so). Participants were selected if the health care provider thought the patient would benefit from attending Branching Out. Patients that were not selected for the Branching Out course continued to receive conventional psychiatric care. Moreover, patients could not be randomly allocated to Branching Out or to conventional care: patients themselves had to elect whether to attend Branching Out. This self-selection may have resulted in some unknown degree of bias in treatment assignment.

The methodology adopted was a *before* and *after* approach. Participants on the Branching Out programme were subject to a health related quality of life assessment before commencing the treatment (Branching Out), and to identical assessments at the end of the programme and at 3 months after completing the programme. A before-and-after study is rigorous if the exogenous variables, other than the experimental treatment, remain unchanged throughout the period of the study.

Patient health and quality of life, before and after attending the Branching Out course during 2007-2008, was assessed by Wilson (2009) using a SF-12 HRQoL indicator. The mean post Branching Out SF-12 scores were higher than the pre-Branching Out SF-12 mean scores across 5 of the 8 dimensions: especially with respect to mental health, and to a lesser extent in relation to physical functioning, body pain, general health, and vitality. This indicates a health improvement in these areas attributable to the Branching Out programme. Higher scores on SF-12 indicate better health states.   However, because of the small sample size (N=74), and relatively large standard deviation (std dev), the pre and post differences were not statistically significant. Moreover, for 3 measures (Role physical, Social functioning, Role emotional) the mean post-Branching Out scores were lower than the pre-Branching Out scores.

The aim of the research reported in this paper was to extend the study by Wilson (2009) in two ways: by surveying more Branching Out participants to assess whether a larger sample would produce statistically significant results; and to translate the SF-12 scores into QALYs, to permit the monetary benefits of Branching Out to be compared to its costs.

Data was collected, using SF-12, on participants attending Branching Out courses in 2011 and 2012. This data was pooled with the SF-12 data collected by Wilson (2009) in 2007-08, where both pre and post health scores were available. This resulted in a data set of 150 participants. The average age of participants was 41.60 years (st dev = 10.5 years) (n=146). The youngest participant was 21 years old and the oldest 66 years.   Males comprised 64.7% of the sample, and females 35.3% (n=150).   The average number of weeks participants attended the Branching Out course was 9.78 (st dev = 2.16) (n=150), with 36 participants reporting the maximum 12 attendances. 88.7% of the 150 participants attended 8 or more of the 12 weeks of the course.

The SF-12 was revised to a 6 dimensional health state classification (SF-6D) based on selecting items to ensure a minimum loss of information. A SF-6D score is inversely related to an SF-12 score: higher scores on SF-12 indicate a better health state, whilst a higher SF-6 score indicates a worse health state.   The rationale for converting the SF-12 scores to SF-6D scores is that QALY values can be calculated from SF-6D scores, following the work of Brazier and Roberts (2004).

Pre and post Branching Out SF-6D health scores for all participants completing the Branching Out course, as well as those for the 2007/08 and 2011/12 groups, are presented in Table 1. The immediate post Branching Out scores for the pooled data set indicates a slight deterioration in physical functioning (post score > pre score),

but an improvement across all other indices (post score < pre score) including mental health which shows one of the largest improvements.

Table 1: Mean pre and post- scores for health dimensions: SF-6D scores

	Pooled data 2007-12		2007/08 data		2011/12 data	
	Pre-	Post-	Pre-	Post-	Pre-	Post-
SFPhys	1.400 (0.591)	1.440 (0.618)	1.377 (0.608)	1.429 (0.658)	1.425 (0.575)	1.452 (0.578)
SFRole	3.287 (1.113)	3.267 (1.072)	2.844 (1.268)	3.078 (1.156)	3.753 (0.662)	3.466 (0.944)
SFSocial	2.700 (1.284)	2.580 (1.143)	2.260 (1.322)	2.429 (1.175)	3.164 (1.067)	2.740 (1.093)
SFMental	2.767 (1.149)	2.420 (0.992)	2.338 (1.108)	2.117 (0.946)	3.219 (1.017)	2.740 (0.943)
SFVital	3.273 (0.940)	3.013 (1.003)	3.169 (0.865)	3.221 (0.898)	3.384 (1.009)	2.795 (1.067)
SFPain	3.100 (1.473)	3.053 (1.514)	3.909 (1.237)	3.948 (1.255)	2.247 (1.199)	2.110 (1.149)
n=	150	150	77	77	73	73

Standard deviation ( ). Phys=physical functioning; Role=limitations; Social=social functioning; Mental=mental health; Vital=vitality; Pain=pain.

In the later period (2011/12) there is an improvement in the post Branching Out scores relative to the pre-Branching Out scores across all measures (role; social functioning; mental health; vitality; and pain) except for physical functioning. The improvement in the mental health score is quite noticeable. In contrast, the earlier data (2007/08) exhibits a deterioration in post Branching Out health scores relative to pre Branching Out health scores across all indices except for mental health.

The pre-Branching Out scores for health measures were higher in the 2011/12 period than in the earlier period, except for the score for "pain". This suggests that the health state of participants was worse for those on Branching Out courses in 2011/12 compared with earlier 2007/08 period.

The improvement in the mental health score was much greater amongst participants in the 2011/12 period than amongst participants in the earlier 2007/08 period. This may be because there was more scope for improvement in patients' health in the latter period, or because of improvements in the Branching Out course itself over time.

Converting the SF-6D scores to QALYs provided a QALY improvement (pre-Branching Out minus post-Branching Out QALY scores) estimate of 0.01948 for all the Branching Out data (150 cases), over the whole period 2007/08 and 2011/12.

Since HRQoL data is based on ordinal scores (e.g. 1 to 5) a non-parametric test of significance is used for changes in QALYs derived from HRQoL scores, rather than a parametric test of significance which assumes a normal distribution.[7] Two non-parametric tests were used: a matched-pairs sign test, and a Wilcoxon matched-pair sign rank test. In the sign test the null hypothesis is that given a pair of measurements x_i and y_i (i.e. pre and post QALY scores) are equally likely to be larger than the other. If Branching Out increased QALYs then the null hypothesis should be rejected: the post scores should indicate a higher HRQoL (and QALY) than the pre-scores. The Wilcoxon matched-pair sign rank test takes into account the magnitude (rank) of the difference between measurements x_i and y_i as well as the sign.

The QALY improvement for the pooled data (0. 01948) is not statistically significant based on a matched-pair sign test (Siegel, 1956): the sign 'p value' = 0.1651; but it is statistically significant based on Wilcoxon matched-pair sign rank test at the 10% level ('p value' = 0.0599) although not at the 5% level.

The data were split between the original data used by Wilson (2009) and participants on the programme in 2011/12. In the sample collected in 2007-2008 (77 cases) the QALY change in Branching Out participants was -0.00902. This is a negative QALY change, but one which was not statistically significant on the sign test or on the sign rank test ('p' value =0.3434).

However, for the later period 2011/12 (73 cases) the mean QALY score for the improvement (=0.04954) attributable to Branching Out is highly statistically significant based on a Wilcoxon matched-pair sign rank test: the sign rank 'p value' = 0.0005; although it is just statistically significant at the 5% level based on the sign test: 'p value' = 0.0498.

The mean QALY score for the improvement attributable to Branching Out based on the pooled data of 0.01948 suggests an average economic value of £584.40 per

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[7] The Student's 't' test is the usual parametric test employed which is based on the normal distribution. A paired sample 't' test was used by Wilson (2009) to test the statistical significance of the pre and post HRQoL scores for 2007/08 Branching Out participant sample, but no significant statistical difference was found in the health dimension scores. The Student's 't' test may produce misleading results if the distribution is not normal; or if the data are not sampled independently from the two populations being compared, i.e. if the data are known to be dependently sampled. In such cases the Student's 't' test may suggest there is a statistically significant difference between the two samples when in fact there is none.

person completing the Branching Out course, based on the NICE QALY value of £30,000; with 95% confidence limits of £0 and £6,786.

The improvement masks considerable differences between the two data sets (2007/08 and 2011/12). The mean QALY score for the improvement attributable to Branching Out in the earlier period is -0.00903, suggesting that the "average participant" on the earlier Branching Out programme did not gain a QALY. Why this result occurred is not known. It might have been a function of the way the early Branching Out programme operated, or the individual participants on the programme.   Table 1 shows that individual participants on the programme in 2007/08 seemed to be in a better health state generally than those on the programme 2011/12. It may be that Branching Out is less effective at improving the health states of those less severely affected by mental health problems. Or it may be that the participants during 2007/08 were in an early mental health state, and that the Branching Out programme actually curtailed an even greater deterioration in their mental health.   That is, although this 2007/08 programme saw a QALY deterioration, the counter factual (without Branching Out programme) QALY deterioration would have been even greater.

This contrasts with the mean QALY score for the improvement attributable to Branching Out in the later period 2011/12. The mean QALY score for the improvement attributable to Branching Out in the later period is 0.04954, with a std dev = 0.10448 (n=73).   This QALY improvement is statistically significant and indicates an average economic value of £1,486 per person completing the Branching Out programme; with 95% confidence limits of £0 and £7,755, based on the NICE QALY value of £30,000.

There are some caveats to this economic value of the Branching Out programme. The health state improvement was measured immediately after the Branching Out course was completed. The mean QALY values of 0.04954 (st dev. =0.10448) for the 2011-2012 period, and 0.01948 (st dev. =0.10336) for the pooled data (2007/08 & 2011/12) are based on a one year improvement: a quality adjusted life <u>year</u>. The estimated value of that is £1,486.43 per person (2011-2012 programme), assuming the health improvement, attributable to Branching Out, lasts one year. In reality the mental health improvement may not last one year, or it may continue for more than one year. If the improvement lasted only 6 months then the QALY value would be £743 per participant completing the course.

Duration of the benefits
In order to provide some evidence on the duration of the benefit the 2011-12 survey included a questionnaire three months after completion of the programme. Only a

small group (21) completed both an immediate post course and a 3 month post course questionnaire. The pre scores, immediate post course scores, and the 3 month post course scores after the Branching Out course ended are reported in Table 2. Again the results are not statistically different between pre-, immediate post- and 3 month post- scores. But the figures seem to suggest that these patients benefitted from the course: apart from SFPhys and SFPain, all the scores were lower immediately post-course compared with pre-course. However, after 3 months, the post-course scores were higher across all the indices compared to the immediate post-course scores. Indeed, 3 months after completing the course two of the health dimensions (SFPhys and SFPain) of these individuals were worse than their pre-course scores. Although improvements were maintained for SFSocial, SFRole, and SFVital, relative to their pre course scores, whilst SFMental remained unchanged.

The immediate post course QALY score for these participants was +0.0478 (st dev = 0.1157), indicating a QALY improvement. The 3 month post course completing QALY was -0.0051 (st dev = 0.0719) indicating that 3 months after completing the course these patients were slightly worse in terms of health status than they were before the course started. In other words the Branching Out course improved the health status of these patients but only for a limited time period.

Table 2: Mean pre- and 3 month post-scores for health dimensions for those participants who completed the pre-, immediate post-, and 3 months post-course questionnaires (2011/12): SF-6D scores

	Mean pre- and post- 3 month scores 2011/12 participants		
	Pre-programme	Post-programme: 0 months	Post-programme: 3 months
SFPhys	1.429 (0.598)	1.476 (0.512)	1.714 (0.644)
SFRole	3.810 (0.680)	3.429 (1.076)	3.619 (0.805)
SFSocial	3.048 (0.921)	2.571 (0.978)	2.667 (0.966)
SFMental	2.905 (0.995)	2.619 (0.921)	2.905 (0.944)
SFVital	3.333 (0.796)	2.667 (0.913)	3.143 (0.964)
SFPain	1.952 (1.161)	2.095 (1.179)	2.429 (1.287)
n=	21	21	21

Standard deviation ( )

Phys=physical functioning; Role=limitations; Social=social functioning; Mental=mental health; Vital=vitality; Pain=pain.

Those 2011/12 participants who did not complete the 3 months post course assessment, but only completed the pre and immediate post course questionnaires, recorded a SFMental health score improvement of 0.558. The SFMental health score (pre and post course 0 months) for patients not completing the post 3 month course questionnaire was almost twice those that did. The QALY score for participants who only completed the pre and immediate post course questionnaires was +0.0503 (st dev = 0.1008), which is a slightly larger QALY improvement compared to those who also completed the 3 month post course questionnaire (+0.0478). So the patients who only completed the pre- and immediate post- course questionnaire appeared to benefit more from Branching Out than those who completed the 3 months post-course questionnaire. This difference could be attributable to a variety of reasons, including sampling and response issues. Those completing the 3 month post course questionnaire may have responded because they had more enduring health issues. Whilst those only completing the immediate post course questionnaire may have benefitted more from the the Branching Out course, and not felt the need to respond to the 3 month post course questionnaire. Further longitudinal research to identify the enduring benefits of Branching Out is necessary to resolve this issue.

Costs of the Branching Out programme

The costs of health interventions can be measured in terms of the financial costs to the organisation concerned, the cost to government, or the cost to society. These will all potentially give different results because of the way taxation; pension and resource costs are treated. Cost effectiveness analysis (CEA) of health outcomes is typically based on financial costs, probably because they are simplest to measure, and this approach is followed here whilst acknowledging that other measures of cost may be appropriate in some circumstances.

The financial cost profile of Branching Out has changed over time. Initially, FCS staff costs (per person attending) were high. This was associated with launching the programme and interfacing with referring agencies and delivery agents. Delivery agents were provided with training and equipment for clients, an investment which lasts for several years.

The approach adopted here assesses the cost-effectiveness of continuing the current programme. This is most relevant to assessing whether funds should continue to be committed to the project. Costs incurred in 2012/13 costs were used in the analysis.

Staff costs

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Staff costs were based on the midpoint of the salary range plus employer national insurance and Forestry Commission pension costs. Staff do not spend all their time on the programme. It was estimated that the programme manager spends 75% of time directly on the programme; while the Health Advisor allocated 10% of his time to the programme.   These staff costs amounted to £27,730 per year.   Since Branching Out does not require and additional office space or place additional costs on the Forestry Commission administration no overhead costs were included.

Payments to Delivery Agents

The programme was delivered to 31 of the Branching Out groups[8] by 11 different Delivery Agents (DAs). DAs delivered the programme to between one and five groups in the year. The total payment for 31 groups was £103,545, with a mean cost of £3,340 per group. On a pro rata basis the cost for 33 groups was estimated at £110,225.

FCS set-up costs

Each new delivery agent (DA) has set-up costs for tools, training, waterproofs etc. and these costs are met by the Forestry Commission. In the 2012/13 year this cost was £3,100 (a mean of £94 per group). This low cost reflected the fact that most of the delivery agents had training and equipment provided in earlier years. There were no costs associated with use of the woodlands since for recreation purposes woodlands are a pre-existing "public good"[9].

Referring Agency costs

The Referring Agencies (RAs) typically allocate one or, when appropriate, two members of staff to accompany the BO service users. A typical cost for mental health day care services is around £126 per person per day[10]. However, the cost to the RA is not increased by participation because the staff would be engaged in some alternative activity looking after the patients. This will in many cases be an alternative (probably in-house) activity.   It was not possible to delineate any additional cost or lost output from participating in Branching Out, and hence a zero cost was assumed.

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[8] Delivery costs for two of the 33 groups were not known at the time this report was written. Costs per delivery agent were thus based on the groups for which there were complete data.

[9] A 'public good' is a good that is non-rival and non-excludable in consumption. For example, recreation in forest *X* can be enjoyed by individual *A* without lessening the enjoyment of the same forest by individual *B* at a different time or in another area of the forest (i.e. it is non-rival: *A's* consumption of the good does not lessen the quantity of the good for individual *B* unless there is congestion), and because there is open public access it is non-excludable and hence a price cannot be charged.

[10] Curtis, L. (2011). Unit costs of health and social care. Personal Social Services Research Unit, University of Kent. http://www.pssru.ac.uk/pdf/uc/uc2011/uc2011.pdf

Travel costs

For service users this is accounted for in the agreed cost of services provided by the DAs. For FCS staff the cost attributable to the Branching Out programme was difficult to estimate because of other activities undertaken by staff. However, travel costs of FCS staff were estimated at £1,640 per year, based on the allocation of vehicle mileage to the Branching Out programme in 2012 at 45p per mile.

Service users' costs

Any costs are minimal since transport is provided and any other costs such as food would form part of the normal service user budget.

Total cost

The total cost for 2012/13 of operating the programme was estimated to be £142,695 (Table 3). On the basis of 335 users attending at least one session in the period over which costs were calculated, this converts to a cost of £426 per user.

Table 3: Financial costs of Branching Out (2012/13 year)[11].

	£ per year
FCS staff costs	27,730
Delivery agents' costs	110,225
FCS set-up costs	3,100
Referring agency costs	0
FCS travel costs	1,640
Service users' costs	0
Total	£142,695
Total per user (n=335)	£425.96

It is clear that the delivery agents' costs are the major cost element although FCS staff costs are also significant. The charges of different delivery agents varied considerably. FCS accepted some high cost agents in order to involve a wide range of agents to obtain wider experience of programme operation; and to facilitate the development of innovative ideas on how best to operate the programme.

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[11] Discounting costs was not relevant since they all took place within one year.

FCS is reducing delivery costs somewhat over time through negotiation and selection. They have also reduced total costs per service user by increasing the scale of operations (throughput) per year, hence spreading the staff cost overheads.

Cost-effectiveness

Financial

The financial cost-effectiveness of Branching Out is defined as the cost per QALY improvement in HRQoL. It is measured as the mean QALY improvement per person divided by the cost per person. Based on 335 service users per year, and using the 2011/12 evaluation results, the cost per QALY is £8,600[12]. In comparison to the NICE threshold of £30,000 per QALY the Branching Out programme is cost-effective.

However, there are caveats. The 335 potential beneficiaries were the total number who attended at least one session. The analysis of benefits to HRQoL was based on those that completed the pre- and post-questionnaires (n=73). It may be that those completing the questionnaires were a biased sample of service users. On average they attended 9.55 sessions whereas the mean attendance of all participants was 7.16 sessions. If it is assumed that the QALY benefit is proportional to the number of sessions attended the mean benefit would be 7.16/9.55 of the benefit observed in the group of 73.   This would reduce the mean QALY gain to 75% of its value based on the sample of 73. The cost-effectiveness corrected in this way is £11,480. It still remains well below the NICE guidelines for cost-effective intervention (see Table 4).

Table 4: QALY change and cost-effectiveness

	Mean QALY change	Cost per QALY at £426 per user per year(£)
Those completing pre- and post-questionnaires (n=73), attending an average of 9.55 sessions	0.0495	£8,600
All participants (n=335), attending 7.16 sessions	0.0371	£11,480

In interpreting the results it should be borne in mind that there was no control group. Any observed benefit might therefore be due to exogenous factors such as a parallel therapy or the passage of time. In addition, the longer-term benefit to service users is uncertain.

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[12] £429/0.0495. Using the pooled results which include those of 2007/08 evaluation the QALY change is 0.0195 and the cost per QALY is £21,840.

The QALY values of 0.0495 for 2012 and 0.0195 for the pooled data (2007-2008 & 2012) are based on a one year improvement: a quality adjusted life year. The estimated value of that is £1,485[13] per person (2011-2012 programme), assuming the health improvement, attributable to Branching Out, lasts one year. The responses to the 3-month post questionnaire do not provide any evidence that the health benefits are maintained, but the numbers were insufficient for any definitive conclusions to be drawn. It may be that those answering the 3-month post questionnaire are not a representative sample Branching Out participants e.g. they may have enduring mental health problems, whilst others benefitting from the scheme became more difficult to contact or ignored the 3-month post questionnaire.

Despite these caveats the fact is that individuals with severe and enduring mental health problems started the programme because they presumably perceived it as potentially beneficial. A mean attendance rate was 7.16 sessions suggests that the majority found the programme sufficiently beneficial to attend most of the programme. Nevertheless, if the benefit is not maintained beyond the three months of the programme the cost per QALY is increased. However, if QALY improvements only lasted 3 months then the benefit would be £371, which is less than the estimated cost of £425 per participant; and indicative of a cost of £34,343 per QALY, marginally above the NICE guidelines.

Social cost-effectiveness

The social costs of operating the programme were not estimated. However if a social CEA were undertaken staff costs (both FCS and other agents) would be lower since tax and national insurance are transfers to government. VAT charged by some of the delivery agents would also be excluded, as would fuel duty. Petrol and diesel fuel costs should be based on the resource cost of the fuel, excluding the tax element. These changes would reduce the cost per QALY of the programme. Other costs would be unchanged apart (possibly) for the cost of delivery by local authorities. These charged below average rates for delivering the programme and it may be that local authorities did not charge FCS their full resource costs. This issue was not investigated, but the net effect of these adjustments would be to reduce the cost per QALY and increase the cost-effectiveness of the programme when measured as a social metric.

Discussion

There are few studies estimating the cost-effectiveness of providing social recovery orientated programmes for mental health illnesses. One such study by Barton et al (2009) investigated the cost-effectiveness of "social recovery orientated cognitive

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[13] Based on the NICE maximum intervention cost of £30,000 per QALY.

behavioural therapy" (SRCBT) for people diagnosed with psychosis, compared to "case management alone" (CMA). SRCBT involved cognitive work to address any feelings of stigma and negative beliefs; and active promotion of social activity, work, education and leisure linked to meaningful goals. The SRCBT was available to patients with psychosis (including schizophrenia, bipolar disorder, and psychotic depression; an illness duration of less than 8 years; and where the patient was currently unemployed or engaged in less than 16 hours per week of work or education. Patients with acute psychosis were excluded. The SRCBT was available to patients over a 9 month period. The mean incremental cost of SRCBT was £668, with a mean incremental QALY gain of 0.035, signifying an incremental cost per QALY of £18,844 (2006/07 GBP prices). The results indicate the cost-effectiveness of the SRCBT treatment below the NICE guidelines of £20,000 to £30,000 per QALY; thus representing a cost-effective use of scarce health and social care resources. If the benefits of the SRCBT intervention were sustained, and the QALY gain calculated over a longer period, then the intervention may well have been estimated to be more cost-effective (Barton et al, 2009). McCrone (2007) points out the need, in health economic measures of schizophrenia, to measure costs and benefits comprehensively, and over an adequate period.

Soeteman et al (2010) chose a 5 year time horizon, which was 2 years beyond the duration of the clinical trial. They assessed the cost-effectiveness of cluster B personality disorders including borderline, antisocial, histrionic, and narcissistic, which are amongst the most prevalent mental disorders in the general population, and are considered more persistent and resistant to change than C personality disorders (avoidant, dependent, and obsessive compulsion) but less so than cluster A personality disorders (paranoid, schizoid, and schizotypal). Using the EuroQol EQ-5D HRQoL index of 5 dimensions (mobility, self-care, usual activities, pain/discomfort, and anxiety/depression), with each dimension divided into 3 response levels) they calculated QALY scores and incremental cost-effectiveness ratios (ICER) for out-patient, day hospital, and in-patient care. Out-patient psychotherapy yielded the lowest costs and health benefits. Day hospital psychotherapy had an ICER of €12,274 per recovered patient year, and an ICER of €55,325 per QALY compared with out-patient psychotherapy. In-patient psychotherapy had the highest costs and health benefits. In terms of incremental QALY values, day hospital cost was €56,325 compared with out-patient psychotherapy, while in-patient incremental cost per QALY was €286,493 compared with out-patient psychotherapy.

The Branching Out programme is roughly comparable in terms of benefits and costs to the out-patient SRCBT programme investigated by Barton et al (2009). Such programs are clearly much more cost-effective than in-patient treatments.

Recent research linking expenditure changes to QALYs in the NHS, estimated a QALY value of £18,317 (Claxton et al, 2013). However, there have been suggestions that society places a greater value on QALYs gained by individuals with relatively high burden of illness (Miners, Cairns and Wailoo, 2013). Glover and Henderson (2010) suggested a QALY value of £60,000 derived from the value of a preventable fatality used by the Department of Transport.   A higher QALY value would clearly justify the branching out programme even if the benefits of the programme only lasted 3 months.

Conclusion

The economic case for Branching Out is assessed on whether a quality adjusted life year (QALY) improvement attributable to Branching Out exceeds the cost of the Branching Out programme.

The Branching Out programme leads to a QALY improvement in the short term. If QALY improvements last 1 year then the value per QALY would be £8,600, which is good value for money in terms of NICE guidelines; however, if QALY improvements only last 3 months this would indicate a value of £34,343 per QALY, marginally above the NICE guidelines. Responses to the 3-month post questionnaire do not provide any evidence that the health benefits are maintained, but the sample was insufficient for any definitive conclusions to be drawn.

The Branching Out programme has exhibited significant efficiency gains since it started in 2007. Whether this is due to the type of patient selected, better selection of patients, or improvements in the Branching Out programme itself, remains to be determined.

Patients starting the programme in the 2011/12 period had more severe mental health problems than patients starting the programme in the 2007/08 period. Thus patients on the programme in the 2011/12 period, who had more severe mental health issues, had potentially more to gain in terms of a QALY improvement. The Branching Out programme also evolved between the two periods. At the start of the programme in 2007/08 only one Forest Ranger led the fieldwork, with an assistant psychologist. Later groups were run with two Rangers, a wider variety of activities were incorporated, a wider range of woodland sites were used resulting in less transport time to sites, timetables became more flexible, greater training was given to Branching Out leaders, and the programme was opened up to a wider range of referral services. Thus the programme became more responsive to the needs of patients.

QALY gains may generate wider economic benefits e.g., increased output through the participant being able to re-join the labour market and contribute to gross national product. This argument has been advanced by Claxton et al (2010). There is evidence in the data from the Branching Out programme that Branching Out has enabled participants to re-enter the labour market.   Of the 21 participants who responded to the post-3 moth questionnaire, one had gained full time employment, five were undertaking training courses, and nine were in full or part-time volunteering posts.   This contrast with only 4 people out of 229 diagnosed with schizophrenia engaged in voluntary work in a study in London (Shimitras et al, 2003). There is evidence of a positive link between social integration and subjective evaluations of well-being from volunteering: volunteers report higher levels of life satisfaction (Howlett, 2004).

Other wider economic benefits from the Branching Out programme may encompass benefits to friends and family of patients recovering from mental health problems. Any assessment of such benefits would need to avoid double counting of altruistic benefits [see Jones-Lee (1992)].

The main uncertainty with the impact of green space on health is the whether the health improvement is enduring, or whether the health improvement is lost when the green space activity stops. If the Branching Out programme imbues a desire in patients to substitute other forms of green space activity, or other beneficial types of activity, then this may ensure a continuation of health benefits. Further longitudinal research is needed to identify the enduring health benefits of the Branching Out programme amongst participants.

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