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# Tranquillity Trails for urban areas

Greg Watts, Centre for Sustainable Environments, University of Bradford

**Abstract**

Tranquil spaces can be found and made in the city and their promotion and use by residents and visitors is an important means of building resilience. Studies have shown that spaces that are rated by visitors as tranquil are more likely to produce higher levels of relaxation and less anxiety that should ultimately result in health and well-being benefits. Such spaces can therefore be classed as restorative environments. Tranquil spaces are characterized by a soundscape dominated by natural sounds and low levels of man-made noise. In addition, the presence of vegetation and wild life has been shown to be an important contributory factor. Levels of rated tranquillity can be reliably predicted using a previously developed model TRAPT and then used to design and identify tranquil spaces, improve existing green spaces and develop Tranquillity Trails to encourage usage. Tranquillity Trails are walking routes that have been designed to enable residents and visitors to reflect and recover from stress while receiving the benefits of healthy exercise. This paper describes Tranquillity Trails designed for three contrasting areas. Predictions of the rated tranquillity have been made along these routes and feedback from users was elicited at one site that confirmed the expected benefits. 199 words

## 1. Introduction

Much research has shown that tranquil spaces are restorative environments that can help reduce stress and relieve anxiety [1,2,3,4,5,6]. Questionnaire surveys of open green spaces have shown a strong association between rated tranquillity of a place and percentage of visitors feeling more relaxed after their visit [7]. Laboratory studies conducted at the University of Bradford have shown that the significant factors affecting rated tranquillity of a place $TR$, are the average level of man-made noise and the percentage of natural and contextual features in the landscape [8]. The equation TRAPT (Tranquillity Rating Prediction Tool) expresses this relationship in urban areas [7] as:

$$TR = 10.55 + 0.041\ NCF - 0.146\ L_{day} + MF \tag{1}$$

Where $TR$ is the tranquility rating on a 0 to 10 rating scales. $NCF$ is the percentage of natural and contextual features and $L_{day}$ is the equivalent constant A-weighted level during daytime (e.g. from 7am to 7pm) from man-made noise sources. Contextual features include listed buildings, religious and historic buildings, landmarks, monuments and elements of the landscape, such as traditional farm buildings, that directly contribute to the visual context of the natural environment. It can be argued that when present, these visually cultural and contextual elements are as fundamental to the construction of 'tranquil space' as are strictly natural features.

The behaviour of this equation has been studied by examining trends in $TR$ with $L_{day}$ at different levels of $NCF$. It was noted that at the extremes of $L_{day}$ where $TR$ becomes greater than 10 or less than 0 then $TR$ values are set to 0 and 10 respectively. $MF$ is a moderating factor that was added to the equation following a study that was designed to take account of the presence of litter and graffiti that would depress the rating, or natural water sounds that would improve it [9]. This minor adjustment is designed to take account of the actual environmental conditions at the time of assessment and is unlikely to influence the calculated $TR$ by more than ±1 scale point. It was considered that the level of any water sounds were very low and the amount of litter and graffiti minor, so both were not considered a significant influence on predicted tranquillity levels at any of the study site locations and so no adjustments were made.

*TR* values in urban open spaces have been related to the level of rated relaxation of people after visiting such spaces where there was a very close relationship $R^2 = 0.96$ [7]. For example, for a *TR* value of 5.0 nearly 50% of visitors report that they are "more relaxed" after visiting the park while at a value of 8 approximately 80% report being "more relaxed". These results have been used to validate the following category limits for *TR* defined previously [7]:

<5   unacceptable
5.0 – 5.9  just acceptable
6.0 – 6.9  fairly good
7.0 – 7.9  good
≥ 8.0   excellent

A previous study [10] employed TRAPT to gauge the benefits of "greening" urban areas. In this paper we look at a means of encouraging people to visit existing green and tranquil spaces. The study described in this paper uses TRAPT to identify tranquil spaces and then to develop Tranquillity Trails (TTs). TTs are walking routes that have been designed to enable residents and visitors to reflect and recover from stress while receiving the benefits of healthy exercise.

On a community level it is important that people use green spaces so they experience, connect and benefit from contact with nature and so are more likely to support nature friendly policies now and in the future [11].

Three TTs designed for contrasting areas are described and then predictions of the rated tranquillity have been made along these widely different walking routes. The *TR* profiles of the TTs have then be compared and contrasted by examining the percentage of time a walker would spend experiencing the different levels of *TR* described above.

It is important to consider the benefits of walking around the TTs since this will help gauge usefulness and could be used to promote usage. Feedback from one site was used to assess the benefits of using that TT. These benefits were then related to the extraversion scale of personality using a shortened form of the Eysenck Personality Questionnaire [12]. It was considered that those scoring lower on the extraversion scale (i.e. more introverted) would value tranquillity more highly due to the tendency to require more peaceful surroundings to perform more efficiently.

## 2.  Method

### 2.1 Study sites

The present study used the insights gained from these previous surveys and experiments to devise walking routes or Tranquillity Trails (TTs) that link quiet green spaces in urban areas using relatively tranquil paths and roads. The aim is to design a route that is simple and safe to follow and will allow users to experience a relatively degree of tranquillity despite being in an urban area. Clearly the challenge is greater in a city with higher concentrations of people and traffic than for a town. The first three TTs that have been designed are in Bradford, Kingsbridge and Guildford. These are all in England though further ones are currently being develop in Ireland and Hong Kong.

Bradford forms part of the West Yorkshire Urban Area conurbation which in 2001 had a population of 1.5 million and is the fourth largest urban area in the United Kingdom with the Bradford subdivision of this urban area having a population of nearly 530,000. In contrast, Kingsbridge is a market town and tourist hub in the South Hams district of Devon, England, with a population of just over 6,000 at the 2011 census. Of intermediate size is Guildford that is a large town with a population of 143,00 lying 43 km south west of central London. Figure 1 shows the study site on a map of England and Wales and it can be seen that they are well separated and lie in quite different geographical areas.

*Figure 1: Location of the three Tranquillity Trails*

## 2.2 Determination of *TR* profile

To compare and contrast levels of tranquillity achieved at each site it was considered necessary to determine the variation of *TR* values around each TT. This involved calculating the values of the important factors $L_{day}$ and *NCF* (see equation (1)) at a sufficient number of points to define a profile.

Noise predictions of $L_{A10,18hr}$ were carried out along each route using the UK traffic noise prediction method "Calculation of Road Traffic Noise" or CRTN [13] and subsequently converted into $L_{day}$ [14]. Where flows were low or road layout complex spot readings of the average A-weighted levels were carried out near the middle of the day informed by advice given in CRTN and subsequently used to estimate $L_{day}$.

As in previous studies in order to calculate the percentage of natural and contextual features *NCF* an eye height of 1.5m was also assumed. The field of view was restricted in the vertical plane to ± 20 degrees. This was approximately the angle of view using a standard camera lens and relates well to studies of the eye's central field of view i.e. the angle over which objects can be recalled without moving the eyes [15]. In the horizontal plane calculations were made over 360 degrees as it is assumed that the observer would make scanning movements in the horizontal plane to take in the full scene. These assumptions were made in earlier surveys which found a close relationship between predicted tranquillity using such a measure and average ratings given by participants visiting a variety of open spaces [7].

For the present study calculations were made of the variable *NCF* by using image processing software (ImageJ). By using a cursor to draw around natural features the program calculates the number of pixels within these areas. This is then compared with the total number of pixels by drawing around the landscape excluding the sky. This process is followed for each of 7 contiguous photographic images covering 360 degrees in the horizontal plane and the average value taken. The value *NCF* is given by:

$$NCF = \frac{\sum_{\theta=1}^{7} \frac{An_\theta \cdot 100}{(At_\theta)}}{7} \tag{2}$$

Where $An_\theta$ and $At_\theta$ are the areas (number of pixels) in the photographic images of natural (including contextual) features and total area, excluding sky, respectively, in image $\theta$.

## 2.3 Guidelines for route selection

Using this technique it is possible to make predictions of *TR* for city streets, squares and parks, alongside major roads as well as residential roads and shopping streets. In this way, it is possible to consider the type of spaces and roads in a city that are likely to have acceptable levels of tranquillity. This is the first step in producing a TT that links tranquil spaces so that the average and range of tranquillity levels experienced on the route provides appropriate levels of tranquillity to facilitate health and wellbeing. Further guidelines for route selection have been considered based on predictions and survey information. These can be summarised as:

- Access is important and so trails that commence near a public transport hub will be useful e.g. town or city centre
- Locate larger open spaces within easy reach of the start as these are likely to have the highest levels of tranquillity and could act as a focus for the walk
- Consider various routes both to and from these larger open spaces
- Locate smaller open spaces on these routes that although not having the highest levels of *TR* to match the larger open spaces may nevertheless have acceptable levels. These could act as "stepping stones" to the larger open areas
- Consider the links to the small and larger open areas selecting where possible routes that avoid heavily trafficked roads and where there are relatively high levels of vegetation visible e.g. hedges, trees, grassy verges
- Consider suitable road crossing points and state of footpaths for safe walking
- Consider points of interest that add interest and motivate the walker to continue e.g. historic sites, interesting architecture, beautiful trees and flowers, view points
- Walk the alternative route options that are expected to have relatively high levels of tranquillity and interest and collect relevant data i.e. traffic flow to predict traffic noise and photographic records so that *NCF* can be calculated
- Analyse data and predict *TR* in open spaces and along the possible linking paths and roads
- Choose a suitable route that has the highest average and smallest range of predicted tranquillity levels but consider points of interest and safety aspects among the options that may prove a deciding factor where alternatives have similar *TR* values

## 2.4 Description of tranquillity trails

Figure 2 shows the leaflet designed for Bradford City. The leaflet is folded into 3 panels with the inside panels describing the route with numbers corresponding to points on the map. The leaflet is available at the tourist office and the cathedral and can be downloaded at:

http://mediafiles.thedms.co.uk/Publication/YS-Brad/cms/pdf/Tranquillity%20Trail%20guide_%2011-05-16.pdf

*Figure 2: Leaflet describing the Bradford City TT*

The TT for Kingsbridge is shown in Figure 3. Again, the leaflet is folded into three panels. This was subsequently amended by Kingsbridge Council to fit with their need to align with the Britain in Bloom map and the revised form can be downloaded at:

http://www.kingsbridgeinbloom.co.uk/uploads/5/6/9/4/56943175/1._tranquillity_trail_pdf.pdf



*Figure 3: Leaflet describing Kingsbridge TT*

A TT for Guildford in the UK is shown in Figure 4. The TT takes just under an hour to complete without rest stops but taking a more leisurely pace may suit better. The guide can be downloaded at:
http://www.guildford.gov.uk/visitguildford/CHttpHandler.ashx?id=21855&p=0



*Figure 4: Leaflet describing Guildford TT*

An app for smart mobile devices describing interesting features of this route together with a map and cursor showing current position is freely available from: http://www.handheldtours.co.uk/

The introduction on the front of all three leaflets describes the health and well-being benefits of being in tranquil environments in terms of stress reduction and the healthy exercise required to complete the route. Also, an indication of the time required to complete the route at a steady walking pace.

**2.5 Questionnaire**

It was considered important to obtain feedback from users of the TT to determine if there were perceived benefits and to understand the nature of any problems that might preclude further visits. In Kingsbridge a questionnaire was used to gather opinions from those who had completed the route. To improve participation a £10 (approximately equal to $12) supermarket voucher was given out to those who had completed route and subsequently completed the questionnaire.
The questions included:

- Importance of tranquility
- Rating of the overall tranquility of the TT
- Changes in states of relaxation and anxiety
- Problems encountered
- Benefits
- Biographic information
- Short series of questions to indicate place on extraversion-introversion scale

The questionnaire is given below:

# Kingsbridge Tranquillity Trail Questionnaire

*Where required please complete answers on spaces provided or circle the most appropriate answer*

Date: _____   Time:_____   Weather:_____

1. What was your personal comfort on this walk? "uncomfortable", "neutral", "comfortable"

2. How important is the tranquillity of the route? Is it "very important"," fairly important" or "unimportant"?

3. Rate the overall tranquillity of this route by circling a number between 0 to 10 where 0 is "least tranquil" and 10 is "most tranquil"

    **Least tranquil**                                                        **Most tranquil**

    | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
    |---|---|---|---|---|---|---|---|---|---|----|

4. Do you feel "more relaxed", less relaxed" or "no change" after walking this route?
5. Do you feel "more anxious", "less anxious" or "no change" after walking the route?
6. Any other benefits? _____
7. Did you have any problems walking around this route e.g. finding your way, too far to walk, paths too steep, difficulty crossing the road, health problems?

    _____

8. Approximately how many minutes did it take you to walk around the route? _____

9.  How often do you think you will walk this route in the future? e.g. "daily", "once a week", "once a month", "never", "other" please specify?_____

10. What would encourage you to walk this route more?_____
_____

11. Personal factors:
    a) Are you a talkative person? ………………………………………………………. Yes/No
    b) Are you rather lively? …………………………………………………………… Yes/No
    c) Can you easily get some life into a rather dull party?......................Yes/No
    d) Do you tend to keep in the background on social occasions?..........Yes/No
    e) Are you mostly quiet when you are with other people?..................Yes/No
    f) Do other people think of you as being very lively………………………….Yes/No
    g) Age _____
    h) "Male" or "Female"
    i) Are you a "visitor" or do you "live in the local area"?

12. Contact: Thank you for taking part. In case of the need for clarification you are invited to provide a contact email or phone number: email address: _____
    Phone number: _____
    If you would like further information about Tranquillity Trails please use email:
    g.r.watts@bradford.ac.uk

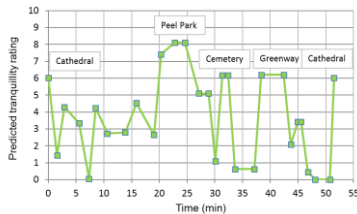    PLEASE HAND IN COMPLETED QUESTIONNAIRE AT KINGSBRIDGE TOURIST INFORMATION CENTRE – THANK YOU
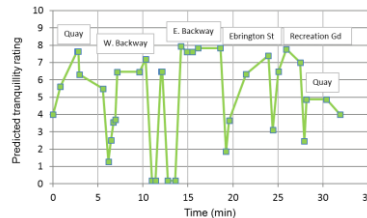
## 3. Results

### 3.1 TR profiles

The predicted tranquillity ratings (*TR*s) over elapsed time from the start assuming a steady walking speed of 4.8 km/h are given for each of these contrasting trails in Figure 5.
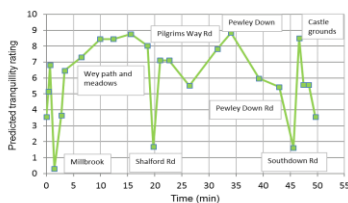
Bradford TT

Kingsbridge TT

Guildford TT



*Figure 5: Tranquillity Rating profiles*

The average *TR* values for the Bradford, Kingsbridge, Guildford trails are 3.7, 5.6 and 6.8 scale points respectively. These averages can be increased if additional time is spent in the most tranquil spaces. To illustrate this 20 extra minutes could be spent in Peel Park in Bradford resulting in an average *TR* of 5.0. If 5 minutes are spent in each of the four quiet spaces in Kingsbridge the average rises to 6.2. For Guildford if 10 minutes were spent at Pewley Down and a further 10 minutes in the Castle Park the average would rise to 7.3. The resulting profiles are shown in Figure 6.
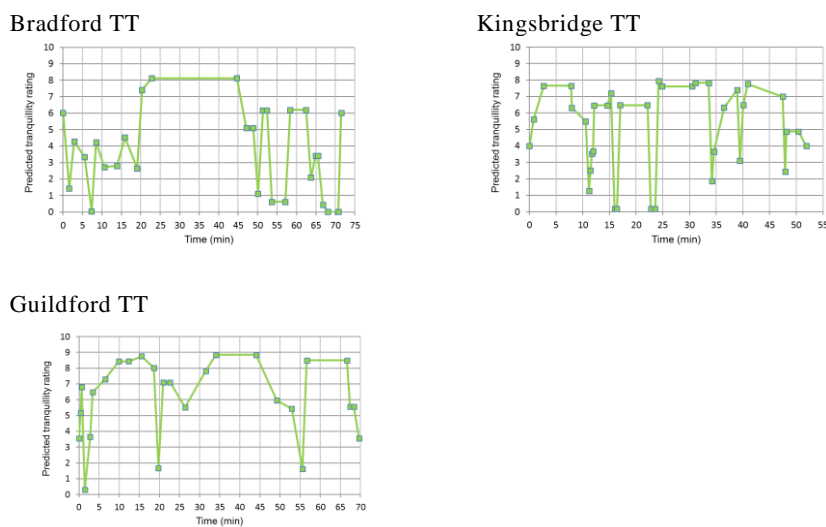
Bradford TT

Kingsbridge TT

Guildford TT

*Figure 6: Tranquillity Rating profiles with extra 20 minutes*
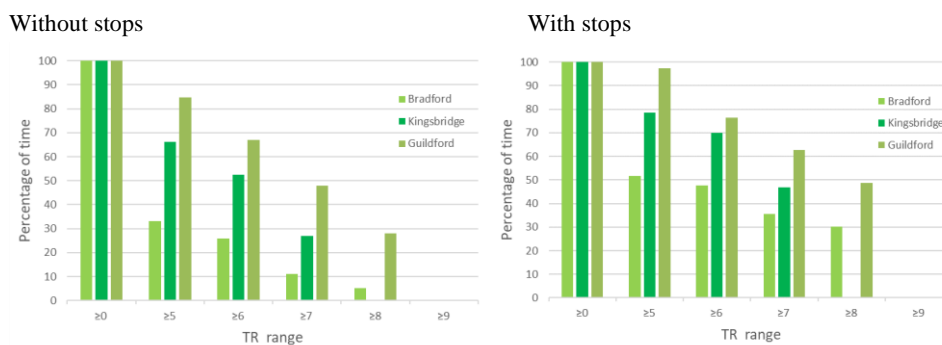
Without stops

With stops

*Figure 7: Percentage of time in each tranquillity range*

Figure 7 indicates the percentage of the time in each *TR* range with and without stops. Clearly with stops in the most tranquil places, the exposure to relatively high levels of tranquility increases substantially. With stops the percentage of time with "good" or "excellent" levels of tranquility ranged from 35% in Bradford to over 60% for the Guildford TT.

**3.2 Questionnaire results**

Twenty-one replies were obtained from the Kingsbridge questionnaire over a period of 10 months though 2 did not complete the course successfully due to steps and steep inclines. Of the 19 valid replies the average age was 57.4 years with a range from 28 to 80 years.

All respondents replied that they considered the tranquility of the route as "very important" or "fairly important". It has been found that introverts are more likely to perform better in quiet environments and would therefore tend to consider tranquil places as more desirable [16,17]. Therefore, it was considered that those who were more introverted would consider the tranquillity of the trail as "very important" rather than "fairly important" or "unimportant" but there was no evidence for this from the replies collected.

It was shown that 78.9% indicated that they were more relaxed and 63.1% were less anxious after completing the TT. It should be noted that none of the respondents indicated that they were less relaxed or more anxious. 78.9% said that they had no problems on the TT (including route finding). However, half the remainder had problems following the route and the other half found difficulty negotiating steep sections or steps.

As to benefits, 47.4% mentioned healthy exercise and 26.3% said that they had new and interesting experiences while 15.8% mentioned social aspect of following the route with a friend or family member.

The average tranquillity rating given by respondents after completing the TT was 7.1 while the predicted value was lower at 6.2. This may be because participants spent longer in the tranquil spaces than assumed. This can be inferred from the fact that the total time assumed for completing the TT and spending 20 minutes in the most tranquil spaces was 52 minutes in contrast to the much longer average reported completion time of 89 minutes.

The question on what would assist in encouraging more use of the TT produced a diversity of replies. The main ones are listed below:

- Less busy
- Living closer
- Improving parts of TT
- Better weather

The fencing along parts of the Western Backway is broken could be improved and sometimes there is uncollected litter. It is known that litter depresses TR values [9] and it is also likely that dilapidated conditions would have a similar effect. Consequently, there are actions that can be taken by the Town Council to address these issues and hence promote greater usage.

A previous survey of visitors to 8 green spaces in Bradford, UK also asked a question on factors that would encourage more visits. In this case the sample was much larger with 169 replying to this question.
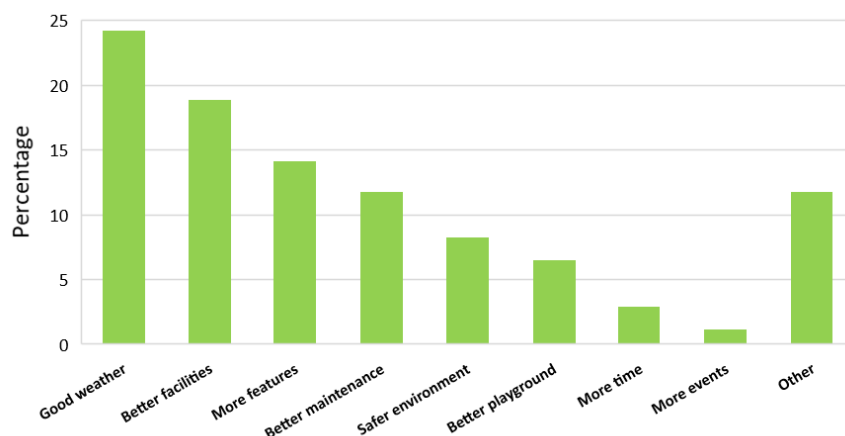


*Figure 8: Factors promoting more visits to green spaces*

The breakdown of these responses is shown in Figure 8. Some of the replies relate to playground equipment so are not directly relevant here. However, the need for better maintenance and safety aspects appear applicable to the present study. It seems probable that if litter and graffiti are not dealt with on a sufficiently frequent basis then the environment becomes less pleasant and feels unsafe. Both may lead to less future visits.

## 4. Discussion and conclusions

There is abundant evidence in the literature that tranquil environments can provide relief from stresses of everyday of life and can be considered restorative environments. For example, it has been established that tranquillity levels relate well to a measure of well-being such as state of relaxation [7]. The prediction tool (TRAPT) has been used to make estimates of the benefits along TTs in terms of perceived tranquillity. The tool has been validated and calibrated by relating $TR$ predictions in green spaces with average ratings obtained from visitors [7]. It was found that there was a good correlation between these two sets of values $r = 0.94$ ($p < 0.001$). A further study in Hong Kong looked at whether the method could be applied across residents from diverse countries [9]. These studies indicate that the tool can be used with some confidence. The effects on predicted perceived tranquillity of town squares, city parks alongside major roads and residential roads and gardens under varying conditions have all been examined [10]. This illustrates the approach that can be taken by concerned groups such as planners, environmentalists, civic leader and citizens in order to determine changes in tranquillity levels brought about by various interventions both positive and negative. In particular, the method can be used to select suitable green spaces and linking paths and roads to create viable TTs that have demonstrable well-being benefits.

The literature shows that in the past TTs have been confined to rural locations [18,19,20] because of the absence of disturbing noise sources and natural surroundings. The concepts of linking tranquil spaces to form a walking route in urban areas is entirely novel and addresses the need to provide relief from the stresses and strains of urban living and healthy exercise. Because these walking routes can all be easily accessed from urban centres it reduces the need to use private or public transport and is therefore additionally a sustainable solution.

It was clear that there were generally high levels of tranquillity along the three TTs. The Guildford TT had the highest overall average tranquillity rating followed by Kingsbridge and then Bradford. For example with stops in Guildford nearly 50% of the time the TR value $\geq 8$ i.e. "excellent" rating. In Kingsbridge the TR $\geq 7$ ("good") was reached nearly 50% of the time while in Bradford TR $\geq 6$ ("fairly good") was found nearly 50% of the time. The layout of the towns and cities and density of traffic constrain what is possible to achieve but the study has demonstrated that across diverse urban environments it was possible to find acceptable levels of tranquillity starting from the urban centre.

The questionnaire results obtained from a sample of participants on the Kingsbridge TT must be judged as preliminary because of the relatively small sample size (19). However, returns showed that overwhelmingly participants reported improved levels of relaxation and reduced anxiety after completing the TT. The average $TR$ given for the TT was 7.1 and 78.9% said they were more relaxed after completing the TT and 63.1% recorded they were less anxious. An 8 park survey showed a similar relationship between rated tranquillity of a green space and the percentage feeling more relaxed [7] after visiting. For an overall rating of 7.1 the predicted percentage reporting being more relaxed was 73.4% and that is close to that reported for the Kingsbridge TT survey (77.9%). Benefits of completing the TT in addition to relaxation and reduced stress included healthy exercise, new experiences and social aspect where the walk was conducted with friends. An important means of encouraging the usage of TTs was to improve the conditions on the walk. For example, reducing the amount of litter and improving infrastructures such as walls and fences where they have become dilapidated. Further improvements involving greening measures along the route and reduction of noise along linking roads could be informed by TRAPT. Currently efforts are being made to identify and characterize TTs both in the UK and abroad.

Making residents and visitors aware of the presence of the TT is another issue that has to be considered. One approach that is currently being explored is to add the TT under "Things to do" on the Tripadvisor

website. An example is given at https://www.tripadvisor.co.uk/Attractions-g551682-Activities-Kingsbridge_Devon_England.html. This should increase the numbers requesting the leaflet and subsequently completing the route. It is expected that the posted comments will be a useful additional source of information on benefits and problems.

## Acknowledgement

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