
Arguing Effectively for Modal Shift

Dr Kate Pangbourne
University Academic Fellow
Institute for Transport Studies, University of Leeds

Dr Al Baker
Research Assistant
Institute for Transport Studies, University of Leeds

Dr Simon Wells
Lecturer
Edinburgh Napier University

Mr Samuel Bennett
Research Assistant
Institute for Transport Studies, University of Leeds

Abstract

In this paper we describe progress with the ADAPT research programme, which seeks to better understand the structure and effectiveness of travel behaviour change communications, and ultimately to make improvements. The interdisciplinary research consists of several independent components that interlock, building new insights into how to author and deliver effective travel behaviour change campaigns. Our ultimate aim is to automate the delivery of personalised arguments. We have created a shareable dataset consisting of examples of travel behaviour change communications produced by lobby groups and transport authorities in the UK. We use a multi-method analysis to understand this corpus, using argumentation diagramming and content analysis. We present the primary argumentation schemes and the principle framings used for different transport modes in this corpus. We describe our associated work on social media dialogues reacting to behaviour change campaigns related to cycling. This reveals the real-world use of common counter-arguments to behaviour change messages and demonstrates that social media campaigns need careful design to maintain control of the message. Finally, we describe progress with our message preference experiments that use these findings to explore how different argument schemes and framings are perceived as effective/ineffective by people segmented for travel attitude and personality.

Section 1: Introduction

The ADAPT project (EP/N030524/1) is investigating smart approaches to voluntary travel behaviour change. In this paper we describe progress with our research programme, which seeks to better understand the structure and effectiveness of travel behaviour change communications, and ultimately to make them better and suitable for use in persuasive technologies. The current main strand of work is investigating the characteristics of effective messages, with a focus on the design of the argumentative content, as a preliminary to moving on to exploring how such messages might be incorporated into persuasive technologies.

In section two we provide some context on the current status of travel behaviour change research. We also briefly reprise the societal and environmental rationale for requiring travel behaviour change. In section three we set out our interdisciplinary methodological approach, which comprises a mixture of methods synthesised from different fields. Section four contains findings and discussion and we offer our conclusions and future plans in Section five.

Section 2: Travel Behaviour Change

In the field of encouraging sustainable behaviours, it is well recognised that only a small part of our observable behavioural choices are conventionally 'rational'. Baumeister et al (2011) conducted a review of the research on the role of conscious evaluation in behaviour, and concluded that its influence is less than generally assumed. It is also generally agreed across a number of fields (e.g. evolutionary psychology and social marketing) that sustainability is not a strong motivator for pro-environmental consumption behaviour, and that a way has to be found to appeal to self-interest (van Trijp, 2014). Lindenberg and Steg (2014) regard it as crucial to strengthen the normative goal of sustainable consumption, to prevent people falling back on hedonic and gain motivations.

How does this impact on transport and travel behaviour change? Whilst the car has been a globally transformative technology (Hoffman et al 2017), it has become clear that it carries with it some very significant social and environmental externalities (e.g. Geels, 2012). Transport is responsible for about a quarter of global greenhouse gas emissions, and has so far been resistant to decarbonisation efforts, due to increasing demand (Ryley and Chapman, 2012). There is no single behavioural or technological climate change mitigation fix for transport. Dawson (2015) highlights the need to change behaviour in order to reduce demand, as well as promoting the use of more efficient technologies, though also highlights the opportunity for infrastructure to be adapted to provide for alternative low-carbon transport opportunities. Additional to the existential threat to humans posed by climate change, the heavy reliance of transport on fossil fuels also underlies some significant public health problems that are socially inequitable (Lucas and Pangbourne, 2012), and a link between urban air pollution and the probability of developing childhood asthma is made in Khreis et al (2017). There is also likely to be an association between obesity and car-oriented habits (c.f. Mytton et al 2017). The impact of traffic accidents is significant: road traffic collisions are a major cause of death (1.25 million people per year) and serious injury (a further 20-50 million people per year) (World Health Organisation 2017). Congestion is also a serious problem in many urban areas, with too many people wishing to travel in single occupant cars on the same roads at the same time. Congestion exacerbates air pollution issues, increases the risk of accidents to cyclists and pedestrians, and impacts on quality of life in communities affected.

Consequently, work to influence travel behaviour towards more sustainable options has been undertaken in a number of advanced economies (Goodwin et al 2004; Brög et al 2009). However, most efforts have been not been fully successful. One exception appears to be personalised travel planning such as the Australian TravelSmart programmes (McGill et al 2012). Personalised travel planning is labour-intensive, and thus cost precludes scaling-up of this approach to larger populations. Furthermore, whilst many of the messages contained in voluntary travel behaviour change (VTBC) campaigns combine factual and emotional arguments, little is known about the role campaign content has on campaign effectiveness (Davis, 2012). Nevertheless, there remains a pressing need to find ways of encouraging greater numbers of people to shift away from unsustainable transport modes. This is a guiding motivation for the ADAPT project, which aims to contribute to the developing field of utilising persuasive technology for personalising VTBC messages (Sunio and Schmocker, 2017), as this would provide a more cost-effective means of scaling up the proven techniques of personalised travel planning. Whilst it is self-evident that persuasion theory (which underpins many behaviour change campaigns, particularly in the environmental and health arenas) involves making use of arguments, there is still great research scope in relation to VTBC, where most effort has been expended on evaluating packages of measures rather than evaluating content as preliminary to designing campaigns (Davis, 2012; Wells and Pangbourne 2016). Therefore, we have developed a methodology for analysing

existing arguments for VTBC and utilising this corpus for message effectiveness experiments. This is described in Section three.

Section 3: Methodology

Advances in persuasive technology (PT) in other fields (e.g. health interventions: Nguyen, 2007) offer some insight into the potential for PT to address these issues in the travel domain. Travel planning PTs offer a number of key benefits over previous methods: (1) Mobile technology allows for greater collection of personal data about participants; (2) Information about travel habits can be acquired with accuracy and ease; (3) data can be used to provide automated messages responsive to changing circumstances and attitudes (4) Persuasive tools can be implemented in real-time (e.g. while participants are travelling) (5) Digital approaches enable large-scale implementation (6) Networking allows for comparison of individuals and feedback about others can be provided. There are a number of projects currently exploring the potential of mobile technology in personal travel planning including OPTIMUM (Anagnostopoulou et al., 2017) I-PET (Meloni & Teulada, 2015) and Blaze (Sunio, Regina, & Estuar, 2017). Using methods such as gamification, personalised persuasive messaging, goal-setting, social comparison and behavioural feedback, these apps aim to provide reproducible and cost-effective approaches to influencing voluntary behaviour change that scale up proven methods of personalised travel planning. However, to our knowledge, none of these initiatives include detailed research into the content of the arguments or messages they rely on. By understanding (1) common argumentative structure in travel behaviour change campaigns (2) the effectiveness of these messages amongst the target audience, and (3) the individual differences in attitudes, personality and circumstance that mediate this effectiveness, we aim to develop a model of argumentation in the travel domain that could be used for automation of tailored message delivery in PT.

The argumentation method

The Sustainable Transport Communications Dataset (STCD) is a shareable corpus of arguments for travel behaviour change found in real-life public-facing sources (mostly web pages).¹ Each entry in the dataset includes a screenshot and the extracted text of the source and a diagrammed analysis of the source as an informal argument. To be included in the STCD, a source must meet the following criteria:

- 1) Explicitly or implicitly attempts to persuade its audience to change travel behaviour
- 2) Targets the general public as an audience (as opposed to, e.g. industry or policy makers)
- 3) Written in English and targets a UK audience²
- 4) Primarily text or dialogue based persuasion

It would be possible to extend the corpus to include industry and government-facing sources, but since there are likely to be significant differences in rhetorical strategies adopted for such an audience, we exclude them. We include only those sources which use text or dialogue based persuasion (for instance, in video or radio pieces) to ensure that every source can be analysed as a piece of informal argumentation, and that each analysis is commensurate with the others.³ For every identified source, an entry in the dataset is created and labelled with a unique identifier (UID). Each entry consists of a) a .jpg and a .pdf screenshot of the source in context; b) a .txt file containing the extracted text of the source; c) an .aml file containing an argumentation analysis of the source in Argument Markup

¹ The STCD can be found at <http://github.com/ADAPT-project/STCD>

² Though in principle our dataset is extendable to any jurisdiction and language

³ Some have argued that wholly or principally pictorial persuasive media can be analysed as informal argumentation (e.g. Birdsell & Groarke 1996). However there are significant theoretical and methodological questions of applicability and commensurability which make it prudent to exclude such sources from the STCD.

Language; d) a .tif file of the diagrammed argument of the entry; and e) a .txt file containing the metadata for the entry (source URL, date collected, analyst name and email and UID).

The extracted text from each source is then restructured as an informal argument. Arguments, for these purposes, are understood as collections of statements and inferences which, taken together, purport to give reasons for belief or action (Hitchcock 2007). Argumentation analysis requires the reconstruction of persuasive text into a more formalised argumentative structure, which is typically carried out in the following way: by 1) identifying the conclusion argued for in the text (or making explicit the conclusion argued for in cases where it is implied), 2) identifying the statements made in the argument intended to provide evidence to support the conclusion, 3) identifying explicit or implied inferences which make logical connections between the premises such that they support the conclusion, and 4) for arguments where not every premise or inference is made explicit (enthymemes), to add such premises and inferences in accordance with the *principle of charity*, so as to reconstruct the most plausible form of the argument in question.

Once reconstructed as arguments, the sources are then diagrammed using specialist software (*Araucaria* (Reed and Rowe 2004)). Each argument, and any sub arguments, are also labelled as matching a particular *argumentation scheme*, a recurring form of argument using a particular set of inferences, and susceptible to the same forms of legitimate critical questioning (Walton et al. 2008). For instance, one particularly prominent argumentation scheme found in the corpus is *argument from example*; an argument that because we agree that F is good, and that G is an example of F, we ought to pursue G. Arguments from example all use the same argumentative structure, and are susceptible to the same critical questions (such as ‘is G really an example of F?’). Each instance of argument from example found in the corpus is labelled as such, allowing us to compare the ways each instance maps onto that form of argument, and addresses or pre-empts the appropriate critical questions.

The arguments we extract from each source are *informal* in that they are not *formalised* using a logical or mathematical language, such as propositional logic; they are analysed as pieces of natural language argumentation. This brings with it some differences in how we can evaluate the arguments we reconstruct as *valid* (the conclusion follows from the premises) or *sound* (the argument is valid *and* the premises are true). For instance, an argument making an appeal to authority is always formally (deductively) invalid (because the authoritative status of a speaker is never sufficient to *guarantee* the truth of what they say). However, the same argument may well be *informally* valid, in that the details of *who* the authority is and the area in which they are expert may make it the case that their testimony makes it *more reasonable* to believe the conclusion, even if it doesn’t guarantee the conclusion’s truth. In practice, this allows us a wide range of options when reconstructing each source as an argument in accordance with the principle of charity, as well as affording us opportunities for a finer grained content analysis than would be possible using a formalised approach (since we can meaningfully refer to the content of arguments’ premises and how that relates to their rational and rhetorical force).

The analytical leeway an informal argumentation approach offers us is especially important for our project for two reasons. First, we are initially not principally interested in the validity or soundness of the arguments made in the corpus, either as intended by their authors, or as received by their audience. Our intention is to understand the effectiveness of different argumentative strategies and their relative prominence and appearance in real-world communications. As such, the freedom to reconstruct arguments in a way which will usually meet a minimum standard of informal validity allows us to analyse those aspects of the arguments that we *are* interested in without also comparing the relative rational persuasiveness of each source. Second, this approach allows us to maintain elements of the sources in our analysis which can go on to become the foundation of comparative content

analyses of the entries in the corpus, potentially allowing us to understand any interplay at work between the effectiveness of the argumentative structures from each source and elements of their respective content. Some initial findings concerning the content of the STCD are presented in a later section, along with some thoughts on possible further work.

To illustrate how our method works in practice, a sample diagram from the STCD is shown below (Figure 1), illustrating the reconstruction of the arguments of a page from a UK based NGO called 'Walking for Health'.⁴ In this case, the conclusion argued for by the source was not explicitly stated (making the argument as written an *enthymeme*), but it is clear from the points made and the context of the page that the intention is to persuade its audience to walk as a way of getting healthy exercise. The analyst therefore began by adding the implied conclusion that 'you should try walking as a healthy exercise' (addition is indicated by dashed lines). The next step is to extract all the statements from the

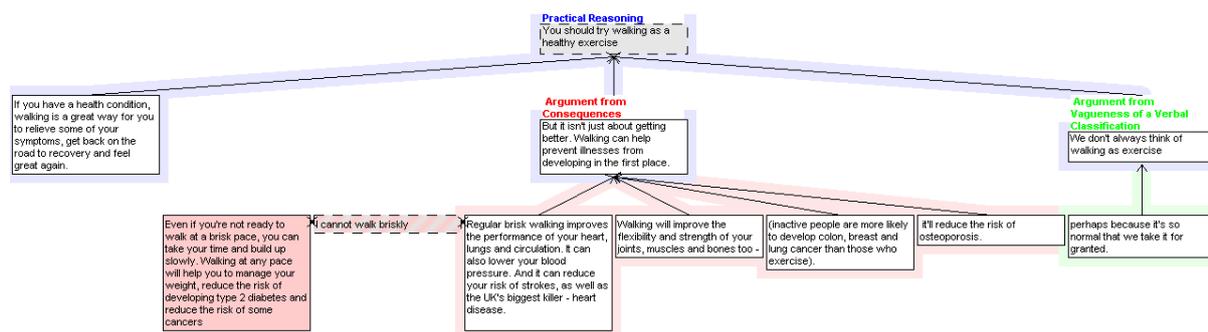


Figure 1 Argument diagram from the STCD illustrating an example of 'Practical Reasoning' with sub-arguments 'Argument from Consequences' and 'Argument from a Vagueness of a Verbal Classification'

source which are intended to support the (implied) conclusion, all of which appear in nodes on the diagram above. The third step is to make explicit the inferences which connect the premises in order to support the conclusion, by assigning the premises to a set of argument schemes. The sample above includes two of the most common argumentation schemes found in the STCD: a broad practical reasoning framework, and an *argument from consequences*, together with a much less common scheme, an *argument from vagueness of a verbal classification*. The sample also includes an instance of a refutation to a pre-empted critical question levelled at an element of the practical reasoning scheme.

Practical reasoning is the form of reasoning we undertake when we think about what we ought to do. As such, we expect that the majority of STCD entries will engage in some form of practical reasoning argument, as the entries all intend to persuade their audience to do something (change their travel behaviour). One of the appropriate critical questions to an argument following a practical reasoning scheme is to query whether the means being argued for as a way to attain the valuable end is available as an option (Walton 2007). In this example, the page is arguing that 'regular brisk walking' is a way of improving the performance of your heart, which in turn is an example of how walking is an optimal means to the end of improving health. The source then pre-empts the critical question "but I cannot walk briskly?" with a refutation noting that walking at any pace will still have significant health benefits. All of these features of the argument structure can be clearly displayed in diagrammed form, as above.

⁴ The original source is at: <http://www.walkingforhealth.org.uk/get-walking/why-walk/healthy-bodies/preventing-illness>

Section 4: Discussion of Initial Findings and Future Work

4.1 Argumentation Initial Findings

The STCD currently contains argument analyses of 118 individual items from 54 different sources, covering England, Scotland and Northern Ireland and a small number of non-UK items. We distinguish between *entries* consisting of one overarching argument (usually one per web page) and *sources*, referring to organisations authoring the material we analyse; the majority of sources provide multiple entries.

While there is no inclusion criterion concerning the specific behaviour change to be argued for by a source, in practice every source discovered so far attempts to persuade its audience to use sustainable modes of transport, with a sizeable number explicitly arguing in favour of using a sustainable transport mode instead of private cars. In most cases, the use of one or more specific transport modes are argued for, including Walking, Cycling, Bike Share, Car Share, Bus, Trains and Electric Vehicles. 2 sources so far collected argue only that its audience should drive less (Anti-Driving), and 2 argue only that they should change their driving behaviour (Eco Driving).

We also have some insight into the distribution of the behaviour changes argued for by source and by geographical region. Some sources argue for a single change in behaviour (sometimes across multiple entries), whereas others argue for multiple changes of behaviour in a single entry, or across several entries. There are 91 behaviour change interventions argued for across the 58 sources, which can be classified as follows: 22 (24.2%) 'Walk more'; 36 (39.6%) 'Cycle more'; 4 (4.4%) 'Use bike share schemes'; 5 (5.5%) 'Use car share schemes'; 5 (5.49%) 'Drive electric vehicles'; 3 (3.3%) 'Practice eco-driving techniques'; 4 (4.40%) 'Take the train'; 8 (8.79%) 'Take the bus'; and 4 (4.4%) 'Don't drive'.

In section 4.3 below we describe our plans for future empirical work building on the STCD resource. We also intend to conduct more in depth content analysis of the STCD as a corpus in order to draw robust conclusions about the argumentative and other rhetorical strategies used in sustainable transport communications. However, in constructing the STCD we have noted some interesting features of the corpus which informed the design of our future empirical experiments, and which we also think are useful to point to as initial findings from the collecting and argumentation analysis of the sources in the corpus.

Although sufficient metadata is not yet in place to formalise observations regarding the frequency and combinations of argumentative and rhetorical strategies, we are nonetheless in a position to make some preliminary observations concerning some themes emerging in the corpus. First, regarding argumentative strategy, it is not surprising that every entry so far is amenable to analysis as an instance of *practical reasoning*. As mentioned above, such schemes are applicable whenever an argument is intended to convince somebody to undertake some action. Since what we are interested in is arguments for behaviour change, we would expect that those arguments all take the form of practical reasoning.

A broad practical reasoning framework is also amenable to supplementation by other arguments. Sub-arguments can, for instance, supply supporting information for why the argued-for choice of action is preferable to alternatives. While some variety in argumentative strategies has been observed, there are two which occur far more frequently than any others. In particular, they are *arguments from example* and *arguments from consequence*. *Arguments from example*, as noted above, are arguments that since we are already committed to the value of F, and G is a way to instantiate value F (or G an example of an action which we have already established instantiates value F), we ought to G. In the

STCD, this usually takes the form of establishing that healthier or cheaper modes of transport are preferable, and then demonstrating ways in which walking and cycling are examples of such healthy or frugal transport modes. *Arguments from consequence* appear with similar frequency. Arguments from consequence come in two kindred forms, differentiated by valence: arguments from *positive* and *negative* consequences respectively. It is notable that the majority of arguments from consequence in the corpus are of the *positive* variety: they argue that we ought to do F because various positive things will happen as a result (we ought to cycle because it will make us healthier, wealthier and happier, for instance). Both of these schemes are common argumentative strategies that can be found in a large variety of domains, and it is not surprising that they should appear frequently in the STCD. What *is* surprising, however, are the *values* usually appealed to in the running of these arguments. It is striking that the majority of entries, despite very many of the sources being organisations with an expressed interest in *sustainable* (qua environmentally friendly) transport, do not appeal to environmental concerns in their arguments for behaviour change. The most commonly recurring values appealed to in the arguments as analysed are health and financial benefits, with others including comfort, efficiency, and altruistic values such as environmental and community concern appearing at a far lesser frequency. However, this strategy is in line with the overall observations about self-interestedness outweighing sustainability as a goal (c.f. van Trijp 2014 above).

It is also interesting to note which argumentative strategies do *not* feature prominently in the corpus, where we might otherwise expect that they would. One such is *arguments from authority*, and another *arguments ad populum*. Although arguments from authority (arguments to the effect that we ought to believe a conclusion because it is believed by someone knowledgeable about the relevant domain) are present in the corpus, they are not present to the extent that might have been expected. We might think, for instance, that the health benefits of walking and cycling, or the financial hazards of driving, would be well communicated by appealing to the views of health or financial professionals. There are two plausible explanations for the relative absence of arguments from authority in the corpus: The first is that while they might not *strictly* have a great presence in the corpus, many of the arguments presented might be termed arguments from authority *in practice*. For instance, although the majority of entries from the NHS Live Well website do not contain arguments from authority, it is plausible that we ought to construe the whole communication as an argument from authority, since it is being delivered by an authoritative source, and that authority is plausibly being implicitly presented as a reason for following the advice given. However, it could also be the case that arguments from authority are not favoured for rhetorical reasons by the communicators. Many of the rhetorical ‘trappings’ of arguments from authority *are* present in the corpus (professional website design, the use of statistics (albeit frequently unsourced), and knowledgeable proclamations about health and financial wellbeing), and it could be that the rhetorical effectiveness of arguments from authority is captured in these instances while the actual structure of such an argument is not present.

Arguments ad populum (argument by appeal to majority belief) are also notably absent from the STCD as it stands. This is surprising given their relative prominence in commercial advertising and similar behaviour change oriented communications (when, for instance, we are told that 8 out of 10 cats prefer Whiskas). One plausible explanation has to do with how we define an argument *ad populum*, which strictly is an appeal to majority belief or majority activity (and an injunction that you, the audience, should do as they do). While there are as yet no examples in the STCD of arguments to the effect that, for instance, you ought to cycle because a majority of people similar to you also cycle, there *are* instances of appealing to the majority in terms of possible *benefits* for a majority, or a majority of people who are like the audience in key respects. For instance, in the example shown in Figure 1, it is noted that various health problems can be partially alleviated by regular brisk walks. This is not an

appeal to a majority belief or action, but it *does* invoke the idea of the majority in its rhetoric (by suggesting that you *and* people similar to you can benefit from this course of action).

These initial observations of the corpus helped to motivate our design of the messaging experiment: specifically, which argumentative strategies we exposed our participants to, and which values we appealed to as a part of those arguments. There is certainly more rigorous analysis of the STCD yet to be completed, and undoubtedly interesting relations to be found between argumentative strategy, transport mode argued for, and possibly even the regional area of the target audience. However, even initial observations of the STCD contents provokes interesting questions as to whether the argumentative strategies most frequently used in the STCD, and the values most frequently appealed to, are popular choices because they are especially effective, or rather the operation of received wisdom on the part of behaviour change communicators. Furthermore, we plan to investigate in more depth emotive features in the corpus.

4.2 Limitations of the STCD

Many of the current examples for walking and cycling current sources in the STCD are also 'national' level communication campaigns rather than local. Of the 148 total entries currently in the STCD, 70 of those are authored by national organisations aimed at a UK-wide audience. The national campaigns identified so far are highly focused on increasing walking and cycling (as an alternative to driving) as the argued-for behaviour change, and this focus appears to replicate throughout the regional distribution, although more sources are needed from local organisations before this can be clearly established. We have manually identified several geographical and modal categories which are currently underrepresented in the STCD (including, for example, Wales and the North of England, and Train and Bus travel), and one current priority is to redress that by actively searching out sources to fill those gaps.

4.3 Future empirical work

Here we describe the design of an initial experiment we are conducting using the STCD as a resource in order to understand the effectiveness of different argumentative strategies in the sustainable transport domain. Our pilot project was reported in Pangbourne and Masthoff (2016). Our message evaluation experiments are designed to contribute to the understanding of the perceived persuasiveness of arguments aimed at reducing car usage and increasing sustainable transport usage amongst the general population.

Our main interest is whether the effectiveness of different argumentative strategies within the transport domain varies depending respondents' attitudes towards travel and other features of their personality⁵. Our studies employ a quantitative design. In Experiment One participants will be presented with four out of sixteen possible arguments giving reasons to walk as a method of transportation. These arguments have been carefully crafted to each instantiate *one* argumentative strategy and appeal to *one* value. Each participant will be exposed to arguments instantiating each of the four argumentative strategies and appealing to each of the four values. We selected four argumentation schemes: one based on their high frequency in the STCD (Arguments from Example), two based on their surprising low frequency in the STCD (Arguments from Authority and Arguments ad Populum), and one to act as a quasi-control (a neutral statement giving a reason for action: a basic form of Practical Reasoning). Four values were chosen, again three for their relatively high frequency in the STCD (health, financial and efficiency), and one for its surprisingly low frequency

⁵ We include personality as that has been demonstrated to have a significant impact on the perceived effectiveness of persuasive strategies in the health domain (Halko and Kientz 2010)

(environmental). The arguments will be selected quasi-randomly so that participants will be presented with exactly one instance of each argumentative strategy and exactly one appeal to each value. For each argument, participants will be asked to rate the extent of the argument's persuasiveness based on a perceived argument strength scale (agreement with a series of statements on a scale of 1-5 focused on the argument's persuasiveness (e.g. "The statement is a reason for walking more that is convincing to me").

The arguments presented to the participants are all informally sound (their premises are true, based on information from peer-reviewed and government sources, and the arguments give good reasons to walk as a form of transport). This ensures both that the soundness of the arguments is excluded as a possible confounding variable, and that we are not unethically exposing our participants to misinformation. For instance, a participant may initially be presented with the following randomly assigned argument from our set:

"Regular walking can buy you three to seven additional years of life. It could also improve your mood, exercise your brain and reduce your risk of heart failure"

This condition is an argument from consequence, appealing to the value of health. The participant will be asked to rate the persuasiveness of this argument, and will then be presented with a second argument which will *not* consist of an argument from consequence, and will *not* appeal to health, such as:

"Scientists say that walking more is a good way to help the environment"

This is an instance of an argument from authority appealing to the value of environmental concern. These two conditions will then be eliminated from the further possible arguments the participant will be exposed to, and so on until the participant has been exposed to four of the sixteen possible arguments.

Participants will then complete the Golden Questions Survey (Anable et al 2013) to ascertain their travel attitude segment, and the IPIP-20 five-factor Mini Personality. This experiment structure is designed to identify differences in the potential effectiveness of different argument structures between the travel attitude segments and personality types, which would provide valuable information for future behaviour change campaigns around transport usage and provide a resource for tailoring campaigns to specific audiences. The data will be collected through an online survey. A mixed ANCOVA analysis will allow us to investigate the effect of the 3 independent variables; travel attitude segment, value domain of argument and argument structure, and their interaction effects on the perceived argument strength of sustainable transport messages while controlling for and analysing the effect of personality. In other words, we will be able to assess the significance of:

1. The impact of argument type and value frame on perceived persuasiveness of VTBC messages;
2. Any variation in the perceived persuasiveness of VTBC messages between travel attitude segments
3. Any variation in the perceived persuasiveness of VTBC messages for each argument type and value frame between the attitude segments; and
4. The extent to which personality traits explain any variance in message persuasiveness.

Section 5: Conclusions

Thus far, we have discovered that the arguments currently in the STCD are largely in the form of *Practical Reasoning*, and we have explained reasons as to why this is plausible. We do not have an explanation for the absence of *arguments ad populum* given the effectiveness of social norms in behavioural work reported by Kahneman and colleagues for example. We were also surprised that ostensibly environmentalist sources for the persuasive texts do not generally use an environmental framing, though this is in line with research highlighting that self-interest goals are more motivational than sustainability goals (see section two above).

In the STCD we have initiated the construction of a resource that we hope will be useful to any who are interested in corpora of natural language arguments in specific domains, or in sustainable transport communications, or in the many and various related fields. The construction of the STCD is an ongoing project, and our aim is to develop a representative sample of argumentation across various modes and geographical regions. To that end, we are currently adding additional metadata to each entry (concerning geographical location of the source's audience, modes argued for and argument forms used), which we will use to continuously identify and fill gaps in the STCDs coverage.

In our future work, we will be continuing to explore message formation, with different modes and framings. We will also use the findings to develop and validate algorithms for selecting messages for use in a persuasive technology context. We will then be able to undertake the final step of running trials to test the most successful messages and algorithms in real-world trials, in order to evaluate for measurable effects on travel behaviour.

References

- Anagnostopoulou, E., Magoutas, B., Bothos, E., Schrammel, J., Orji, R., & Mentzas, G. (2017). Exploring the links between persuasion, personality and mobility types in personalized mobility applications. In Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics). https://doi.org/10.1007/978-3-319-55134-0_9
- Anable, J., & Wright, S. (2013). Work Package 7 Golden Questions and Social Marketing Guidance Report. Intelligent Energy Europe (IEE). At [http://www.segmentproject.eu/hounslow/segment.nsf/Files/SFF-266/\\$file/Deliverable 7.8.4 GOLDEN QUESTIONS AND SOCIAL MARKETING GUIDANCE REPORT.pdf](http://www.segmentproject.eu/hounslow/segment.nsf/Files/SFF-266/$file/Deliverable%207.8.4%20GOLDEN%20QUESTIONS%20AND%20SOCIAL%20MARKETING%20GUIDANCE%20REPORT.pdf)
- Baumeister, R F, Masicampo, E J, and Vohs, K D (2011) Do conscious thoughts cause behaviour? *Annual Review of Psychology*, 62, 331-361
- Birdsell, D. S. & Groarke, L (1996) "Toward a Theory of Visual Argument" *Argumentation and Advocacy*, 33, 1-10
- Brög, W., Erl, E., Ker, I., Ryle, J., Wall, R. (2009). Evaluation of voluntary behaviour change: experiences from three continents. *Transp. Policy*, 16, 281-292
- Davies, N (2012) What are the ingredients of successful travel behavioural change campaigns? *Transport Policy*, 24, 19-29
- Dawson R. J. (ed) (2015) A Climate Change Report Card for Infrastructure. LWEC Report Card. Living With Environmental Change.

-
- Geels, F. (2012) A socio-technical analysis of low-carbon transitions: introducing the multi-level perspective into transport studies. *Journal of Transport Geography*, 24, 471-482.
- Goodwin, P., Cairns, S., Newson, C., Sloman, L., Goodwin, P., Cairns, S., ... Sloman, L. (2004). Smarter choices: Changing the way we travel. Retrieved from <http://eprints.uwe.ac.uk/6074/>
- Halko, S. and Klientz, J. (2010) "Personality and persuasive technology: an exploratory study on health-promoting mobile applications", *Persuasion 2010 Proceedings*, 150-161
- Hitchcock, D. (2007) "Informal logic and the concept of argument," in Dale Jacquette (ed.), *Philosophy of Logic* (Volume 5, Handbook of the Philosophy of Science), Amsterdam: Elsevier, 101–129
- Hoffmann, S. Weyer, J. and Longen, J. (2017) Discontinuation of the automobility regime? An integrated approach to multi-level governance. *Transportation Research Part A: Policy and Practice*, 103, 391-408.
- Kahneman, D. (2011) *Thinking, Fast and Slow*. 2012 edition: Penguin, London.
- Khreis, H., Kelly, C., Tate, J., Parslow, R., Lucas, K. and Nieuwenhuijsen, M., (2017) Exposure to traffic-related air pollution and risk of development of childhood asthma: A systematic review and meta-analysis. *Environment international*, 100, pp.1-31.
- Lindenberg, S. and Steg, L. (2014) Goal-framing theory and norm-guided environmental behaviour. In van Trijp, H. C. M. (ed) *Encouraging Sustainable Behaviour: Psychology and the Environment*. Psychology Press, New York and Hove.
- McGill, J et al (2012) Not everyone gets a back pack: developing a targeted approach to travel behavior change. Proceedings, ATRF 2012 35th Australasian Transport Research Forum, ATRF 2012.
- Meloni, I., & Teulada, B. (2015). I-Pet Individual Persuasive Eco-travel Technology: A Tool for VTBC Program Implementation. *Transportation Research Procedia*, 11, 422–433.
<https://doi.org/10.1016/J.TRPRO.2015.12.035>
- Mytton, O.T., Ogilvie, D., Griffin, S., Brage, S., Wareham, N. and Panter, J., (2017). Associations of active commuting with body fat and visceral adipose tissue: A cross-sectional population based study in the UK. *Preventive Medicine*.
- Nguyen, H. (2007). Designing Persuasive Health Behaviour Change Dialogues. In Conati, C. et al (Eds.) UK 2007, LNAI 4511, pp 475-479.
- Pangbourne, K. and Masthoff, J. (2016). Personalised messaging for voluntary travel behaviour change: interactions between segmentation and modal messaging. UTSG 2016.
- Reed, C. & Rowe, G. (2004). "Araucaria: software for argument analysis, diagramming and representation" *International Journal on Artificial Intelligence Tools*, 13, 4, 961-979.
- Sunio, V. and Schmocker, J-D. (2017) Can we promote sustainable travel behavior through mobile apps? Evaluation and review of evidence. *International Journal of Sustainable Transportation*, 11, 553-566.

Sunio, V., Regina, M., & Estuar, J. (2017). Implementation of a mobility behavior change support system in Manila Philippines. In *2017 IEEE 20th International Conference on Intelligent Transportation Systems (ITSC): Workshop Implementation* (pp. 324–329).

Van Trijp, H. C. M. (2014). Recurring themes on sustainable behaviour and their implications for intervention. In van Trijp H. C. M. (ed) *Encouraging Sustainable Behaviour: Psychology and the Environment*. Psychology Press, New York and Hove.

Walton, D (2007) "Evaluating Practical Reasoning", *Synthese*, 157:2, 197-240.

Walton, D. Reed, C. and Macagno, F. (2008) *Argumentation Schemes*, Cambridge: Cambridge University Press.

Wells, S and Pangbourne, K (2016) Using Argumentation within Sustainable Transport Communication. In: Mohammed, D and Lewiński, M, (eds.) *Argumentation and Reasoned Action: Proceedings of the 1st European Conference on Argumentation*. 1st European Conference on Argumentation, 09-12 Jun 2015, Lisbon. pp. 781-801

World Health Organisation (2017) *Road Traffic Injuries Fact Sheet*. At <http://www.who.int/mediacentre/factsheets/fs358/en/> last accessed 17th November 2017.
