Argumentation and Reasoned Action

Proceedings of the 1st European Conference on Argumentation, Lisbon 2015

Volume I

Edited by

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and

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ISBN 978-1-84890-211-4

College Publications
Scientific Director: Dov Gabbay
Managing Director: Jane Spurr

http://www.collegepublications.co.uk

Original cover design by Orchid Creative www.orchidcreative.co.uk
Printed by Lightning Source, Milton Keynes, UK

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Using Argumentation within Sustainable Transport Communication

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In this paper we present the preliminary results of a survey of persuasive communication within the sustainable transport domain. This survey is underpinned by a reconstruction of the arguments used, a scheme oriented analysis of the corpus of reconstructed arguments, and elements of a theoretical and applied framework for using the corpus to effect lasting behaviour change using argumentative techniques within the self-same domain.

KEYWORDS: argumentation schemes, behaviour change, corpus building, motivation, persuasion, sustainable transport

1. INTRODUCTION

In this paper we present the preliminary results of an ongoing survey of persuasive communication within the sustainable transport domain.

This survey is underpinned by a reconstruction of the arguments used, a scheme-oriented analysis of the corpus of reconstructed arguments, and elements of a theoretical and applied framework for using the corpus to effect lasting behaviour change using argumentative techniques within the self-same domain.

Our aim is three-fold; primarily to develop and deploy computational argumentation within a, from the perspective of argumentation theory, novel domain where such technologies have the potential for real societal benefit. A key issue for computational argumentation technologies is how we smoothly move from theoretic

D. Mohammed & M. Lewiński (eds.) (2016). *Argumentation and Reasoned Action: Proceedings of the 1st European Conference on Argumentation, Lisbon, 2015. Vol. I, 781-801.* London: College Publications.

issues of argument to useful tools for the domain practitioner. We aim for our experiences to inform this process and for this paper to outline and report on two preparatory steps in such a process, the gathering of knowledge that an intelligent argumentation process can consume and the identification of a gross architectural framework. Secondly, we aim to explore the linkages and overlaps between the behaviour change theory and argumentation theory research areas. Behaviour change theory incorporates rich psychological models of how individuals form, break, and re-form new or adjusted habitual behaviours whereas argumentation theory focusses on how rational and justifiable decisions are made. By aligning both approaches we propose that argumentation performs an important ethical role in ensuring that individuals who are exposed to behaviour change techniques do so in an informed way. Additionally, argumentative interaction can perform a significant role in building motivation, a critical prerequisite in achieving behaviour change; argumentation theory can thus improve the likelihood of behaviour change being successful and sustainable. Finally, we aim to exemplify current best-practice in the construction, initial release and ongoing development of a flagship dataset for sustainable transport and to make clear a range of attributes that should be considered, and ideally satisfied, when building and sharing datasets in order for them to be sustainable resources.

In section 5 we lay out a program of future work that seeks to provide a solid quantitative foundation for the current approach though evaluation of both our corpus of sustainable transport arguments and our interaction mechanisms to ensure that they are both effective and appropriate. In the longer term we aim to identify effective, scalable, and reproducible communicative and argumentative techniques that can be used to help people to make informed and justifiable choices about their behaviours.

The major contribution of this research is to underpin existing motivational and behaviour change communications within the sustainable transport domain with solid argumentation theoretic foundations and to provide an extended corpus of analysed and reusable arguments. This approach brings together two important and complementary research areas, one of which has focussed on psychological models at the expense of practical techniques, and the other which has focussed more heavily on ideal reasoners and normative models, almost to the exclusion of consideration of the messy thinking that characterises human action in the real world.

2. BACKGROUND

Transport, particularly that relating to personal mobility is a huge source of environmentally damaging emissions and pollutants.

Additionally the transport sector alone accounts for 40% of final energy consumption in the European Union. We focus on the problem domain of reducing unsustainable travel behaviours, which is a normative policy goal in many developed world contexts.

In order to tackle climate change, there is an imperative to reduce greenhouse gas (GHG) emissions from all sectors. Whilst emissions in most sectors are falling, those from transport-related emissions have risen by 36% since 1990. Cars alone account for 12% of the total EU CO2 emissions, with similar figures for CO, NO, Ozone, particulate matter, and other toxic and volatile chemicals (figures gathered from the European Commission[1]). In aggregate individual travel habits therefore have a large impact on the quality of the environment, particularly in urban environments in which, as of 2014, 54% of the world's population now live[2]. Transport is a particular 'offender' in relation to GHG emissions and considerable effort has been devoted to addressing the issue. For example, the recent UN Climate Summit in New York announced four global transport-related initiatives to progress the goal of low carbon mobility.

9. The Urban Electric Mobility Initiative (UEMI) aims to increase the number of electric vehicles (e-vehicles) in cities to at least 30% of all new vehicles sold annually by 2030, and to make cities e-vehicle friendly.
10. The International Union of Railways (UIC) Low-Carbon Sustainable Rail Transport Challenge will promote the use of railways for both freight and passenger transport.
11. The International Association of Public Transport (UITP) Declaration of Climate Leadership brings together 1300 member organisations across 92 countries that are providing clean public transport (PT) for city populations.
12. A new commitment by the International Civil Aviation Organisation (ICAO) to develop more sustainable alternative fuels for aviation, to develop a global CO2 standard for new aircraft and design and implement a measure for international aviation from 2020.

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[1] Climate Action Policies:
http://ec.europa.eu/clima/policies/transport/index_en.htm

[2] World Health Organisation Global Health Observatory Data:
http://www.who.int/gho/urban_health/situation_trends/urban_population_growth_text/en/

The UN regards these initiatives as crucial to reducing GHG emissions. However, it is clear that all these initiatives will require attention to the demand side for success. In essence this translates to achieving behavioural changes. In the main this requires persuading individuals to switch away from private cars fuelled by the internal combustion engine either to public transport and to active travel, i.e. walking and cycling or to low-carbon vehicles. However, whilst it is important to develop low-carbon vehicles, in many urban transport contexts the widespread adoption of low-carbon cars will fail to solve another severe issue related with car use: congestion. Therefore, urban transport authorities have two imperatives in relation to changing citizens' behaviour: reducing GHG emissions (which addresses both climate change targets and local air quality issues) and traffic congestion problems. Indeed, this is an issue that has already received quite a lot of attention from urban authorities, involving many different approaches to influencing travel behaviour, often founded on psychological understandings of behaviour (Howarth & Riley, 2012).

The European Union (EU) has been particularly active in the sustainable transport domain for a number of years, and has explicitly linked achieving greater sustainability in the transport domain to information technology, branded as Smart Mobility. Furthermore, the EU is committed to Intelligent Transport Systems (ITS), deploying the affordances of information technology and big data to improve the efficiency of transport networks across Europe[3], and a number of projects that deliver different aspects of personalised transport information to consumers (either through technology, such as Multi-modal Journey Planners or other means such as those used in SEGMENT) have been funded (e.g. SUPERHUB, MyWay, SEGMENT) by the European Commission, as traffic and travel information is an early priority under directive 2010/40/EU which requires standards for interoperability, compatibility and continuity of systems across Europe by 2017.

Therefore, in this paper we focus primarily on arguments for and against sustainable travel in urban mobility contexts. In such contexts the widest variety of alternative travel modes are most likely to exist: walking, cycling and public transport use as sustainable, and increasingly Mobility 2.0 (Lanzendorff, 2014) innovations which combine new models of vehicle use (such as pooling, sharing or leasing) with new types of vehicle, fuels and powertrains, particularly electric

[3] *http://ec.europa.eu/transport/themes/its/road/action_plan/index_en.htm*

vehicles). Where more alternatives to the private car exist, the arguments for travel behaviour change are both more varied, and in theory more persuasive. However, in our preliminary investigations we have ascertained that whilst there is a great deal of effort being put into behaviour change campaigns, much less is known about the effectiveness of such campaigns, particularly in relation to the messages (arguments) that are being promoted to the public (Pangbourne & Masthoff, 2015; Davies, 2012). Nevertheless, small-scale voluntary travel behaviour change programmes appear to have achieved some success in demonstrating that personalised "encouragement, motivation and information" (Rocci, 2012) does result in an increase in the use of more sustainable transport alternatives.

Therefore, if people can be persuaded to modify their habitual behaviours, to choose to use more sustainable transport modes where those are available, then real improvements in the environment can be achieved. To achieve this requires three important factors to be taken into account. Firstly, how to effect lasting behaviour change, in this case we see argumentation-based interaction as a key factor that will enhance the effect of existing digital behaviour change approaches. In section 4.1 we survey current approaches to behaviour change and make the case for argumentative interaction as a key enhancement to those approaches. Secondly, how to effect such behaviour change at scale. We propose that behaviour change supported by digital technology, particularly mobile digital devices, is a way to scale behaviour change to societal scope. Mobile devices such as phone and tablets have achieved high usage within much of western society. These devices usually contain high fidelity sensors which can, with the owner's consent, track behaviour, as well as provide increasingly powerful computational resources to underpin intelligent decision-making software. Such devices therefore offer an unparalleled opportunity to place a behaviour change assistant in the pockets of everyone. We discuss some of the issues associated with this approach in Section 4.2. Finally we must collate sufficient resources, in this case arguments, to populate an autonomous argumentation system and to enable such a digital behaviour change support system to act sustainably within the problem domain.

A preparatory step in developing an argumentation system that targets a specific problem domain is the acquisition, structuring and preparation of useful domain-knowledge. It is this knowledge acquisition step upon which we focus in the core of this paper and which is detailed in Section 3. There have been many public awareness campaigns and communications over the last few decades which have aimed to change personal transportation habits, for example,

encouraging cycle use or discouraging car use. These campaigns often reduce the message to the level of a slogan, removing nuance that might otherwise make a developed argument more persuasive. We have collated motivational messages and argumentative communication from a large number of existing sustainable transport communication campaigns deployed around the world. These messages have, where necessary, been treated as enthymemes and have been reconstructed to instantiate unexpressed premises and conclusions. The resulting arguments have been subjected to a scheme oriented analysis to yield more complete argument resources that include consideration of critical questions and the ways in which the argument might be responded to. By reconstructing these arguments and storing them in a reusable way using the Argument Markup Language (AML) and Argument Interchange Format (AIF), we have been able to construct a corpus, that we name the Sustainable Transport Communication (STC) Dataset, which can be explored using appropriate interaction techniques, and whose elements can be framed and presented in the most strategically appropriate way, given consideration of the specific person and the behaviour that is being targeted. This builds on the approach identified in (Reed & Wells, 2007) in which the knowledge bases of agents within a Multi-Agent System (MAS) were populated using AML structures to provide both knowledge and argumentative relationships between items of knowledge. In (Reed & Wells, 2007) it was demonstrated that dialogues generated from such a knowledge base can appear to be realistic. Interaction with argument structured knowledge bases, mediated by dialogue games such as those described in (Wells & Reed, 2012) and collated in (Wells, 2012), thus provide a way to approach natural-seeming mixed initiative interaction even in the absence of more complex strategic capabilities.

We propose that to effect lasting behaviour change, the recipient must make an informed decision about their behaviour and the habits that they wish to change. Non-permanent behaviour change could occur through happenstance, the participant tries something different for no apparent reason, or trickery, the participant does something different because it is made easier to perform the new behaviour, or bribery, the participant is offered some incentive to alter their behaviour. However lasting and persistent habit formation will occur when a person understands the context in which their behaviour must change and can fall back upon their personal reasons for doing so, especially if the old habits are difficult to break or the new habits are difficult to form. Additionally it is also important to recognise that for a person to change their established habits is difficult and that they need to be supported in forming new and different habitual behaviours; behaviour change,

especially in difficult problem domains does not easily occur in a vacuum but can require external support. Whilst behaviour change theory can provide relatively rich psychological models, particularly of the process that underpins how new behaviours are formed, it is argumentation that can provide well developed models of (1) dialogical interaction, (2) reasoning, and (3) supporting knowledge representation. Together these will enable effective and repeatable behaviour change in targeted problem domains like sustainable transport. Whilst behaviour change provides mechanisms for supporting the formation of new habits, for example, through the use of targeted interventions and challenges, argumentation provides the mechanisms for ensuring that a person is making an informed choice and has established a personal justification for why they are performing such a difficult task. It is the person deciding to make an informed and justifiable choice, to change their behaviour, that is a key aspect to effecting long lasting behaviour change. Additionally, to achieve this kind of behaviour change at scale requires the adoption of digital technologies and the use of personalised and appropriate interaction techniques to ensure that arguments are both selected and framed so as to be as effective as possible for the given person. Our eventual aim is to use arguments to increase motivation, to use dialogue to interact with users, and to adapt the rich range of argumentation schemes and dialogue models to work with behaviour change theories.

3. THE STC DATASET

In this section we describe the STC dataset.

In subsection 3.1 we describe the data collection process which is available as a Git repository[4] or as a citeable snapshot via DOI[5]. In 3.2 we describe how the data and associated metadata that comprise the dataset are stored, in subsection 3.4 we summarise the contents of the data set, and in subsection 3.3 we describe how we have aimed to construct a reusable data resource by adhering to current best practices for data release.

The dataset has been released in two modes, firstly as a Git repository shared publically using the GitHub site[6] and secondly as an archived release that has been uploaded to the Figshare site[7].

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[4] *https://github.com/siwells/STCD*

[5] *http://dx.doi.org/10.6084/m9.figshare.1386856*

[6] *https://github.com/*

[7] *http://figshare.com*

Git is a version control system for software development that has become very popular and is used for many large software development projects including the Linux Kernel. Because Git primarily tracks changes to plain text files it is equally well suited to maintaining text-based datasets as software source code. Each change to the dataset, for example, addition of a new resource or updated metadata, is known as a commit and a cryptographic hash is made of each commit so that every change is tracked in a reliable way and so that every earlier commit can be retrieved. The author of each commit is also tracked within that commit so that a history of the dataset is available, viewable, and navigable with respect to what changed, who changed it, and when this occurred. This system also supports trivial branching to create alternative versions of the dataset for experimentation, distribution so that many people can work concurrently on the dataset, and good tooling for merging the results back into a single canonical repository for the dataset. Starting from the initial commit, all subsequent branches and commits form a distributed and cryptographically verifiable connected directed graph of commits which can be recombined in a variety of ways to suit the needs of the user. For our purposes, Git provides history and versioning for the contents of the dataset, enabling the data to be mutated and reused whilst tracking every change that occurs and allowing subsequent changes and updates, as well as the provenance of the changes and updates, to be tracked.

Figshare is a web site that enables research outputs to be allocated a Digital Object Identifier (DOI) and shared in a freely available manner. Subsequent downloads and citations are tracked and metrics can be retrieved from the site. As data reporting is handled by a third party this makes the provenance of metrics associated with dataset uptake more objective and reliable than if the data were hosted by the originators of the dataset, subject to the usual caveats related to the potential for gaming online metrics and so-called alt-metrics.

By adopting both approaches, using Git and Figshare, we are able to provide a versioned and manageable working dataset alongside defined releases which are allocated a DOI and are subject to citation tracking. This enables us to satisfy some of the best practices laid out in section 3.3. The strategy for deciding on a release is that, minimally, any publication based upon the dataset should define a specific release that can be cited by DOI. Any subsequent work that builds upon that publication can thus confidently reuse the data associated with that publication in a form that is both reproducible and replicable. Between publications, the dataset will continue to grow and potentially bugs or incorrect data will be fixed. However this will occur in a manner that

allows all previous versions of the dataset to be recovered, and for the dataset itself to be mutated to suit the needs of specific experiments.

3.1 Data Collection

The raw data that forms the basis for the STC dataset was collected during 2014 and 2015 from publically accessible UK based websites associated either with public transport authorities, news organisations, green travel, or environmental awareness groups.

A key question in corpus building concerns the representativeness of the data. Whilst some of the data related to the STC dataset is presented within this paper and associated dataset release, the dataset is far from complete and currently merely serves to collate a variety of arguments that can be found in the wild. One measure of whether an argument corpus can be said to be tending towards completeness could be when the number of new arguments falls toward zero as new resources are added, e.g. new resources incorporated within the dataset merely tend to repeat or rephrase arguments that already exist within the dataset. We are not at that stage yet. An alternative approach might be to exhaustively analyse some of the collections of case studies that now exist. With the EU's interest in sustainable and smart mobility a number of resources have been built that collate English language case-studies of various sustainable transport initiatives that have occurred within the European context. For example, the ELTIS urban mobility observatory[8] maintains a large collection of urban transport and traffic management case studies that could be argued are representative of the European-wide sustainable urban transport context, but unfortunately these are not publically available and the general public, in the role of travellers, are not the targetted audience. For the moment however the STC dataset should be treated as a living resource that will grow over time.

3.2 Data Formatting & Handling Procedures

For each resource that is identified for inclusion a new resource folder, is created in the dataset repository under the resources folder.

Each resource folder is named according to a URI[9] for the resource. All current resources have been sourced online and thus their

[8] *http://www.eltis.org/*

[9] For more information about URI syntax see RFC-2986: *http://www.rfcbase.org/rfc-3986.html*

URLs have been used. Into this folder are placed, minimally, the non-optional artifacts from the following list:

1. A single UTF8 plain text file representing the argumentative text of the entire resource prepared for argument analysis using the Araucaria software.

2. Araucaria Analysis saved into both AML and AIF files named analysis.aml and analysis.aif respectively.

3. (Optional) Annotated/extended text to show placement of graphics, pictures or animations/videos for subsequent contextual analysis of non-textual aspects of the presented arguments.

4. (Optional) Additional notes regarding the resources stored in a single UTF8 plain text file.

5. (Optional) Screen shot of the resource in situ (so that the analysis can be revisited to see the resource in the way that it was presented). Screenshots must be archived as PDF or PNG files, named resource.pdf or resource.png, and at a resolution that means text is easily legible.

6. Metadata: Stored in a single UTF8 plain text file named metadata.txt the contents of which are quoted key:value pairs which can easily be converted by script into JSON format by converting the pairs into a comma separated list and enclosing everything in curly brackets. This means that it is a simple matter to load all metadata into a JSON-based, document-oriented, NoSQL database for further processing.
    a. Global Unique ID (GUID) generated using a standard tool[10] e.g. **"guid":"580e0d27-3cc2-41f7-97cb-98631a3832e2"**
    b. (b) Date and time of collection in ISO-8601 format, e.g. **"datetime":"2015-04-12T13:00:28+00:00"[11].**
    c. (c) Location of original resource (URL, URI, DOI as suits the resource). e.g. **"url":"*http://www.transportscotland.gov.uk*"** NB. If a URL is used then it is assumed that the URL is navigable so that updated resources can be retrieved using automated tools and scripts. A DOI should include only the identifier portion, scripts should

[10] The following Python one-liner will generate a new globally unique ID (GUID) each time it is run:

$ python -c "import uuid; print uuid.uuid4()"

[11] The following Python one-liner will generate the current time in ISO 8601-format:

$ python -c "import datetime; print datetime.datetime.now().isoformat()"

add the DOI resolution part to form a complete URL. If a URI is used then no assumption is made that the resource indicated is necessarily navigable.

It should be noted that because Araucaria has been effectively abandoned by its original developers and no longer compiles for modern versions of Java, but is available under the GPL, a new version was bug-fixed and built and the fixed version made available from GitHub[12].

3.3 Best Practises for Working With Datasets

In the past it has been sufficient for a dataset to be merely zipped up and deposited on an institutional website, if it has been made available at all, and often on the personal page of a researcher, and subject, in the longer term, to so-called linkrot.

More recently there have been efforts to make such data more accessible, for example, by providing web interfaces to databases that can be accessed online as exemplified by the AraucariaDB which ran from circa 2001 until it was subsumed into the ArgDB[13]. More recently the idea of data as a citable academic output has gained traction, with impetus particularly from the Biological and Physical Science community that has given rise to the concept of the data journal[14] and increased requirements from funding agencies for open and reusable data from experimental research. In response, efforts have been directed at ensuring that data is appropriately managed in order to support optimal reuse. In (de Waard, 2014) a hierarchy of aspects associated with optimal data reuse is identified which are summarised, along with how we addressed them, as follows:

Preserved *Existing in some format* - We selected the Argument Markup Language (AML)(Reed and Rowe, 2001) in the first instance which can be trivially converted to the Argument Interchange Format (AIF)(Chesnevar *et al.*, 2006). The choice of AML over AIF was due to the simplicity of AML and the option to 'upconvert' the data to AIF if necessary. We adopted the principle of only using a format that is as complicated as necessary for the primary representation of data. Subsequent reuse may, of course, require additional processing in order to address specific questions but that might be from AML into any

[12] *https://github.com/siwells/monkeypuzzle*

[13] *http://www.arg.dundee.ac.uk/AIFdb/search*

[14] *http://www.nature.com/sdata/*

number of other suitable formats so beginning with the simplest machine-readable format for data representation was a pragmatic choice. Whilst plain text would be simpler, the goal of eventually reusing this dataset as knowledge within intelligent agents means that the starting format should at least be in a markup language that is easy for both machines and humans to read and use.

Archived *Existing in a long-term durable format* – Each resource is stored as plain-text files using UTF-8 unicode character encoding[15]. By taking this approach we obviate the need to provide virtual machines or similar in order for basic data to be read or otherwise manipulated. The AML format itself has also existed for around fifteen years and is well documented. Because AML is an XML language, the DTD for the format itself is also included within the Git repository. Additionally, by using Git, any source code that manipulates the basic data can also be included within any distribution of the dataset, thus leading towards increasingly reproducible research.

Accessible *Available to others, other than the researcher* - The dataset has been publically released under permissive licensing in two primary locations. Consumers of the dataset who use the Git repository, particularly those using the Github releaase, can optionally request for their alterations or branches to be included in the core branch.

Comprehensible *Understandable by others* - All formats used to represent data within the repository are either international standards, e.g. UTF8 plain text, or else based on well documented and stable data formats, e.g. Portable Document Format (PDF), AML. Where possible information for recreating readers for the data has been included.

Discoverable *Can be indexed by a search engine* - Both the GitHub and Figshare sites are indexed by Google and other search engines which means that they can be serendipitously discovered.

Reproducible *Others can reproduce the experiment* - The STC dataset is not related to an experiment but where possible sufficient metadata for each resource that comprises the dataset has been recorded to enable the dataset to be rebuilt from first principles. In addition screenshots of original resources are included to provide additional contextual information about how the data was originally presented.

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[15] http://www.unicode.org/versions/Unicode6.0.0/

Trusted *Provenance known* - Whilst the data has been collated by researchers who are publically active within both the argumentation and transport fields and employed by UK higher education institutions, this argument from expert opinion is not alone sufficient to ensure the provenance of the data. In addition the data that comprises the STC Dataset has been collated from public resources, which can all be verified by visiting the original URLs and the metadata is structured in such a way that retrieving the original data and reconstructing the dataset from first principles could be automated. However, because much data that is publicly available on the web is transient, is often never archived and may disappear, screenshots of the original data resources in context are included within the dataset.

Citable *Able to link to dataset and track citations* - The public instances of the dataset, at Github and at Figshare can be linked to, for example, using hyperlinks. Furthermore, objects stored at Figshare are allocated a DOI which makes the citation of specific snapshots a trivial and straightforward task.

Usable *Allow tools to run over the data* - The dataset is amenable to processing by any number of text-based, and other, tools, for example Python scripts. Furthermore, the licensing used specifically allows the dataset to be mined. The adoption of Git makes it a straightforward task for a researcher to gain access to their own complete copy of the dataset

Integrated *Upstream and downstream align* - The authors believe that their approach as outlined in the preceding steps means that all aspects of the best practices proposed in (de Waard, 2014) have been satisfied as well as can be expected.

In producing and publishing the STC dataset we have aimed to satisfy as many of these requirements as are practicable.

3.4 Summary & Preliminary Analysis of the Data

At time of writing the STC Dataset contains greater than sixty resources gathered from a range of public-facing websites.

Whilst building this collection a number of features were noted that recur across the sources of data; the use of population segmentation by transport type, the use of testimonials, the use of devil's advocate questions, use of non-argumentative behaviour change interventions, and the use of blog posts.

Population segmentation by transport type is when the messages are split into groups that are directed towards users, or potential users, of particular transport modes, for example, grouping together messages about cycling on one pages and messages about car-sharing on another. Frequently such approaches occur with a matching of both transport modes and life-style preferences. For example, messages about cycling are frequently associated with health benefits. Segmentation occurs frequently and is a feature of campaigns that (1) focus on increasing sustainable transport, and (2) target multiple transport modes.

Testimonials are frequently used to convey a more personable face associated with sustainable transport rather than just the plain facts. Usually these are either aspirational, of the form "I am fed up with x and desire to do y because z" or else are from people who have successfully altered their behaviour and are now advocating the change with messages that typically have the form "Since I started doing x I have seen benefits y because z".

Slightly less popular are the use of devil's advocate questions. A good example of this approach comes from the Walkit urban walking route planner site[16] which poses some tougher questions associated with walking in which the answers are more argumentative and presumptive, for example, "The tube or bus will run anyway, so does walking really save carbon?". It can be assumed that the authors of such communications wanted to aim for honesty, they don't have the answers, but also that in asking for the recipients position, they are prompting people to think, and it is self-reflection that is a critical but often overlooked aspect of persuasive communication.

Many communications also incorporate challenges that are typical of behaviour change theory, e.g. try out walking to work during the "Walk to Work Week"[17] but interleaving the challenge with reasons and argumentation for why the target of the communication should try it.

Finally, on platforms that are generally not associated directly with transport providers there are often blog posts that contain more in depth argumentation with respect to topics in sustainable transport. These provide more reasoned and better framed prose associated with transport behaviours that underpin the, more brief, advertising messages of many campaigns.

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[16] *http://walkit.com/going- green/*

[17] *http://walkit.com/walking- to- work/walk- to- work- week/*

In addition to the aforementioned features, early analysis of individual statements within the corpus has also given rise to a number of preliminary findings. For example, as a rule the statements used are either positive or neutral in tone rather than negative. In addition nearly all statements are couched in terms of a shift of transport behaviour to a suggested mode. The only occasions when a mode is suggested as one that should be moved away from is when the mode is the car. This is of course excepting car shares, car-pooling, and taxis.

Of course the real test is to determine which presentational approaches and which arguments work best for a given individual. In the remainder of this paper we focus on technical preliminaries necessary to enable us to usefully tackle this question.

4. TOWARD SUSTAINABLE BEHAVIOUR CHANGE AT SCALE

The work thus far reported forms only our attempts to skirt the traditional AI knowledge acquisition bottleneck (Forsythe & Buchanan, 1993) by building a foundational knowledge base.

In this section we explore the roles of arguments and dialogue within models of behaviour change, before sketching a scenario of using mobile devices, behaviour management techniques, and arguments to effect large scale behaviour change.

4.1 Behaviour Change Models

There are two main approaches to behaviour change based upon the psychological models devised by Michie (Michie et al., 2011) and the digital behaviour change, or captology, models due to Fogg (Fogg, 2003).

Michie's approach may be applied in the presence of absence of technology and deals with habit forming behaviours whereas Fogg's approach is predicated on the mediating role of digital technology in providing a trigger for behaviour change.

Fogg's Captology is an approach to building persuasive technology that is based in a presumptive model of behaviour change. In the presence of *Motivation,* the desire to achieve something, *Ability,* the capacity to perform the behaviour, and a *Trigger* or facilitator, then changes in behaviour may occur, such that $M + A + T$ = *behaviour change is more likely to occur.* Additionally, the intersection of motivation and ability form an action line along which the behaviour occurs. The curve of the action line defines how a highly motivated person is able to perform hard tasks whilst a person with low motivation can perform easier tasks. There is a tension between motivation and ability such that in order to give a targeted behaviour change an increased chance of

success, either the task must be made easier or else the participants motivation must be increased. Michie's approach use a similar but slightly different presumptive model in which behaviour change occurs in the presence of the correct levels of *Capability, Opportunity* and *Motivation* such that C+O+M → B. This approach is known as the or COM-B model of behaviour change (Michie et al., 2011).

There are many common elements between Michie and Fogg's approaches. Capabilities, and abilities are obviously similar, and opportunities and triggers are related, although in Michie's approach, opportunity relates more to the circumstances in which the behaviour occurs whereas Fogg's triggers relate more to a technological action, the trigger, which causes the behaviour to occur. Both models also recognise motivation as a significant attribute of the behaviour change process. Motivation should however be viewed as critical when addressing the question of how to effect lasting behaviour change rather than mere incidental or "triggered" behaviour change. In the presence of both capability and opportunity, or ability and a trigger if you are that way inclined, a person who is not motivated will likely not perform the behaviour anyway, and even if they do then they are unlikely to do so enough for the behaviour to become habitual. However a motivated person is both more likely to overcome questions of ability, but is also more likely to effect behaviour change that is sustained over the long term.

The problem with both the Fogg and the Michie approaches is that they are predicated on a sufficient level of motivation existing in order to facilitate the behaviour change but neither model provides practical and replicable mechanisms for increasing motivation and therefore increasing the likelihood of a resultant behaviour change. This suggests a role for argumentation, and particularly strategic argumentative dialogue, within behaviour change. At this point we should also note that a person may not even be sufficiently motivated enough to listen to the arguments or engage in dialogue. Behaviour change, particularly societal behaviour change that seeks to change the habits of large numbers of people does not occur in isolation but as a part of a multitude of both independent and complementary practices. For example, governmental policy and public information campaigns often raise awareness of issues, laws may be introduced to curb the worst excesses of specific behaviours, and people often recognise either individually or within their social groups that particular behaviours are problematic. It is therefore pragmatic to assume a form of social diffusion; social norms can and do shift as a result of both local and national political will, the actions of opinion formers, and issue awareness amongst affected communities. Against this background,

whilst there will always be some recalcitrant groups, awareness is raised over time and people will either self-select to find out more and tackle problem behaviours or else will be forced, through personal crisis, to engage with some form of behaviour change. Whilst this process has historically been *ad hoc* behaviour change theories and particularly digital technology supported approaches seek to make behaviour change directed, predictable and repeatable.

However, it is unethical to seek to change a person's behaviour without their informed and active consent. Informed choices are made in the presence of sufficient knowledge. Dialogue is a good mechanism for increasing a person's knowledge about the context of their behaviour and argument is a good way to structure information related to the justification of positions. Thus the assumption can be made that for behaviour change to be sustained then a person must be able to make informed choice about their behaviour. Behaviour change must be a conscious and deliberative process, not a side-effect of rote, Skinner-box style mechanisms. We conjecture that informed consent, based upon increased knowledge and capacity for decision making, is likely a contributing factor to longer term behaviour change. By engaging in motivation building processes, which increase both a person's knowledge and their abilty to reason with that knowledge, a person is more likely to decide to change their behaviour, to do so for identifiable, enumerable, and justifiable reasons, and for the change to be lasting.

To achieve this we extend the Michie and Fogg approaches by incorporating argumentative interaction as both an important, motivation building, early step in behaviour change, but also as an important process sustaining activity. This step should occur early in the behaviour change process, before such techniques as goal setting and review, monitoring and feedback, comparison and ranking, or prompts and personalisation are applied. In summation, current behaviour change theories incorporate well developed models for managing behaviour but practical techniques for achieving behaviour change are less well developed and usually involve rudimentary forms of information-seeking and persuasive dialogue type interactions that are more highly developed within argumentation theory. Instead, the rich psychological models of behaviour change should be augmented with arguments aimed at increasing motivation, and dialogue to increase engagement and investment.

4.2 Scaling Behaviour Change using Mobile Devices

It should be noted that behaviour change deals with people in the real world whose decisions can often be characterised as messy, wrong,

unjustifiable, or unreasonable; often behaviour exhibits all of these characteristics simultaneously.

Consequently, no single approach can be guaranteed to be successful in altering the behaviour of an individual. As a result multiple techniques must often be combined, for example, within the EU FP7 funded SUPERHUB project a variety of behaviour change techniques were deployed (Forbes et al., 2012), (Gabrielli et al., 2014), (Gabrielli et al., 2013a), (Gabrielli et al., 2013b) with the aim of effecting behaviour change in large overlapping groups of users and encouraging them towards more sustainable travel habits. One to one support has also been shown to vastly improve the success of behaviour change interventions, for example, the smoking cessation nurses used by NHS Scotland and the personal sponsor systems used by twelve step programs, but at great expense in terms of time and/or money. However when the scope of a behaviour change intervention encompasses a city or nation, then such levels of support become untenable and scaling up successful behaviour change interventions becomes a massively expensive proposition.

The advent of, and increasing penetration within society of mobile digital devices suggests one way to target behaviours and support behaviour change at scale. By incorporating intelligent software digital agents into mobile apps for popular phones, behaviour change support can be brought to the masses. However, if a person does not wish to install such software then they risk being missed. A solution to this was also proposed in the SUPERHUB project (Forbes et al., 2012), instead of getting people to opt directly for behaviour change software, they were offered journey management software that was of standalone benefit and which could better solve their personal journey planning problems. However this software also incorporated functionality that provided personalised travel recommendations, it learnt about the individual user and their travel habits, as well as incorporating some behaviour change techniques to attempt to influence the uptake of more sustainable travel choices. Unfortunately this system did not incorporate argumentative capability aimed at increasing the motivation of users to engage with the behaviour change functionality so an opportunity was missed. Whilst SUPERHUB had missed opportunities it did demonstrate how personalisation, behaviour change interventions, and gamified interactions (Wells et al., 2014) could be combined with more mundane journey planning functionality to form a compelling if incomplete behaviour management system.

5. FURTHER WORK & DISCUSSION

There are a number of directions for further work.

One of the drawbacks of analysing existing persuasive communication from sustainable transport campaigns is that there is no data about how the campaigns performed and there is no data that sheds light on whether a given communication campaign had objective effects on the behaviour of individuals who were exposed to it. Similarly there is no data about how individuals react to the individual messages and arguments that are communicated. Additionally there is no data about how the persuasive weight of individual communications is altered by the way in which they are presented. We plan therefore, subject to the vagaries of research funding, to engage in user centred evaluations of the arguments within the STC dataset. It is assumed that individuals will respond differently and that categorising individual, for example using Annable-style user segmentation techniques (Annable, 2005) which build on an expand theory of planned behaviour (Ajzen, 1991) to identify and group different kinds of user and correlating those segments against more and less successful communications from the dataset will provide a mechanism for strategic interaction, enabling more successful arguments to be deployed as required to maximise the motivation building phase of behaviour change.

6. CONCLUSION

We have presented some preliminary results of a survey of persuasive communication from public websites within the sustainable transport domain alongside an approach to storing, sharing and reusing argumentation corpora in a manner that is current best practise.

This dataset however is only a preliminary step in a more ambitious plan for applying argumentation concepts within sustainable transport communication. To this end the major contribution of this research has been to underpin existing motivational and behaviour change communications within the sustainable transport domain with elements of a solid argumentation theoretic foundation.

REFERENCES

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211.

Annable, J. (2005). 'Complacent car addicts' or 'aspiring environmentalists'? Identifying travel behaviour segments using attitude theory. *Transport Policy*, *12*, 65–78.

Chesnevar, C., McGinnis, J., Modgil, S., Rahwan, I., Reed, C., Simari, G., South, M., Vreeswijk, G., & Willmott, S. (2006) Towards an argument interchange format. *Knowledge Engineering Review*, *21*(4), 293–316.

Davies, N. (2012). What are the ingredients of successful travel behaviour campaigns? *Transport Policy*, *24*, 19–29.

de Waard, A. (2014). Ten habits of highly effective data. In *Proceedings of the AAAI Discovery Informatics Workshop*.

Fogg, B. J. (2003). *Persuasive Technology: Using Computers to Change What We Think and Do* (Interactive Technologies). Morgan Kaufmann Publishers.

Forbes, P. J., Wells, S., Masthoff, J., & Nguyen, H. (2012). Superhub: Integrating behaviour change theories into a sustainable urban-mobility platform. In *BCS HCI Workshop on Using Technology to Facilitate Behaviour Change and Support Healthy, Sustainable Living*.

Forsythe, D. E., & Buchanan, B. G. (1993). Knowledge acquisition for expert systems: some pitfalls and suggestions. Chapter in *Readings in knowledge acquisition and learning: automating the construction and improvement of expert systems* (pp. 117–124). Morgan Kaufmann Publishers Inc.

Gabrielli, S., Forbes, P., Jylha, A., Wells, S., Siiren, M., Hemminki, S., Nurmi, P., Maimone, R., Masthoff, J., & Jaccuci, G. (2014) Design challenges in motivating change for sustainable urban mobility. *Computers in Human Behavior*, *41*, 416–423.

Gabrielli, S., Maimone, R., Forbes, P., Masthoff, J., Wells, S., Primerano, L., Pompa, M., & Haverinen, L. (2013). Co-designing motivational features for sustainable urban mobility. In *Proceedings of the ACM SIG-CHI Conference on Human Factors in Computing Systems (CHI 2013)*.

Gabrielli, S., Maimone, R., Forbes, P., & Wells, S. (2013). Exploring change strategies for sustainable urban mobility. In *Proceedings of the Designing Social Media for Change Workshop*.

Howarth, C., & Riley, T. (2012). A behavioural perspective on the relationship between transport and climate change. Chapter in *Transport and Climate Change, volume 2*, (pp. 261–286). Emerald Group Publishing Limited.

Lanzendorff, M. (2014). The black spot of policy evaluations: Social change and mobility 2.0. In *Proceedings of the Royal Geographic Society Annual International Conference*.

Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel. *Implementation Science*, *6*(42).

Pangbourne, K., & Masthoff, J. (2015). The message is the medium - influencing travel behaviour change using persuasive techologies. In *Universities Transport Studies Group annual conference.*

Reed, C., & Rowe, G. (2001). Araucaria: Software for puzzles in argument diagramming and xml. *Technical report, University Of Dundee*.

Reed, C., & Wells, S. (2007) Dialogical argument as an interface to complex debates. *IEEE Intelligent Systems Journal: Special Issue on Argumentation Technology*, *22*(6), 60–65.

Rocci, A. (2012). Encouraging changes in travel behaviour towards more sustainable mobility patterns: the role of information. Chapter in *Transition towards sustainable mobility: the role of instruments, individuals and institutions*. Ashgate.

Wells, S. (2012). Collation of formal dialectical games from the literature. *Technical Report UOD-SOC-2012-001*, University of Dundee.

Wells, S., Kotkanen, H., Schlafli, M., Gabrielli, S., Masthoff, J., Jylha, A., & Forbes, P. (2014). Towards an applied gamification model for tracking, managing, & encouraging sustainable travel behaviours. *EAI Endorsed Transactions on Ambient Systems*, *14*(4).

Wells, S., & Reed, C. (2012). A domain specific language for describing diverse systems of dialogue. *Journal of Applied Logic*, *10*(4), 309–329.

Commentary on Wells and Pangbourne's Using Argumentation within Sustainable Transport Communication

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1. INTRODUCTION

The project reported by Wells and Pangbourne offers an important case for reflecting on the relationship between design and argumentation. Their project seeks to integrate computation and argumentation to develop means to cultivate behavioral change in transportation behavior that in turn fosters sustainability. It is a project with big aspirations, which is appropriate because transportation and sustainability are big, wicked problems that require commensurate ambition. Their report focuses on the project aims and plans, and thus offers insights into some kinds of contributions a design stance toward argumentation research could deliver. A design stance seeks knowledge through interventions and inventions, which is different from but complementary to empirical and critical investigations more common in argumentation theory and research (Jackson, 2015). These comments first highlight key design elements of the project and then reflect on design for argumentation and ways in which design projects, such as the one proposed by Wells and Pangbourne, could deliver for argumentation theory and practice in big ways.

2. ARGUMENTATION AS MEANS FOR CHANGE

The project describes a plan for inventing a computational means to intervene on the way people think and talk about their transportation behaviors. The aim was to build a system that could support how individuals develop their reasoning about transportation choices and actions so as to decrease carbon emissions and traffic congestion.

One key design element of the project was the use of argumentation theory to assess the context of intervention for constraints and opportunities. Within the larger context of

D. Mohammed & M. Lewiński (eds.) (2016). *Argumentation and Reasoned Action: Proceedings of the 1st European Conference on Argumentation, Lisbon, 2015. Vol. I, 803-806.* London: College Publications.

transportation and sustainability, the project locates a problem and opportunity in supporting behaviour change. Prior approaches focused solely on the development of persuasive messages, while argumentation theory pointed to the need for external support of change. The project planners drew upon the insights about dialogue, reasoning, and knowledge representations as basis for designing behavioural change support. From argumentation theory, the planners also developed a design hypothesis that the intervention should support behaviour change as informed consent and grounding in justifications.

A second key design element was the use of argumentation theory to develop and shape the communicative materials. On one hand this involved collecting examples of how transportation choices and behaviour are reasoned about to identify the variety of justifications people use. That corpus required coding to differentiate the messages and labelling to make the examples searchable and retrievable by a computer. This resulted in an initial corpus that provided a knowledge base about how people reason about transportation choices and behaviour.

A third key design element was the proposed personalization of the intervention. The intervention sought to make the rationales for sustainable transportation choice part of the journey management software people use on the computers and smartphone applications. Rather than requiring people to choose to engage the behavioural change intervention, the proposal was to more subtly incorporate it into an ongoing, more routine technology use.

3. DESIGN AS A WAY OF KNOWING

The sustainable transport communication project reveals a puzzling dimension of designing communication: the object of design is not simply the system, technology, or language-use, but communication. As Lyytinen (1985, p. 61) put it long ago: “The very idea of an information system, however, is to provide a means and an environment for human communication." The aim of interventions and inventions is to make communication possible that was previously difficult, impossible, or unimagined (Aakhus, 2007). The three key design elements described above point to the relationship between the design of digital and computational artifacts and the construction of communicative contexts. An essential aim of the project is for users to experience interaction in making transportation choices.

Attempts to invent and intervene require generating hypothesis about how the arrangement of interaction and language-use can foster some qualities of communication while downplaying others. The

transport project had developed particular ideas about how communication works and how it ought to work by using argumentation theory to critique given theories of change and propose new ways forward. The artifacts and systems developed embodied hypotheses about communication that could be tested against the realities of the setting and whether the context could be shaped or disciplined in a particular way. Presumably the artifacts and systems will be revised and developed based on how they work. It will be in the iterative development of artifacts/system and procedures of implementation that knowledge about realizing contexts that support new habit formation will be built.

What is noteworthy about design is that it is a way of knowing. Knowledge is built in, and expressed through, interventions and inventions. While the transportation communication project report focused on its direct design task, it also suggests some further ways in which design can contribute to building argumentation theory and practice.

First, the project suggests a bottom up method for changing practice by changing argumentation. Argumentation research is typically interested in describing the broad discourses and micro-discourse practices people engage in or criticizing those uses. The proposed collection, storage, and re-use of transportation argumentation illustrates a both-and strategy regarding broad discourses and micro-discourse practices as the corpus reflects both. By making the corpus a resource for individuals to invent rationales for new behaviour, the project suggests how information infrastructures are generative of action and communication and not merely repositories. This generativity is made possible because both macro and micro aspects of discourse are available and descriptive and critical uses of that discourse are made possible.

Second, the project suggests how theories of reasoning and persuasion are built into the information and communication technologies and infrastructures. The proposed expansion of the rational model of behavioral change by incorporating common insights from argumentation theory changes the technology from persuasive to reflective. The approach highlights the possibility for participants to engage the very communicative conditions that make their current behaviour rational. The building of the corpus and its means of use scaffolds participation that could become reflective of the argumentative patterns and structures in the corpus to the point that they participate in constructing new patterns and structures for reasoning about the domain represented by the corpus.

Third, the project suggests that argumentation research could be in for a big change if it can further embrace architectures for collecting, storing, retrieving, and sharing that enable large research projects. The current state of the art in scholarly exchange are conferences where participants report on work they have completed elsewhere at another time. The format facilitates a kind of interaction and exchange that is very important but that has not leveraged the collective intelligence of the broad field. By and large, current scholarly exchange preserves the various camps that have developed around particular theories and modes of analysis. Architectures, such as illustrated in the sustainable transport project, can enable entirely new ways of scholarly engagement. For instance, by building large repositories of arguments it becomes possible to test the implications of the perspectives of various camps against each other relative to grand challenges. The perspectives and methodological strategies for description, analysis, and invention of the various camps could be compared relative to common data and common goals. Moreover, it would be possible to discover the actual unique contribution of each perspective relative to the common contributions across perspectives.

REFERENCES

Aakhus, M. (2007). Communication as design. *Communication Monographs*, *74*(1), 112–117. doi:10.1080/03637750701196383.

Jackson, S. (2015). Design thinking in argumentation theory and practice. *Argumentation*, *29*(3), 243–263. doi:10.1007/s10503-015-9353-7.

Lyytinen, K. J. (1985). Implications of theories of language for information systems. *MIS Quartely*, *9*(1), 61–74.