A design for life

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The social, ethical, legislative and business cases for products, services and environments that are accessible and inclusive are well established. Yet, ‘good design’ is perhaps not as common as it might be, with many products being designed without due care and attention to the needs of all users. However, practitioners (designers, ergonomists, transport or urban environment planners etc.) are increasingly ‘on board’ with this need and so what then leads to designs still being produced that incorporate short-sighted and exclusive decision making?

The complexity of design should not be underestimated and often designers are managing a complex array of stakeholder requirements. Some requirements may be conflicting and demand different directions for the design. Essentially what is required is more support for these practitioners in ways to identify, understand and accommodate the needs, desires and aspirations of as many users as is possible.

With this in mind the Design Ergonomics Group in the Department of Design & Technology at Loughborough University has been researching into means to provide this support. As part of the AUNT-SUE project (see www.aunt-sue.info) and funded by the Engineering and Physical Sciences Research Council (EPSRC), Loughborough have developed a number of tools centred around providing a better understanding of the variability in people, but also in fostering empathy with those who are being designed for.

The research has identified two main issues. Designing to be accessible and inclusive can be difficult when access to data on people is limited. At a basic level, most easily available data is relatively old and so of questionable relevance today, in addition most of the data are constrained by how they were collected and presented, focused more on the data themselves than how they may be applied. In addition, existing data sources are rarely representative of the needs and capabilities of people who are older or disabled. Also, even with access to appropriate data, existing data tools are often not in a format or language that designers can access, relate to, or apply easily.

What (or who) is HADRIAN?

HADRIAN is a software database of 103 people, with an age range of 18-89 years, and including 59 people with a broad range and severity of disability. The data in the database are presented in a highly visual manner and comprise a broad range of body size, shape, joint range of motion, and task based capability. In addition to physical information, the HADRIAN Database includes a wide range of data about behaviour, and lifestyle, both at home and out and about. The data can then be explored in a number of ways depending on the needs of the user, including disability and demographics, anthropometry, behaviour and emotion, transport use and so on. Presenting the data in this manner and allowing the exploration of individuals within the database provides empathy with the people being designed for. Practitioners are presented with a data-driven description of a very broad range of people, are able to watch video clips of those people performing tasks to understand their abilities but also to understand how the tasks are performed and the strategies employed, and are able to watch selected clips from interviews where the people in the database relate experiences of travel and modes of transport.
At present an online resource is being developed that will enable access to the HADRIAN data. It is hoped that this will be available later in 2010.

In addition to fostering empathy the data also support design decision making. HADRIAN is a 3D human modelling and task analysis system capable of simulating discrete physical interactions that are based on the complex limitations of real people rather than generic population data. 3D human modelling is a technique that allows real people to be modelled within a computer environment and their interactions with products to be evaluated. Whilst this is not a replacement for working with real people and using mock-ups or prototypes of products and environments, the benefits are that this can be done during the early stages of development to positively inform the design direction.

HADRIAN is used to perform an analysis of a design by firstly defining a task. The task is broken down into various elements such as look at the screen, reach to the slot etc.

HADRIAN will then run the analysis building the people in the database together with their correct size, shape, and capabilities and perform an automated analysis that attempts to perform the task as described. When the analysis is complete the system then provides details of who experienced difficulties in performing that task and why. For example, a particular interaction point, such as a
coin slot on a ticket machine, may be out of reach for an arthritis sufferer due to the limitation that the condition applies to joint movement, and the same reaching location may be out of reach for a wheelchair user due to the difficulty in orientating the wheelchair. The practitioner can then explore the individuals who experienced problems, understand why these problems occurred and experiment with solutions by modifying the computer model of the design and re-running the analysis in HADRIAN.

**HADRIAN in use**
The final phase of the research conducted as part of AUNT-SUE consisted of two validation exercises. The first was a three-way evaluation of two cash points (ATMs). The ATMs were mounted at different heights to represent the range of height that could be encountered by a user. HADRIAN was compared with 10 real people using the actual ATMs. The second validation assessed a more complex scenario by examining part of a journey, evaluating the purchase of a ticket, navigation to, and access onto a Docklands Light Railway train at Greenwich station in London. Again HADRIAN was compared with real people performing the tasks.

The results highlighted that HADRIAN is a good predictor of real world problems experienced by people. Also, HADRIAN can simplify assessment for practitioners and address their need for applicable data. HADRIAN also provides much of the feedback provided by real people, in addition to providing empathy with target users.

![Image of a ticket machine and a wheelchair user](image)

Whilst not yet for sale, Loughborough are fielding a number of enquiries about providing consultancy using HADRIAN on various transport related projects.

**Other tools**
HADRIAN is ideally suited to assessing the accessibility and inclusiveness of discrete interaction points. As part of broader research into transport it became clear that a means of assessing whole journey accessibility was required.

For many, the use of public transport can be a stressful experience. This is especially true when making a journey for the first time primarily because there are so many uncertainties. Uncertainties cover every element of a journey and whilst most can be minimised through planning, and detailed
and up-to-date information about services, many have to be managed en-route. This management requires a degree of adaptability, to be able to modify a journey to overcome some form of barrier. However, for older people or people with disabilities there may be additional concerns combined with a reduced ability to adapt. Issues such as the presence of steps at a station; whether there will be a lift; appropriate accessibility (level access, hand rails etc.) to the train or bus; how to tell if the correct train has been boarded; if there are locations to sit and rest; and the potential for contributing factors such as heavy crowds all add to the potential for stress. All of these uncertainties can be collectively identified as anticipatory stressors. One potential response to this stress, particularly for those who have an alternative or for who the journey is not necessary, is to avoid making the journey altogether. Therefore people can experience exclusion from public transport even if they are capable of using it.

Two tools have been developed that apply a stressor elimination philosophy to support practitioners in improving public transport. These include ‘i-Journey’ the inclusive journey planner which aims to minimise the anticipatory stressors that people experience before a journey, and the ‘HADRIAN Journey Stresstimator’ which aims to show transport professionals which stressors are likely to exclude a variety of people from any given journey.

**i-Journey**
Existing online journey planners can go a long way to reducing uncertainty about a journey. Just knowing when and where vehicles depart may be enough for most people to set off on a journey without a prohibitive level of anticipatory stress. The aim of the Inclusive Journey Planner is to demonstrate the extent to which the use of a journey planner prior to travel could eliminate pre-travel uncertainty for all users, including those who are disadvantaged by disability or circumstance. Interviews and trials with a range of inexperienced users based around existing journey planners and proposed design improvements has lead to a number of recommendations that are largely encompassed by three main concepts: personalised information, a genuine choice of journey alternatives, and rich journey plans.

Currently Loughborough are working with Transport for London to develop these concepts into a new Accessible Journey Planner to sit alongside the existing TfL Journey Planner.

**The HADRIAN Journey Stresstimator**
The HADRIAN Journey Stresstimator is a software application that enables a transport practitioner to interrogate the stress levels induced by any known journey. It effectively sends all of the HADRIAN database individuals on a journey and records every stress transaction providing results that can be used in many different ways. For example, a particular journey segment may require a 10 minute walk between interchanges. If there was no place to rest during this walk, this would be highlighted as a ‘stressor’ by the system based upon the HADRIAN data. The practitioner could then compare the cost benefits of adding benches along this route, to the cost benefits of other issues such as adding drop kerbs, for example. This allows the practitioner to compare the inclusiveness of different routes, find out which people are most likely to be excluded, see which stages in a journey cause most stress, find out which stressors are causing the most stress and explore the effect that eliminating different stressors would have on a journey. The practical implementation of the Journey Stresstimator requires a detailed understanding of the environment that is to be traversed by people that are travelling, but has the potential to provide a unique ‘whole journey’ view point of
accessibility issues. Because HADRIAN enables this analysis to be based on the real concerns of real people it is also unique in its ability to deliver an empathic understanding of the importance of problems that might otherwise be overlooked.

The suite of tools discussed are in various stages of development, but have already influenced the design processes undertaken to develop the TfL Journey Planner that is used by millions of people. It is the aim of the Loughborough researchers to expand the use of the various HADRIAN datasets in both professional and academic practice. The ageing population provides a strong impetus for a greater understanding of how the effects of age and disability can affect the ability to travel and the broader requirements upon products, environments and services.