Ageing and the Kitchen: A Study of everyday object interactions

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Abstract

The process of ageing causes the physical abilities of the body to decline. This research aims to gather data and understanding of the nature of this process in relationship to the kitchen and the use of utensils. With this data, a design guide can be written to help avoid some of these difficulties by aiding inclusive design.

The research is being undertaken at three universities, with three distinct linked streams.

Initial results from focus groups and surveys have outlined some of the areas where difficulties arise. This information gives an understanding of the nature and cause of the difficulties which arise, and the coping mechanisms employed.

The initial physical abilities testing has produced a baseline of results against which the abilities of the older subjects can be compared and contrasted. This gives a measure of the physical abilities of the user, and more importantly, the links between the key areas of physical abilities.

Affective Engineering tests have produced baseline results for tactile feedback measurements, which can be used for compensatory cues and tactile feedback to assist the user. This can aid the use of the tools and enhance the feel of the product, to instil confidence and comfort.

Keywords
Aging, kitchen utensils, inclusive design

Introduction

‘We've put more effort into helping folks reach old age than into helping them enjoy it.’ Frank Howard Clark

Ageing is a fact of life. None of us can avoid the passage of time, however changing physical abilities need not lead to difficulties with manual tasks if we can use tools designed to compensate for the changes associated with ageing. When we age, grip strength, manual dexterity and sensitivity of the hands all decrease. Although changes are incremental they are not unnoticed and may result in emotional and psychological distress.

There are significant amounts of data available regarding the ageing process and accidents in the workplace[1], however, there is little data regarding the nature and severity of accidents with age in the domestic environment. There is accident and injury data available from RoSPA[2]. However, this is based purely on hospital admissions. There is evidence that a large number of the injuries in the over 60's go unreported to the higher authorities or result in emergency hospitalisation[3]. When this is combined with the fact that often, minor injuries in older people have a greater effect on the life of the victim relative to minor injuries in younger people, there is a strong case for the need to improve the environment of older people.

The Design Guide

The overall aim of this research is to produce a design guide that will direct selection of dimensions and grip texture for universally usable handles for kitchen tools. Although there are guidelines available for helping guide the design process towards being inclusive[4][5], there is little information which is of a specific nature and readily available to designers.

The information required to produce a design guide is twofold: firstly, an in depth analysis of the users is needed. Understanding their needs and wants; their usage habits; and the nature of the kitchen as part of their activities of daily living are all essential to this. Secondly, an understanding of the physical aspects of the hand-handle interface is required, including the grip characteristics, the physical attributes and limitations of the users, and the nature of the contact and its emotional effects.

In order to gather usage, background and perception data on the users, the research team has run focus groups, food and shopping diaries and questionnaires. Through the different methods, they sought to reach a wide range of older participants.

To gather information about the physical nature of the interface, physical testing of the aspects of grip and manipulation need to be assessed. The response to textures and grip on an emotional level is also required, as the feel of a tool can have a significant impact on its uptake and usage.

Once these sets of data are gathered, the design guide should then be able to determine many different aspects of the handle design, based upon the demographic being designed for, and the particular tools usage (associated parameters such as forces applied and manipulation characteristics). Many different specific aspects could then be derived, such as the correct dimensions for the tool handle; the texture compromises available for optimal emotional response or grip characteristics; as well as definition of grip shapes and angles between gripping surfaces and work faces for maximum comfort and utility.

Understanding the Users

The initial research at York University has been to explore the attitudes, behaviours and language related to cooking by older people. Two methods were used; focus groups to stimulate discussion and discover what issues were important to the participants and food and shopping diaries to capture behaviour and triangulate with data from the focus groups.

Cooking and Eating Habits of Older Adults

Fifteen older adults (4 male, 11 female, aged between 62 and 75) were recruited from the membership of University of Third Age (U3A) in York and York Older People's Assembly (YOPA) to take part in the focus groups. 18 participants (14 female, 4 male, aged between 62 and 88) were recruited from the same organisations to participate in the food and shopping diary study.

The focus groups were organised to be relaxed social settings with refreshments, with between three and five participants in line with work by Newell et al. [6]. Participants were asked to bring two kitchen utensils to the focus group; one which they could not live without and one which they did not like or had difficulty using. These were used to stimulate discussion about cooking practices and how utensils empowered or frustrated their efforts. Researchers from Leeds and Sheffield each participated in at least one focus group.

The food and shopping diaries were designed to capture food related behaviour over a seven day period that could be triangulated against behaviour and attitudes described in the focus groups. Food diaries are an established tool for anthropologists[7] as well as dieticians [8] because they closely reflect what people do rather than what they say.

Results

A total of 33 different kitchen utensils were brought along to the focus groups, among them two categories of utensil, vegetable peelers (see Figure 1 and Figure 2) and jar openers (Figure 3 and Figure 4), were brought along by more than a third of participants.

Figure 1(Left): Y-shape vegetable peelers
Figure 2(Right): Lancashire style vegetable peelers

Figure 1 and Figure 2 show the two main styles of vegetable peelers brought to the focus groups. The two styles require different hand motions to apply the blade to the vegetable. Participants were enthusiastically for one style and against the other and made no distinction about the shape or material of the handle.

Figure 3 shows a Brabantia jar opener, which was brought in by three participants and owned by several more. All owners described it as useful, but fiddly - something you would not use if you had an alternative;

> "if you've got a husband you wouldn't want to use this because it's fiddly, because you have to get it flat before you tighten it so it doesn't slip off...it wouldn't do someone with really arthritic hands, but [for someone who doesn't have a] brilliant grip and nobody else there, it works"

While the strap wrench, Figure 4, had never successfully been used to open a jar and was described as "a useless object - looks like an instrument of torture".

Figure 3 (Left):Brabantia multi-jar opener
Figure 4(Right): Strap-wrench style jar opener

All the participants of the focus groups were enthusiastic cooks and valued home cooked meals over pre-prepared foods.

The food diaries were followed by interviews at home. The size and organisation of the kitchen was a common cause of complaint, (even for those who had installed new kitchen layouts of their own choice) because this constrained the space for preparation and ease of storing and accessing foods and utensils. Many had terrific tools to help them in the kitchen, but lacked the space to make good use of them.

Questionnaire into Lifestyle and Habits in the Kitchen

As part of the discovery of the personal habits and difficulties of the users, a survey was written based upon the findings of the focus groups held at York.

The aim of the survey was to ask basic questions about the occupation, health, and activity levels of the participants, as well as their cooking habits, and the difficulties and preferences in the kitchen environment.

Initial results

The initial results have been collected and analysed. The data contained was typical of what was expected, with a range of difficulties observed. The respondents of the survey were predominantly female (76%), ranging from the age group of 60-64 up to 90+. There was as expected, a relationship between the reported difficulties in the activities of daily living and age. There also appeared to be a link between the disclosed disabilities of the respondents and the perceived difficulties in the kitchen. The uptake of assistive products appeared not to be linked with any other variable, with almost 62% of the respondents owning some assistive kitchen device, with 73%

of the devices being Jar openers, and 18% being large handled knives. Almost 92% of respondents reported some form of disability that could reduce their ability to perform kitchen related tasks. Of these disabilities, 82% were forms of Arthritis. This sample, however, is too small to draw any firm conclusions or reach statistical significance from at this stage. The results are promising, and with the collection of further data, these observations can be built upon and used.

Understanding the Physical Aspects of the Hand-handle interface

Physical Grip and Manipulation of the Kitchen Objects

This branch of the research, undertaken at The University of Sheffield, was based on the engineering principles behind the physical grip and manipulation of the kitchen objects. The aim of this testing was to produce data about the relationships between different manual abilities with relation to age and disability. This data will form part of the guidelines to inform the designer of the limitations of a given persons abilities, and how by designing to exploit a person's strengths, what overall impact that may have on the usage of an object.

Outline of tests

A selection of tests were taken from the literature as measures of the vital components of human grip and manipulation. The tests selected were confirmed to be appropriate for older people. The tests included the Purdue Pegboard test (fine manual dexterity), Jebsen Hand Function Test (fine and gross manual dexterity), Jamar Dynamometer (grip strength measurement), Two point discrimination test (finger sensitivity test), as well as two custom tests based upon previous studies (a door handle rig based upon the paper by Peebles [9], and a jug pouring test based on the TEMPA test by Desrosiers [10]). There were also measurements of skin friction and moisture content taken using a custom friction rig[11] and moisture measurements using a 'Moistsense' probe (Moritex Cosmetics, http://www.moritexcosmetics.com/).

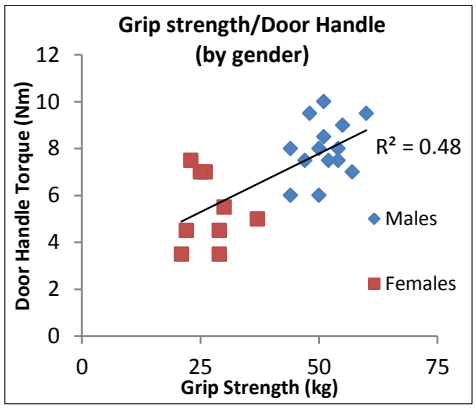
The whole range of tests were administered to all participants. Correlations between the different measurements for each participant were ascertained, finding links between individual's strengths and weaknesses and finding commonalities between participants. Young, able bodied participants were tested first in order to gather a baseline measurement, and older participants will be tested shortly to discover the changes associated with ageing and the encroachment of infirmities.

Test results

Twenty-seven participants (16 male, 11 female, aged 21-34, mean 25) with no reported physical disabilities were recruited from staff and students at The University of Sheffield.

The graphs in Figure 5 and Figure 6 show the relationship between the maximum torque achieved on the Door handle test and the grip strength measurements of the participants and skin friction measurements of the fingers respectively. The relationship observed in figures 5 and 6 are as expected, as the grip strength is the parameter assumed to generate the normal force for torque to be generated at the handle. The strong relationship to friction was observed due to the slip of the hand in

every case, suggesting that a lack of friction is a factor in the maximum force generated.



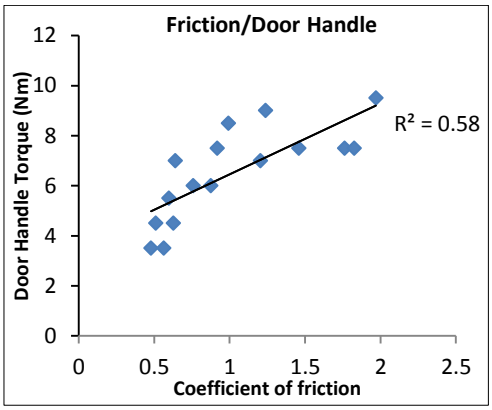


Figure 5 (Left): Graph showing the link between grip strength test results and the Door Handle torque test results, divided into male and female data
Figure 6 (Right): Graph showing the relationship between the maximum torque achieved on the door handle test and the skin friction coefficient of the participants

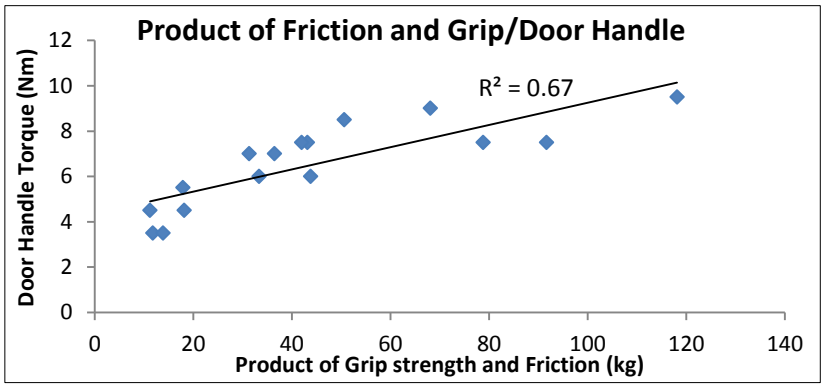


Figure 7: Graph showing relationship between the product of Grip strength and Friction Coefficient in relation to the maximum torque applied on the door handle

From Figure 7, it is clear that the relationship between the door handle torque test is most closely linked to the product of the friction and the grip strength. This makes sense as this is how torque would be calculated using the handle radius, the normal force applied to the handle and the coefficient of friction between the hand and handle.

Table 1: Table showing the correlations between the different tasks of the Jebsen hand function test and both the dominant handed Purdue test and the Assembly scores for the Purdue test (Pearson's Product Moment Coefficient, and the associated p values)

Jebsen Hand Function Test	1H Purdue (p Value)	Purdue Assembly (p Value)
Turning Cards	-0.255 (0.219)	-0.430 (0.032)
Manipulating small objects	-0.057 (0.785)	-0.108 (0.606)
Simulated Feeding	-0.191 (0.359)	-0.087 (0.680)
Stacking	-0.564 (0.003)	-0.322 (0.116)
Large Light Objects	-0.239 (0.250)	-0.087 (0.679)
Large Heavy Objects	0.011 (0.960)	-0.110 (0.600)

The data in Table 1 shows that there is very little correlation between the two dexterity tests of the Jebsen hand function test and the Purdue Pegboard test.

There is a noticeable change in correlation between the Dominant hand test of the Purdue Pegboard test and the stacking task within the Jebsen test. Both of these tasks are of a similar nature but on a different scale.

Affective Engineering of kitchen utensils

The characterisation of the emotional responses to different material compositions and surface textures is termed 'Affective Engineering'. The focus of affective engineering is to improve the users' product experience by creating pleasurable and confident feelings in the design of new products. Designing an appreciated product using affective engineering requires the developers to study the needs and wants of the users [12] and apprehend people's emotions, and perceptions.

Consumers require a likeable, personalised feeling product that they can identify with. *"An increasing number of people want to express their individuality."*[13]. Affective engineering involves translating consumers' feelings for a product into design elements, in order to implement likeable or expected characteristics into a product. Omitting it inevitably leads to bad inclusive design.

'Affective engineering' was first introduced as 'Kansei Engineering' [14]. Kansei engineering is a form of product development methodology [13][15]. "*Kansei is the impression somebody gets from a certain artefact, environment or situation using all their senses of sight, hearing, feeling, smell, taste as well as their recognition*" [16]. Kansei has been used in many different fields for many different products, and has proven itself to be efficient in producing successful products [17].

In order to transcribe people's impression into a design one must know what influences the perception. Hands are at the heart of everyday lives, which results in not only an overdeveloped sensitivity in the hands [18], but also a strong customer reliance for "making product evaluations" [19]. It is very difficult to identify what parameters influence affective feelings and perception of physical characteristics, such as the influence of vibrations on the rating of roughness and warmth [20]. Tactile perception is often associated with more than one physical property [21].

Affective Adjectives in the Kitchen

York's focus groups investigated people's own experience in their kitchen. This information needed to be built upon and focused to produce data that could support the design process.

In order to run fitted affective experiments, Leeds University had to get a list of adjectives or expressions that people use to describe their experience of kitchen utensils. Therefore Leeds organised a focus group, based on those ran at York's, involving five participants (university students). Through different exercises, they evaluated nine distinct utensils. They had to focus on the tactile perception of the item, not on its utility. Nice, comfortable, rough, cold, confident, slippery, different, hard, useful, and weird, were the ten most used and repeated adjectives, hence the most representative lexicon. Further research on kitchen utensils carried out at Leeds will be based on the latter lexicon and therefore hoped to be as clear to most

participants as possible.

Tactile Perception Testing

The current methodology used in tactile perception evaluation consists of a fingertip sliding over flat stimuli. However, if the shape of a contact surface has a large influence on tactile perception then the results obtained for a texture would not be translatable to any product design.

To discover the support shape's influence on the texture perception, the University of Leeds ran a forced choice experiment. The textural percept, elicited when scanning silicon textures with the fingertips on a flat surface, were compared to those evoked when the same textures, mounted on pan's handles, were in contact with the entire hand.

Twenty-three participants, University staff and students of Leeds University between the age of 20 to 50, compared textures on flat supports and on pan's handles (see Figure 8) against different adjectives (rough, warm, hard, controllable, wet, confident).

Figure 8: Flat and pan stimuli tested in this experiment

Test results

From the answers of the participants (i.e. the pan or the flat support felt more expressive), it could be concluded that, in most cases, subjects could not identify similar textures on different supports. Therefore, it could be hypothesised that the tactile perception of a texture can differ depending on the support it rests on. Therefore tactile perceptions resulting from finger stroking assessments of a texture might not be representative of real product experience and results should not be extrapolated to any kind of product. Further analysis also demonstrated that the subjects of this experiment tended to feel the flat surface as more expressive.

However, the validity of the results gathered in this study is to be looked at cautiously. The glue holding the textures on the handle was not strong enough; which resulted, as the experiment went on, in loosening of the texture, which might have influenced people's perceptions. Even though the irregularities were minor, they might not be negligible and could have had an influence on the results.

Conclusions and future work

The work at York provided a good foundation of understanding of the perceptions of users and their attitudes towards the kitchen. It also produced information on tools, their usage, and the reasons for their selection.

The initial physical attributes experiments in Sheffield based upon a young participant group was intended to produce a baseline of physical abilities for the able bodied against which the results from the planned testing of older participants will be compared. The physical variation between participants was very small and so the conclusions drawn and the indications of links observed at this stage will be investigated further when the older participant data is collected and a wider range of abilities is available to compare.

The research at Leeds on the affective engineering tests has been based on kitchen utensils. Further work will be done to complete the obtained data and try to evaluate the importance of each influencing factors. The data obtained in this way could be combined with the data obtained in Sheffield on grip in order to aid the design of efficient but pleasurable products. The planned second part of the research will focus on the tactile evolution with age, in order to see if the data collected in affective studies with young people can be extended to older people.

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