Package openability:
design for novel packaging for older people

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Abstract

This study examines how novel packaging could be designed so that opening is easy for older people. Research into package openability is well established, possibly because of increases in the number of older people, whose ability to open packaging declines with ageing. However, research focusing on the design of indications that provide effective opening information for older people has not been extensive. Indications in this study were defined as packaging elements such as shapes, textures, symbols and diagrams.

This study employed mixed methods research, based on a participatory design approach. Focus groups and in-depth interviews were used to provide rich insights into older peoples' design requirements for opening indications.

Through focus groups, both qualitative and quantitative approaches were used to accurately elicit design requirements derived from participants' varied views on openability of novel packaging samples. These combined data informed the creation of design recommendations for packaging concerning sensory, cognitive and hand functions.

In-depth interviews recorded older peoples' interactions with packaging. These provided data consequently used to define the relationship between two and three dimensional indications. Design recommendations concerning the use of combined two and three dimensional indications were also developed.

All research results were synthesised to create an indication centred *Design Framework Tool.* This new, practical tool presents design problems and solutions associated with the different stages of package opening alongside the cognitive processes that occur at each stage. Designers can use this tool to diagnostically create novel packaging that is easy for older people to open.

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This thesis has not been submitted in whole or in part in support of an application for another degree or qualification of this or any other university, or other institutions of learning.

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Chapter 1

Introduction

Product packaging is a feature of everyday life, protecting the quality of contents and aiding convenient use. Packaging closures play a key role, protecting contents from contamination whilst also providing access. Striking a balance between these two functions is important when designing closures because over emphasizing one function may lead to weaknesses in the other.

Packaging can be difficult for older people to open if it is designed without taking their age-related needs into account. Opening difficulty has been established in relation to age-related decline in sensory (Cayton, 1995; Moore, 1993), cognitive (CEN/CENELEC, 2002; Carse *et al.*, 2007; Mawle, 2003; Woodcock *et al.*, 2004) and hand (Blakey *et al.*, 2009; Lewis *et al.*, 2007; Janson *et al.*, 2005; Yoxall *et al.*, 2010) functions. However, research into the design of novel packaging whose opening is easy for older people to understand has not been extensive.

Winder (2006) indicated that the introduction of thousands of new products each year brings a variety of novel designs and packaging closures. Novel packaging, whose appearance is unfamiliar to consumers may still be welcomed by older people, if the contents meet their needs. A new opening mechanism may offer new packaging features such as better safety or greater ease of use, but Moore and Nayak (1992) noted that such packaging, exhibiting unfamiliar appearance and features may be difficult for older people to understand how to open. Consequently, it is essential to study older peoples' requirements in order to provide packaging that is easy for them to open (Moore and Nayak, ibid.).

1.1 Motivation for the study

Packaging offers physical and psychological functions to users. Physical functions potentially make it easy for users to actually use the packaging; that is, to hold and to open the packaging, and then to dispense the contents. Psychological functions potentially make packaging use pleasurable for users both aesthetically and in terms of understanding how to use the packaging.

According to the researcher's own personal observations as a packaging design lecturer, aesthetics and physical functions have been prioritised in lectures and assignments, whereas design methods promoting ease of understanding how to use packaging appear to have been neglected.

Observing one's own elderly parents experiencing severe difficulty in understanding how to open packages also provided a strong motivation for the researcher as a design practitioner to further examine how packaging could be designed so that older people find opening easy to understand.

In addition, the population of older people is growing rapidly (WHO, 2002). Products that older people used easily when they were younger can become more difficult for them to use when older (Keates and Clarkson, 2003).

1.2 Importance of this study

The importance of this study arises from its consideration of the following linked aspects.

1.2.1 Opening difficulty

Aesthetics and safety are two of the most important requirements for the design of packaging. Design aesthetics permits packaging to attract consumers' attention and to

present the quality of contents. Design for safety offers packaging closures that protect the quality of contents and in some cases ensure that children are protected from potentially harmful contents such as medicines. However, closures designed for packaging aesthetics and safety can be difficult for older people to open, as shown by the real-world examples below:

- It can be difficult for older people to see where to start removing a tamper-evident transparent plastic film, wrapped around the lid of a jar provided for an aesthetic reason rather than for the visibility of indications (Keates and Clarkson, ibid.). The term *indication* in this study refers to design elements, for example: shapes, textures, symbols, written instructions and diagrams, which communicate how to open packaging.

- A safe packaging closure, such as a vacuum lug, provides better content preservation, but can be too tight for older people to open (Janson *et al.*, op. cit.).

- A tamper-evident closure is essential to let users know if packaging has already been opened alerting them to possible contamination of the contents. However, a tamper-evident band on the neck of a container can be too difficult for older people to remove (Duizer *et al.*, 2009).

- A child-resistant closure prevents children from accessing potentially harmful contents. However, releasing this kind of closure requires users to squeeze the lid whilst turning it, which can be physically difficult for older people to do (Carse *et al.*, op. cit.; Moore, 1995).

The Department of Trade and Industry[1] (DTI) (1999d) stated that in the UK, 39% of accidents related to packaging were associated with opening and that consumers used unsuitable tools such as knives, pliers and screwdrivers to open packaging that could not be opened easily and quickly.

As well as causing opening difficulty by making excessive demands on hand strength, packaging can be difficult for users to open because they do not notice the indications for opening provided on the packaging. Woodcock *et al.* (op. cit.) noted that older participants struggled to open a plastic tray of bacon because the indication showing where to open it was not sufficiently evident. Difficulty can also be experienced when opening novel or unfamiliar packaging. Winder *et al.* (2002) suggested that unclear indications for opening can cause users to become frustrated, leading to the adoption of risky opening strategies.

1.2.2 Openability

Cayton (op. cit.) suggested that easy opening had become an important criterion for packaging design as a result of the increase in the older population. This is because age-related decline in visual, cognitive and hand functions reduces older peoples' ability to open packaging.

The term *openability* has been commonly used in literature (DTI, 1999a; Janson *et al.*, op. cit.; Moore, 1995, op. cit.; Moore and Nayak, op. cit.). Although openability was not clearly defined in these studies, two perspectives regarding openability were addressed:

[1] The DTI was replaced by the Department for Business, Enterprise and Regulatory Reform (BERR) in 2007 (the Department for Business, Innovation and Skills (BIS), 2010). In 2009, the BERR was replaced by the BIS (2009).

1) older peoples' ability to open packaging.

2) packaging which is easy to understand how to open and to physically open.

When evolving a definition of openability for the purpose of this study, it was noted that the key function of packaging closures was to allow users to access the contents inside. Accordingly, the term openability in this study refers to *characteristics of packaging that make it easy for older people to: understand how to open packaging, to physically open packaging and to access the contents of packaging.*

1.2.3 The design knowledge gap

A gap in design knowledge was identified through a literature review in related fields. Design knowledge is well established in the areas of increasing openability in relation to sensory (Moore, 1993, op. cit.; Cayton, op. cit.) and hand impairments (Blakey *et al.*, op. cit.; Lewis *et al.*, op. cit.; Janson *et al.*, op. cit.; Yoxall *et al.*, 2010, op. cit.). Related studies into cognitive functions address older users' attitudes towards the use of assistive tools or devices used for packaging (Carse, op. cit.), older users' memory impairment which leads to forgetting to take their medicines on time (Mawle, op. cit.) and older users' emotional responses to opening packaging (Woodcock *et al.*, op. cit.). de la Fuente and Bix (2010) conducted research focusing on hand and cognitive functions for improving child-resistant packaging that contains medicines. CEN/CENELEC (op. cit.) suggested desirable characteristics of packaging indications that would accommodate older peoples' sensory and cognitive impairment when opening packages. However, these characteristics did not suggest how to design such indications to encourage effective package opening for older people. Furthermore, the role of cognitive functions in older users' ability to understand how to open novel packaging has not been specifically examined in the literature.

1.3 The aims of this study

This study set out to address the knowledge-gap area by initially focusing on understanding older peoples' requirements when opening packaging, taking into account their age-related decline and consequently their use of indications in understanding how to open novel packaging. The data gathered, post analysis were used to create a framework presenting structured insights into these two areas and a set of design recommendations for use by designers wishing to provide packaging whose opening is easy for older people to understand.

The three aims of this study are:

1) To understand the problems older people have when opening packages.

2) To investigate the relative importance of 2D and 3D indications during the different stages of package opening.

3) To produce a design framework which can be used by packaging designers to increase the understandability of packaging information for older people, with respect to openability.

1.4 Research methods

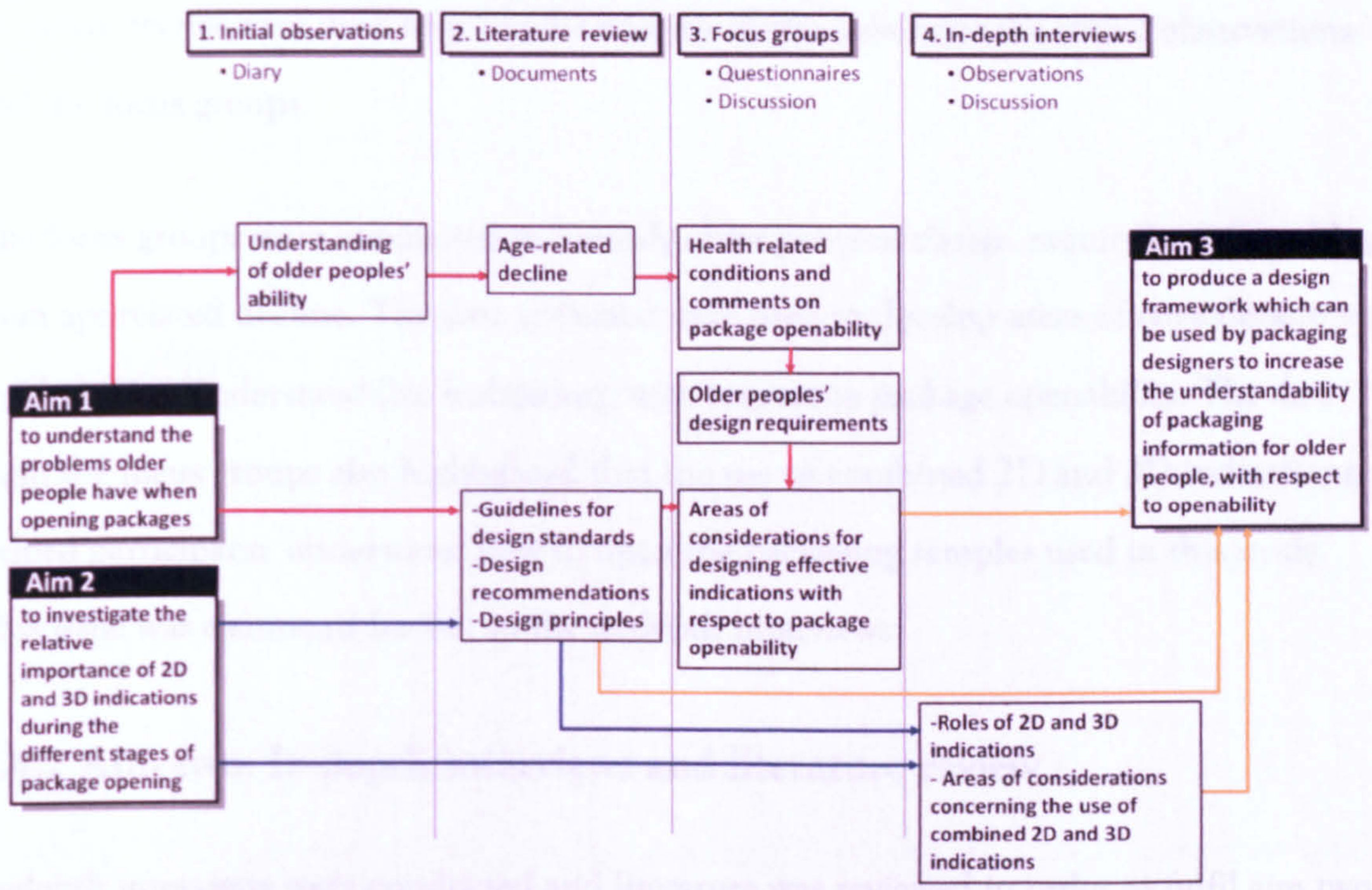
This study employed a mixed methods approach, combining quantitative and qualitative data. Quantitative approaches were used when asking participants to rate packaging samples on three key factors related to openability: familiarity, understanding of opening methods and how easy or difficult it was for them to physically open the packages. The data gathered were compared with qualitative data derived from discussions about how packaging familiarity and the participants' physical ability to open packaging influenced their understanding of opening methods.

Qualitative approaches were also used when identifying older peoples' packaging design requirements and when seeking insights into older peoples' thinking processes when using indications to open novel packaging.

This study subscribed to participatory design principles (Gulliksen *et al.*, 2003) where users are involved in design decision making during the design process. Participatory design is used in this study as a tool to produce packaging design recommendations that compensate for older peoples' decline so that it is easy for them to open the packaging. Therefore, older people were included in making design decisions that resulted in recommendations aimed at ensuring that packaging meets their needs.

The participants in this study were selected from a reference group known as *the Thousand Elders*. This database of older individuals is maintained by the Centre for Applied Gerontology at the University of Birmingham. The Thousand Elders is composed of people aged over 50, both male and female, from a variety of socio-economic backgrounds (Nayak, 1998), who are resident in the West Midlands. The Thousand Elders is a useful panel for this research because of its potential in representing the UK's older population.

Figure 1 below shows the methods employed to collect data according to the aims of this study.



Note: Red lines with arrowheads show the link of related data to achieve aim one.
Blue lines with arrowheads show the link of related data to achieve aim two.
Yellow lines with arrowheads show the link of related data to achieve aim three

Figure 1: The research methods employed in this study

1.4.1 Aim one: Initial observations, literature review and focus groups

Initial observations were carried out, literature was reviewed and focus groups were conducted in order to meet aim one (see Figure 1).

The initial observations were conducted in order to develop a fundamental understanding of older peoples' ability to open packaging by observing the day-to-day activities of a small selection of older people at two social centres.

The literature review provided an understanding of how age-related decline limits older peoples' ability to open packaging and presented existing design guidelines, recommendations and principles concerning package openability. This also identified the need for practical design recommendations that could be used to provide effective indications to older people when opening packaging. Additionally, the data from the

literature review were used to guide the analysis of the data from the initial observations and the focus groups.

The focus groups were conducted to identify older peoples' design requirements resulting from age-related decline. The data collected were used to develop areas of considerations for designing understandable indications with respect to package openability. The data from the focus groups also highlighted that the use of combined 2D and 3D indications helped participants understand how to open the packaging samples used in this study. This issue was examined further in the in-depth interviews.

1.4.2 Aim two: In-depth interviews and literature review

In-depth interviews were conducted and literature was reviewed in order to fulfil aim two (see Figure 1).

In-depth interviews were carried out to gain insights into how older people used 2D and 3D indications when opening novel packaging. The data from the interviews were used to examine the roles of 2D and 3D indications during the different stages of opening. This revealed the areas of considerations on the use of combined 2D and 3D indications to provide effective opening information for older people. The literature review of existing design guidelines, recommendations and principles was also used in guiding the creation of these design considerations.

1.4.3 Aim three: The synthesis of data from different sources

Aim three was achieved through a synthesis of the data drawn from the literature, the focus groups and the in-depth interviews. The synthesised data were used to produce a novel design framework.

1.5 The structure of the thesis

This thesis is divided into eight chapters as follows:

Chapter one; *Introduction*, explains the importance of the research and briefly introduces the aims of this study and methods.

Chapter two; *Literature Review*, presents s review of relevant literature covering the impact of older peoples' age-related decline on their ability to understand how to open packaging and the need for additional design recommendations.

Chapter three; *Research Methodology*, describes the selection of research methods, the rationale behind participant and packaging sampling and the data analysis methods used.

Chapter four; *Research Results*, presents the results of the initial observations, the focus groups and the in-depth interviews.

Chapter five, *Discussion of Results*, discusses the results concentrating on areas of considerations for designing effective indications with respect to openability derived from the focus groups and those concerning the use of combined 3D and 2D indications drawn from the in-depth interviews.

Chapter six; *Development of the Framework*, presents a synthesis of data from the literature and the experimental works before formulating a set of design problems and solutions that can be used by designers to create understandable packaging indications for older people.

Chapter seven; *A Design Framework Tool*, presents a reference guide that can be easily used by designers.

Chapter eight; *Summary and Conclusion*, discusses how this study fulfilled the three aims and concludes by stating the contribution made to knowledge.

1.6 Proposed contribution to knowledge

The contribution to knowledge from this study relates to:

1) A design framework tool comprising a set of design problems and solutions that can be used by designers to create opening indications that easy for older people to understand.

2) A diagnostic tool presenting the relationship between 2D and 3D indications and information for opening that can be used by designers to review the understandability of opening indications.

3) An understanding of the use of 2D and 3D indications during the different opening stages and how 2D and 3D indications can be successfully combined to stimulate effective package opening for older people.

4) An understanding of how packaging communicates opening methods.

5) An understanding of how age-related decline impacts on older peoples' ability to open packaging.

Chapter 2

Literature review

The first aim of this study is *to understand the problems older people have when opening packages*. To fulfil this aim, selected literature connected with: packaging, openability and older people were reviewed. The first section is contextual, examining the packaging industry, the role of design in this industry and types of packaging. The second section examines literature around openability. Openability is created by an interaction between older people and openable packaging. Therefore, how older people interact with packaging using tacit knowledge and action learning is also discussed. This leads to the third section which considers the information for opening provided on packaging. The fourth section describes the influence of age-related decline on older peoples' ability to open packaging. Design is the core issue of this study; therefore, the fifth section discusses the design principles for usability subscribed in this study to develop approaches for creating packages that meet older peoples' needs. The sixth section reviews existing design guidelines, recommendations and principles, concerning package openability. The last section, then, addresses the knowledge gap filled by this study concerning the need for additional design recommendations.

2.1 Packaging

Key perspectives of packaging in the context of this study are described as follows.

2.1.1 The packaging industry

The structure of the packaging industry supply chain is shown below in Figure 2.

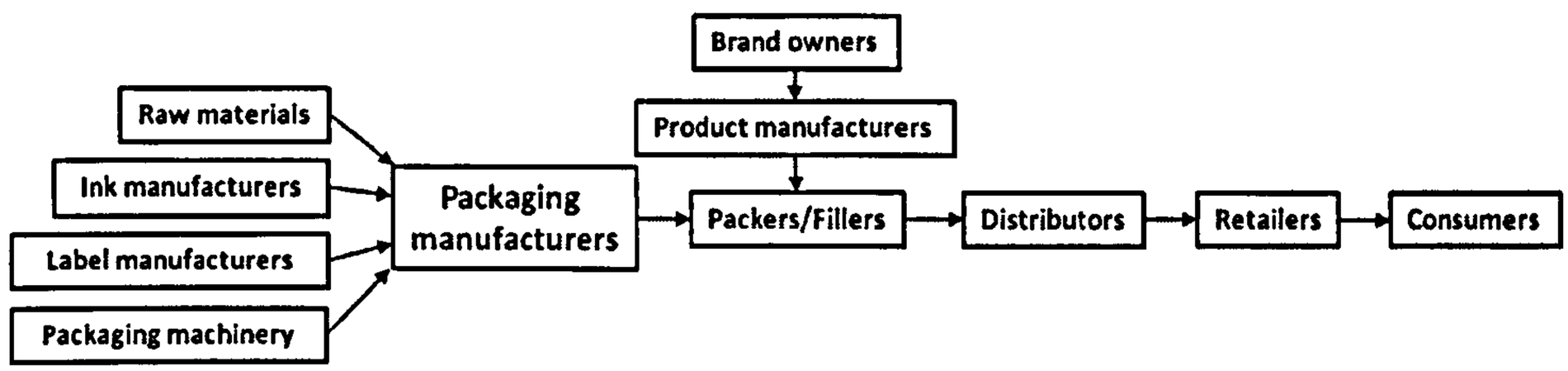


Figure 2: Packaging manufacturer and suppliers (adapted from the Packaging Federation, 2003 and 2006)

Making a package requires four sub processes: raw materials supply, ink supply, labelling (the Packaging Federation (PF), 2006) and packaging machinery supply (PF, 2003). Raw materials used in packaging include: plastics, carton board, metals and glass. Packaging machinery is for the production of empty packages. Ink can be for printing directly on a package or printing onto a label made of paper or film, affixed to the package. A manufactured package is filled with a product provided by a product manufacturer. The product is transported to a distributor and then a retailer to be displayed on a shelf for purchasing.

The PF (2001) notes that the packaging industry is an important industry in the UK because it is an integral part of the product manufacturing industry. Most products require packaging for containment, transportation and storage (PF, ibid.). The PF (2006, op. cit.) reported that the annual average growth of the packaging industry was 0.6% from 2000 to 2005. The future growth of this industry is challenged by a variety of concerns including environmental sustainability and globalisation.

2.1.1.1 Environmental sustainability

The Department for Environment, Food and Rural Affairs (DEFRA) (2010) stated that the amount of packaging waste in the UK is approximately 10 million tonnes per annum. Environmental legislation has been developed in order to reduce the amount of packaging waste (PF, 2003, op. cit.). The legislation recommended three key strategies to

conserve the environment: *reduce*, *reuse* and *recycle* (PF, ibid.). Reduce refers to a reduction in the thickness and weight of packaging (PF, ibid.). Reuse represents an attempt to extend package life by refilling (Waste Watch, 2006). Recycle focuses on the recovery of packaging waste (PF, 2003, op. cit.) so that it can be used again as raw materials.

2.1.1.2 Globalisation

The packaging industry in Western Europe and North America is considered to be a part of a mature market. New markets in Asia and Eastern Europe present opportunities for business growth (PF, 2006, op. cit.). The UK-based packaging industry is often disadvantaged by currency exchange rates for packaging exports (PF, 2003, op. cit.) as well as by expensive raw materials, energy and labour (PF, ibid.; PF, 2006, op. cit.). Thus, many UK packaging companies have moved to other countries such as China and India where they find cheaper labour and raw materials (PF, 2003, op. cit.) as well as fewer environmental regulations (PF, 2006, op. cit.). This may encourage industry consolidation through mergers among international packaging companies to maintain market competitiveness (PF, ibid.). The economies of scale and location also lead to reductions in the number of packaging manufactories and employees (PF, 2004).

Although environmental legislation and globalisation have produced a number of challenges for the packaging industry, the PF (2003, op. cit.) stated that they also present opportunities for growth. For example, reducing the use of raw materials by recycling packaging waste represents a long term investment in sustainable business (PF, ibid.). Globalisation offers the opportunity to open new markets and to maintain close relationships with international consumers whilst reducing production costs (PF, ibid.).

2.1.2 The role of design in the packaging industry

Design is a tool for brand owners and retailers to use in providing packaging that meets consumer needs. Packaging may be difficult for older users to open due to a communication gap between designers and users. Zeisel (1984) used the term *user-need gap* to represent such gaps between designers and paying clients; and users. This concept was placed into the context of packaging design in Figure 3 below.

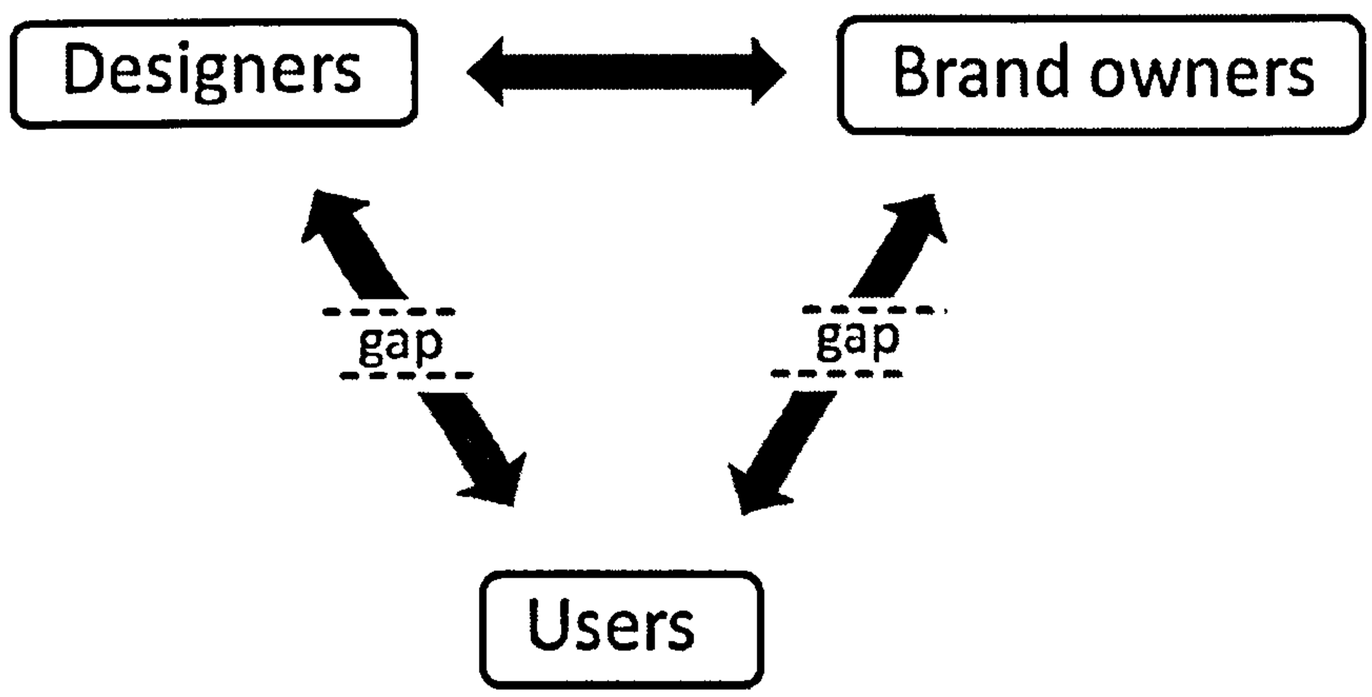


Figure 3: Zeisel's (1984) user-need gap model adapted for the context of packaging

The PF (2003, op. cit.) stated that most UK retailers are also brand owners. For convenience, the term *brand owners*, which also refers to retailers, was used in this Figure.

The gap between designers and users occurs because designers are likely to design packaging according to design briefs provided by brand owners, rather than by users. The gap between brand owners and users emerges because brand owners are unlikely to draw information directly from users when developing a design brief. Lawson (2006) noted that data on user needs may be drawn from studies conducted by researchers in other fields, for example, ergonomics and psychology. However, the data provided may not fully address the range of user needs required. So, designers may not have a full insight into user needs when designing.

Norman (2002) also explained the gap between the designer's conceptual model and the user's mental model. Norman's model (ibid.) used the terms *system* and *system image* to refer to the designed object and its appearance and behaviour. This model was placed into the context of packaging design in Figure 4 below.

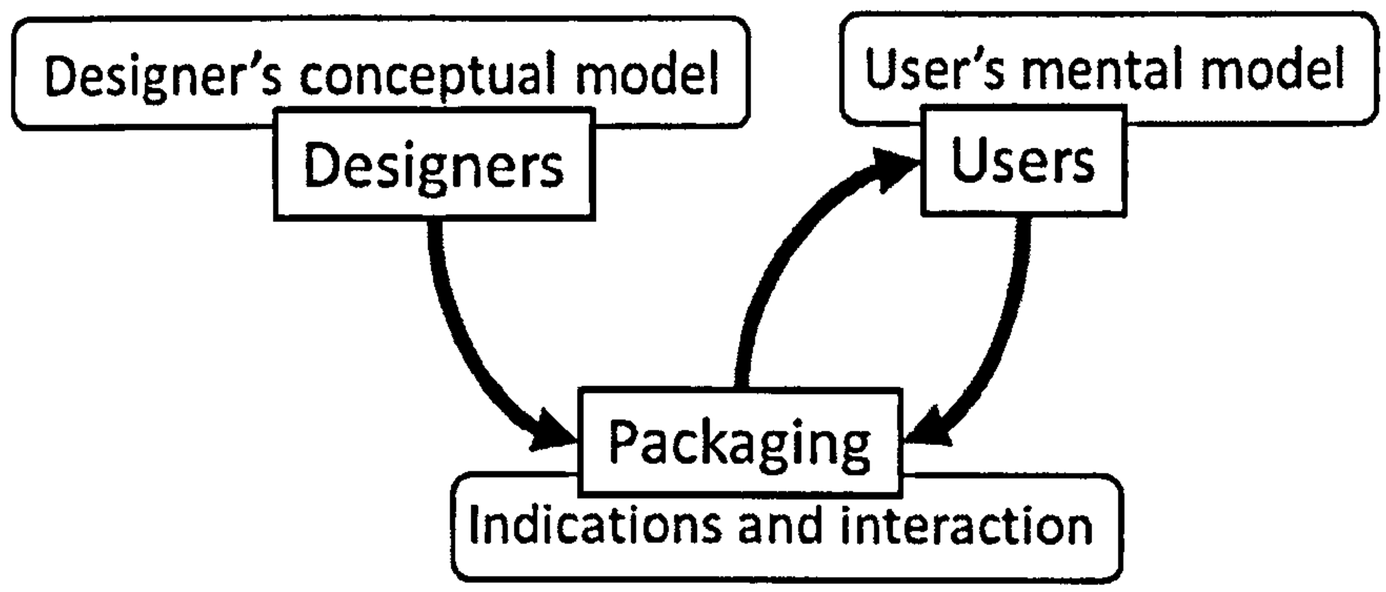


Figure 4: Conceptual model (Norman, 2002) adapted for the context of packaging

In Norman's model, the designer is only able to communicate with the user about how to open packaging through indications (packaging appearances) and interactions between users and packaging (packaging behaviour). However, the designer may be overly familiar with the design, and may make erroneous assumptions about package openability, especially in the hands of older people.

The user-need gap model in Figure 3 and the conceptual model in Figure 4 above illustrate that it is important to understand older users' needs in order to bridge the communication gap between older users and designers.

2.1.3 Types of packaging

Packaging can be categorised by different factors, for example, functions (e.g. transit and household packaging) and materials (e.g. paperboard, glass and plastics). This study focuses on the category of packaging designed for everyday use. As this category is significantly influenced by materials, this portion of the literature review will focus on materials.

The most commonly used packaging materials are: plastics, paperboard, metals and glass. Rexam (2005) reported that in global terms, plastics hold the biggest market share of packaging materials followed by paperboard, and then metals and glass. In the UK, the Packaging Federation (PF) (2006, op. cit.) pointed out that paperboard rather than plastics has obtained the biggest market share. Taken together, paperboard and plastics represent over 70% of the UK packaging market (PF, ibid.).

Paperboard, metal and glass packaging tend to be more environmentally friendly than plastic packaging, but plastic packaging has greater design potential than these other packaging materials. It is not surprising therefore to see that plastic packaging has gradually replaced paperboard, metal and glass packaging because it also offers light weight, shatter-resistance and excellent content protection at a lower price. Furthermore, plastics are flexible and can be produced in a variety of shapes and functions (PF, 2003, op. cit.). For these reasons, new packaging designs commonly use plastics.

2.1.4 The types of packaging most used by older people

Family spending: a report on the 2007 expenditure and food survey (ONS, 2008a) identified the thirteen categories of household expenditure in the UK. Six of these include products requiring packaging. Among these six categories, older people spend proportionately more on the top three categories: food and non alcoholic drinks (16.57%), miscellaneous products (e.g. personal care) (9.35%) and household goods and services (8.99%) than they spend on the remainder: clothing and footwear (4.40%), alcoholic drinks, tobacco and narcotics (3.04%) and health (2.42%). This spending pattern suggests that older people are likely to experience a large amount of packaging drawn from the top three categories. Accordingly, this study focuses on packaging for the products from these three categories. This focus is also consistent with the types of packaging samples used in the related studies concerning openability, for example, food (Blakey *et al.*, op. cit.; Carse *et al.*, op. cit.; Duizer *et al.*, op. cit.; Janson *et al.*, op. cit.; Yoxall *et al.*, 2010, op. cit.), personal care

products (Blakey *et al.*, op. cit.; Yoxall *et al.*, 2010, ibid.) and household cleaners (Cayton, op. cit.).

2.2 Openability

Openability in this study was defined in chapter one as: characteristics of packaging that make it easy for older people to: understand how to open packaging, to physically open packaging and to access the contents of packaging. In this section, openability is discussed through the following perspectives.

2.2.1 The stages in opening a package

Interactions between consumers and packaging comprise three major stages: purchasing, using and disposing as shown in Figure 5 below. The *using* stage can be divided into: carrying, storing, opening, dispensing and closing. The duration of the using stage can vary, from only a few minutes after purchase up to a month or even more, depending on product types; for example, a chocolate bar or a bottle of washing up liquid. In some cases, the using stage can be further sub-divided into: initial opening and reopening, dispensing and re-dispensing as well as closing and reclosing (Winder, op. cit.). This study focuses on packaging openability which takes place in the using stage. Thus, stages of using and opening are highlighted in bold line boxes.

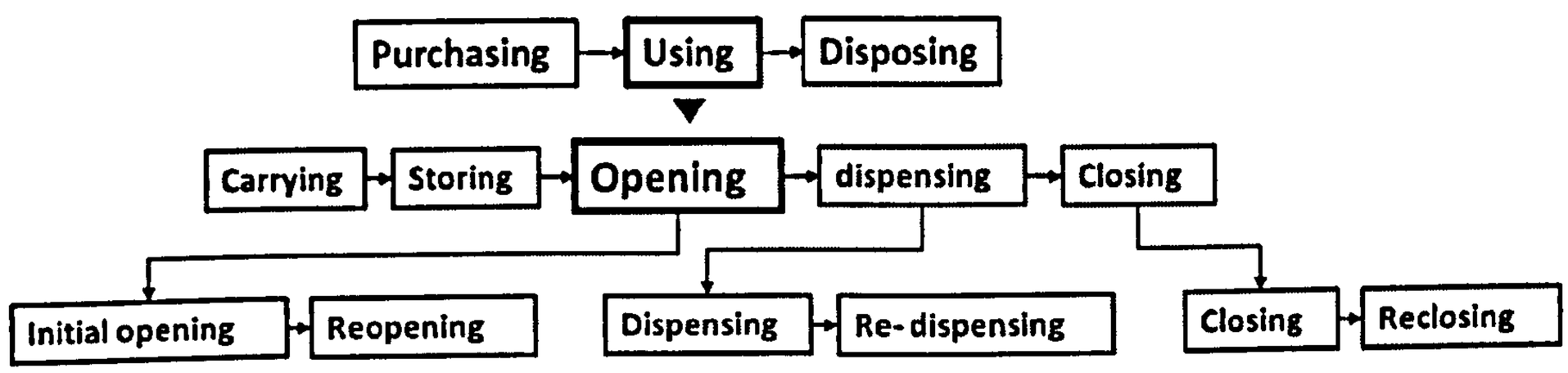


Figure 5: The stages of using packaging

Among the five stages of using, opening appears to be the more significant because without opening a package, it is impossible to access the contents inside.

Duizer *et al.* (op. cit.) stated that opening a package causes more problems than closing one. Experiencing opening difficulty can also lead to negative feelings about packaging. Galley *et al.* (2005) noted that users may not repurchase a package that was difficult for them to open.

In some packages, the boundary between opening, dispensing and closing is relatively blurred. For example, the appearance of some trigger spray bottles does not clearly show whether or not the bottle is open. In such cases, dispensing the contents is the only reliable way for the user to confirm whether the bottle is open or closed in order to see if the contents are accessible. Consequently, opening in this study also included the stage of dispensing contents. Closing can normally be seen as the reverse of opening.

2.2.2 Packaging closures

Emblem *et al.* (2000) defined a *closure* as a device used for closing a package in order to protect and preserve its contents. Opening a package may be seen as the act of releasing a packaging closure. As this study relates to the user's ability to open a package, closures must also be taken into account.

2.2.2.1 Key types of packaging closures

Packaging closures can be categorised by their materials as explained below.

Glass closures

The properties of glass are excellent for preserving and displaying the products contained (Opie, 1989), therefore glass is historically one of the more significant packaging

materials. The *Stopper* was a glass closure that was widely used in the 19th century (Lindsey, 2010). The two main types of stopper are introduced here.

The first, simply called a *glass stopper* was made of three parts: the *shank* used for sealing, the *final* used for gripping and the *neck* connecting the shank and the final (Lindsey, ibid.). As glass is a rigid material; additional seals were needed to maintain the quality of contents. Usually, a cork was placed between the stopper (the shank) and the neck of the bottle to form a tight seal (Lindsey, ibid.).

The second, namely *Codd's ball stopper*, was a glass ball stopper used inside carbonated drink bottles (Lindsey, ibid.). The bottle was tightly sealed by pressure from the carbonated contents pushing the glass ball in place against a rubber gasket mounted at the neck of the bottle (Lindsey, ibid.). Nowadays, glass closures have mostly been replaced by metals and plastics which offer better properties for preserving contents and broader design possibilities.

Paperboard closures

Types of paperboard closure vary with types of packaging application. Paperboard is most commonly used in corrugated boards and cartons (PF, 2003, op. cit.). Corrugated boards are primarily used for transit purposes, whereas cartons are commonly used to contain food, personal care products and household goods. As this study focuses on packaging for these products, only cartons will be discussed here. Commonly used cartons fall into two kinds: folding and multilayer.

Folding cartons are used to contain a variety of dry goods, for example, confectionery, cigarettes and toiletries such as soap. The closing mechanism of folding cartons is found at the end or top of the carton where the flaps are locked or glued (Golledge, 1967). These cartons can be opened by levering off a flap with the fingers or by tearing a perforation. Also, Golledge (ibid.) observed that there is another type of folding carton

closure called a *flip top*. This is designed for easy opening and closing with one hand. This carton is commonly used for cigarettes and sweets such as chewing gums and mints.

Multilayer cartons are commonly used for liquid products like milk. Fundamentally, this carton is sealed by a heated polyethylene layer applied to the top of the carton flaps. The carton can be opened by tearing or cutting along a perforation. In addition, plastic fitments, for example, a flip or screw top can be inserted into the top of the carton for easier opening and reclosing (Spong, 2006).

Metal closures

Metal closures are mainly used in metal and glass packaging (Page, 2006; Theobald, 2006). A common closure is formed where the body and lid of a metal container are jointed and rolled at the edge of the container (Cowan, 1967), for example, soup and baked bean cans. These cans need special openers. Cans that can be opened without special openers were also developed, for example, cans with keys in the 1880s and with ring pulls in 1967 (Opie, op. cit.).

Metal closures are also used on glass packaging, for example, tinplate and aluminium caps. Tinplate caps are commonly used on glass jars where a vacuum is formed in the jar to better preserve the contents. The internal vacuum creates a concave shape on the top of the cap. When opening, the vacuum in the jar is released, and the concave shape on the cap disappears. Opening this jar also creates a *pop* sound. This creates a tamper-evident (TE) function which lets users know if the package has previously been opened (Theobald, op. cit.).

Aluminium caps can also be formed into a kind of tamper-evident closure that is commonly used on alcohol bottles. They are known as *roll-on pilfer-proof* (ROPP) closures. Opening these closures will also break their seals letting users know that the bottles have previously been opened (Theobald, ibid.).

Plastic closures

The two major types of plastic closure are flexible and rigid (PF, 2003, op. cit.). Flexible closures are used on flexible packaging such as plastic pouches and trays. The tops of these packages are sealed by heating (Durston, 2006). Rigid closures are used on a variety of packaging types, for example, a pull tab closure on a carton of milk, a screw top on a glass bottle, a spray dispenser on an aerosol can and a pump dispenser on a plastic bottle.

The most commonly used polymers for rigid closures are the thermoplastics comprising high-density polyethylene (HDPE) and polypropylene (PP) (Larbey, 2006) where the closures are formed by injection moulding (Emblem *et al.*, op. cit.). Two fundamental kinds of rigid closures are *screw* and *push-on*. Airtight seals for screw closures are provided by the screw threads between the closures and bottle necks. The same feature for push-on closures are provided by the interlocks between the closures and bottle necks (Larbey, op. cit.). Screw or push-on closures can be combined with additional features, for example, flip top closures, spray pumps, dispensing pumps, tamper-evident closures and child-resistant closures, for convenient use and safety (Larbey, ibid.). These features are discussed in the next section.

2.2.2.2 Opening mechanisms

Glass, paperboard and metal closures were developed to protect the quality of contents and to offer convenient use. As manufacturers exploited the versatility of plastic materials, plastic closures were also developed for additional purposes, for example, safety for children and easy dispensing.

Similarly to the US (de la Fuente and Bix, 2005), the UK has regulations for using child-resistant closures on medicine (Farmer, 1990; DTI, 1999c) and chemical (DTI, ibid.) packaging. Child-resistant and tamper-evident features are commonly combined in some closures because of safety considerations. However, packaging with these features is

difficult for older people to open (Farmer, op. cit.). A number of closures have been developed concerning easy opening and dispensing. For example, users can dispense a tablet without removing the *Roll-a-pill* closure (Farmer, ibid). This particular design development may introduce unfamiliar design appearances into the package. Thus, clear indications for opening this type of package must be provided so that they can be understood easily by older people.

2.2.3 The indications for opening a package

Indications were defined in chapter one as: design elements, for example, shapes, textures, symbols, written instructions and diagrams, which communicate how to open packaging. In this study, indications are categorised into 2D and 3D types. Two dimensional indications (2D) refer to surface, embossed or imprinted indications which users can see and read to interpret meanings. Examples include: written instructions, diagrams or embossed arrows. Three dimensional indications (3D) refer to shape, embossed or imprinted indications which users can see and feel to interpret meanings. Examples include: trigger shapes, ridges around lids or imprinted marks between the lid and body of packaging, suggesting that the packaging is open. An embossed arrow is defined as a 2D indication because its meaning is perceived by seeing rather than feeling. Those imprinted marks are seen as 3D indications because their meaning can be perceived by feeling.

2.2.4 The role of tacit knowledge

Tacit knowledge refers to inarticulate, personal knowledge (Polanyi, 1962), used to understand how to perform tasks (Ryle, 1946). Tacit knowledge is gained from information perceived through senses and prior experience (Polanyi, 1968). Similarly, tacit knowledge used to understand how to open packaging can also be accumulated through prior experience. Figure 6 below was developed from Stanton's explanation of

demands and resources (Stanton, 2004). This will now be used to discuss the role of tacit knowledge in designing indications for opening.

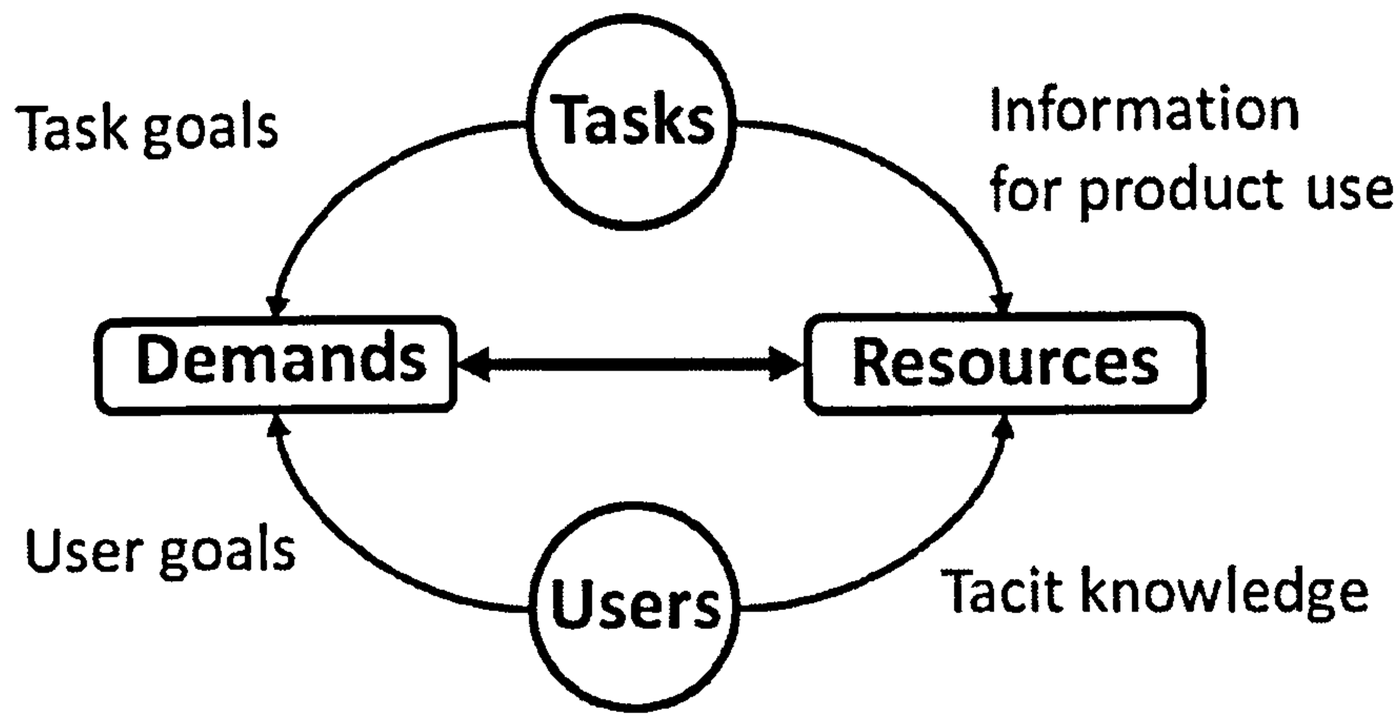


Figure 6: The balance of demands and resources in relation to tasks and users (Stanton, 2004)

Figure 6 shows that there are two aspects of demands and resources: tasks and users. Task demands refer to task goals where products are successfully used. Task resources present information for product use such as instructions. User demands can be seen as user goals based around their understanding of how to use products. User resources involve prior experience of using similar kinds of products (Stanton, ibid.) which can be seen as tacit knowledge.

Stanton (ibid.) noted that an imbalance of demands and resources has a negative impact on task performance. Users may not clearly understand how to use products (user demands) and therefore not be able to successfully use them (task demands). This may be because 1) there are no familiar indications (task resources) where users can use tacit knowledge (user resources) in guiding how products could be used or 2) indications (task resources) do not clearly explain how to use products.

Equally, when opening a package, information for opening (task resources) should be provided in a way that allows tacit knowledge (user resources) to be employed in

understanding package opening methods (user demands) leading to successful opening (task demands).

2.2.5 The role of action learning

Learning is a cognitive function developed through experience (when taking actions to solve a problem) (Birren, 1964). Revans (1998) introduced the term *action learning* where the importance of actions are highlighted. He used what he called the scientific method in describing the cycle of action learning comprising 1) *observation*, 2) *hypothesis*, 3) *trial*, 4) *audit* and 5) *review*. Observation is to collect and classify information; hypothesis is to create a strategy in dealing with a problem; trial is to take actions following the hypothesis; audit is to evaluate the outcome; and review is to draw a conclusion to see if the hypothesis will be accepted or rejected (Revans, ibid.). If the hypothesis is rejected then, this cycle comprising the five sequential steps can be repeated until the problem is resolved. The cycle shows that trial is the key characteristic of action learning as it provides feedback of what has been done. Although error tends to be undesirable, Revans (ibid.) noted that error plays an important role in helping a person develop their learning.

Action learning also helps users understand package opening methods. Trial allows users to evaluate if they opened a package successfully. If it does not, the error also suggests that other strategies used for opening are required.

2.3 Information design

It is important that consumers receive effective information when deciding which product to purchase. It is also important that they receive sufficient information to help them understand how to use products once purchased. Equally, information is essential in guiding users to successfully open packages. This section explores types of information

that help users open packages. It is helpful however, to begin with a look at types of information used in packages in general.

Packaging for food carries three key types of information (the Office of Public Sector Information (OPSI), 1996): 1) product identification, 2) detailed information about products such as net weight, a list of ingredients, a durability indication and nutrition and 3) instructions for use and/or storage. Packaging for household goods carries two key types of tactile information (Cayton, op. cit.): 1) product identification and 2) danger warnings concerning potentially harmful contents. The product identification and those instructions for use on food packaging can also describe how to open packages which will be explained further below.

The literature studied identifies three key types of information for opening: product identification, explanation of how to open a package and feedback on opening or closing. Packaging shape suggests the opening method whilst also identifying the contents (Cayton, ibid.). How to open packaging can be explained by presenting information showing: the required hand action (Moore, 1993, op. cit.), direction (Moore, ibid.) and position (Moore, ibid.; Cayton, op. cit.). Galley *et al.* (op. cit.) suggested that clear instructions are essential in explaining how to open packaging. Additionally, feedback (CEN/CENELEC, op. cit.), an audible click after opening or closing, indicates a successful manipulation.

2.4 The ageing population

This section starts by setting a definition of old age for use within the study.

2.4.1 Definition of older people

In the UK, the age of retirement; 65 for men and 60 for women; is commonly used to define the beginning of old age (Stuart-Hamilton, 2000; Zaidi, 2008) (The age of

retirement for women was raised to 65 from 6 April 2010 (Directgov, 2010).). However, Stokes (1992) suggested that the definition of ageing is more complex, and cannot be determined by chronological age alone. Other perspectives including *biological age*, *psychological age* and *social age* were proposed by Birren (op. cit.) and Birren and Renner (1977).

Biological age is determined by a person's life span as measured by the condition of one's organs and body systems. Psychological age is concerned with the cognitive ability of a person to deal with everyday life situations, for example, making decisions, solving problems and learning. Psychological age can also be affected by emotion and self-awareness. Social age offers another perspective from which individual age may be viewed, mainly through the expectations of society. For example, a grandfather is expected to be an older (more mature) person, even though his age may be the same as a parent.

This study focuses on how packaging can be designed in order to compensate for the age-related decline which affects older peoples' ability to open packaging. Visual, cognitive and hand functions are mainly used when opening packaging (DTI, 1999a, op. cit.). Visual and hand functions relate to biological age, whereas cognitive functions relate to psychological age. Ageing in this study will mainly relate to biological and psychological age. Social age is excluded as it has little impact on visual, cognitive and hand functions in relation to openability.

When clarifying the meaning of old age, the perspectives of biological and psychological age seem to be based on a wide range of factors. In the case of biological age, Stokes (op. cit.) suggested that each of one's organs and body systems may have its own life span which leads to different age-related effects. This can lead to difficulty when setting the standard for defining who in fact, is old.

Even though psychological age refers to cognitive ability when dealing with activities on a day-to-day basis, to some extent this age perspective also relates to biological age. This can be explained by the fact that cognitive ability is controlled by the brain; a human organ that naturally declines through ageing. As with other human organs, the brain might have its own ageing clock. Therefore, determining how old a person is by using psychological age, is also problematic.

Hayslip and Panek (1989) argued that biological and chronological age are not correlated. For example, an 87 year old woman might enjoy the same good health as a 50 year old. Similarly, chronological age may not correspond with psychological age, for example, the same older woman may have better cognitive functions than the younger one. However, Izaks and Westendorp (2003) pointed out that chronological age influences biological and psychological age, as human organs all decline chronologically. Although an older person may be healthier than a younger one, the older is more likely to be affected by accumulated component causes of disease. Therefore, older people tend to be at greater risk of physical and mental decline.

The discussion above shows that defining the biological and the psychological age of a person is likely to be highly problematic. Therefore, chronological age which also relates to biological and psychological age will be used to underpin references to *older people* herein.

For the purpose of this study, the beginning of old age will be set at age 65, an age where limitations in performing day-to-day activities are widely reported (the Department of Health (DH), 2001; Midwinter, 1988; Pynoos *et al.*, 1987). The older people become, the more vulnerable and dependent they are likely to be (Minkler, 1994; Tomassini, 2005). Sharp increases in deterioration were noted at the ages of 75 (Midwinter, op. cit.; Pitt, 1982) and 85 (Tomassini, op. cit.). Therefore, these two age points (75 and 85) will be used to mark further key age bands.

The study will therefore use the following three age groups: *young-old* 65-74, *old-old* 75-84 and *oldest-old* 85+. This will ensure that older people who potentially have different levels of decline are accommodated.

2.4.2 Older population in the UK

The World Health Organization (WHO) (2002, op. cit.) reported that by 2025, one third of the population in developed countries, including the UK will be aged 60+. ONS (2008b) focused on people aged 65+ in the UK and noted that in the last 35 years the number of people in this age group has drastically increased, whereas the number of people aged under 16 has rapidly reduced. By 2021, the number of people aged 65+ will exceed the number of people aged under 16 (ONS, ibid.). ONS (ibid.) also projected that the UK's older population will increase by 20 % from 1971 to 2026.

The UK's older population has increasingly lived alone (ONS, 2005). Thompson and West (1984) and Coleman (1996) all noted that it is very important for older people to be independent in day-to-day life. This is because being physically dependent on others can cause older people anxiety (Fiske, 1980). This study, in increasing package openability, can contribute to an independent life style for older people.

2.4.3 Older consumers' needs

Long (1998) and Morgan (1993) suggested that to understand the needs of older consumers, we need to consider not only their chronological age, but also their attitudes. Moschis (1996) noted that the past life experiences of older consumers affect their attitudes. These attitudes then, influence their behaviour.

The attitudes and behaviour of older consumers are influenced by external and internal factors. External factors refer to health conditions (Morgan, op. cit.; Moschis, ibid.; Pirkl,

1994), life stages (Moschis, ibid.; Pirkl, ibid.), financial status (Morgan, op. cit.; Moschis, ibid.; Pirkl, ibid.), political and social changes and technologies (IGD, 2001).

Internal factors relate to the individual characteristics of older consumers. The Institute of Grocery Distribution (IGD) (ibid.) noted that older consumers are individually different. Hence, they may react differently in response to the same external factors. For example, retirement may represent the end of life for one person, but may signal a positive beginning for another. Understanding the needs of older consumers, therefore, requires an understanding of older peoples' external and internal factors.

Furthermore, Crilly (2004) noted that users' individual differences influence their cognitive responses to products. Cognitive responses "refer to the judgements that the user or consumer makes about the product based on the information perceived by the senses" (Crilly, ibid., p. 552). Users' cognitive responses can be divided into three categories: *semantic interpretation*, *aesthetic expression* and *symbolic association* (Crilly, ibid.). Semantic interpretation relates to product functions, aesthetic expression involves product attractiveness and symbolic association relates to how products reflect users' personal identity, social status and characteristics (e.g. chic, sophisticated or feminine) (Crilly, ibid.). These categories can be used to explain users' cognitive responses to: how packaging could be used, packaging aesthetics and how packaging expresses consumer characteristics.

Long (op. cit., p. 80) suggested that "they [older consumers] are unwilling to attribute brands with any greater emotional or social significance than their perceived functional or performance capabilities". The importance of a cognitive response in terms of semantic interpretation may increase as people become older because this influences their performance in everyday life tasks such as opening packaging.

2.4.4 Novel packaging and older people

Most food and personal care and household products need packaging for containment and protection. Accordingly, the packaging which contains these products effectively becomes their appearance. Packaging appearance is used to differentiate products that belong to different brands. Consequently, products, packaging and brand names are unlikely to be separated in the minds of users. Therefore, attitudes towards new products and brands need to be understood when discussing novel packaging. Novel packaging here refers to a package whose appearance is unfamiliar to consumers.

When consumers consider novel packaging, four scenarios apply (see Table 1 below). The first scenario contains a new product, but an old brand. For example, the same brand that a consumer regularly buys extends its product range; thus, a novel package is required.

Table 1: Four scenarios when consumers consider novel packaging

Scenario no.	Package	Product	Brand
1	New	New	Old
2	New	Old	New
3	New	New	New
4	New	Old	Old

One of the commonly held stereotypes about older people is that they are not willing to change and are not likely to try new experiences (Stroud, 2005). This view falsely maintains that older peoples' resistance to change may form a barrier, preventing them from trying new products in novel packages.

There is however, another view, that older people try new products just as younger people do, but are driven differently (Leventhal, 1997; Thompson and Thompson, 2009). Younger people may look for new products that are trendy, whereas older people tend to look for new products that meet their personal, specific needs (Leventhal, ibid.).

The second scenario shown in Table 1 refers to a new brand, but an old product. For example, there is a new brand of a product that a consumer regularly uses. The brand owner differentiates itself through a novel package.

Cole and Balasubramanian (1993) noted that older people have higher brand loyalty than their younger counterparts. Thus, they buy a product with a brand that they know and a package that they are familiar with. Stroud (op. cit.) stated that older peoples' willingness to try new brands may decline, but not in all cases. Older people are also willing to try new brands that meet their needs (Ambrosius, 2010).

Furthermore, self-perceived age tends to be more useful than chronological age in understanding older people's product and brand consumption (Wilkes, 1992). Gana *et al.* (2004) stated that self-perceived age refers to how old a person feels she or he is. Older people with a younger self-perceived age tend to be open-minded in trying new products and brands (Schiffman and Sherman, 1991).

The discussion above shows that older consumers may try new products in novel packaging (scenario one) and new brands with novel packaging (scenario two), if the products and brands meet their needs. This introduces scenario three, where a product and brand are both new (see Table 1) as well as the packaging. For example, a new brand launches a new product in a novel package.

Despite older peoples' preferences for products with tried and tested branding, it is unlikely that they can completely avoid experiencing new products. Any product has a life cycle (Onkvisit and Shaw, 1989). Even though some products may survive in the market for many years, eventually, they will become less and less popular (Onkvisit and Shaw, ibid.). Outdated products are replaced by new ones, often with enhanced packaging.

In the first stage of product decline, a brand owner may employ a minor change to extend product life by changing its packaging. This event is described in scenario four where an old product and brand are in a novel package (see Table 1 above). In this case, older consumers may have to accept a novel package, if they prefer to continue using a brand and product that they are familiar with.

2.4.5 Age-related decline in relation to openability

As we grow old, physical decline takes place, for example, reduction in size, weight or elasticity of muscles, bones, tissues, cells and nerves (Windmill, 1990). The decline can cause difficulties in performing everyday activities including opening packages. In the literature on age-related decline, the terms *impairment* and *disability* (Minkler, op. cit.; Mehta *et al.*, 2002; Percival and Hanson, 2005) are used to describe a person's health-related condition. In addition, the terms *normal ageing* and *pathological ageing* (Anderton, 2002; Atchley, 2000; Hayslip and Panek, op. cit.; Hedden and Gabrieli, 2004) are used to define causes of age-related decline. It is helpful to clarify how these terms relate to age-related decline in the context of this study before moving on to the discussion.

WHO (1999) used the terms *impairments* and *activity limitations* (instead of disability) to describe a person's negative health conditions in reference to 1) body functions and structures and 2) an individual's ability to maintain everyday activities.

In this study, the term impairment represents negative changes in sensory, cognitive and hand functions. Such changes then, lead to activity limitations causing older people to have reduced ability to open a package.

The terms normal and pathological ageing are widely used in gerontological literature. There are two schools of thought describing these two terms from 1) the sociological and psychological fields and 2) the medical field. The views from the medical field were

subscribed in this study because the focus is on biological rather than sociological impacts on older peoples' ability to open packaging.

From the medical point of view, the impairment of organs and cell decline is inevitable when a person grows old. This is considered to be part of normal ageing. Also, through a person's life time, it can be expected that injuries of the organs and cells will occur. Such injuries cause permanent damage to organs and cells, although the injuries may have been cured. Due to the decline and damage of organs and cells then, component causes of disease are accumulated. Consequently, older people are more at risk of infection and disease. This can be defined as pathological ageing. Therefore, it is not possible to separate normal ageing and pathological ageing (Izaks and Westendorp, op. cit.).

Age-related impairment is not only caused by normal and pathological ageing, but also by individual differences, for example, genetic influences (Gates and Mills, 2005), environments (Izaks and Westendorp, op. cit.; Stuart-Hamilton, op. cit.) as well as socio-economic backgrounds (Bäckman *et al.*, 2000; Sorce, 1995; Stokes, op. cit.) and life styles (Bäckman *et al.*, ibid.). However, in this study, only normal and pathological ageing will be discussed because they occur to everybody. Before the discussion of how normal and pathological ageing affect older peoples' ability to open packaging, the activities related to the opening stages of packaging are rehearsed below.

Section *2.2.1 The stages in opening a package* suggested two opening stages: opening (releasing a closure) and dispensing. These two stages tend to be concerned with hand functions. However, before a package is physically opened, other activities, for example, receiving information from the package and thinking about how to open it, must take place. These activities refer to the earlier stage of inspecting the package. Therefore, the major opening stages comprise 1) inspecting a packaging, 2) releasing a closure and 3) dispensing contents. Inspecting a packaging involves sensory organs as a combined channel for information input and also cognitive processes. This leads to the next two

stages, releasing a closure and dispensing contents, which both involve movement and strength of hands and fingers.

The impairment of sensory, cognitive and hand functions caused by normal and pathological ageing will now be discussed.

2.4.5.1 Sensory functions

Everyday things are experienced through the senses of sight, smell, taste, hearing and touch. However, it is unlikely that a user would require all senses when opening a package. Smelling and tasting a package may not tell the user anything about how to open it. The user can both see and feel the shape of a package, and can also see the graphic information that it carries. Where packages make sounds during use such as the sound of breaking the seal on a lid, feedback is provided. Three kinds of sensory decline affecting: vision, hearing and touch which can influence older peoples' ability to understand how to open packaging are described below.

Visual impairment

Age-related visual impairment which may influence older peoples' ability to understand how to open a package is discussed below.

Visual acuity

Visual acuity is "the ability to see objects clearly at a distance" (Stuart-Hamilton, op. cit., p. 28). Seeing an object begins with light which is reflected from the object to the eye through the cornea, iris and lens onto the retina before visual information is transmitted by optic nerves to be interpreted by the brain (Watkinson, 2005). A defect in any of these eye structures such as the cornea, iris, lens (Pirkl, op. cit.) or retina (Watkinson, op. cit.) can cause a loss of sharp focus on an image or an object.

Presbyopia is long-sightedness in older people due to normal ageing caused by the loss of elasticity of the lens and strength of the eye muscles (Goldstein, 1980; Pirkl, op. cit.). This reduces the ability to focus on close objects (visual accommodation) (Pirkl, ibid.). The following effects of pathological ageing can also lead to a loss of focusing ability.

Cataracts is the name given to an eye disease which causes an opaque lens making vision unclear (Ah-Chan and Downes, 2006; Evamy and Roberts, 2004; Goldstein, op. cit.; Watkinson, op.cit.).

Diabetic retinopathy and age-related macular degeneration cause damage to the retina (Chivers, 2003; Evamy and Roberts, ibid.; Goldstein, ibid.; Stuart-Hamilton, op.cit.).

Diabetic retinopathy causes leaking (Evamy and Roberts, ibid., Goldstein, ibid.) and swollen (Goldstein, ibid.) capillaries to form in the eyes. The disease can develop further where abnormal and fragile blood vessels grow on the retina (Chivers, op. cit.; Goldstein, ibid.). Such advanced disease can also cause retinal detachment (Goldstein, ibid., Watkinson, op. cit.).

Age-related macular degeneration is caused by 1) poor nutrition (Watkinson, ibid.) and 2) the growth of abnormal blood vessels which afterward leak into the *macula* (Chivers, op. cit.; Evamy and Roberts, op. cit.; Watkinson, ibid.). The macula is a region of the retina (Goldstein, op. cit.) which performs a significant number of seeing functions, for example, object identification in terms of shape, size and colour (Watkinson, op. cit.), visual acuity (Evamy and Roberts, op. cit.; Watkinson, ibid.), central vision (Chivers, op. cit., Evamy and Roberts, ibid., Goldstein, op. cit.; Watkinson, ibid.), brightness and darkness adaptation and sensitivity to glare (Watkinson, ibid.).

Goldstein (op. cit.) indicated that glaucoma is a disease which causes damage to the optic nerve. The outflow of aqueous humour, the fluid in the inner structure of the eyes, is blocked causing high pressure which damages the optic nerve (Evamy and Roberts, op. cit.; Goldstein, ibid.). Such damage leads to *tunnel vision*, in other words, the loss of peripheral vision (Chivers, op. cit.; Evamy and Roberts, ibid.; Goldstein, ibid.; Watkinson, op. cit.).

Colour perception

Stuart-Hamilton (op. cit.) suggested that older peoples' eyes perceive yellow, orange and red better than green, blue and purple. Thus, the ability to identify the latter colour group decreases (Pirkl, op. cit.). Possible reasons for this change are less clarity of the lens (Pirkl, ibid.) and changes in the nervous system (Marsh, 1980). Such decline can be caused by normal and pathological ageing. The function of colour perception is performed by the macula (Watkinson, op. cit.). Therefore, any disease that damages this structure, for example, age-related macular degeneration, can lead to impaired colour perception.

Brightness and darkness adaptation

Decline in brightness and darkness adaptation can be caused by normal and pathological ageing. Ah-Chan and Downes (op. cit.) and Pirkl (op. cit.) suggested that the reduction of iris muscle reactivity to light decreases the ability to control incoming light to the eyes. Too little light entering the eyes causes older people to need greater levels of illumination and contrast in order to see objects clearly (Pirkl, ibid.). Also, certain effects of pathological ageing such as cataracts can reduce the transparency of the lens which then diminishes contrast sensitivity (Pirkl, ibid.). Furthermore, transmission of too much light through an opaque lens can result in seeing excessive light reflections on shiny surfaces (Osterburg, 1987).

Impairment of the sense of touch

Pirkl (op. cit.) and Stuart-Hamilton (op. cit.) suggested that thinner skin due to normal ageing can reduce the number of touch receptors, which therefore impairs touch sensitivity. However, Woodward (1993) noted that defects of the central nervous system can also impair touch sensitivity. Such defects may be caused by pathological ageing.

Pirkl (op. cit.) suggested that there are three kinds of touch sensitivity: *tactile*, *pressure* and *thermal*. Tactile and pressure sensitivity both describe the ability to feel an object, but in different ways. Tactile sensitivity is concerned with the shape and texture of an object; pressure sensitivity involves how hard or soft an object is as we press on it with our fingers or hands (Pirkl, ibid.). Thermal sensitivity concerns hot and cold. It is likely that only tactile and pressure sensitivity will relate to opening a package.

Hearing impairment

Hearing impairment can be caused by both normal and pathological ageing. *Presbycusis* is the term for age-related hearing impairment (Gates and Mills, op. cit.; Pirkl, ibid.; Stuart-Hamilton, op. cit.). The impairment can be caused by the deterioration of ear structures (Gates and Mills, ibid.; Goldstein, op. cit.; Stuart-Hamilton, ibid.) and of the central auditory system (Gates and Mills, ibid.).

In the middle ear, sound transmitters such as the bones, hammer, anvil and stirrup, may become stiffer. Also, Stuart-Hamilton (op. cit.) suggested that these sound transmitters may become stiffer because of pathological ageing, for example, due to calcification or arthritis. In the inner ear, sound receptor cells may be lost (Gates and Rees, 1997). Likewise, auditory nerve fibres may diminish in size. These impairments decrease hearing ability for high frequency sounds (Stuart-Hamilton, op. cit.) which can cause problems with everyday activities. These are, for example, the inability to hear high frequency sound in speech and not noticing warning beepers on some electronic utensils (Gates and

Mills, op. cit.). Additionally, ear impairment can cause ringing, hissing or buzzing noises in the ear (Kart *et al.*, 1978; Parsons and Felton, 1990) and can decrease an individual's ability to identify the direction of a sound (Gates and Mills, op. cit.; Pirkl, op. cit.). These can reduce hearing sensitivity to sounds in the environment (Pirkl, ibid.).

In addition, age-related changes in the central auditory system can negatively affect speed of information processing and therefore, reduce the ability to understand speech in noisy environments (Gates and Mills, op. cit.).

2.4.5.2 Cognitive functions

Benjafield (1992) suggested that *cognition* is complex because it means different things in different contexts and at different times. Natsoulas (1978) divides cognition into two areas: one relating to the processes for acquiring knowledge and the other being involved with the ability to acquire knowledge. Cognition will be discussed under two headings: firstly-what cognitive processes are and secondly-how normal and pathological ageing impair cognitive performance.

The model of cognition shown in Figure 7 was developed by combining data related to cognitive processes drawn from different sources: (Benjafield, op. cit. ; Birren, op. cit.; Goldstein, op. cit. ; Schonfield, 1980; Smyth *et al.*, 1994; Solso, 2001; Stokes, op. cit.; Welford, 1980). The model will now be explained.

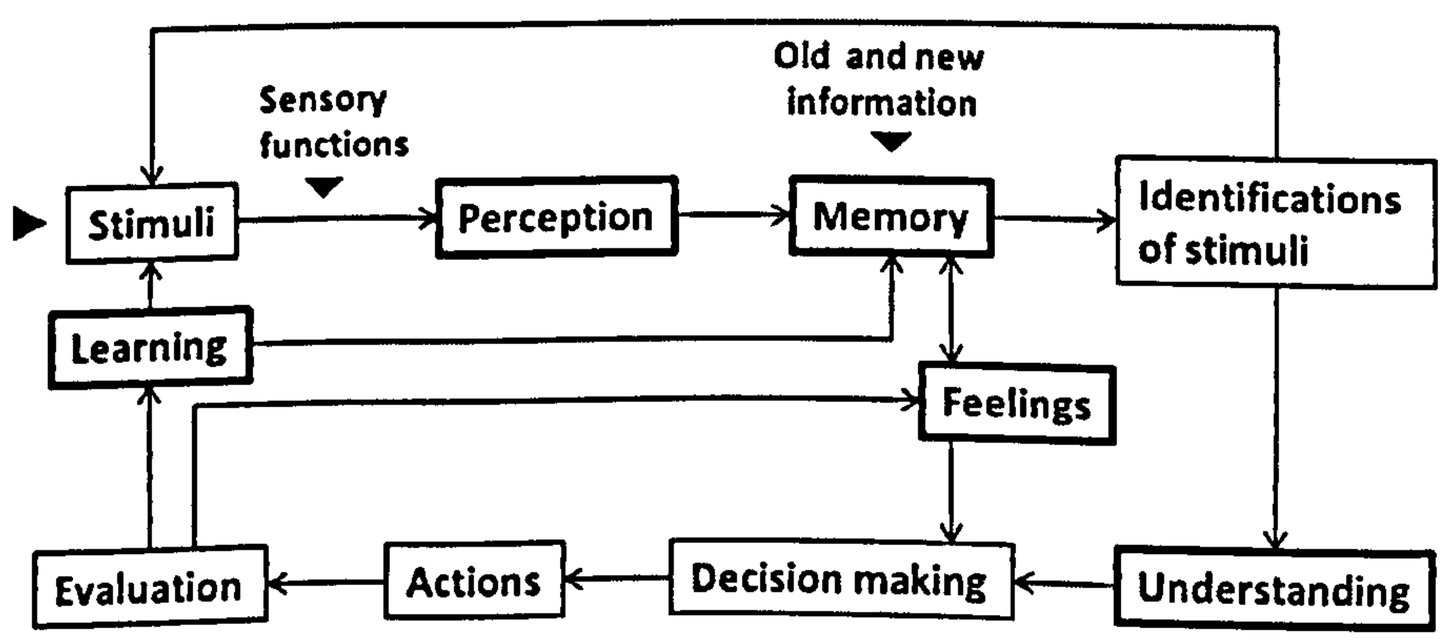


Figure 7: A model of everyday cognitive processes

Cognition comprises a number of functions, which are seen differently by different authors (Benjafield, ibid.; Smyth *et al.*, ibid.; Solso, ibid.). However, cognition can be grouped into five major functions: perception, memory, understanding (Smyth *et al.*, ibid.; Solso, ibid.; Welford, op. cit.), learning (Solso, ibid.) and feelings (Benjafield, op. cit.; Solso, ibid.). These five functions were highlighted in bold line boxes in Figure 7.

Perception is the stage by which a person examines sensory *stimuli* before making the decision whether or not to respond (Cunningham and Brookback, 1988). Through application of *memory*, previous knowledge helps a person classify old and new information in order to try to identify the *stimulus* (Benjafield, op. cit.; Smyth *et al.*, op. cit.). If this succeeds, then *understanding* takes place through the integration of old and new information (Smyth *et al.*, ibid.; Welford, op. cit.). From this integration, ideas are constructed for *decision making* (Smyth *et al.*, ibid.) which lead to *actions* (Welford, op. cit.). Having taken *actions*, the outcomes are *evaluated* resulting in *learning* (Kolb, 1984) and *feelings* are aroused by the experience, which are stored in *memory* (Zajonc, 1980). Subsequently, the experience from these cognitive processes can be recalled from *memory* for future use (Smyth *et al.*, op. cit.). If the *stimulus* is not resolved, more information from *stimuli* may be needed for further cognitive processing through iteratively revisiting the stages in the model until either the *stimulus* is resolved or the decision is made to end the process.

Perception

Goldstein (op. cit.), Stokes (op. cit.) and Solso (op. cit.) noted that perception is not only the stage where information is received from the senses, but it is also the initial stage at which the meaning of the information is interpreted. Goldstein (ibid.) proposed a sequence of perception processes: 1) information input, 2) information processing through the central nervous system and 3) integration of the arriving information with previous knowledge, and then, 4) responses.

Goldstein (ibid.) stated that the processes of perception are continued as long as more information, interpretation and exploration are required to identify the stimuli. As with cognitive processes, further cycles of information processing may be required to find more appropriate solutions for a problem. Birren (op. cit.) suggested that during cognitive processing, multiple hypotheses for a problem solution are made and evaluated. If one hypothesis has not solved the problem, then the next hypothesis is evaluated.

Memory

Memory is cerebral storage in which information is retained (van Beijsterveldt, 1998) and retrieved for later use (Stokes, op. cit.). Memory plays a significant role in cognitive processes because it helps a person identify stimuli (*perception*) (Goldstein, op. cit.), develop ideas to solve problems (*understanding*) (Stokes, op. cit.) and enhances a person's performance in manipulating tasks (*learning*) (Birren, op. cit.). Additionally, *feelings* towards a stimulus which influence decision making are recalled from memory (Zajonc, op. cit.). Memory can be categorised into two kinds: short-term and long-term as explained below.

Short-term memory

Short-term memory can be described as limited-capacity storage of information over a very short duration (Kensinger and Corkin, 2003; van Beijsterveldt, 1998). After information enters into the brain, it can be retained in short-term memory through rehearsal (Stokes, op. cit.; van Beijsterveldt, ibid.) and is transferred to long-term memory, if it is regularly retrieved (Stokes, ibid.).

Two further terms related to short-term memory can be found in the literature: primary memory (Craik and Bosman, 1992; Stokes, ibid.) and working memory (Craik and Bosman, ibid.; Kensinger and Corkin, op. cit.; Stokes, ibid.). There appears to be no clear

agreement on defining all three terms (short-term memory, primary memory and working memory) in the literature reviewed.

Craik and Bosman (ibid.) noted that short-term memory comprises primary memory and working memory. Stokes (op. cit.) defined primary memory as short-term memory. Kensinger and Corkin (op. cit.) addressed two different kinds of memory: short-term and working memory.

For the purpose of this study, if primary memory and short-term memory can be seen as the same kinds of memory, the two categories of memory used will be: 1) primary memory and short term memory and 2) working memory. Primary memory (Craik and Bosman, op. cit.; Stokes, op. cit.) and short-term memory (Kensinger and Corkin, op. cit.) are both used as a kind of temporary information storage. Working memory is used to manipulate stored information in planning a task (Kensinger and Corkin, ibid.; Stokes, op. cit.). Hence, working memory is concerned with information processing.

Long-term memory

In contrast to short-term memory, long-term memory acts as a permanent information store (van Beijsterveldt, op. cit.). There are three kinds of long-term memory: episodic, semantic and procedural.

Kensinger and Corkin (op. cit.) and Tulving (1972) noted that episodic memory is involved with personal experience in relation to time and space, for example, when and where a person moved from an old to a new home.

Semantic memory refers to knowledge and facts about the world (Smith *et al.*, 2000) which have previously been learned, for example, how to speak and read, or the fact that Bangkok is the capital city of Thailand. White (1993) explained that what a person has learned helps a person learn new things.

The kinds of memory mentioned above; short-term, episodic and semantic, are categorised as explicit memory where a person has awareness and pays attention when memorising information (van Beijsterveldt, op. cit.). In contrast, procedural memory is seen as implicit memory through which information is memorised without awareness and attention (van Beijsterveldt, ibid.). Procedural memory is concerned with the knowledge of how to perform everyday activities (Smith *et al.*, op. cit.) associated with motor and cognitive skills (Craik and Bosman, op. cit.; Smith *et al.*, ibid.). For example, explicit memory helps a beginner remember particular steps of how to cook. Implicit memory subsequently helps her or him improve their cooking skills.

Intelligence

Benjafield (op. cit.) suggested that understanding is associated with intelligence. Also, the Oxford English Dictionary (1989) defined intelligence as *the faculty of understanding.* Cattell (1963) and Bäckman *et al.* (op. cit.) indicated that there are two kinds of intelligence: fluid and crystallised. Fluid intelligence and crystallised intelligence as implied by their names refer to flexibility and rigidity. Fluid intelligence involves the ability to reason, to acquire new ideas (Stokes, op. cit.) and to solve new problems (Bäckman *et al.*, op. cit.). Crystallised intelligence is concerned with specific knowledge and methods for solving problems increasing with experience (Cunningham and Brookback, op. cit.).

Learning

Learning is defined as the development of behaviour according to experience (Birren, op. cit.; Schonfield, op. cit.). Stokes (op. cit.) stated that there is a similarity between memory and learning in the way that both relate to remembering. However, Stokes (ibid.) noted in relation to learning that information is not only retrieved, but also processed further which results in a solution for a response (an action).

Emotion

Schwarz (2000) suggested that there is an interplay between cognition, feeling and decision making. Likewise, Benjafield (op. cit.) noted that making a decision does not only involve cognition, but also emotion or feeling.

Feelings arise when perceiving an object early on in the initial stage of cognitive processing and even after decision making (Zajonc, op. cit.). The feelings arising from prior experience about an object, whether positive or negative, then influence any decision that will be made (Dolan, 2002). Equally, positive or negative feelings towards a package may influence a decision on what a person can do about opening a package. For example, an older person may avoid squeezing the lid of packaging because this caused finger pain during a previous opening attempt.

Cognitive impairment

Key areas of cognitive impairment are discussed as below.

Normal ageing

Normal ageing concerning cognitive functions comprises 1) deficits in sensory perception (Stokes, op. cit.) and 2) negative changes in the brain, for example, the decrease of neurons (White, op. cit.) and deficits in the central nervous system (Stokes, op. cit.).

Perception impairment

Impairment of sight, touch and hearing is likely to contribute to a deterioration in perception. Normal ageing that impairs sensory functions was discussed in section *2.4.5.1 Sensory functions*. Stokes (ibid.) highlighted that the decline occurs both in terms of quantity and quality. For example, the loss of iris muscle flexibility limits the amount of light entering the eyes. This then reduces contrast perception and visual acuity when seeing images.

Memory impairment

Memory functions decline with ageing. Such decline then, affects other cognitive functions such as intelligence and learning which also rely on memory functions. Ageing does not impair all kinds of memory functions as shown below.

Impairment of primary memory (short-term memory) and working memory

Craik and Bosman (op. cit.) and Kensinger and Corkin (op. cit.) stated that ageing slightly affects primary memory (short-term memory), but substantially affects working memory. Kensinger and Corkin (ibid.) explained that the decline of working memory in older people may be caused by three kinds of cognitive limitations. Firstly, older people take longer to process information. Secondly, they find it difficult to simultaneously store different types of information. Thirdly, it is difficult for them to distinguish relevant from irrelevant information.

Impairment of long-term memory

This section considers impairment of the three kinds of long-term memory: episodic, semantic and procedural.

Craik and Bosman (op. cit.) reviewed a range of tests that were conducted with older participants to measure their episodic and semantic memory. Their findings were inconclusive, suggesting that it was not possible to determine whether ageing affects these two kinds of memory.

However, ageing appears to have a more negative effect on episodic memory than it does on semantic memory (Craik and Bosman, ibid.). In addition, Bäckman *et al.* (op. cit.) pointed out that semantic memory declines gradually in very old age (75).

Smith *et al.* (op. cit.) suggested that there are three kinds of procedural memory: classical conditioning, priming and skill learning.

Classical conditioning relates to learning ability associated with two related sequential stimuli provided (Smith *et al.*, ibid.). For example, if an experimental participant is repeatedly presented with an audio tone before receiving a puff of air into the eyes, after a period of time (s)he will automatically blink after hearing the tone, even if no puff of air is received (Kensinger and Corkin, op. cit.)

Priming involves the ability to recognise stimuli (words, objects or pictures) influenced by prior experience (Kensinger and Corkin, ibid.; Smith *et al.*, op. cit.). For example, an experimental participant is given a list of words for study. Then, the participant is asked to complete word stems (e.g. att_, bus_ and car_) with the first word that comes to mind. The participant tends to complete the word stems using the studied words more often than novel words (Kensinger and Corkin, ibid.).

Skill learning relates to the ability to learn a wide range of skills, from motor to cognitive. Motor skills involve physical activities such as swimming and cycling, whereas cognitive skills rely more on mental activities such as using a computer and playing chess (Smith *et al.*, op. cit.).

Classical conditioning and skill learning decline with ageing, but priming is only slightly affected by ageing (Smith *et al.*, ibid.). However, Craik and Bosman (op. cit.) indicated that skill learning and priming decline slightly with ageing. Furthermore, Craik and Bosman (ibid.) noted that procedural memory is likely to be least affected by ageing compared to other kinds of memory. Likewise, Bäckman *et al.* (op. cit.) showed that generally ageing does not affect procedural memory.

The discussion above indicates that it is not possible to conclude whether ageing does or does not affect episodic, semantic and procedural memory. However, taking an overview of the relevant literature discussed above, it seems reasonable to prioritise the degree of age-related decline in the three kinds of long-term memory from the greatest to the least as follows: episodic, semantic and then procedural.

Intelligence impairment

Bäckman *et al.* (ibid.), Sorce (op. cit.) and Stokes (op. cit.) argued that ageing does not affect all aspects of intelligence. Fluid intelligence declines with ageing (Sorce, ibid.), whereas crystallised intelligence is stable through adulthood (Stokes, op. cit.), but starts to decline around the age of 75 (White, op. cit.). However, Horn (1982) argued that crystallised intelligence is not only stable, but even improves in later life. This discussion suggests that ageing may affect fluid more than crystallised intelligence.

Bäckman *et al.* (op. cit.) highlighted that there is a similarity between two categories of tasks used for assessing cognitive functions. The first category refers to tasks concerning flexible adaptation to unfamiliar situations, used for assessing fluid intelligence and episodic memory. The second category refers to tasks involving the use of prior knowledge, used for assessing crystallised intelligence and semantic memory. The first category declines with ageing, whereas the second category tends to stabilise with ageing.

Impairment of learning

Stokes (op. cit.) pointed out that learning takes place in older people, but it is slower than in their younger counterparts. Birren (op. cit.) suggested that learning occurs when experience is memorised. Therefore, the decline of memory also affects learning ability (Stokes, op. cit.).

Pathological ageing

Pathological ageing that reduces cognitive functions involving memory impairment can be caused by Dementia, which is now discussed.

Dementia refers to the symptoms of mental disorders caused by damage to the brain (Alzheimer's Society, 2010; the Department of Health (DH), 2007). The symptoms include loss of memory and problems with communication (Alzheimer's Society, ibid.; DH, ibid.) and understanding (DH, ibid.). The majority of dementia patients are older people (DH, ibid.) because the potential factors that lead to dementia are accumulated when people grow old. However, there is no consensus about which particular factors cause dementia. The most common type of dementia is Alzheimer's (Alzheimer's Society, op. cit.). Alzheimer's relates to negative changes in the chemistry and structure in the brain which destroy brain cells (Alzheimer's Society, ibid.).

There is wide acceptance that dementia inhibits the functions of memory (Baddeley *et al.*, 1986; Baddeley *et al.*, 1991; Graham and Hodges, 1997; Morris, 1994; Morris and Kopelman, 1986; Ober *et al.*, 1986). Morris and Kopelman (ibid.) stated that Alzheimer's affects working, primary, semantic and episodic memory, but does not affect implicit memory (procedural memory).

Alzheimer's impairs working memory used when performing two or more concurrent tasks (Baddeley *et al.*, 1986, op. cit.; Baddeley *et al.*, 1991, op. cit.; Morris, op. cit.; Morris and Kopelman, ibid.). Alzheimer's inhibits primary memory used when recalling information (e.g. digits, letters and words) in the correct order and when retaining small items of information while interrupted by a distracting activity (e.g. counting backwards) (Morris and Kopelman, ibid.). These two tests are known as memory span and Brown-Peterson respectively (Morris and Kopelman, ibid.). Alzheimer's also impairs semantic memory when recalling the names of people and objects (naming tasks) (Morris and Kopelman, ibid.; Ober *et al.*, op. cit.).

When affected by Alzheimer's, working memory decline may impair older peoples' ability to understand opening methods, but primary memory and semantic memory decline appear not to. In the case of working memory, difficulty can arise when different items of opening information must be processed concurrently. In the case of primary memory, successfully understanding opening methods is unlikely to require the ability to recall different items of opening information in the correct order, or the ability to retain opening information during distractions. Additionally, naming tasks as used in the assessment of semantic memory are unlikely to be used when opening packages.

Episodic memory declines when affected by Alzheimer's, but episodic memory relates to an individual's experience in relation to what, where and when an event happened (Tulving, op. cit.). It is less likely that users will need to recall information from memory about where and when they opened a certain package to understand the opening method.

2.4.5.3 Hand functions

Everyday life activities are significantly based on hand functions, which comprise hand strength and hand dexterity (Carmeli *et al.*, 2003; Printz *et al.*, 2008). Different hand functions are required for different kinds of activities; for example, a considerable amount of strength is required when using pliers or a screwdriver. In contrast, a fine and delicate task such as threading a needle requires hand dexterity (Carmeli *et al.*, ibid.).

Similarly, the hand functions required for opening packaging tend to depend on the particular closures used. For example, hand strength is likely to be crucial for opening a jar of marmalade. Conversely, hand dexterity might be needed when lifting the tiny lip on the lid of a seasoning bottle. A combination of hand strength and dexterity may be required to remove a tamper-evident ring before squeezing and turning the lid of a child-resistant bottle.

Hand functions decline in old age (Carmeli *et al.*, ibid.; Ranganathan *et al.*, 2002; Smith *et al.*, 1999; Thorngren and Werner, 1979). Therefore, older people can find it difficult to physically open a certain package when considerable hand strength, movement or dexterity is needed.

Impairment of hand functions

Impairment of hand functions is described through the following perspectives.

Normal ageing

Decline of hand functions mainly relates to physical impairment of hand structures. Hand functions can also be affected by the decline of the nervous system. In addition, sensory impairment can inhibit hand performance.

Three major kinds of physical hand structures will be addressed: muscles, tendons and bones. Carmeli *et al.* (ibid.) and Metter *et al.* (1998) suggested that age-related loss of muscle mass decreases muscle strength. Also, an age-related reduction in muscle fibre length negatively affects action potential (Lateva *et al.*, 1996).

Hand tendons consist of collagen fibres (Kannus, 2000) connecting muscles and bones (Carmeli *et al.*, op. cit.). The function of tendons is to transmit forces from muscles to bones and provide strength for movement (Carmeli *et al.*, ibid.; Tuite *et al.*, 1997). With advanced age, the physical structure of collagen fibres diminishes bringing about a loss of flexibility and tensile strength (Tuite *et al.*, ibid.). This leads to limitations in joint movements (Carmeli *et al.*, op. cit.), for example, difficulty experienced when bending fingers. Older people may experience pain which restrict joint movements. Therefore, they may prefer not to move their fingers to perform a task, even though they are able to.

Schoutens *et al.*(1989) suggested that bone mass decreases after the age of 40. Also, calcium levels in the human body diminish with ageing. This decrease of bone mass

causes bone-thinning especially in postmenopausal women (Huachou *et al.*, 2001). Martin (1993) indicated that ageing bones become less strong and more fragile.

Flanagan and Johansson (2002) explained that the nervous system plays a significant role in controlling hand movements. The nervous system transmits (Welford, op. cit.) and processes (Stokes, op. cit.) information received from senses before triggering a response back to the hands for an action (Flanagan and Johansson, op. cit.). Therefore, the decline of the nervous system, for example, the loss of nerve cells, can decrease the ability to control hand movements (Carmeli *et al.*, op. cit.).

The decline of the senses also affects hand performance. The two senses that relate most to hand performance are vision and touch. Age-related decline of the senses decreases the accuracy of information input. Inaccurate information input may negatively affect decision making and subsequently, a hand action, especially when performing a delicate task or manipulating a small object (Carmeli *et al.*, ibid.).

Pathological ageing

Osteoarthritis (Aigner *et al.*, 2007; Estes *et al.*, 2000; Reginster, 2002) and rheumatoid arthritis (Reginster, ibid.) are joint diseases commonly found in older people. Older women are at greater risk of being affected by osteoarthritis (Carmeli *et al.*, op. cit.) and rheumatoid arthritis (Symmons *et al.*, 2002). Osteoarthritis (Altman *et al.*, 1990) and rheumatoid arthritis (Symmons *et al.*, op. cit.) cause pain, swelling, stiffness and deformation of fingers. This makes it difficult to move wrists and fingers (Carmeli *et al.*, op. cit.).

2.4.6 Impacts of age-related decline on older peoples' ability to open packaging

This section discusses the impact of sensory, cognitive and hand impairment on older peoples' ability to open packaging.

2.4.6.1 Sensory functions

Sensory impairment has an impact on the quality of information received from packaging during inspection. Inaccurate information can negatively affect hand performance when releasing a closure and dispensing contents. For example, with the decline of the senses of sight and touch, older users may not notice a surface texture on the lid of a shower gel bottle (the indication for pressing). Thus, they may twist the lid instead of pressing it. Key aspects of sensory impairment are discussed as follows.

Visual acuity

Decline in visual acuity basically makes reading difficult (Pirkl, op. cit.; Watkinson, op. cit.). Although written instructions can be used to fully explain how to open a package, it is less likely that older people will be able to read them when shown in small print sizes.

Colour perception

Changes in colour perception may affect the ability to distinguish the colour of indications for opening on a package. However, the ability to notice, identify and read indications tends to depend on the degree of colour contrast between the indications and the background. Consequently, colour contrast may have a greater impact on older peoples' ability to identify indications than colour perception.

Brightness and darkness adaptation

As a result of declining brightness and darkness adaptation, it may be difficult for older people to read instructions and to identify indications where there is low colour contrast

between the instructions or between the indications and their background. Also, if an embossed arrow is used on a shiny surface, it can be difficult to identify.

Hand sensation

Information provided by feeling a certain shape or surface texture (tactile sensitivity) on a package can suggest the method of opening required. For example, a recessed shape on a lid can indicate that the action of pressing is needed. Hand pressure sensitivity applied to a particular action when trying to open a package may guide a user in knowing if this package has been opened properly. For example, if the trigger of a spray package is squeezed without first unlocking the lock, then the trigger will not move. A user can feel through his or her fingers the hard pressure reaction from the locked trigger. In contrast, when the trigger lock is released, the user can feel through his or her fingers the soft pressure reaction when pressing the trigger. Thus, decline in the sense of touch may reduce the ability to receive information from packaging that aids opening.

Hearing

Opening and closing a package can make a sound. Such sounds can be interpreted as a kind of feedback, letting users know if the package was opened successfully. Due to hearing impairment, these sounds may not be heard clearly or at all.

2.4.6.2 Cognitive functions

Cognitive impairment can affect opening performance when inspecting a package, releasing a closure and dispensing contents. Key aspects of cognitive impairment are now discussed with regard to their impacts on openability.

Perception

Perception used when opening packages appears to mainly rely on sensory functions. Stronger sensory stimuli are required to compensate for the reduced quality of information that is caused by sensory impairment (Stokes, op. cit.).

Working memory

When older people are faced with a complex opening task in which they have to store, update and retrieve information gathered from different indications, working memory impairment may decrease their ability to understand how to open packaging.

Long-term memory

The subsection *Impairment of long-term memory* in section *2.4.5.2 Cognitive functions* described three kinds of long-term memory: episodic, semantic and procedural.

Procedural memory and semantic memory tend to play a key role when opening packages. Episodic memory appears to have little impact on package opening. This is because it is less likely that information from this memory concerning when and where packaging is opened will help users understand the opening method.

The roles played by procedural memory and semantic memory on openability can be explained in relation to how familiar users are with a package. If users open a package every day, then they can open it spontaneously without thinking. This kind of ability derives from procedural memory whereby users can open packaging without awareness or attention.

If users have not opened a certain package very often, then they may need to think about how to open it. This case relates to semantic memory whereby users need to access prior knowledge about opening the package.

If a particular package is unfamiliar to users, then they may need to read instructions and understand shapes and symbols on the package to find out how to open it. This case again relates to semantic memory whereby users need to access prior knowledge of language, meanings of shapes and symbols to understand the opening method.

Semantic memory is useful when opening both familiar and unfamiliar packaging, whereas procedural memory only appears to be useful when opening familiar packaging. Users' attempts to employ a subconscious mode to open a package with a new opening mechanism may lead to errors. Thus, indications for opening have to be clearly identified to signal that a different way of opening is required when opening novel packaging.

Intelligence

Older peoples' crystallised intelligence appears to be efficient. Consequently, older users may draw upon prior knowledge to help them open a familiar package. In contrast, ageing affects fluid intelligence. Thus, understanding the opening method of an unfamiliar package may not be easy for older users. However, the opening method of an unfamiliar package may become clear, if indications for opening are provided based on prior knowledge, for example, through known shapes and symbols. CEN/CENELEC (op. cit.) noted that familiar forms help a person who has impaired cognitive functions identify a product.

Learning

Rabbitt (1965) indicated that a distraction caused by irrelevant stimuli limits learning performance. Such distractions have a great impact on older people (Schonfield, op. cit.). Accordingly, presenting a small volume of material for older people to learn at any one time would be helpful (Stokes, op. cit.). Stokes (ibid.) also noted that instructions would help learning. However, an extensive amount of information presented as instructions may hamper the learning of package opening.

Trial and error which can help older users find out how to open packaging requires interactions between hands and packaging. Hand impairment, therefore, may hinder older peoples' ability to learn how to open packaging.

2.4.6.3 Hand functions

Hand impairment can negatively affect the hand strength, movement or dexterity required for releasing a closure and dispensing contents, for example, when turning the lid of a jar (Janson *et al.*, op. cit.), pushing and turning a child-resistant closure (CEN/CENELEC, op. cit.), or squeezing bottles (Blakey *et al.*, op. cit.).

2.5 Inclusive design, ergonomics and design for older people

Inclusive design, ergonomics, and design for older people all aim to provide products that meet users' needs. It is helpful to discuss how the drive towards designing for older people at the heart of this study relates to ergonomics and inclusive design. Ergonomics aims to optimise the overall productivity of human activity based on safety, comfort and satisfaction (Sanders and McCormick, 1993). Dul and Weerdmeester (1993) suggested that ergonomic principles are provided for user groups with homogenous characteristics, for example, able-bodied users, older people with age-related impairment or people who have severe impairment.

Keates and Clarkson (op. cit., preface) suggested that "Inclusive design is about maximizing the market potential of your products by making sure that the maximum number of people can use them". Inclusive design principles attempt to include as many users as possible from all three user groups noted above (able-bodied users, older people with age-related impairment and people who have severe impairment).

This study focuses on design for older people. Bennett *et al.*(1996) noted that nearly 50% of people with a disability that relates to movement, vision or hearing are aged 65+. Coleman (1998) stated that the needs of disabled and older people are significantly different. For example, blind people and people who have slight visual impairment because of ageing, have very different needs. For the sake of clarity, it should be noted

that older people who have severe impairment are not included in this study (for detailed explanation see the subsection *The focus group participants* in section *3.5.2.3 Focus groups*).

Design within the terms of this study can be seen as ergonomic design for older people. However, this study subscribes to the concept of inclusive design because the design recommendations forming one of the research outcomes can be used to improve packages. In this way, the number of users who are capable of opening the packages will be expanded. As the slogan of the Centre for Applied Gerontology, University of Birmingham, states, *design for the young and you exclude the old; design for the old and you include the young.*

User involvement during the design process plays an important role in helping designers understand user needs in both user-centred design (Abras *et al.*, 2004; Norman and Draper, 1986) and participatory design (Gulliksen *et al.*, op. cit.; Luck, 2003; Muller, 1993) methods. Hence, both methods can potentially be adopted in this study. However, the difference between these two approaches can be recognised through the different degrees of user involvement permitted. In participatory design, users are seen as co-designers (Abras *et al.*,op. cit.); they make decisions on design together with designers (Bravo, 1993). In user-centred design, users supply information for designers, but do not make design decisions (Iivari, 2004; Kujala, 2003). In this study, design is used to improve packaging to compensate for older peoples' decline. Thus, older users' involvement during the design process as co-designers is important in developing approaches to packaging design that meet their needs. This study, therefore, subscribes to a participatory design method.

2.6 Existing design guidelines, recommendations and principles to enhance package openability

This section presents existing packaging design guidelines, recommendations and principles drawn from the literature that can be used to enhance openability for older people. The information is presented under three headings which correspond to the three functions used when opening a package: sensory, cognitive and hand.

2.6.1 Sensory functions

The design guidelines, recommendations and principles concerning sensory functions describe the following key concepts.

2.6.1.1 Provide alternative indications

The first concept relates to the design guideline for *alternative formats* (CEN/CENELEC, op. cit.) and the design principles of *sensory affordance* (Hartson, 2003) and *consideration of user resources* (Jordan, 1998). These suggest that indications for opening provided should be received by alternative senses e.g. seeing, feeling and hearing, so that older people who have different kinds of sensory impairment can still read and identify the indications.

2.6.1.2 Make indications visible

The second concept is concerned with how to make indications easy to notice, identify and read.

Visual indications

The design principles addressing the concept of making indications more visible are *visibility* (Norman, 2002, op. cit.) and *visual clarity* (Jordan, op. cit.). Indications can be made more visible by using size and colour contrast (CEN/CENELEC, op. cit.; Moore,

1993, op. cit.) and by placing them near the opening in a noticeable position (Moore, ibid.). In addition, CEN/CENELEC (op. cit.) suggested that indications on shiny surfaces may not work well as they have reduced visibility.

When short or even longer written statements are included in opening instructions, it is helpful for older people when layout and typography are managed by using length and spacing of lines, type case (Moore, 1993, op. cit.), type size (the Food Standards Agency (FSA), 2002), type font (Moore, 1993, op. cit.) and colour contrast (Bix, 2002; Bix *et al.*, 2003; Moore, ibid.).

General design recommendations concerning these factors include, for example, that text lines should not be longer than 50 characters (Moore, ibid.), that type size (for food labels) should not be smaller than 8 point (FSA, op. cit.) and that high colour contrast between print and background (e.g. black print on white) is preferable (Bix, op. cit.; Bix *et al.*, op. cit.; Moore, 1993, op. cit.). However, Moore (ibid.) suggested that it is impractical to specify those factors as standards because of the diversity of packaging, for example, in terms of form, shape and colour. Instead, those factors should be considered co-jointly to provide readability. For example, optimal spacing of lines relies on type font and text layout. It is the responsibility of designers to adapt these recommendations to specific situations. It is also important that the printing process used (e.g. substrates and inks) should provide clarity of print where particular design factors (e.g. colours, type sizes and fonts) are applied (Moore, ibid.).

Tactile indications

The Institute of Grocery Distribution established packaging design guidelines for the provision of tactile information to blind and partially sighted users so that the information is easy to notice, identify and read. The tactile information guidelines cover shape, surface texture, size, spacing and position (Cayton, op. cit.).

Packaging shapes can help users identify products and can also suggest how to use them. For example, the offset neck found in a toilet cleaning package identifies the contents and suggests how it could be used. Furthermore, different kinds of surface textures, ridged and smooth, on a *squeeze and turn* lid help users identify where to squeeze the lid (Cayton, ibid.).

The shape of Braille, embossed letters and danger warning symbols should be well defined to ensure that they are easy to read. In the case of size, Standard American (Braille) and European Standard EN 272 and British Standard BS 7820 (danger warning symbols) should be applied. Additionally, embossed letters should be at least 3mm apart (Cayton, ibid.).

Opening information should be sited close to the top of packaging. An embossed triangle (a danger warning symbol) should be sited not more than 50 mm above the packaging bottom following European Standard EN 272 and British Standard BS 7820 (Cayton, ibid.).

Cayton (ibid.) noted that embossed illustrations, for example, on the lid of child-resistant bottles, can be confusing to partially sighted and blind users. This may be because partially sighted and blind users rely more on touch than on vision, making it difficult for them to identify the embossed illustrations. However, the embossed illustrations may be of benefit to users with slight visual impairment.

Braille seems to benefit partially sighted and blind people rather than people who have slight visual impairment. This is because Braille communicates its meaning through particular codes which require learning. Although people with slight visual impairment may see and feel Braille, they may have no idea about its meaning.

Audible indications

Audible indications can provide feedback on what has been done (Jordan, op. cit.; Krippendroff, 1990; Norman, 2002, op. cit.), for example, when opening or closing packages. Literature suggesting how to make it easy to identify and notice audible indications has not been found.

2.6.2 Cognitive functions

The following key notions deriving from the existing design guidelines, recommendations and principles mainly relate to communications of product use. These notions are discussed in the context of packaging design.

2.6.2.1 Communicate how to open packaging by using familiar design appearance

The first concept relates to guidance on how to open packaging by triggering users' prior experience. Blackler *et al.* (2003) used the term *intuitive use* to refer to this concept. However, there are several design principles surrounding this concept which will now be discussed.

Identification and categorisation

Identification refers to various ways that a product is recognised, for example, via brand names, product families, product categories and via their purposes. The latter two kinds of identification can also guide users in using the product (Monö, 1997).

Muller (2001) used the term *categorisation* to refer to product classification which suggests its use. In cognitive psychology, to categorise a stimulus, is not only to classify it into a group comprising other similar stimuli, but also to separate it from groups that it does not belong to (Rosch, 2002). Muller (2001, op. cit.) suggested that users will learn to

categorise a product through their prior experience of using the same kind of product. In this way, the relationship between product appearance and function is recognised and memorised for later use. Thus, designers can communicate the intended use of a product through design appearance, for example, shape, colour and texture (Muller, ibid.). CEN/CENELEC (op. cit.) also suggested that distinctive and familiar forms should be used to identify products as well as packages. How a product appearance describes its function and use will now be discussed.

Description

The identification of a product not only explains what the product is, but also describes its use. Thus, the boundary between the stages of identification and description is blurred. Monö (op. cit.) established that two kinds of product identification: name and appearance, can describe product use. Monö (ibid.) also noted that the description of the use of a product can be divided into the *purpose* of the product, its *function* and how to *use* it. The purpose of a product indicates what the product is used for. The function of a product explains how it works. The use of a product describes how users can use their hands and fingers to manipulate it (Monö, ibid.).

The identification of a product by name can suggest its purpose. For example, users know that a tap is for releasing and controlling an amount of water (Monö, ibid.). This knowledge can guide users on how a product works and how to use it. For example, it is known that there is a mechanism in a tap to regulate the flow of water, which is controlled by operating a valve or handle.

Apart from identification by product name, the visual identification of a product can describe its purpose and how to use it. The appearance of a tap explains its purpose as a device for releasing and controlling water (Monö, ibid.). Its shape does not clearly describe how this works because the mechanism for controlling the flow of water is

underneath its surface. However, the shape describes how to use it; for example, two valves, one on the right and one on the left describe that there are two kinds of water, usually one is for hot and the other is for cold water.

In the case of packaging, identification by product name and packaging appearance also describes the method of opening.

A product name can suggest the packaging format. For example, sardines are typically contained in a tin can. Consequently, users' prior experience guides them as to how a tin can could be opened. A product name can also describe the contents of a package, for example, semi-skimmed milk or chicken flavour soup mix. This will help users manage hand strength or posture when opening those packages. For example, users may open a carton of milk more carefully than they would open a packet of a powdered soup.

Also, visual identification of the sardine can, the illustration on the label and the appearance of the package for example, can describe its use for containing sardines. A ring-pull on the top, explains its function as an opener into which users can insert a finger to hold the ring, pull it up and take the lid off.

Additionally, other design principles that support the concept of description: product sign and construction of products are explained below.

Product sign

Product sign refers to a particular product element which describes the product purpose and method of use (Monö, ibid.). Users recognise this sign through prior experience gained by repeatedly seeing the same sign on a number of similar products. For example, the slot on a mailbox is its product sign (Monö, ibid.). Monö (ibid.) also pointed out the significance of product signs for novel products noting that if their product signs are clear, the design appearance of novel products can be varied without misunderstandings

of how to use them arising. For example, the nozzle and the slanted shape of an atomiser can be the product sign of an aerosol whose contents can be dispensed by pressing the atomiser.

Construction of products

Construction of products refers to the notion that detailed structures on products can guide users about how to use the products (Monö, ibid.). For example, on an alarm clock, there is a narrow gap around the edge of the battery compartment lid. This gap informs the user that the lid can be separated from the main body of the alarm clock. On packaging, a hinge connecting the two parts of a flip-top lid suggests that the flip-top can be lifted up from the main body of the lid.

Exhortation

Monö (ibid.) used the term *exhortation* when products signal a direct message for performing a particular action. For example, a red traffic light signals *stop*; a continued beeping sound at a pedestrian crossing signals *walk*; a watch invites a user to *wear* it; and a remote control signals a user to *press* its buttons.

Signals from packaging vary depending on position in life cycle. For example, at the supermarket, a package may say *buy me*. In the kitchen, it may tell users to *open me* and to *throw me away* when it is finished with. Also, different kinds of packaging formats can trigger different opening actions, for example, a bag or carton is for tearing and a bottle is for unscrewing. In this way, the exhortation of a package may be associated with the particular packaging format to which users have repeatedly applied the same method of opening. For example, most bottles are opened by unscrewing their lids, which can be an immediate response that users have when first seeing them.

Perceived affordances

Affordances is the term created by Gibson (1986) referring to a message derived from a relationship between the environment and persons or animals. Information received from the environment such as terrain, shelter, water, objects and tools, guides a person or animal on what they can do (Gibson, ibid.). Objects can also have affordances, for example, a piece of porous rubber, a sponge, affords squeezing (Gibson, ibid.). The notion of affordance was adopted by Norman (1988) in a design context to examine users' interactions with everyday things.

Affordances can be divided into *perceived* and *real affordances* (Norman, 1999). *Perceived affordances* refer to the properties of products that indicate how they could be used. *Real affordances* relate to the properties of products that allow users to physically use the products, guided by perceived affordances (Hartson, op. cit.; Norman, ibid.). For example, the appearance of a ballpoint pen guides users to press the button on top so that the tip of the pen is exposed for writing. This is a perceived affordance, guiding users on how to use the pen. Once the top button is pressed, the writing tip of the pen will be exposed only if the mechanism responds to the action that users apply. This is a real affordance.

Perceived and real affordances also work together to achieve openability. For example, the appearance of a screw-top bottle offers perceived affordances showing that this bottle can be opened by turning the lid. A mechanism that permits the action of unscrewing to be achieved is a real affordance. In addition, Hartson (ibid.) introduced the term *sensory affordance* which was already discussed in section *2.6.1 Sensory functions*.

There is a similarity between perceived affordances and description (the design principle discussed above). Perceived affordances describe how design appearance indicates products' possible uses, functions and the actions required for use (Norman, 2002, op.

cit.). Description also makes use of perceived affordances in explaining how to use products. In this study, the term *indications* refers to design appearance that explains how to open packaging.

Consistency, compatibility and standardisation

The design principles of *consistency* and *compatibility* and the design guideline for *standardisation* consider the use of learned indications in guiding how to use products. The indications become a convention after they have been used for a period of time. For example, every car adopts the same position and sequence of foot pedals for the accelerator, brake and clutch (Jordan, op. cit.). Jordan (ibid.) introduced the term consistency suggesting that similar indications should be used to describe similar functions.

Jordan (ibid.) explained that similar indications for product use can be found across different kinds of products. Jordan (ibid.) used the term compatibility in this case. For example, the same computer interface between Microsoft ® Office Word and Excel programmes helps users save a file.

Particular indications can be found across products and packages. For example, arrows on the buttons of a cassette recorder indicate the direction in which the audio tape will be wound. Arrows on the closure of a child-resistant bottle indicate the direction required when twisting the closure to release it. On packaging, arrows are used in many different kinds of product categories, for example, medicines, household cleaning products and food.

The guidelines for design standards (CEN/CENELEC, op. cit.) and the design recommendations for tactile information (Cayton, op. cit.) noted that warning symbols should be standardised. Galley *et al.* (op. cit.) also recommended the use of the same

formats of diagrams. For convenience, this notion is named standardisation. Using the same indications makes it easy for users to recognise their meanings.

2.6.2.2 Avoid using ambiguous indications that mislead users about opening methods

CEN/CENELEC (op. cit.) noted that the *relationship of information to actions to be undertaken* should be taken into account when designing information. Equally, indications should clearly describe opening methods required.

2.6.2.3 Prioritise information for opening

Jordan (op. cit.) introduced the design principle of *prioritisation of functionality and information*. Some products possess multiple functions and information. Highlighting only the important ones would make it easier to understand how to use. For example, a TV remote control has a number of buttons. To avoid confusion caused by the sight of too many buttons, only those which are frequently used or which are important should be on view. The rest can be hidden by a cover which users can open when necessary (Jordan, ibid.).

A packaging label presents various kinds of information, for example, ingredients as well as directions for opening and use. Prioritisation of such information would help older people to more easily discriminate information for opening from other information. This can be achieved by 1) layout design including using readable text size, using space to group information and sequential numbering of the opening steps and 2) using colour to highlight important information.

2.6.2.4 Use clear language in opening instructions

CEN/CENELEC (op. cit.) suggested that *clear language in written information* should be used by preferring simple, straightforward and non-technical language or by using illustrations together with language to explain opening methods.

2.6.2.5 Use logical opening methods

CEN/CENELEC (ibid.) used the term *logical process* to suggest that simple and straightforward opening methods should be applied so that they are easy to understand.

2.6.2.6 Prevent impossible manipulations

Norman (2002, op. cit.) used the term *physical constraints* for the design principle which prevents users performing an impossible action when using products. Norman (ibid.) noted that physical constraints should be visually communicated through product appearance, so that users notice an impossible manipulation before trying to perform it. For example, the shape of a keyhole on a door guides users on how to position the key before inserting it. Equally, indications for opening should be used to prevent impossible manipulations.

2.6.2.7 Confirm what has been done

Jordan (op. cit.), Krippendroff (op. cit.) and Norman (ibid.) used the term *feedback* to refer to products' responses to users' actions when showing if the products have been successfully used. CEN/CENELEC (op. cit.) also suggested that feedback (e.g. a click sound) should be provided to indicate successful package opening.

2.6.2.8 Use packaging appearance to create positive expression

Monö (op. cit.) used the term *expression* to explain that product appearance such as curve, step and angle, depicts the product's characteristics. This triggers users' feelings towards the product and influences their interaction with the product, for example, by carefully and gently using it. Similarly, packaging expression may influence users' feelings towards opening the packaging.

2.6.3 Hand functions

The existing design guidelines, recommendations and principles concerning hand functions used when opening packages describe the following key concepts.

2.6.3.1 Optimise hand strength

Packaging design elements that influence hand strength required for releasing a lid comprise: 1) lid diameters (Crawford *et al.*, 2002; Imrhan and Loo, 1988; Yoxall and Janson, 2008), 2) shapes (Berns, 1981; Crawford *et al.*, ibid.; DTI, 1999b) and 3) surface textures (DTI, ibid.).

Specific lid diameters that permit older users to exert maximum hand strength when releasing screw tops are: 5.00 cm (Crawford *et al.*, ibid.), 7.40 cm (Imrhan and Loo, op. cit.) and 7.30 cm (Yoxall and Janson, op. cit.). The data disagreement may be due to differences in materials or packaging samples used in the particular experiments. Crawford *et al.* (op. cit.) used packaging maquettes made from nylon. Additionally, Crawford *et al.* (ibid.) did not include samples of lids with 7.30 cm or 7.40 cm diameters in their study, but used instead those with 8.00 cm diameter noting that hand strength decreased when releasing them.

DTI (1999b, op. cit.) and Crawford *et al.* (ibid.) noted that square and angular lids are easier to release than round ones. Packaging shapes should be developed to encourage hand grip styles that allow older people to comfortably open packaging (Yoxall *et al.*, 2010, op. cit.). Yoxall *et al.* (ibid.) observed that older women who have limited hand strength will use a particular two-handed grip style when squeezing bottles, which appeared to be comfortable.

Packaging that provides a large contact surface with fingers permits the application of increased hand strength (Lewis *et al.*, op. cit.). For example, grooves on the lid of a jar (Berns, op. cit.) help users to have a firm grip when releasing the lid. Surface roughness of a lid can also provide a firm grip (DTI, 1999b, op. cit.).

Shape and materials of bottles and diameters and lengths of nozzle tubes can be used to reduce the hand strength required for squeezing the bottles (Blakey *et al.*, op. cit.). Ease or difficulty in squeezing a bottle is determined by its stiffness which in turn is influenced by the bottle's shape and materials. The diameter and length of nozzle tubes influence the flow rate of liquid contents dispensed from bottles and the hand strength required in order to dispense the contents for use. Blakey *et al.* (ibid.) developed a set of equations that relate the hand strength required when squeezing bottles to these design factors (shape, materials and the geometry of nozzles). Once the required hand strength is determined, taking into account older peoples' ability, these related design factors can be calculated by using the equations provided (Blakey *et al.*, ibid.).

2.6.3.2 Optimise hand dexterity

Duizer *et al.* (op. cit.) noted that increasing the tab size on a heat-sealed plastic or foil lid can provide a greater pinch and pull grip area when removing the lid. CEN/CENELEC (op. cit.) stated that surface textures help people who have hand dexterity impairment

grip an object when manipulating it. Surface textures would also increase hand dexterity, for example, when gripping a tab to open packaging.

2.6.3.3 Eliminate excessive hand stresses

Packaging shape and lid diameter may cause users excessive hand stresses when opening a package. Packaging with curved edges is preferable to those with sharp edges because any part of a product which concentrates compression stresses on small areas of the hands causes pain and should be avoided (Tichauer and Gage, 1977).

Yoxall *et al.* (2008) suggested that lid diameters should not be larger than 5.00 cm to minimise joint stresses which may occur when releasing the lid. However, as noted in section *2.6.3.1 Optimise hand strength*, Yoxall and Janson (op. cit.) recommended a diameter of 7.30 cm for optimising hand strength required for releasing a lid. Yoxall *et al.* (2008, op. cit.) noted that a small lid diameter may provide a comfortable grip for older people, but it may also reduce the level of hand strength that older users can apply when releasing the lid. To draw a conclusion on a lid diameter for a particular product and package, designers may have to strike a good balance between 1) an attempt to minimise joint stresses and maximise hand strength when releasing a lid and 2) other requirements. These *other* requirements concern, for example, convenient use and protection of the quality of contents. In the case of jars of pasta sauce, a diameter of 7.30 cm seems to be more desirable than one of 5.00 cm. This is because large lid diameters tend to provide a smooth flow of contents when pouring. Additionally, 7.30 cm lid diameters may be preferable because vacuum lug closures (which are commonly used on jars as they offer high quality of content preservation) require considerable hand strength to release.

2.6.3.4 Balance the quality of sealing and openability

Packaging closures that are too tight can be impossible for older people to open. Langley *et al.* (2005) developed a design methodology to provide roll-on pilfer-proof (ROPP) closures that older people can more easily release while still maintaining a good seal. This methodology comprised three kinds of analyses: analytical, computational and experimental. The analytic analysis was conducted to create a set of equations that illustrated the relationship between the hand strength required for releasing the closure and the physical attributes of the sealing system such as the friction between the glass bottle and the closure. Using this set of equations, the computational and experimental analyses were carried out to identify parameters that can be used to produce an easily openable closure whilst retaining the quality of sealing.

2.6.3.5 Avoid using opening methods that require excessive hand functions, that cause hand pain or fatigue or that may injure the hand

The impact of particular opening methods on hand function should be taken into account when designing a package. Certain opening methods, for example, twisting the cap of a jar (Janson *et al.*, op. cit.) that require excessive hand strength can prevent older people from accessing the contents.

Opening methods which require prolonged hand actions and excessive wrist movements should be avoided because they can cause fatigue and hand pain when opening packaging (CEN/CENELEC, op. cit.).

The range of movement possible without risking damage to the hand and the wrist was discussed by Gelberman *et al.* (1984), Rempel and Horie (1994) and Rempel *et al.* (1994). Hedge (2004) identified *a neutral zone of hand movement* comprising 15-20 degree wrist extension and 20-40 degree wrist flexion. The hand action required for any opening task should not require wrist movements in excess of this.

In addition, opening methods should not lead to excessive pressure on the middle of the palm which can injure the hand. Tichauer and Gage (op. cit.) noted that this area of the palm is sensitive, as nerves and blood vessels are close to the skin. This may be why older users of *push and turn* bottles who have to push the lid with the palm while simultaneously turning the lid (CEN/CENELEC, op. cit.), find the actions physically difficult to performs, often experiencing hand pain.

2.6.3.6 Ensure that mechanisms permit successful opening as guided by indications

Opening mechanisms should allow older people to successfully open packaging as guided by the indications. This is consistent with the relationship between the design principles of real and perceived affordances (Hartson, op. cit.; Norman, 1999, op. cit.) where a product mechanism must allow users to successfully use the product as guided by its appearance.

2.7 The need for additional design recommendations with respect to package openability

The existing design principles (Monö, op. cit.; Norman, 2002, op. cit.; Jordan, op. cit.) in the area of cognitive function described how product appearance communicates its use, but did not explain how packaging appearance communicates opening methods.

Although the existing design guidelines (CEN/CENELEC, op. cit.) suggested preferable characteristics of indications and information on packaging, these guidelines focused on indication design in order to compensate for age-related decline in visual and cognitive functions. Importantly, these guidelines did not identify how to design indications that provide effective information for opening. This design knowledge gap represented the

original aspect of this study in order to develop additional recommendations for the design of openable novel packaging.

2.8 Summary

This chapter can be summarised into three areas: 1) the problems that older people have when opening a package, 2) the existing design principles, recommendations and guidelines aimed at solving these problems and 3) the research strategy employed to create additional design recommendations for openability.

2.8.1 Problems that older people have when opening a package

This section begins with considerations of age-related decline in relation to openability. This leads to the key summary detailing the impact of age-related decline on older peoples' ability to open packaging. Additionally, this section addresses the literature around the ageing population, packaging and openability.

2.8.1.1 Age-related decline in relation to openability

Age-related decline that influences openability involves sensory, cognitive and hand functions. Sensory impairment relates to vision, hearing and touch. Visual impairment negatively affects visual acuity and brightness and darkness adaptation. Hearing impairment may reduce hearing sensitivity. Impairment of the sense of touch may decrease tactile and pressure sensitivity. Sensory impairment then negatively affects perception.

Cognitive impairment is mainly influenced by memory impairment. Impaired memory reduces the capacity for intelligence and learning. Ageing tends to affect working memory

and fluid intelligence more than semantic memory and crystallised intelligence. There is a mutually supportive relationship between learning and memory. Thus, memory impairment can negatively influence learning. Furthermore, learning takes place when taking an action to achieve a task. Accordingly, limitations in hand function can inhibit learning.

Hand impairment is concerned with hand strength, movement and dexterity. Hand impairment is influenced by negative changes in hand structures and the nervous system. Sensory impairment also negatively affects hand performance when handling a task.

The key issues from literature are summarised in Table 2 below.

Table 2: The key issues concerning age-related decline in relation to openability and the associated key literature

Key issues	Key literature
Sensory impairment • Visual acuity • Brightness and darkness adaptation • Hearing sensitivity • Tactile sensitivity and pressure sensitivity	Ah-Chan and Downes (op. cit.) Chivers (op. cit.) Goldstein (op. cit.) Pirkl (op. cit.) Stuart-Hamilton (op. cit.) Watkinson (op. cit.)
Cognitive impairment • Perception • Working memory (Efficient semantic memory) • Fluid intelligence (Efficient crystallised intelligence) • Learning • Hand functions influence learning	Craik and Bosman (op. cit.) Bäckman *et al.* (op. cit.) Goldstein (op. cit.) Kensinger and Corkin (op. cit.) Sorce (op. cit.) Stokes (op. cit.)
Hand impairment • Hand strength, movement and dexterity • Hand performance and sensory functions	Carmeli *et al.* (op. cit.) Flanagan and Johansson (op. cit.)

2.8.1.2 Impacts of age-related decline on older peoples' ability to open packaging

Due to sensory impairment, the quality of information received through the senses reduces. Stronger sensory stimuli are needed to make it easy for older people to perceive information. Working memory impairment can cause older people difficulty in distinguishing information for opening from other different types of information.

However, semantic memory appears to be efficient and makes opening easier to understand, for example, by using familiar indications. Using a subconscious mode of thinking such as procedural memory to open a package with an unfamiliar opening mechanism can cause an error. Indications should clarify that new opening methods are required. Hand impairment can limit hand strength, movement and dexterity available for opening a package.

The key issues from literature are summarised in Table 3 below.

Table 3: The key issues regarding the impact of age-related decline on older peoples' ability to open packaging and the associated key literature

Key issues	Key literature
Sensory impairment • Decrease in the quality of information	Stokes (op. cit.)
Cognitive impairment • Impaired working memory can make it difficult to distinguish relevant information from other different types of information. • Using familiar indications (semantic memory) helps older people understand opening methods. • Using a subconscious mode of thinking (procedural memory) to open packaging with a new opening mechanism may lead to an error.	CEN/CENELEC (op. cit.)
Hand impairment • Limitations in hand functions used for opening a package	CEN/CENELEC (ibid.) Janson *et al.* (op. cit.)

2.8.1.3 The ageing population

Older people for the purpose of this study are divided into three age groups: 65-74, 75-84 and 85+. There has been a dramatic increase in the UK's older population, whereas the population aged under 16 has fallen. Due to the growth in the number of older people who live alone, better package openability would be one way to support an independent life style.

The users' cognitive response; namely semantic interpretation concerning communications of product use; tends to play a key role in helping older people maintain their everyday activities such as opening packages.

There is a stereotype that older consumers are unlikely to try new products or brands in novel packaging. Similarly to younger people however, older people purchase products and brands that meet their needs. Therefore, new brands, products and packaging are welcomed, if the products and brands are desirable.

The key issues from literature are summarised in Table 4 below.

Table 4: The key issues concerning the ageing population and the associated key literature

Key issues	Key literature
• Definition of older people for this study	Izaks and Westendorp (op. cit.) Pitt (op. cit.) Stokes (op. cit.) Tomassini (op. cit.)
• The drastic increase in older population • The importance of being independent	Coleman (1996, op. cit.) ONS (2008b, op. cit.) Thompson and West (op. cit.) WHO (2002, op. cit.)
• The importance of semantic interpretation	Crilly (op. cit.) Long (op. cit.)
• Older consumers' attitudes towards novel packaging	Leventhal (op. cit.) Schiffman and Sherman (op. cit.) Stroud (op. cit.)

2.8.1.4 Packaging

Design is an important tool for brand owners to use in providing packaging that meets consumer needs. Without direct communication between older consumers and designers during the design process, designers may rely too much on their own design judgement which may result in packaging that does not fully meet older consumers' needs.

The packaging samples used in this study were all for food, personal care products and household goods. This type of packaging appears to be most used by older people because they spend proportionately more of their income on these products.

The key issues from literature are summarised in Table 5 below.

Table 5: The key issues in accordance with packaging and the related key literature

Key issues	Key literature
• The role of design in the packaging industry • The problems that designers face	Lawson (op. cit.) Norman (2002, op. cit.) PF (2003, op. cit.)
• Packaging for food, personal care products and household goods was used in this study.	ONS (2008a, op. cit.)

2.8.1.5 Openability

The stages in opening a package considered in this study concern inspecting a package, releasing a lid and dispensing contents. This study focuses on the openability of novel packaging. Opening a package mainly relates to users' interactions with packaging closures. Closures with new appearances and opening mechanisms are most commonly manufactured in plastic due to the high design potential of this material. Consequently, plastic closures were used in this study. Opening indications for the purpose of this study are defined as those packaging design elements comprising 2D indications which users can see and read and 3D indications which users can see and feel. Indications should provide information for opening in connection with tacit knowledge and action learning to help older people understand opening methods.

The key issues from literature are summarised in Table 6 below.

Table 6: The key issues in relation to openability and the associated key literature

Key issues	Key literature
• Stages in opening a package for this study	Winder (op. cit.)
• Plastic closures were used in this study.	PF (2003, op. cit.)
• The role of tacit knowledge and action learning on opening a package	Polanyi (1968, op. cit.) Revans (op. cit.)

2.8.2 Existing design guidelines, recommendations and principles

This section begins by summarising the existing design guidelines, recommendations and principles in relation to openability. These can be seen as practical solutions for the problems that older people have when opening a package. The review of existing design guidelines, recommendations and principles identified the design knowledge gap where

additional design recommendations with respect to package openability were needed. Furthermore, this section describes information design.

The key issues from literature are summarised in Table 7 below.

Table 7: The existing design guidelines, recommendations and principles and the related key literature

Key issues	Key literature
Sensory functions • Provide alternative indications • Make indication visible	Cayton (op. cit.) CEN/CENELEC (op. cit.) Jordan (op. cit.) Moore (1993, op. cit.) Norman (2002, op. cit.)
Cognitive functions • Communicate how to open packaging by using familiar design appearance • Avoid using ambiguous indications that mislead users about opening methods • Prioritise information for opening • Use clear language in opening instructions • Use logical opening methods • Prevent impossible manipulations • Confirm what has been done • Use packaging appearance to create positive expression	CEN/CENELEC (op. cit.) Jordan (op. cit.) Krippendroff (op. cit.) Monö (op. cit.) Norman (2002, op. cit.)
Hand functions • Optimise hand strength • Optimise hand dexterity • Eliminate excessive hand stresses • Balance the quality of sealing and openability • Avoid using opening methods that require excessive hand functions, that cause hand pain or fatigue or that may injure the hand • Ensure that mechanisms permit successful opening as guided by indications	Blakey *et al.* (op. cit.) Crawford *et al.* (op. cit.) CEN/CENELEC (op. cit.) Duizer *et al.* (op. cit.) Hedge (op. cit.) Langley *et al.* (op. cit.) Norman (1999, op. cit.) Tichauer and Gage (op. cit.) Yoxall and Janson (op. cit.) Yoxall *et al.* (2008, op. cit.)

2.8.2.1 The need for additional design recommendations with respect to package openability

The literature review of the existing design guidelines, recommendations and principles concerning sensory, cognitive and hand functions revealed a knowledge gap in the area of cognitive functions. This involved the lack of specific design recommendations to create effective indications for opening novel packaging which were investigated in this study.

2.8.2.2 Information design

The existing design guidelines and recommendations have suggested information for opening a package relating to product identification, explanation of how to open a package and feedback on opening or closing.

The key issue from literature is summarised in Table 8 below.

Table 8: The key issues in connection with information design and the related key literature

Key issues	Key literature
• Types of information used to help older people open packaging	Cayton (op. cit.) CEN/CENELEC (op. cit.) Moore (1993, op. cit.)

2.8.3 Research strategy employed to create additional design recommendations for openability

This section summarises the principle of design usability subscribed in this study. The principle was employed as the research strategy in developing the design recommendations for openable novel packaging when used by older people.

Design for older people appears to fit well with ergonomic principles. However, this study subscribed to inclusive design principles because this study sought to expand the number of people who can open packaging. Packaging which is easy for older people to open would be also easy for young and able-bodied people to open. To achieve this, participatory design approaches where older users were involved in design decision making were applied.

The key issues from literature are summarised in Table 9 below.

Table 9: The key issues concerning the research strategy employed in this study and the associated key literature

Key issues	Key literature
• How design for older people in this study relates to ergonomics and inclusive design • This study subscribed to participatory design approaches	Abras *et al.* (op. cit.) Dul and Weerdmeester (op. cit.) Keates and Clarkson (op. cit.) Muller (1993, op. cit.) Sanders and McCormick (op. cit.)

In the next chapter, the methodology employed in this research, the methods selected to collect and to analyse the data will be discussed.

Chapter 3

Research methodology

This chapter describes the research methodology employed in this study. To begin with, the research problem underlying the study is discussed before describing how the research paradigm and the study aims were developed. The study aims are then used to describe the selection of the research methodology and methods employed to collect the data. The methods adopted to analyse the data collected are also presented. Afterward, reliability, validity and generalisation are discussed, followed by an explanation of the ethical issues surrounding the study.

3.1 Research problems

A *research problem* refers to an issue that motivates a study (Creswell, 2003). The research problem in this study was derived from the researcher's personal interest and from the potential contribution to knowledge in the under explored area of design recommendations for providing effective indication for opening novel packaging, identified in chapter two.

The researcher's personal interest concerns how to design elements of novel packaging such as shape, colour, surface texture and symbols in order to increase the understandability of opening information.

The potential contribution to knowledge arising from this study concerns how to design indications that provide older people with understandable information for opening novel packaging. Age-related decline of sensory, cognitive and hand functions can be seen as an important driver for packaging design development. The sensory (Pirkl, op. cit.; Stuart-

Hamilton, op. cit.; Watkinson, op. cit.), cognitive (Craik and Bosman, op. cit.; Kensinger and Corkin, op. cit.; Stokes, op. cit.) and hand functions (Carmeli *et al.*, op. cit.; Flanagan and Johansson, op. cit.) that support everyday life activities decline with ageing. Such states of decline can also affect older peoples' ability to open packaging.

The combination of these two perspectives: the researcher's personal interest and the potential contribution to knowledge made by this study, led to the formulation of the research question of *how novel packaging could be designed so that older people find opening easy to understand.*

3.2 Research paradigms

Guba and Lincoln (1998, p. 108) noted that "inquiry paradigms define for inquirers what it is they are about, and what falls within and outside the limits of legitimate inquiry". A research paradigm can be described by considering three interconnected perspectives about what researchers will learn (ontology), the relationship between researchers and what is being learnt (epistemology) and how researchers will learn it (methodology) (Guba and Lincoln, ibid.).

The research question (of how novel packaging could be designed so that older people find opening easy to understand) was used to develop the paradigm of this study determining the ontological, epistemological and methodological perspectives.

From the ontological perspective, the researcher needed to understand individuals' needs towards package openability and thinking processes when opening packaging. This was to elicit design requirements for providing older people with effective information when opening novel packaging. These requirements were later used in the creation of design recommendations.

Regarding the epistemological perspective, interactions with participants allowed the researcher to develop an understanding of individuals' design needs and how individuals opened packaging. With respect to the methodological perspective, the interactions between the researcher and individuals therefore, were the preferable approach for data collection.

The research paradigm of this study accordingly relies on naturalistic research. This focuses on understanding individuals' cognition (Cohen *et al.*, 2007; Guba and Lincoln, ibid.), experiences and views (Cohen *et al.*, ibid.; Guba and Lincoln, ibid.; Hayes, ibid.). Such understanding is developed through interactions between researchers and study participants (Guba and Lincoln, ibid.).

Furthermore, the methodological perspective of this study subscribed to idiographic research (Hayes, op.cit.). This approach centres on understanding individuals' experiences rather than seeking to identify general laws (Cohen *et al.*, op.cit.).

In this study, an insight into older peoples' design needs on package openability was derived from the focus groups. A detailed understanding of older peoples' thinking processes when opening packaging was drawn from the in-depth interviews. Additionally, *mixed methods* approaches were employed in order to maximise the data validity. In the focus groups, quantitative data derived from questionnaires were combined with qualitative data drawn from the discussions. The combination of rich data enhanced the researcher's understanding of older peoples' design requirements and facilitated the creation of design recommendations.

3.3 Research aims

The research question addresses two main issues: 1) older peoples' design requirements and 2) design recommendations that can be used to provide older people with effective

information for opening novel packaging. These two issues were used to develop the aims of this study.

Older peoples' design requirements were addressed in aim one: *to understand the problems older people have when opening packages.* These design requirements were used to develop areas of considerations for creating effective indications with respect to openability.

Aim two is *to investigate the relative importance of 2D and 3D indications during the different stages of package opening.* The data derived from this aim were used to create a set of considerations concerning the use of combined 2D and 3D indications.

Aim three is *to produce a design framework which can be used by packaging designers to increase the understandability of packaging information for older people, with respect to openability.* The design considerations derived from aims one and two were combined to create the design recommendations and framework.

3.4 Research methodology

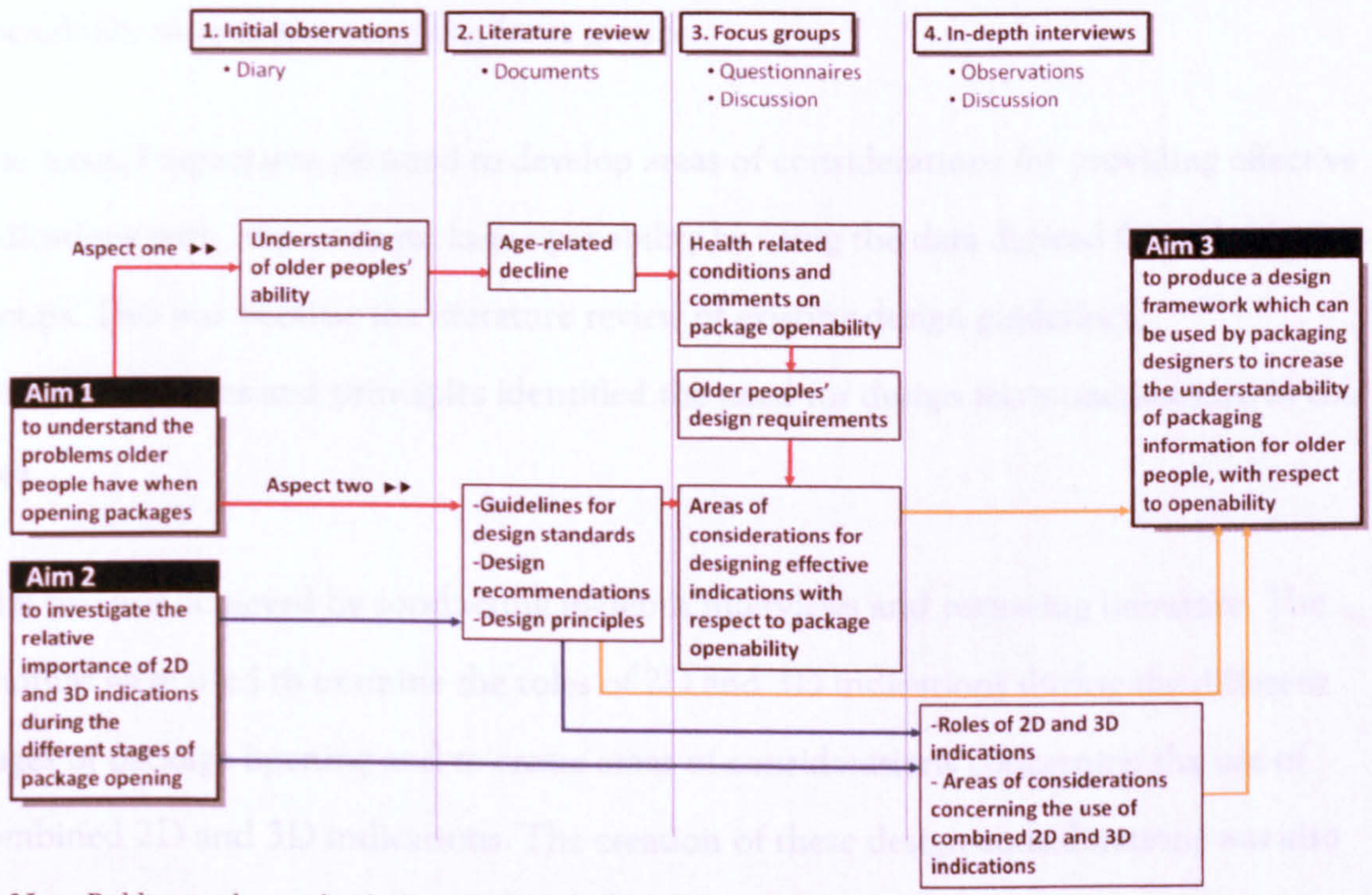
From a design methodology point of view, design processes utilise both inductive and deductive reasoning. Inductive reasoning is used during the analytical phases of data collection (Archer, 1984) and classification (Luckman, 1984) regarding user needs. These processes help to define design requirements during new product development. Deductive reasoning is used during the creative phases of development and in the evaluation of design solutions (Archer, op. cit.).

From a research methodology point of view, an inductive approach is appropriate for the examination of a new area, which begins with data collection to create knowledge (Hayes, op. cit.). In contrast, a deductive approach is useful when testing hypotheses drawn from an existing theory, leading to conclusions on whether the hypotheses are supported or rejected (Hayes, ibid.).

Both perspectives from the design and research disciplines suggested that the aims of this study required an inductive approach to the elicitation of design requirements from older people in order to create design recommendations.

3.5 Research methods

The research methods employed to fulfil the aims of this study are explained below.



Note: Red lines with arrowheads show the link of related data to achieve aim one.
Blue lines with arrowheads show the link of related data to achieve aim two.
Yellow lines with arrowheads show the link of related data to achieve aim three

Figure 8: Two aspects of study aim one

Aim one was achieved by making initial observations, reviewing literature and then conducting focus groups. Two key aspects concerning the problems older people have when opening packages addressed in this aim are: 1) older peoples' age-related needs and 2) packaging designed without taking older peoples' age-related needs into account.

The first aspect (see Figure 8) was planned to identify older peoples' design requirements drawn from information on their age-related decline, and their comments on package openability. The data concerning age-related decline were derived from the initial observations, the literature review and the focus groups. These data provided insight into: 1) an understanding of older peoples' ability to perform everyday life activities, 2) the impact of age-related decline on older peoples' ability to open packaging and 3) health related conditions in relation to openability. Older peoples' comments on package openability were drawn from the focus groups.

The second aspect was planned to develop areas of considerations for providing effective indications with respect to package openability by using the data derived from the focus groups. This was because the literature review of existing design guidelines, recommendations and principles identified the need for design recommendations in this area.

Aim two was achieved by conducting in-depth interviews and reviewing literature. The findings were used to examine the roles of 2D and 3D indications during the different stages of package opening and to create areas of considerations concerning the use of combined 2D and 3D indications. The creation of these design considerations was also guided by the literature on existing design guidelines, recommendations and principles.

Aim three was achieved through a synthesis of the materials from the literature review, the focus groups and the in-depth interviews.

3.5.1 My observations on a design framework tool

A synthesis of the data from across this study was used to develop a design framework tool reflecting the complexity of older peoples' design needs for effective opening information regarding openability. The tool presents how 3D, 2D and *other* design

elements should be combined to provide solutions for problems with package opening at different cognitive processes and opening stages. The tool was created in order that designers may easily use selected observations and findings from the research. In this way, the tool can be used to bridge a communication gap between (often younger) designers and older users.

The next section will explain each study aim in more detail including: 1) the purpose of each method employed (e.g. the initial observations and the focus groups), 2) the rationale for the selection of each method and 3) the procedure employed when conducting each method.

3.5.2 Understanding the problems older people have when opening packages

The overall aim of experimental works (initial observations and focus groups) is to elicit insights into age-related design needs for package openability from individuals' experiences. Literature was also reviewed in order to address study aim one.

3.5.2.1 Initial observations

Initial observations were carried out to gain a better understanding of how older peoples' reduced ability affects their everyday life activities. Observations provide direct information about events and behaviour (Cohen *et al.*, op. cit.; Denscombe, 2007) and were therefore appropriate to use in gathering these data.

Procedures for the initial observations

The initial observations were conducted during two lunch clubs at the local branch of Age Concern[2] attended by older people aged 60+ and 80+ respectively (see further explanation in appendix A). The mission of Age Concern is to support older people in terms of their well-being as well as in fulfilling and making their later life enjoyable (Age Concern England (ACE), 2009).

The observations focused on activities which the older people attending the lunch clubs found easy or difficult to achieve. Whilst observing, the researcher solicited general opinions on package openability. These observations were recorded in the form of a reflective diary. Bryman (2004) stated that it is essential to take detailed notes on a daily basis recording events and behaviour, for use when analysing the data.

3.5.2.2 Literature review

The literature review played a key role in providing the background knowledge used when analysing the data collected to fulfil aims one, two and three, as explained in section *3.5 Research methods*. Importantly, the literature review highlighted a knowledge gap concerning the need for additional design recommendations to create easily understood opening information for novel packaging when used by older people.

3.5.2.3 Focus groups

Focus groups were conducted to help fulfil the first study aim in identifying older peoples' design requirements for openable packaging.

[2] Age Concern England and Help the Aged joined together in April 2009. They are now known as Age UK (Age UK, 2010).

Interviews, either individual or group, can be used to explore complex and deep data (Cohen *et al.*, op. cit.; Denscombe, op. cit.). Group interviews were used to identify older peoples' design requirements, as a wider variety of participants' opinions could be gathered. Participants not only shared their views on the particular issue provided, but also responded to views expressed by other members of the group. This could not have happened using individual interviews (Denscombe, ibid.; Langford and McDonagh, 2003).

The focus group participants

The criteria used for the selection of focus group participants were intended to provide participants: 1) from a wide range of socio-economic backgrounds and 2) who did not have severe sensory, cognitive or hand impairment. These criteria were developed through the advice of the director of the Centre for Applied Gerontology, University of Birmingham, where many similar focus groups have been held.

The participants were selected from the members of the *Thousand Elders*. At the time when the focus groups were conducted, there were around 3,000 members. Two main sociological factors were used as the criteria to select participants: age and gender.

Each focus group comprised six participants, female and male, in three age groups. The selection of participants by age group was to ensure that older people who had different levels of age-related decline were represented in the study. The selection was intended to be indicative, but not representative of older people in general.

Older people with severe impairment of sensory, cognitive or hand functions were excluded from the study, as such severe impairments can negatively impact older peoples' ability to understand how to open packaging, which is the focus of this study.

Two focus groups were required, one to consider a packaging sample that was found to be very easy to understand how to open, the other to consider a packaging sample that was found to be very difficult to understand how to open.

Procedures for the selection of participants

A stratified sample (Cohen *et al.*, op. cit.) was used to select focus group participants. The two characteristics for the selection were age and gender. Starting with a list of around 1,000 *Thousand Elders* members who were resident in the Midlands area of the UK where the study was to take place, those members who met the sampling criteria were placed in a shortlist of potential participants categorised by age and gender. Potential participants were randomly selected from this shortlist before being contacted individually by phone to ask if they were willing to participate in a focus group. If they were not, then another person was randomly selected and then asked, until the target number of participants was reached.

Packaging samples for the focus groups

Three criteria were employed for the selection of packaging samples to be used in the focus groups. These were: 1) the packaging had to be of a type most used by older people, 2) the packaging had to use a variety of indications and opening methods and 3) the packaging had to feature unfamiliar relationships of indications to opening methods.

The types of packaging most used by older people appeared to be packaging for food and personal care and household products. According to ONS (2008a, op. cit.), older people spend a greater proportion of their total expenditure on these product categories than on others.

The selection of packaging samples that utilised a variety of indications and opening methods allowed the researcher to explore the relationship between these two factors. As

indications and opening methods mainly concern packaging closures, a variety of packaging closures was sought when selecting the packaging samples.

The closures of packaging samples used in this research were all made of plastic (the bodies of the packaging samples were made of plastic or metal). Section *2.1.3 Types of packaging* noted that plastics have a high design potential, therefore the greatest variety of indications and opening methods was to be found in this material.

This study focuses on how to provide indications that effectively explain to older people how to open novel packaging. Hence, novel packaging, where the relationship of indications to opening methods was unfamiliar to participants, was examined. It would have been problematic to ask participants to identify such packaging from all of the existing packages that are found in supermarkets. Instead, the researcher surveyed available packages, and categorised the relationships of indications to opening methods that were most commonly found (see Table 10 below). Packaging where the relationship of indications to opening methods was different from those shown in the table was selected for use in the focus groups.

Table 10: Reference list of standard opening methods

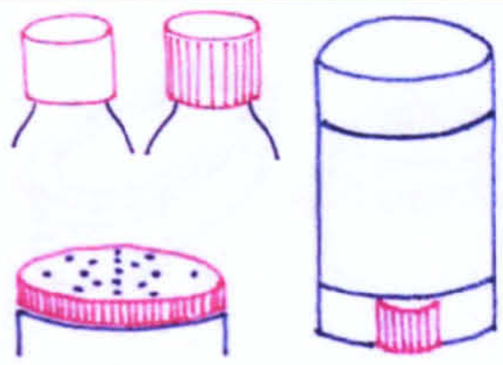
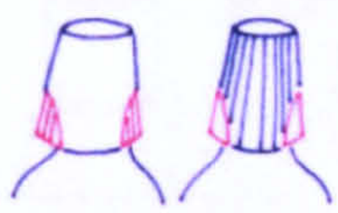
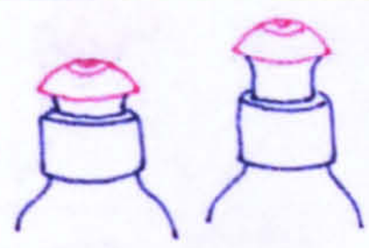
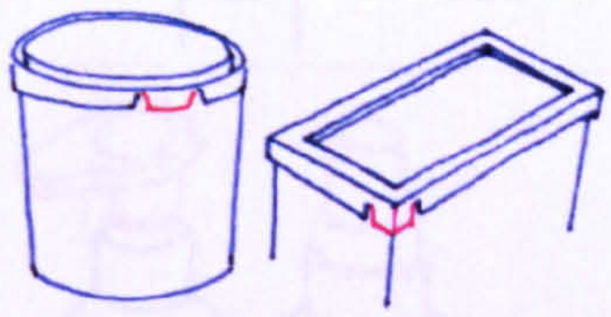
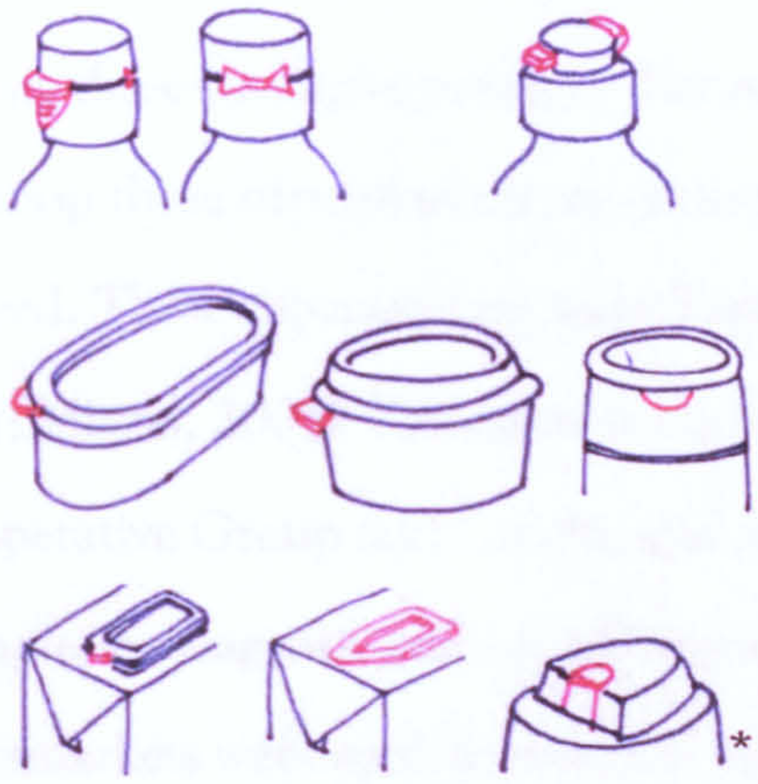
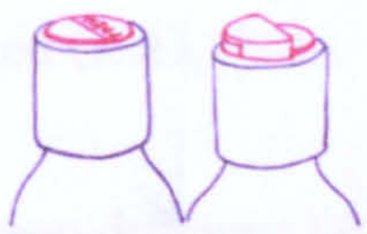
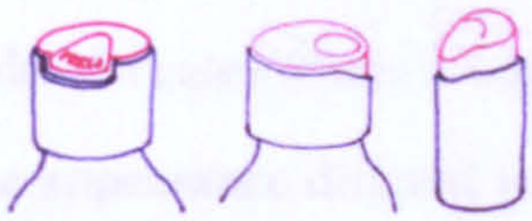
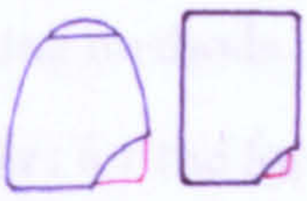
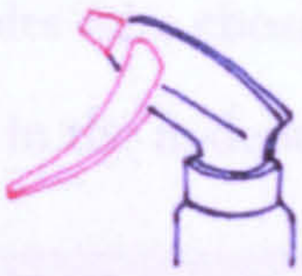
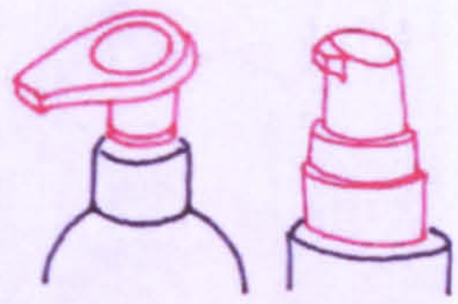
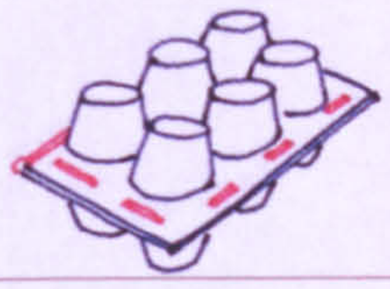
No	Examples	Indications	Opening methods
1		A smooth cylindrical lid	Holding the lid and pulling it off
2		A smooth cylindrical lid or a lid or a knob with ridges around	Twisting the lid or the knob anticlockwise
3		A ridged cylindrical lid with an embossed diagram on the top	Pushing and turning the lid
4		A smooth cylindrical lid with ridged grips on either side of the lid or a ridged cylindrical lid with smooth grips on either side of the lid	Squeezing and turning the lid
5		A spout with a nozzle on the top	Pushing the lid up
6		A lid with a rim	Gripping the rim and lifting the lid up
7		A lid with ridges on the top	Pushing the ridge clockwise or anticlockwise to open and to adjust amount of the contents required
8		A smooth or a ridged cylindrical lid with a tab attached to a removable ring	Removing the ring on the lid before turning it
9		A lid with a tab	Lifting the tab up to break the seal and taking the whole lid off

Table 10: Reference list of standard opening methods (continued)

No	Examples	Indications	Opening methods
10		A lid with a lip and/or a hinge and/or an indentation	Gripping the lip and lifting it up or moving it down*
11		Two semi-circular pieces on the lid top with a small gap around The word *press* on one of the two semi-circular pieces	Pressing the piece with the word *press* on it
12		A smooth cylindrical lid with an indentation on the top	Pressing the top lid
13		A flat shape package with a small attached piece at the corner	Pressing the small attached piece at the corner into the main body
14		A lid with ridges on the top	Pressing the top lid
15		A trigger on the top of a bottle A nozzle On the nozzle there is a turnable section attached to a spout.	Turning the lock on the nozzle before pressing the trigger
16		A thumb or flat shape of a pump on the top of a bottle A spout or nozzle Underneath the pump, there is a tube for carrying the contents from the bottle to the spout or to the nozzle at the top.	Turning the top lid to unlock the lid before pumping it
17		A tray and lid joined by a hinge Snap locks between the tray and lid	Releasing the lock on the lid (which can snap open and close) before lifting the lid

Procedures for the selection of the packaging samples

Twenty three packaging samples that met the sampling criteria were selected from the UK's top three supermarkets, to ensure that a wide range of novel opening methods was covered. These supermarkets were Tesco, Asda and Sainsbury's (Blythman, 2004; Garner, 2007; Mintel, 2004). Packaging is also available at grocery retailers, for example, SPAR, Co-operative Group and Londis, and traditional retailers and convenience stores, for example, newsagents, grocers, off-licences and some garage forecourts (IGD, 2008). Supermarkets were used in this case because of the very wide range of packaging types stocked (IGD, ibid.).

Thirteen different kinds of opening methods were observed among the 23 packaging samples. In cases where a number of packages used the same opening method, the sample whose appearance differed most from the packages in the reference list of standard opening methods (Table 10) was selected. This resulted in a shortlist of 13 packaging samples for the focus groups. However, a group discussion covering 13 packages would take many hours, which may cause older participants to tire when contributing during the session and this could have negative implications for the data. Therefore, six of the 13 samples were chosen at random for use in the focus groups. The remaining seven were used in the in-depth interviews. The six samples are shown in Figure 9 below.

Package no.1

Package no.2

Package no.3

Figure 9: Six packaging samples for the focus groups

Package no.4

Package no.5

Package no.6

Figure 9: Six packaging samples for the focus groups (continued)

Packages no.1 and 2 are both opened by releasing a lock before dispensing the contents. The locks of these two packages are released by turning. However, the contents in these packages are dispensed by different methods. Package no.1 requires a user to press the trigger on the top. Package no.2 requires a user to press the whole package down onto the atomiser at the bottom. Package no.3 requires two opening steps: squeezing and lifting the lid up. The seal on the base of package no.4 has to be removed before pressing the lid to dispense the contents. The seal (which is also the label) on the side of package no.5 has to be removed before the lid can be removed. Package no.6 is opened by pressing the lid.

Additionally, the six packaging samples employed a variety of indications. Only 3D indications were found on packages no.4 and no.6; both 2D and 3D indications were found on the remainder. For example, the indications present on package no. 1 comprised the shapes of the trigger and the grooves, the ridges around the collar underneath the trigger, the nozzle (all 3D indications), the product name and the arrow (all 2D indications).

Planning the focus groups

Three issues needed to be resolved in order to run the focus groups smoothly. The first involved procedures, questions and staging between: introduction, informed consent, questionnaires and the focus group discussion. The second issue concerned ensuring that

the language and terms used in the questions were easy for participants to understand. The third issue related to moderator skill. A skilful moderator helps all participants contribute their opinions to the discussion (Greenbaum, 1998; Litosseliti, 2003). The Director of Studies was kind enough to be the moderator for the focus groups.

Conducting pilot focus groups appears to require a specific effort in terms of time and budget. Krueger and Casey (2000) suggested that to get around this the first focus group can be retrospectively considered as a pilot focus group, if it requires improvement. If it does not, it then remains the first focus group. However, in order to maximise the reliability of data from the focus groups, the procedure and questions for use in the focus groups were developed beforehand. The initial version of the procedure and questions was firstly discussed with the director of the Centre for Applied Gerontology, University of Birmingham. The feedback drawn from this discussion was used to develop the subsequent versions. The researcher tested pilot questions individually with 10 older participants including four males and six females aged 65+.

Procedures for the focus groups

Two focus groups were hosted by the Centre for Applied Gerontology, University of Birmingham. Taxis were provided to bring participants to and from the focus groups, as were refreshments on arrival and at the end of the focus groups. The director of the Centre for Applied Gerontology introduced the purpose of the focus groups and asked participants to provide informed consent.

Each focus group consisted of two sessions. In the first session, participants were asked to complete three questionnaires. Questionnaires are appropriate for use when collecting straightforward information concerning facts and opinions (Denscombe, op. cit.). The first and second questionnaires used Likert scales for participants to rate the packaging samples in terms of 1) familiarity and 2) understanding and how easy or difficult it was to

physically open the packages. Each participant was asked to open the six packaging samples provided before completing these questionnaires. The third questionnaire asked participants to disclose any health related decline affecting their ability to open packaging, for example, visual impairment or arthritis.

The researcher calculated the mean of the *understanding* scores that participants had provided for each of the packaging samples in the second questionnaire while participants were completing the third questionnaire. This was to permit the selection of one packaging sample for discussion. Focus group one discussed the packaging sample (package no.1) that they found the easiest to understand how to open. Focus group two discussed the packaging sample (package no.4) that they found the most difficult to understand how to open. The opening methods and indications employed on packages no. 1 and 4 are described in Appendix B-1.

In the second session, participants discussed the selected packaging sample to identify design requirements for openable packages. In focus group one, the discussion of the easiest packaging sample examined the characteristics of indications which provided for easy understanding. In focus group two, the discussion of the most difficult packaging sample explored how to improve indications so that they would be easy to understand.

At the end of the focus groups, the moderator concluded the session and solicited additional opinions on package openability.

3.5.3 Investigating the relative importance of 2D and 3D indications during the different stages of package opening

The overall aim of in-depth interviews is to elicit individuals' tacit knowing of how they used indications when opening packages.

Denscombe (ibid.) noted that in-depth interviews are appropriate when seeking insights into opinions and experiences. The data revealed the roles of 2D and 3D indications during the different stages of opening and contributed to the formulation of design considerations concerning the use of combined 2D and 3D indications to provide effective opening information for older people.

Some flexibility in the interviews was needed to allow the researcher to gain in-depth data on how older people perceived and understood indications, and on how they made decisions when opening the packaging samples. Individual interviews using semi-structured questions were selected as the most appropriate method to gather the data. This was because this approach uses specific questions and sequences, within which interviewers can ask further questions following up participants' responses, giving participants a great deal of leeway to share their opinions (Bryman, op. cit.).

The in-depth interview participants

The interviews were conducted with a small number of participants so that in-depth data could be collected. The Centre for Applied Gerontology, University of Birmingham, provided six participants selected from the twelve original focus group participants, female and male, in three age groups, 65-74, 75-84 and 85+. In the in-depth interviews, different packaging samples, procedures and questions were used. Consequently, any experience which the participants had already gained from the focus groups was unlikely to negatively affect the new data. In contrast, the participants' extended understanding of the context of the research acquired from the focus groups may have helped them contribute in-depth data about package openability.

Packaging samples for the in-depth interviews

The two criteria used for selecting packaging samples were that participants should be unfamiliar with the sample and that participants should find the package opening

method of the sample difficult to understand. To obtain a pool of potentially unfamiliar packaging samples, seven out of the original 13 packaging samples which had not been previously used in the focus groups were selected.

In the focus groups, it was noted that participants had commented more on the packages that they found difficult to understand how to open than on the ones they found easier to understand how to open. Packaging samples with two or more opening steps or unfamiliar opening methods tended to demand more cognitive processing. Unfamiliar opening methods are those different from the standard opening methods presented in the reference list shown in Table 10. Accordingly, five out of the seven packaging samples which have two or more opening steps or unfamiliar opening methods were chosen as shown in Figure 10 below.

Package no.1

Package no.2

Package no.3

Package no.4

Package no.5

Figure 10: Five packaging samples for the in-depth interviews

In the case of package no.1, the lid has to be twisted clockwise before it can be pressed down to spray the contents. Package no.2 is opened by twisting the lid 180 degrees, turning the bottle upside down and then squeezing it to dispense the contents. Squeezing and turning are required for opening package no.3. Package no.4 is opened by levering the tab on the lid before lifting the whole lid. Package no.5 can be opened by pressing the button on the front of the lid.

Additionally, it was important that packaging samples had a range of 2D and 3D indications because the in-depth interviews focused on uses of 2D and 3D design. For example, indications found on package no.1 were the shapes of the lid and body, the ridges around the lid and on the lid, the nozzle, the indented bottom (all 3D indications), the product name, the diagrams and the arrows (all 2D indications).

The in-depth interviews sought insights into the cognitive processes employed when participants used indications to open the packaging samples. The packaging sample that was the most unfamiliar to each participant and the most difficult for them to understand how to open was selected for discussion. This packaging sample was selected by asking participants to complete two questionnaires to assess the packaging samples in terms of unfamiliarity and understanding. Package no.1 was selected by participants 2MA and 2ME; package no.2 was selected by participants 1FB, 2FD, 2FF and 2MC. These code names with one digit and two letters were created in reference to the focus group number that participants belonged to (one or two), their gender (the first letter) and their sitting position in the focus groups (the second letter). The opening methods and indications employed on packages no. 1 and 2 are described in Appendix C-1.

Pilot interviews

Pilot interviews were conducted to resolve four issues that could impact on the ability of the in-depth interviews to gain the required data. The first related to procedure, sequence

and staging between: introduction, informed consent, observations, questionnaires and the interviews. The second issue was to ensure that the language and terms used in the questions were easy for participants to understand. The third issue involved the researcher's skill to conduct the interviews. The fourth issue related to the approach needed to acquire information about participants' cognitive processes. The researcher had initially used a *think aloud* approach in a number of pilot interviews by asking participants individually to speak about indications whilst opening the packaging samples. Hayes (op. cit.) noted that this approach is appropriate for gaining insights into participants' thinking processes when performing a task. However, the participants tended to remain silent whilst concentrating on finding out how to open the packages. The participants did not readily verbalise their thoughts, even when reminded by the researcher. This may be due to the impact of ageing on working memory as discussed in chapter two, suggesting that it is not easy for older people to perform two tasks simultaneously. To accommodate this, the researcher asked the participants to speak about indications for opening after they had finished opening the packages. In this way, the participants contributed more information. Fifteen older volunteers aged 65+ participated in the pilot interviews, three males and 12 females.

Procedure for the in-depth interviews

With the help of the Centre for Applied Gerontology, University of Birmingham, the researcher contacted the participants individually to make appointments for the interviews. The interviews were conducted at Birmingham City University in the User-lab interview room. Taxis were provided to bring participants to and from the interviews which were conducted in an easily accessible interview room. Reimbursement for participation in the form of a £10 shopping voucher was provided. The position of the table and chairs in the interview room was set to ensure that the participants were comfortable during the session. A video camera was located in an appropriate position to capture the participants' interaction with the packaging samples.

Each of the two in-depth interview sessions collected qualitative data. In the first session, observations were made during the participants' interactions with the packaging samples. The observations provided first hand information (Bryman, op. cit.; Denscombe, op. cit.) on how participants used indications for opening. The researcher made careful notes in a journal of all relevant aspects of the interactions. Interactions were also video recorded for later use. After participants had finished opening each of the five packaging samples provided, they were asked to rate each one on two factors: familiarity and understanding.

During a refreshment break between sessions, the researcher calculated the scores from the participant ratings to select the package that participants found the most unfamiliar and the most difficult to understand how to open. Additionally, information on participants' interactions with the selected package drawn from the journal and from the video recording was compared to maximise accuracy.

In the second session, the information derived from both the journal and the video recording was used to inform specific enquiries into the participants' interactions with the selected package during the follow-up discussion. This was to examine how participants used indications when opening the package.

3.5.4 Producing a design framework which can be used by packaging designers to increase the understandability of packaging information for older people, with respect to openability

To produce the framework, information was synthesised from different sources. These were: existing design guidelines, recommendations and principles derived from the literature; areas of considerations for providing effective indications with respect to package openability drawn from the focus groups and areas of considerations concerning how to use combined 2D and 3D indications derived from the in-depth interviews.

3.6 Data analysis methods

This section presents the methods used to analyse the data drawn from the initial observations, the focus groups and the in-depth interviews.

3.6.1 Initial observations

The data from the observations of older peoples' ability to perform everyday life activities at the lunch clubs were collected in the form of a journal. Content analysis (Cohen *et al.*, op. cit.; Denscombe, ibid.) was used where the researcher examined the journal repeatedly and categorised the data. These findings were used to refine the overall study aims and to clarify the area of interest to be examined in the focus groups.

3.6.2 Focus groups

The data gathered in the focus groups were placed into three kinds: 1) scores that participants provided for the packaging samples on *openability*, 2) information on older participants' health related decline and 3) the record of the discussion.

The scores were used to identify: 1) how familiar or unfamiliar the packaging samples provided were to participants, 2) how easy or difficult it was for participants to understand how to open the packaging samples and 3) how easy or difficult it was for participants to physically open the packaging samples. These scores were compared with data drawn from the discussions in order to analyse the impact of packaging familiarity and the participants' physical ability to open the packaging samples on their understanding of how to open them.

Impairments such as long-sightedness, cataracts or arthritis drawn from the information on participants' health related decline were tabulated and factored into the identification

of possible reasons behind any difficulties that participants had when opening the packaging samples.

The discussions were recorded and transcribed verbatim. The researcher scrutinised the transcriptions repeatedly to become familiar with the data prior to analysis. Content analysis (Cohen *et al.*, ibid.; Denscombe, ibid.) was then used, where the data were coded and categorised manually so that any relationships could be identified.

3.6.3 In-depth interviews

The data gathered in the in-depth interviews were placed into two kinds: 1) observations of participants' interactions with the packaging samples and 2) discussions with participants on how they used indications when opening the packaging samples.

The observations were derived from: 1) extensive notes made in the journal and 2) the video recordings. Both were compared to maximise accuracy before being used to inform further enquiries into the participants' interactions with the packaging samples in the discussion. The observations drawn from the video recordings were also used during data analysis as explained below.

The data from the audio recordings (the discussion) were transcribed verbatim. The transcriptions were scrutinised repeatedly. The data from the video recordings (the observations) were repeatedly watched. The researcher was therefore familiar with the data prior to analysis. More detailed information about participants' interactions with the packaging samples from the video recordings was added to the data from the audio recordings.

The researcher analysed how participants used 2D and 3D indications when they inspected the packaging samples, released the lids and dispensed the contents. Detailed content analysis (Cohen *et al.*, ibid.; Denscombe, ibid.) was used. The data were

repeatedly scrutinised, coded and categorised to aid synthesis of design considerations concerning the use of combined 2D and 3D indications.

3.7 Reliability

Denscombe (ibid., p.298) defines reliability as the characteristic determining the question "If someone else did the research would he or she have got the same results and arrived at the same conclusions?". The selection of appropriate research instruments plays a key role in providing consistent research results (Denscombe, ibid.).

The instruments used in the focus groups and the in-depth interviews comprised the procedures, the questionnaires and the questions for the discussion. A number of pilot sessions were conducted to ensure that 1) the required data could be collected by these instruments and 2) the same procedures, questionnaires and questions were applied consistently when collecting the data.

Naturally, qualitative research is influenced by the presence of the researcher. Denscombe (ibid.) introduced the term *researcher's self* referring to researchers' identities, values and beliefs which can have both positive and negative implications when collecting and interpreting data. On the one hand, a researcher's expertise on a particular topic may contribute to the development of strategies to collect and interpret data. On the other hand, results may be influenced by the researcher's interpretation based on their prior experience.

A researcher should be open-minded when interpreting data (Denscombe, ibid.). For example, when the data present unexpected findings or contradictions, the researcher should examine these kinds of data carefully seeking to explain them (Seale, 1990; Silverman, 2006). This principle was adopted in this study. For example, the data showed that it was easy for participants to physically open the packaging samples, when it was easy

for them to understand how to open the packages. However, there were cases in which these two factors did not correlate. These cases were discussed further to explain the reasons for the contradiction as shown in Appendix B-2.

3.8 Validity

Hammersley (1987, p. 69) describes validity thus: "An account is valid or true if it represents accurately those features of the phenomena, that it is intended to describe, explain or theorise.". To increase the accuracy of the data, this study employed a *triangulation* approach. Cohen (op. cit., p. 141) pointed out that a triangulation approach is an attempt to "explain more fully, the richness and complexity of human behaviour by studying it from more than one standpoint". The examination of data from different perspectives can be conducted by using more than one data source, researcher or method (Denscombe, op.cit.).

Triangulation was employed in this study to examine both focus group and in-depth interview data. In the focus groups, qualitative and quantitative approaches were used to collect the data. Group discussions and questionnaires were used, which allowed the researcher to explore the data from widely different angles.

In the in-depth interviews, the data were gathered by using two qualitative approaches: observations and discussions. As both methods are qualitative, the data perspectives may not be as widely differentiated as those derived from the focus groups. However, the in-depth interview data provided insights into the rich and complex thinking processes used by participants when opening packages.

Furthermore, the combination of the detailed data from observing participants' interactions with the packaging samples with the discussions on how they open the packages provided a fuller understanding of older peoples' needs for opening indications.

3.9 Generalisation

Generalisation is the term used in quantitative research where data collected from a sufficiently large sample may be applied to the wider population (Bryman, op. cit.). This study is mainly based on a qualitative methodology where the design requirements used to create the recommendations were collected from a small number of participants. Therefore, this detailed study does not seek to generalise its findings to the wider population of older people. However, it is possible to discuss the broad implications of the findings from this small scale and specific study and to offer these to designers for consideration when designing packaging for older people.

From a naturalistic research (e.g. ethnographic, case study and qualitative research) point of view, Guba and Lincoln (1981) noted that the ability to apply findings from one research study to other cases is based on the similarity of context between the research study in question and the other cases. This study clearly and transparently explained its context comprising the relationship between the study aims and the methodology, the methods for data collection, the sampling of participants and packages and the methods for data analysis. This explanation allows this study to be compared with others by future researchers.

The findings of this study cannot claim to be representative; however, the deep study into a small numbers of participants offers an opportunity to gain an indicative insight into the individual perspective *to illuminate the general by looking at the particular* (Denscombe, op. cit., p.36).

3.10 Ethical issues

The data for this study were collected from older people. It is important to consider participants' rights in relation to their participation and the use of their data. Three

phases of data collection involving older participants took place: the initial observations, the focus groups and the in-depth interviews. In response to the ethical framework of Birmingham City University (BCU, 2009), the ethical issues encountered and in particular *informed consent* at these three stages are discussed below.

3.10.1 Initial observations

Two initial observation sessions were conducted at each of two lunch clubs. In session one, the researcher informed the supervisors of the lunch clubs about the research project. To ensure that participants' ability to perform everyday life activities were observed in a natural setting, the researcher conducted the observations without written informed consent from participants. In session two, the researcher verbally explained the purpose of the study to the participants and asked for their participation in trying to open packaging samples and in commenting on openability.

Although these observations did not cause participants physical or psychological harm and the participants were not identified when reporting the observations, collecting the data without written informed consent raised ethical issues. In all future research, the researcher will secure written informed consent to protect participants' rights.

3.10.2 Focus groups and in-depth interviews

At the beginning of the focus groups and the in-depth interviews, the researcher explained to participants the aims and procedures of the studies. The participants were asked to provide written informed consent (see Appendices D and E). The written informed consent highlighted three important ethical concerns as explained below.

1) Data confidentiality

All data from the participants were confidential and only used for the academic purpose of this study. If the data are to be used for other purposes in the future, this would only be possible with the participants' consent.

2) Participants' anonymity

The participants are referred to in all documentation by code names; therefore, they were anonymous both during the analysis of the data and during the discussion of the findings.

3) Participants' rights

The researcher asked the participants' permission to audio and video record the data that they contributed to the research. The participants were informed that they had the right to withdraw their participation from the session at any time.

3.11 Summary

This section summarises the research paradigm and the methodology adopted in this study and the methods employed to collect and to analyse the data. The summary also touches on reliability, validity, generalisation and the ethical issues encountered.

3.11.1 Research paradigms

This study was based on naturalistic research in order to understand individuals' design needs for package openability and thinking processes when opening packaging. An idiographic approach was used to collect qualitative data seeking a detailed understanding

of older peoples' design requirements for effective opening indications. Quantitative data were also gathered to maximise data validity. These combined data were used to create design recommendations required in the research question.

3.11.2 Research methodology

This study was defined as inductive research where a *mixed methods* approach was adopted. Qualitative approaches were predominantly employed to collect the data from older people to develop design recommendations and to produce a framework tool that can be used to design packaging whose opening is easy for older people to understand.

3.11.3 Research methods

The first study aim, *to understand the problems older people have when opening packages*, was addressed through the initial observations, the literature review and the focus groups. The second study aim, *to investigate the relative importance of 2D and 3D indications during the different stages of package opening*, was fulfilled through the in-depth interviews and the literature review. The third study aim, *to produce a design framework which can be used by packaging designers to increase the understandability of packaging information for older people, with respect to openability*, was accomplished through the synthesis of the data drawn from the literature, the focus groups and the in-depth interviews.

3.11.4 Data analysis

The data from the observations were scrutinised and categorised to gain an initial understanding of older peoples' ability to perform everyday life activities. A manual content analysis approach was adopted to analyse the data from the focus groups and the in-depth interviews. Five main steps of data analysis included: establishing familiarity with the data, coding and categorising the data, detecting relationships between the categorised data and drawing of conclusions. The data from the literature review were used to guide

the analysis of the data drawn from the initial observations, the focus groups and the in-depth interviews.

3.11.5 Reliability

Reliability concerns the matter of whether different researchers would have gained the same results when using the same instruments to conduct the research. The procedures and questions used for the data collection were developed through a number of pilots to maximise their reliability. In addition, the researcher was aware of the need to minimise the influence of particular expectations which she may have had due to prior experience on the interpretation of data.

3.11.6 Validity

The validity of this study refers to the accuracy of the data. A *triangulation* approach was adopted where different methods were used in the focus groups and in the in-depth interviews. The focus groups employed questionnaires and discussions; the in-depth interviews adopted observations and discussions.

3.11.7 Generalisation

The data in this study were drawn from a small number of participants. Therefore, the findings cannot be applied to the wider population. However, a critical analysis of the data from a small number of participants allowed the researcher to develop an indicative insight into how older people individually used indications when opening novel packaging. These valuable and highly detailed data were used in creating the design recommendations to increase the understandability of package opening information for older people.

3.11.8 Ethical issues

The focus groups and the in-depth interviews were carried out ethically according to the ethical framework of Birmingham City University (BCU, ibid.). The rights and dignity of participants as well as the use of their data were taken into account.

In the initial observations, the data were collected from the participants without asking them to provide written informed consent. This raised ethical issues as identified and acknowledged in section *3.10.1 Initial observations*. All future research will be in full compliance with ethical guidelines, in particular the gathering of written informed consent prior to collecting data from participants.

The next chapter will present the research results drawn from the data collected and analysed by using the methods described in this chapter.

Chapter 4

Research results

This chapter presents results from the initial observations, the focus groups and the in-depth interviews arranged by their contribution to the first and second aims of the research (*to understand the problems older people have when opening packages* and *to investigate the relative importance of 2D and 3D indications during the different stages of package opening*). The relationship of the results to the two aims, data sources, types of raw data and literature are summarised in Table 11 below.

Table 11: Research results in relation to the aims, data sources, types of raw data and literature guides

Study aims	Data sources	Types of raw data	Literature guides	Results
One	Initial observations	Older peoples' ability in everyday life activities	Age-related decline	Initial understanding of older peoples' ability in everyday life activities
	Focus groups	Health related decline affecting ability to open packages	Age-related decline in relation to ability to open packaging	Areas of considerations for designing effective indications with respect to openability
		Older peoples' comments on package openability	Existing design guidelines, recommendations and principles	
Two	In-depth interviews	Older peoples' uses of 2D and 3D indications during the different stage of opening	No literature was found.	Novel findings regarding the roles of 2D and 3D indications during the different stages of opening
		Older peoples' uses of 2D and 3D indications to successfully and unsuccessfully opened novel packages	Existing design guidelines, recommendations and principles	Areas of considerations concerning the use of combined 3D and 2D indications to provide effective opening information for older people

The research results will now be discussed.

4.1 Aim one: to understand the problems older people have when opening packages

4.1.1 Initial observations

Data from the initial observations offered early insights into selected older peoples' ability to conduct everyday life activities. The initial observations were carried out at two lunch clubs which were attended by older people aged 80+ in the first instance and 60+ in the second. During these session participants exhibited limitations in varying degrees in terms of: vision (Ah-Chan and Downes, op. cit.; Chivers, op. cit.; Watkinson, op. cit.), hearing (Gates and Mills, op. cit.; Stuart-Hamilton, op. cit.), short-term memory, mobility (Daley and Spinks, 2000; Guralnik *et al.*, 1993; Metz, 2000) and hand dexterity (Carmeli *et al.*, op. cit.), when taking part in the activities at the lunch clubs (see detailed explanation in Appendix A). Two out of the thirteen attendees aged 80+ exhibited limitations in short-term memory. However, as Kensinger and Corkin (op. cit.) suggested that ageing is unlikely to negatively affect short-term memory, the observed memory limitations may have other causes.

As noted in section *2.4.6 Impacts of age-related decline on older peoples' ability to open packaging*, age-related limitations of sensory and hand function can reduce older peoples' ability to open packages. With regard to cognitive function however, impaired short-term memory caused by brain diseases such as Alzheimer's is unlikely to affect older peoples' ability to open packages (see in the section *Pathological ageing* in section *2.4.5.2 Cognitive functions*).

The attendees of lunch club one (who were all aged 80+) exhibited a wider range of age related impairments than the attendees of lunch club two (focusing on who aged 60-80). The degree of impairment observed was also more severe. This led to the use of three

different participant age groups in the study. This was to ensure that older people who have potentially different levels and kinds of decline were included.

The researcher also learned that understanding of how to open packaging was affected by: 1) prior knowledge of how to open packaging, 2) indications, 3) the use of trial and error to find out how to open packaging, 4) the older peoples' attitudes to particular kinds of opening methods and packaging shapes and 5) their visual decline. These factors were examined further in the focus groups.

4.1.2 Focus groups

Data from the focus groups were used to create areas of considerations for providing effective indications with respect to openability. These design considerations were drawn from the data on participants' health related decline and the participants' comments on package openability. These data will be presented below under three headings: sensory functions, cognitive functions and hand functions.

4.1.2.1 Sensory functions

Participants' health related decline

Seven of the twelve participants reported some kind of visual impairment including: short-sightedness, long-sightedness, cataracts and diabetic retinopathy. Six of these twelve participants disclosed that they had a hearing impairment such as partial deafness. In chapter two it was explained that the types of visual impairment reported can negatively influence two kinds of visual function: visual acuity (Ah-Chan and Downes, op. cit.; Chivers, op. cit.; Goldstein, op. cit.; Pirkl, op. cit.; Watkinson, op. cit.) and brightness and darkness adaptation (Pirkl, ibid.). In addition, it was suggested in chapter two that

the hearing impairment reported may reduce hearing sensitivity when receiving feedback information from packaging.

Participants' comments on package openability

The factors that made it difficult for participants to notice, identify and read the indications were: 1) low colour contrast, 2) small print, 3) shiny surfaces, 4) elaborate instructions, 5) indications positioned far from the opening and 6) blurred printing.

A frequency count made from the participants' comments on both the easy-rated and the difficult-rated packaging samples (for detailed explanation see Appendix B-2) was used to rank the importance of these six factors. Highest ranked was low colour contrast followed by small print. Shiny surfaces, elaborate instructions and indications positioned far from the opening were all equally ranked in third place, followed by blurred printing.

The factors that helped participants understand how to open the packaging samples were: 1) feeling shape indications and 2) hearing audible indications. These factors were ranked by importance according to the frequency of participants' comments on the easy-rated packaging samples (for detailed explanation see Appendix B-2).

Difficulties in noticing, identifying and reading indications appeared to be caused by 1) age-related impairment of visual acuity and brightness and darkness adaptation as explained in the previous section and 2) design factors such as small print, low colour contrast and shiny surfaces, as addressed in this section.

Areas of considerations concerning sensory functions

The six factors seen in the previous section that made it difficult for participants to notice, identify and read indications suggest the need for *indication visibility*. The two factors seen in the previous section that helped participants understand package opening

methods suggest the need for *alternative indications* that can also be received by the senses of touch and hearing. Table 12 presents specific areas of considerations that address these two design issues.

Table 12: Areas of considerations in relation to sensory functions

		Considerations							
		Indication visibility						Alternative indications	
Indications		Colour contrast (use high colour contrast)	Size (use readable print size)	Surface textures (avoid placing indications on shiny surfaces)	Design layouts (avoid using elaborate instructions)	Position (place indications near the opening)	Printing quality (avoid using blurred printing)	Shape indications (use shape indications)	Audible indications (use audible indications)
2D compact indications	Arrows	•		•					
	Single-word imperatives					•			
2D indications	Long instructions	•	•		•		•		
3D indications	Triggers							•	
	Grooves							•	
	Indentations	•							
	A tab					•			
Audible indications	Sounds of contents								•
	A sound *click* when unlocking the trigger								•

Note: • *indicates the areas of considerations for indication design*

Participants commented on two kinds of two dimensional indications. The first kind refers to indications presented in compact forms: arrows and single-word imperatives such as *press*. The second kind refers to long instructions.

Participants commented on three dimensional indications comprising: the trigger, the grooves, the indentations and the tab. Additionally, participants commented on audible indications, such as the sound of liquid contents.

Arrows

Two key areas that should be taken into account when using arrows are colour contrast and shiny surfaces. High colour contrast between arrows and their background should be provided so that they are easily noticed and identified. Arrows should not be placed on shiny surfaces because this can reduce their visibility.

Single-word imperatives

When using single-word imperatives such as *press*, these should be placed near the opening to the package, as this is where the packaging user looks.

Long instructions

Four key areas that should be considered when designing long instructions are: colour contrast, size, design layout (concerning spacing of lines, type case and type font) and printing quality. Small print and low colour contrast between the instructions and their background should be avoided as these reduce readability. Clear design layouts should be used to make information in long instructions easy to identify, read and understand. Blurred print should be avoided as it reduces readability.

3D indications

Three key areas that should be taken into account when designing 3D indications are shape, contrast and position. The shape of 3D indications such as triggers and grooves should be used to help older people understand which hand actions are required for opening. High colour contrast between small 3D indications such as indentations and their background should be applied so that the indications are easily noticed and identified. Also, small 3D indications such as tabs should be placed near the package opening, as this helps older users easily notice the indications.

Audible indications

Audible indications such as sounds of contents should be taken into account when designing a package and audible feedback to confirm opening should be used where possible, as this may also help older people understand how to open packaging.

4.1.2.2 Cognitive functions

Participants' health related decline

As no specific tests of participants' cognitive impairments were conducted, the data concerning cognitive impairment were drawn from the literature. Chapter two indicated that semantic memory tends to be more stable with ageing than working memory (Craik and Bosman, op. cit.). Additionally, ageing appears to have a more negative effect on fluid intelligence than it does on crystallised intelligence (Bäckman *et al.*, op. cit.). Older people can use prior knowledge (semantic memory and crystallised intelligence) to easily perform familiar tasks, but may find it difficult to perform unfamiliar tasks (that require fluid intelligence) and can be distracted easily by irrelevant items of information (that overload working memory). Prior knowledge (that uses semantic memory) may also help a person learn how to perform unfamiliar tasks (White, op. cit.).

Participants' comments on package openability

The factors affecting understanding of how to open the packaging samples were: 1) prior experience 2) indications 3) low indication visibility 4) trial and error and 5) impacts of prior negative opening experiences, 6) difficulties in performing package opening and 7) impacts of danger warnings concerning potentially harmful contents.

A frequency count made from the participants' comments on both the easy-rated and the difficult-rated packaging samples (for detailed explanation see Appendix B-2) was used to

rank the importance of these seven factors. Highest ranked was prior experience followed by indications, then low indication visibility then trial and error. Finally, impacts of prior negative opening experiences, difficulties in performing package opening and impacts of danger warnings concerning potentially harmful contents were all equally ranked in fifth place.

The importance of prior experience highlighted in this section supported the conclusion from the previous section that older peoples' prior knowledge remains efficient and may help them understand how to open novel packaging.

Areas of considerations concerning cognitive functions

The seven key factors highlighted in the previous section can be categorised under three headings: sensory functions, cognitive functions and hand functions. Low indication visibility relates to sensory function. Prior experience, indications, trial and error and impacts of prior negative opening experiences and danger warnings all involve cognitive functions. Difficulties in performing package opening tasks relate to hand function. This suggests that both sensory and hand functions influenced understanding of how to open the packaging samples.

The areas of considerations concerning sensory functions were already discussed in section *4.1.2.1 Sensory functions.*

Areas of considerations involving cognitive functions are summarised as follows:

- Familiar indications which are commonly found on existing packages should be used to help older people understand package opening methods.

• Indications should prevent impossible manipulations whilst permitting correct manipulations when opening packages. This is to reduce the need for repeated trial and error attempts which may cause frustration.

• Clear indications should be provided to reduce the impact of prior negative opening experiences or danger warnings, on older peoples' ability to understand how to open packaging.

• Colour contrast and design layouts which should be used and managed to make indications visible should also be used and managed to prioritise opening information for easy understanding.

Areas of considerations concerning hand functions will be discussed in the next section.

4.1.2.3 Hand functions

Participants' health related decline

Six of the twelve participants reported arthritis in their hands. Chapter two explained that hand arthritis causes hand pain and deformation (Altman *et al.*, op. cit.; Symmons *et al.*, op. cit.) which can reduce both hand function and hand performance when opening packages.

Participants' comments on package openability

The key factors influencing participants' ability to physically open the packaging samples were: 1) understanding of how to open packaging, 2) limitations in hand strength, 3) hand and wrist pain and 4) limitations in hand dexterity. These factors were ranked by importance according to the frequency of participants' comments on both the easy-rated and the difficult-rated packaging samples (for detailed explanation see Appendix B-2).

Areas of considerations concerning hand functions

The key factors highlighted in the previous section were used to form the areas of considerations. Understanding of how to open packaging appeared to be the key factor influencing participants' ability to physically open the packaging samples. The areas of considerations concerning the understanding of how to open packaging were already discussed in section *4.1.2.2 Cognitive functions.*

Areas of considerations involving limitations in hand strength, hand and wrist pain and limitations in hand dexterity are now summarised.

- Packaging shapes and surface textures on lids should be used to optimise the users' hand strength when opening packages.

- Opening methods should not require excessive hand strength, movement and dexterity or cause hand and wrist pain when opening packages.

- Opening mechanisms should allow older people to successfully open packaging as guided by indications.

4.2 Aim two: to investigate the relative importance of 2D and 3D indications during the different stages of package opening

Data from the in-depth interviews revealed how older participants used 2D and 3D indications when opening the packaging samples. The findings will be presented below.

4.2.1 Roles of 2D and 3D indications

The roles of 2D and 3D indications were examined during the stages of inspecting the package, releasing the lid and dispensing the contents (for detailed explanation see Appendix C-2). When inspecting the package and releasing the lid, 2D indications

appeared to be more important than 3D indications. However, the importance of 3D indications was greater when releasing the lid than when inspecting the package. This may be because participants mainly interacted with the lid and body of the packaging samples when releasing the lid. Participants, therefore, relied more on information from these 3D indications.

When dispensing the contents, the importance of 2D or 3D indications tended to depend on participants' prior experience. Three dimensional indications appeared to be more important than 2D indications, when participants were familiar with the opening method. They may recognise how to open the package through 3D indications. Conversely, when participants were unfamiliar with the opening method, 2D indications (if provided) tended to be more important than 3D indications.

4.2.2 Areas of considerations concerning the use of combined 2D and 3D indications to provide effective opening information for older people

This section presents three subsections concerning: 1) visually representing the relationship between indications and information for opening, 2) analysing successful and unsuccessful uses of indications and information for opening and 3) formulating design considerations for the use of combined 2D and 3D indications.

4.2.2.1 Diagram representing the relationship between indications and information for opening

Figure 11 below summarises the indications and the information required for opening packages, that is: how to release the lid and dispense the contents.

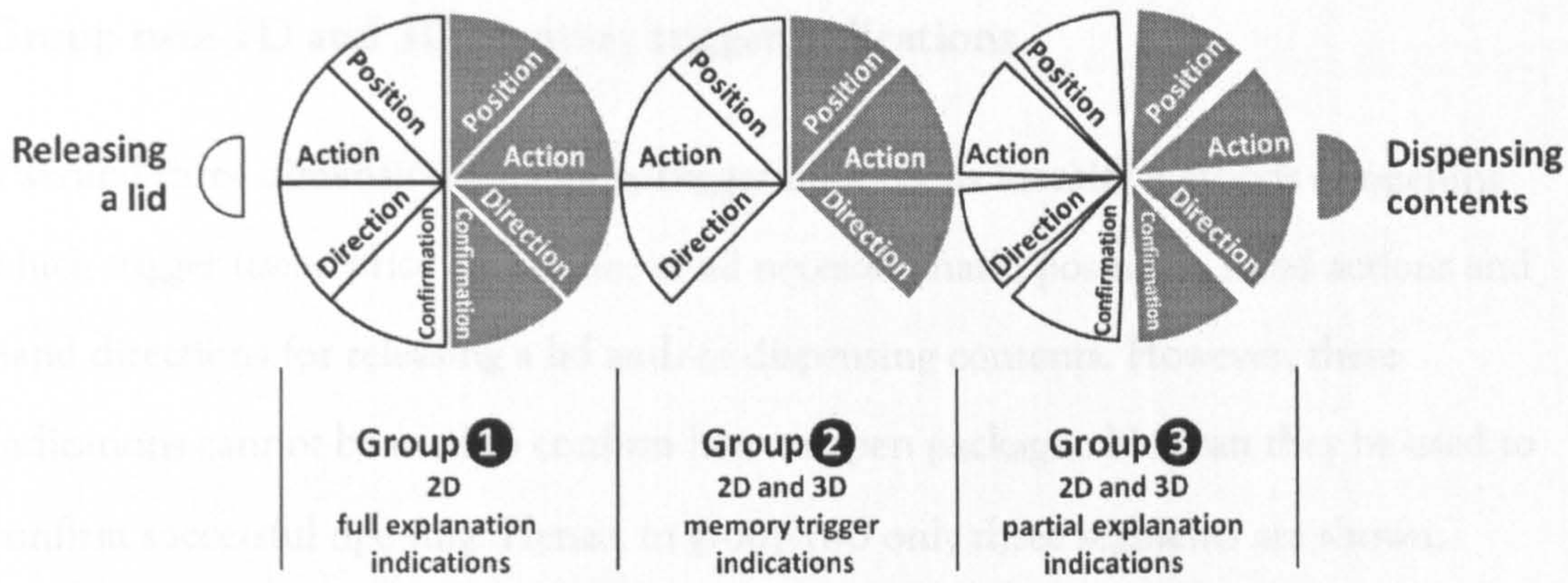


Figure 11: The diagram representing the relationship between indications and information for releasing a lid and dispensing contents

For convenience, hereafter the diagram representing the relationship between indications and information for opening illustrated in Figure 11 will be termed *RIIO*. The RIIO diagram shows the three groups of indications found on packages: 2D full explanation, 2D and 3D memory trigger and 2D and 3D partial explanation. In each of these three groups, semi-circular segments to the left and right represent the activities of releasing a lid and dispensing contents respectively. For clarity, these are shown in different colours, white and grey.

Group one: 2D full explanation indications

Two dimensional full explanation indications refer to diagrams on packages that fully explain the required hand positions, hand actions and hand directions for releasing a lid and dispensing contents. Participants also used these diagrams on packages to confirm their understanding of how to release a lid and how to dispense contents. In Figure 11, the white and grey semi-circles in group one are subdivided into four segments representing these four types of information. The ability to understand such diagrams on packages appears to rely on clear illustrations (Moore, 1993, op. cit.) and clearly written instructions (CEN/CENELEC, op. cit.).

Group two: 2D and 3D memory trigger indications

Two and three dimensional memory trigger indications identify methods of opening which trigger users' prior experience of all necessary hand positions, hand actions and hand directions for releasing a lid and/or dispensing contents. However, these indications cannot be used to confirm how to open packages. Nor can they be used to confirm successful opening. Hence, in group two only three segments are shown, representing the three types of information (see Figure 11).

The ability to understand the indications in this group relates to the design principles found in the literature associated with prior experience; such as description (Monö, op. cit.), perceived affordances (Norman, 1999, op. cit.), identification and product sign (Monö, op. cit.). Prior experience of opening packages forms a stereotypical relationship between indications and opening methods. Users can recognise the opening methods from the indications.

Group three: 2D and 3D partial explanation indications

Two and three dimensional partial explanation indications partially describe information for opening, for example, only showing the required hand directions for releasing a lid, or only confirming how to dispense contents. To illustrate the *partial* characteristic where an explanation of how to open packaging is partially achieved, the segments representing the four types of information in this group are slightly separated from each other (see Figure 11).

The ability to understand the indications in this group involves the design principles found in the literature associated with prior experience and trial and error. The design principles related to prior experience; include: consistency and compatibility (Jordan, op. cit.) and construction of products (Monö, ibid.). Familiar indications guide users about required opening manipulations.

The design principles concerning trial and error; include: feedback (CEN/CENELEC, op. cit.; Jordan, op. cit.; Krippendroff, op. cit.; Norman, 2002, op. cit.) where a response from packaging indicates what has been done, and physical constraints (Norman, ibid.) where clear indications are needed to prevent impossible opening manipulations.

4.2.2.2 Successful and unsuccessful uses of indications and information for opening the packaging samples

The RIIO diagram (Figure 11) was used as a tool to analyse both successful and unsuccessful uses of indications and information for opening with the packaging samples evaluated in the in-depth interviews. By comparing the diagrams from successful cases (see Appendix C-3), conclusions could be drawn regarding successful uses of indications and information. Equally, it was possible to draw conclusions around unsuccessful uses of indications and information.

Characteristics of successful uses of indications and information

The data derived from participant sessions are summarised below.

Firstly, five of the six participants, used combined 2D and 3D indications to successfully open the packaging samples.

Secondly, participants used at least two types of information (e.g. hand positions and hand actions) from at least two groups of indications (e.g. full explanation and memory trigger) to successfully open the packaging samples.

Thirdly, the participants used different indications to elicit the same information for opening; which may have been influenced by individual differences in visual impairment and perception of indications.

Fourthly, when there were no memory trigger indications, participants used full and partial explanation indications to successfully open the packaging sample (package no.2).

Fifthly, some participants used: 1) full explanation indications to confirm how to open the packaging sample (package no.1) or 2) partial explanation indications to confirm successful opening of the packaging sample (package no.2).

Characteristics of unsuccessful uses of indications and information

The data drawn from participant sessions are summarised below.

Firstly, none of the three kinds of indications (full explanation, memory trigger and partial explanation) successfully indicated to participants the three types of information needed for successful opening (hand positions, hand actions and hand directions). This was because the indications on the packaging samples were not visually clear and the language used with the diagrams did not clearly indicate the required hand action.

Secondly, the 3D memory trigger indications on one packaging sample misled participants about the required hand direction for opening. (The shapes of the lid and body of package no.1 are cylindrical. Without clear indications, participants assumed that lid could be released by turning it anticlockwise. Actually, the lid had to be turned clockwise.)

Thirdly, some participants used full explanation indications to confirm how to open the packaging sample (package no.1). Others used partial explanation indications to confirm: how to open the packaging sample (package no.2) and/or whether the package had been successfully opened.

4.2.2.3 Presentation of design considerations concerning the use of combined 2D and 3D indications

The characteristics of successful and unsuccessful uses of indications and information drawn from the previous section were used to create areas of considerations concerning the use of combined 2D and 3D indications. This information is shown in Table 13 below. The table presents each area of consideration together with its rationale. Corroborative literature is also cited.

Table 13: Areas of considerations concerning the use of combined 2D and 3D indications to provide effective opening information for older people

No.	Areas of considerations	Rationale	Sources
1	Two and three dimensional indications should be combined when designing a package.	The majority of participants used combined 2D and 3D indications to successfully open the packaging samples.	Findings from the in-depth interviews.
2	When designing memory trigger and partial explanation indications, both 2D and 3D indications should be provided on a package.	Participants used different indications to understand how to open the packaging samples. Alternative indications (different 2D and 3D indications showing the same information) appeared to help participants to understand how to open the package samples due to differences in their visual impairment and perception.	Findings from the in-depth interviews. Sensory affordances (Hartson, op. cit.) Alternative formats (CEN/ CENELEC, op. cit.) Consideration of user resources (Jordan, op. cit.)

Table 13: Areas of considerations concerning the use of combined 2D and 3D indications to provide effective opening information for older people (continued)

No.	Areas of considerations	Rationale	Sources
3	Designers should utilise the three groups of indications (full explanation, memory trigger and partial explanation) when communicating how to open packaging.	All participants used two or three groups of indications to effectively understand how to open the packaging samples.	Findings from the in-depth interviews. **Indication group one** Clear illustrations (Moore, 1993, op. cit.) Clear language in written information (CEN/CENELEC, op. cit.) **Indication group two** Description (Monö, op. cit.) Perceived affordances (Norman, 2002, op. cit.) Identification (Monö, op. cit.) Categorisation (Muller, 2001, op. cit.) Product sign (Monö, op. cit.) Exhortation (Monö, ibid.) **Indication group three** Consistency and compatibility (Jordan, op. cit.) Standardisation (CEN/CENELEC, op. cit.) Construction of products (Jordan, op. cit.) Feedback (CEN/CENELEC, op. cit.; Jordan, ibid.; Krippendroff, op. cit.; Norman , 2002, op. cit.) Physical constraints (Norman, ibid.)
4	Each of the three indication groups (full explanation, memory trigger and partial explanation) should present three types of information: hand positions, hand actions and hand directions required for opening packaging.	All participants used two or three types of information (e.g. hand positions and hand actions) from two or three groups of indications (e.g. full explanation and memory trigger) to understand how to open the packaging samples.	Findings from the in-depth interviews. Hand positions (Moore, 1993, op. cit.; Cayton, op. cit.) Hand actions (Moore, ibid.) Hand directions (Moore, ibid.)
5	Full explanation indications should be provided for older users to confirm how to open packaging.	Participants used full explanation indications to confirm how to open the packaging sample (package no.1).	Findings from the in-depth interviews.
6	Partial explanation indications should be provided for older users to confirm how to open packaging and to confirm successful package opening.	Participants used partial explanation indications to confirm: how to open the packaging sample (package no.2) and/or whether the package had been successfully opened.	Findings from the in-depth interviews. Feedback (CEN/CENELEC, op. cit.; Jordan, op. cit.; Krippendroff, op. cit.; Norman , 2002, op. cit.)

Table 13: Areas of considerations concerning the use of combined 2D and 3D indications to provide effective opening information for older people (continued)

No.	Areas of considerations	Rationale	Sources
7	The appearance of unfamiliar packaging does not normally identify potential opening methods. In other words, there are no memory trigger indications. Both full and partial explanation indications should be provided to show the three types of information (hand positions, hand actions and hand directions).	Without memory trigger indications, participants relied on full and partial explanation indications to successfully open the packaging sample (package no.2). The more information provided, the more easily participants understood how to open the packaging sample.	Findings from the in-depth interviews.
8	Designers should avoid using 3D memory trigger indications that may mislead. Additional indications may be needed to clearly explain how to open packaging.	Participants initially misunderstood about the opening method because of ambiguous 3D memory trigger indications.	Findings from the in-depth interviews. Relationship of information to actions to be undertaken (CEN/CENELEC, op. cit.)
9	Indications should be easily noticed, identified and read (visibility).	Although there were indications on some of the packaging samples, participants did not notice them because of their small size and the low colour contrast between the indications and their background. Accordingly, it was difficult for participants to identify the indications and understand how to open the packaging samples.	Findings from the in-depth interviews. Visibility (Norman, 2002, op. cit.) Visual clarity (Jordan, op. cit.)
10	Use clear language (2D indications) to explain how to open packaging.	Ambiguous language misled participants about how to open the packaging sample (package no.2).	Findings from the in-depth interviews. Clear language in written information (CEN/CENELEC, op. cit.)

4.3 A diagnostic tool to evaluate openability of novel packaging

The RIIO diagram (shown at Figure 11) has the potential to be used by designers as a diagnostic tool to evaluate the understandability of work-in-progress designs. The segments in the semi-circles used in the diagram depict the information required for successful opening. When used during design reviews, if some of these segments are missing, designers are alerted to deficiencies which often causes unsuccessful opening.

Indications provided by designers may mislead older users about opening methods or may be difficult to notice, identify and read which all can also cause unsuccessful opening. Older users should therefore be included in testing of draft designs when using the RIIO diagram.

As this study examined the use of indications on packages that participants found the most unfamiliar and the most difficult to understand, the RIIO diagram would be especially useful when designing novel packaging with unfamiliar and complex opening methods. Further tests however, would be required to review how useful this tool would be when designing novel packaging as addressed in section *8.4 Future work*.

4.4 Summary

This chapter summary has three sections. The first section involves the contribution of the initial observations and the focus groups to the first study aim. The second section concerns the contribution of the in-depth interviews to the second study aim. The third section tabulates the areas of considerations derived from the focus groups and the in-depth interviews.

4.4.1 Aim one: to understand the problems older people have when opening packages

The data from the initial observations suggested that age-related decline can hinder older peoples' ability to open packaging. Also, prior experience, indications, trial and error, older peoples' attitudes towards particular opening methods and package shapes and their visual decline had an impact on understanding of how to open packaging.

The data from the focus groups revealed participants' design requirements in relation to their age-related decline in sensory, cognitive and hand functions. These requirements were used to develop the areas of considerations in relation to these three functions.

Sensory functions

Receiving information for opening appeared to rely more on vision than touch and hearing. Impaired visual acuity and brightness and darkness adaptation negatively affected participants' ability to notice, identify and read opening information. The design consideration to compensate for such impairment is to make indications easily visible.

However, information for opening received by touch and hearing also helped participants understand how to open the packaging samples. The design consideration, accordingly, is to use visual, tactile and audible indications to show information for opening.

Cognitive functions

The information concerning cognitive impairment based on the literature reviewed in chapter two noted that older people may find it difficult to perform a task that they are unfamiliar with and where they have to distinguish relevant from irrelevant items of information. In contrast, prior knowledge appears to remain efficient with ageing and was the key strategy that participants used to understand how to open the packaging samples. The design considerations concerning cognitive functions are: to use familiar indications in communicating how to open packaging and to prioritise information for opening.

Clear indications should be provided to obviate the need for repeated trial and error attempts at opening, as this may cause frustration. Also, clear indications should be provided to reduce the impact of prior negative opening experiences or danger warnings, on older peoples' ability to understand how to open packaging.

Hand functions

Understanding of how to open packaging had a great impact on successful opening. However, limitations in hand strength appeared to be the major factor that inhibited participants' ability to physically open the packaging samples. Hand arthritis caused hand and wrist pain when opening the packaging samples and therefore can be a factor that reduces hand function.

The design considerations concerning hand function are: 1) to optimise hand strength when opening packages by: using packaging shapes and surface textures on lids, 2) to avoid using opening methods that require excessive hand functions or that cause hand and wrist pain and 3) to ensure that mechanisms permit successful opening as guided by indications.

4.4.2 Aim two: to investigate the relative importance of 2D and 3D indications during the different stages of package opening

The data from the in-depth interviews revealed the participants' use of 2D and 3D indications to understand how to open the packaging samples. The data were then used to evaluate the importance of 2D and 3D indications during the different stages of opening and to identify areas of considerations concerning the use of combined 2D and 3D indications to provide effective opening information for older people.

Roles of 2D and 3D indications

Although the importance of 2D and 3D indications varied during the different stages of opening, it also varied according to participants' prior experience. The area of consideration concerning the use of indications is to provide both 2D and 3D indications so that older people who individually have different degrees of familiarity with packaging still find opening easy to understand. For example, if 3D indications are unfamiliar to

older people, then 2D indications such as diagrams can still explain how to open packaging.

Areas of considerations concerning the use of combined 2D and 3D indications to provide effective opening information for older people

The data on how older participants used 2D and 3D indications when opening the packaging samples were used to create a diagram representing the relationship between indications and information for opening (RIIO) (see Figure 11). This diagram then was used to analyse the use of 2D and 3D indications. This resulted in areas of considerations concerning the use of combined 2D and 3D indications which suggested that packaging should provide three key groups of indications and four key types of information for opening.

The three key groups of indications are: 2D full explanation, 2D and 3D memory trigger and 2D and 3D partial explanation. Clear illustrations and clearly written instructions play an important role in helping older people understand information from 2D full explanation indications such as diagrams. Prior knowledge helps older people understand information from 2D and 3D memory trigger and partial explanation indications. Additionally, information from 3D partial explanation indications can be extended during trial and error attempts at opening. Feedback on opening and prevention of impossible manipulations help older people open packaging successfully.

The four key types of information for opening are: 1) hand positions, 2) hand actions, 3) hand directions and 4) confirmations of package opening. Participants sought two kinds of confirmation: to ratify their understanding of how to open the packaging samples and to indicate that they had opened the packaging successfully. Both 2D and 3D indications should be used to provide these types of information so that older people who have

different visual impairment and varying perceptions of indications can understand the information.

The RIIO diagram also has the potential to be used during the design process by designers to evaluate the understandablility of information for opening novel packaging.

4.4.3 Areas of considerations for providing effective package opening

The areas of considerations derived from this study are summarised in relation to the study aims, data sources and functions used when opening packages in Table 14 below.

Table 14: The areas of considerations drawn from the focus groups and the in-depth interviews

	Study aims	Aim one	Aim two
	Data sources	Focus groups	In-depth interviews
Functions used when opening packages	Sensory functions	• Make indications visible. • Provide alternative indications.	• Make indications visible. • Provide alternative indications.
	Cognitive functions	• Communicate how to open packaging by using familiar design appearance. • Prioritise information for opening. • Prevent impossible manipulations. • Use clear indications to reduce impacts of negative opening experiences or warnings.	• Use combined 2D and 3D Indications. • Communicate how to open packaging by using familiar design appearance. • Avoid using ambiguous indications that mislead users about opening methods. • Use clear language in opening instructions. • Use logical opening methods. • Prevent impossible manipulations. • Confirm what has been done. • Use packaging appearance to create positive expression.
	Hand functions	• Optimise hand strength when opening packages by: using packaging shapes and surface textures on lids. • Avoid using opening methods that require excessive hand functions or that cause hand and wrist pain • Ensure that mechanisms permit successful opening as guided by indications.	• Avoid using opening methods that cause hand pain.

The research results presented in this chapter will be discussed in the next chapter.

Chapter 5

Discussion of results

The results of this study will be addressed in three sections. The first section concentrates on the results derived from the focus groups that contributed to the first study aim. The second section centres on the results drawn from the in-depth interviews that contributed to the second study aim. The data drawn from the focus groups and the in-depth interviews were used to create areas of considerations for the design of effective information for opening. The relationship of these design considerations to the stages of opening and the cognitive processes that occur at each stage is discussed in the third section.

5.1 Aim one: to understand the problems older people have when opening packages

Gaining an understanding of the problems older people have when opening packages allowed the researcher to identify design requirements for packaging openability. These design requirements were used to create areas of considerations for designing openable packaging. Design considerations intended to accommodate sensory impairment and hand impairment will be discussed before moving on to discuss those intended to accommodate cognitive impairment.

5.1.1 Sensory impairment

The data from the focus groups were consistent with the literature, in that ageing impairs visual acuity and brightness and darkness adaptation (Pirkl, op. cit.). Such impairment reduced participants' ability to notice, identify and read indications for opening. Design

considerations drawn from the focus group information therefore, centred on increasing the visibility of opening indications. Colour contrast is the key design attribute for both 2D and 3D indications. Size is the key design attribute for 2D indications.

Because of the limited space on packaging, 2D indications such as written instructions tend to be small. Three dimensional indications can be divided into large and small sizes. Large indications might include the lid or the body of a package. Small indications might include indentations on the lid of a package. Colour contrast between indications and background is likely to have more of an effect on the visibility of 2D indications and small 3D indications than on the visibility of large 3D indications. Indication size appears to have more of an effect on the visibility of 2D indications than it does on the visibility of small and large 3D indications. No participants commented that size affected the visibility of small 3D indications. The visibility of small 3D indications tends to be more affected by colour contrast than by size.

The data from the focus groups showed that participants mainly received information for opening through vision. However, alternative formats of information that can be received through the senses of hearing and touch should be provided so that users have multiple channels of information to choose from, depending on their perceptions and the sensory functions that they rely on.

The literature review showed that the sense of hearing (Gates and Mills, op. cit.; Pirkl, ibid.; Stuart-Hamilton, op. cit.) and the sense of touch (Pirkl, ibid.; Stuart-Hamilton, ibid.) both decline with ageing. The data from the focus groups also showed that participants had hearing impairment, but the data did not show that this impairment negatively affected their ability to understand how to open the packaging samples. Although audible indications did not directly show how to open packaging, these indications (e.g. sounds of liquid contents) helped participants to identify the packaging

contents which then suggested how to dispense them. Also, audible feedback can be used to confirm successful package opening.

Participants in the focus groups did not disclose any impairment to their sense of touch. Tactile sensitivity, which refers to the ability to feel shapes and surface textures, guided participants about the hand actions required when opening the packaging samples. Pressure sensitivity, which refers in this context to the ability to feel soft or hard pressure on hands when attempting to open packages, identified possible or impossible manipulations and suggested that opening was successful or different methods of opening were required.

5.1.2 Hand impairment

The literature review (Carmeli *et al.*, op. cit.) showed that age-related decline of hand functions and hand arthritis limit older peoples' hand performance when handling tasks.

The data from the focus groups revealed that limitations in hand strength were the key reason for difficulties in performing package opening. Therefore, the design considerations concerning such difficulties, focused on optimising older users' hand strength as applied to opening packages and on reducing the overall hand strength required for opening.

The literature review showed that arthritis (Altman *et al.*, op. cit.; Symmons *et al.*, op. cit.) can cause pain. Similarly, the data from the focus groups revealed that opening the packaging sample provided caused pain in the wrist of the participant who had hand arthritis. Therefore, the design consideration concerning the impact of hand arthritis, is to avoid using opening methods that can cause hand pain.

The data from the focus groups showed that limitations in hand dexterity also had an impact on successful opening of the packaging sample. Although these data were derived

from one participant, it remains the case that limitations in hand dexterity should not be neglected. Therefore, the design consideration concerning this hand function, is to avoid using opening methods that require excessive hand dexterity.

The data from the focus groups also showed that understanding of how to open the packaging samples had a great impact on successful opening. In order to further explain this, cognitive processes used when opening a package are examined in the next section.

5.1.3 Cognitive impairment

It is helpful to discuss the cognitive processes that occur when opening packages before moving on to discuss the design considerations intended to accommodate cognitive impairment.

5.1.3.1 Cognitive processes used when opening a package

With the data derived from the focus groups, the model of everyday cognitive processes in chapter two (see Figure 7) was adapted to create a model of cognitive processes used when opening a package as shown in Figure 12 below.

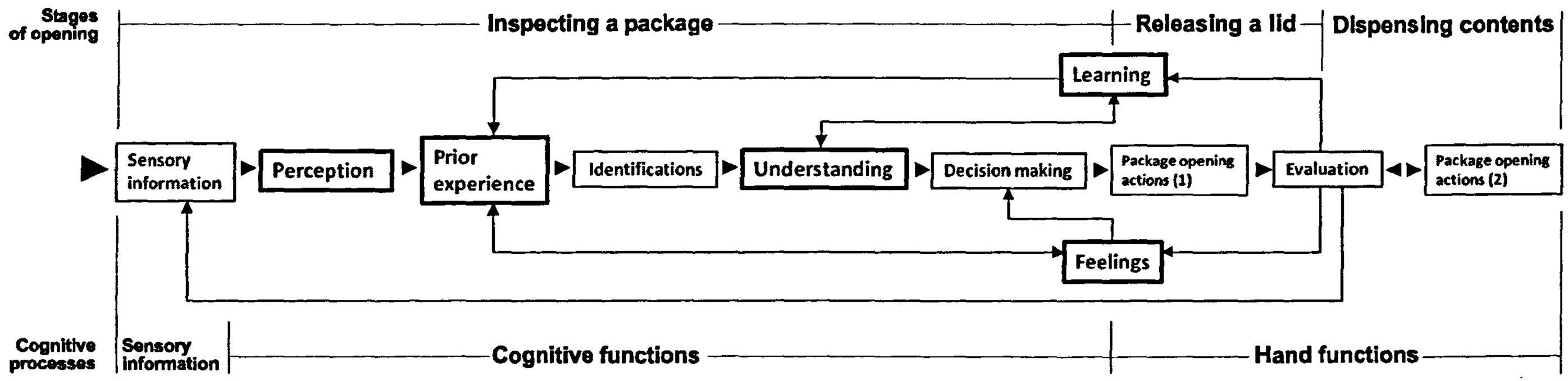


Figure 12: A model of cognitive processes used when opening a package

This model shows the relationship of cognitive processes to the stages of opening a package. As noted in section *2.4.5 Age-related decline in relation to openability*, the three stages of opening a package are: 1) inspecting a package, 2) releasing a lid and 3) dispensing contents. Inspecting a package requires two cognitive processes: sensory information and cognitive functions. The five key cognitive functions used when opening a package: *perception*, *prior experience*, *understanding*, *learning* and *feelings*, are highlighted in bold line boxes. Releasing a lid and dispensing contents can be seen as the second and third stages of package opening. These actions allow package opening to be evaluated and learned.

Figure 12 shows that *learning* and *feelings* sit on the boundary between cognitive functions and hand functions. This is because learning and feelings are associated with both of these two functions.

The five key cognitive functions used when opening a package, which are derived from the focus groups, will now be described.

Perception

Sensory information (see Figure 12) received from a package is compared to information retrieved from prior experience in order to identify the package. Recognised information can aid in understanding of how to open the package. Unrecognised information may also help users understand how to open the package, if it is simply and clearly presented.

Prior experience

Three aspects of prior experience were used by participants to understand how to open the packaging samples. The first aspect relates to indications and their meaning. For example, an indentation indicates that pressing is the hand action required. The second aspect relates to the relationship of indications to opening methods. For example, a

trigger is a common indication for a household cleaning product where a safety lock has to be released before the contents can be dispensed. The third aspect relates to indications which suggest other indications that are commonly found together. For example, a lid with a hinge suggests other indications such as a lip and/or an indentation. These related indications helped users understand how to open packaging.

Understanding

Two aspects of understanding how to open packaging were found concerning familiar and unfamiliar packaging. In the case of familiar packaging, understanding tends to mainly rely on prior experience. In the case of unfamiliar packaging, understanding appears to rely more on clearly written instructions or trial and error. Trial and error involves learning gained from the evaluation of repeated attempts at opening.

Learning

Learning how to open packaging requires a combination of both cognitive and hand functions. Cognitive functions are used to understand the opening method required. Hand functions are used to physically open the package. Understanding of the opening method helps users make decisions on which actions should be undertaken when opening the package, whereas the opening actions performed help users evaluate whether the package has been opened successfully. If it has not, then further sensory information must be sought to find out how to open the package successfully. Finally, once the package is open, the opening experience is memorised for future use.

Feelings

The experience of opening a package can result in positive, neutral or negative feelings. Participants used the terms *easy*, *very good*, *self-explanatory*, *straightforward* and *helpful* to express positive feelings when opening the packaging samples. Conversely, the terms

problem, *trouble*, *difficult*, *fiddly*, *shudder* and *horrible* were used to express negative feelings. Participants who remained quiet might have had neutral feelings towards opening the packaging samples or may have chosen not to express their feelings. Particularly strong feelings aroused by package opening episodes from the past may influence older peoples' attitudes towards opening other similar packages, in the future.

5.1.3.2 Design considerations concerning cognitive impairment

The literature review showed that working memory is impaired by ageing (Craik and Bosman, op. cit.; Kensinger and Corkin, op. cit.). The data from the focus groups also showed that the presence of too much information on packaging can make it difficult for older participants to discriminate opening information from other information. The design consideration, therefore, is to visually prioritise opening information.

In addition, the literature review showed that ageing negatively affects fluid intelligence used when dealing with unfamiliar tasks, whereas semantic memory and crystallised intelligence appear to be more efficient when related to uses of prior knowledge (Bäckman *et al.*, op. cit.). The data from the focus groups also revealed a correlation between familiarity with and understanding of how to open the packaging samples. The design consideration, therefore, is to use familiar indications commonly found on existing packages such as arrows, indentations or ridges, to help participants understand how to open novel packaging.

As noted in sections *2.2.4 The role of tacit knowledge* and *2.2.5 The role of action learning*, tacit knowledge and action learning tend to play an important role in opening a package successfully. Tacit knowledge gained from sensory information and prior experience helps users understand how to open packaging.

Action learning and trial and error appear to help users discover how to open unfamiliar packaging. These require users to cognitively process different items of information for opening. As cognitive functions decline with ageing, effective indications should be provided so that older people find opening easy to understand. This will be discussed in the next section.

5.2 Aim two: to investigate the relative importance of 2D and 3D indications during the different stages of package opening

The data from the in-depth interviews revealed that the use of combined 2D and 3D indications provided alternative channels by which information could be presented, which helped participants understand opening of the packaging samples.

The data from the in-depth interviews were used to create a diagram (see Figure 11) representing the relationship between indications and information for opening (RIIO). This diagram illustrated the three key groups of indications and the four key types of information for opening.

The three key groups of indications comprise: 2D full explanation, 2D and 3D memory trigger and 2D and 3D partial explanation. These indications present three key aspects that lead to successful package opening. The first aspect relates to the visibility and simplicity of indications such as clear illustrations (Moore, 1993, op. cit.) and clearly written instructions (CEN/CENELEC, op. cit.). The second and third aspects concern the importance of tacit knowledge and action learning respectively on participants' ability to understand package opening methods.

In the case of tacit knowledge, participants tried to make sense of the information received from the packaging samples by using their personal prior knowledge. Familiar indications helped participants understand the package opening methods. Designing such

indications concerns the principles of affordances (Norman, 1999, op. cit.), identification (Monö, op. cit.) and consistency and compatibility (Jordan, op. cit.).

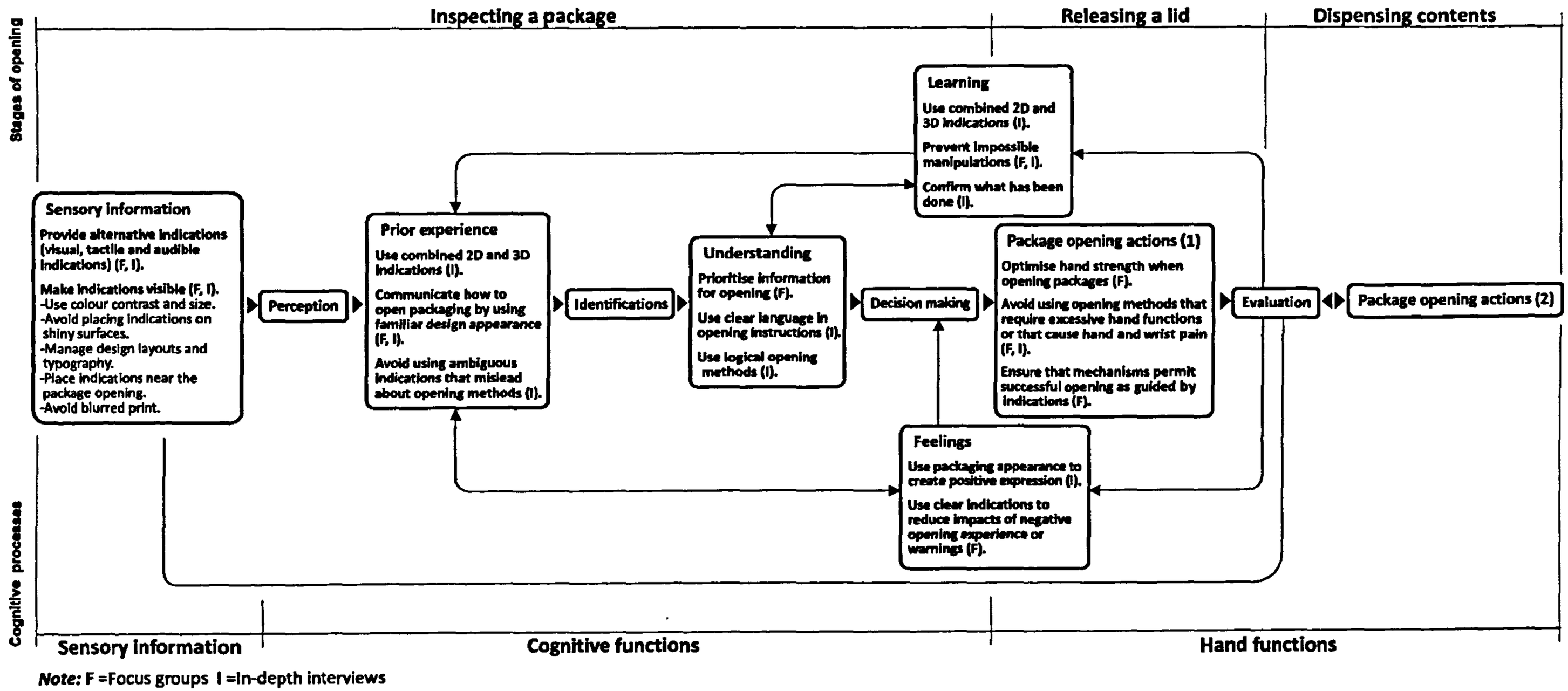
In the case of action learning, participants evaluated their understanding of the opening methods required by the packaging samples through episodes of trial and error. Indications that provide feedback on opening whilst also preventing impossible manipulations are useful in suggesting how to open packaging successfully. Designing such indications concerns the principles of feedback (CEN/CENELEC, op. cit.; Jordan, ibid.; Krippendroff, op. cit.; Norman, 2002, op. cit.) and physical constraints (Norman, ibid.).

The four key types of information required for package opening comprise: hand positions, hand actions, hand directions and confirmations of package opening. Such information presents two key aspects that lead to successful package opening. The first aspect relates to information describing how to manipulate package opening (hand positions, hand actions and hand directions). The second aspect concerns information which can be used to confirm: 1) how to open packaging and 2) successful package opening. Corroborative literature involves: hand positions (Moore, 1993, op. cit.; Cayton, op. cit.), hand actions (Moore, ibid.), hand directions (Moore, ibid) and feedback on opening (CEN/CENELEC, op. cit.).

The RIIO diagram shown at Figure 11 discussed above was used to analyse how participants employed indications when opening the packaging samples. This led to the formulation of novel design considerations concerning the combined use of 2D and 3D indications that can be used by designers to increase the understandability of opening information.

5.3 The relationship of design considerations to the stages of opening and the cognitive processes that occur at each stage

The areas of considerations were derived from the focus group and in-depth interview data (see Table 14 in chapter four) seeking how to design indications that effectively communicate information for opening. It is helpful to present how these design considerations relate to the cognitive processes used when opening packages. Therefore, these design considerations are combined with the model in Figure 12 which presents the cognitive processes that occur at each stage of opening (inspecting a package, releasing a lid and dispensing contents). The combined model is shown in Figure 13 below.



Note: F =Focus groups I =In-depth interviews

Figure 13: A model that combines the design considerations, the stages of opening a packaging, and the cognitive processes that occur at each stage

The design considerations are located in six major cognitive processes: *sensory information, prior experience, understanding, learning, feelings* and *package opening actions* as shown in Figure 13. These are now explained.

Two key design considerations regarding *sensory information* are: 1) to provide alternative indications (visual, tactile and audible indications) and 2) to make indications visible. The visibility of indications can be assured by: using colour contrast and size, avoiding placing indications on shiny surfaces, management of design layouts and typography, placing indications near the package opening and avoiding blurred print. These two considerations were derived from both the focus groups and the in-depth interviews.

The design considerations concerning *prior experience* are: 1) to use combined 2D and 3D indications, 2) to communicate how to open packaging by using familiar design appearance and 3) to avoid using ambiguous indications that mislead users about opening methods. The first and the third considerations were derived from the in-depth interviews. The second consideration was derived from both the focus groups and the in-depth interviews.

The design considerations regarding *understanding* are: 1) to prioritise information for opening, 2) to use clear language in opening instructions and 3) to use logical opening methods. The first consideration was derived from the focus groups. The second and third considerations were drawn from the in-depth interviews.

The design considerations in relation to *learning* are: 1) to use combined 2D and 3D indications, 2) to prevent impossible manipulations and 3) to confirm what has been done. The first and third considerations were drawn from the in-depth interviews. The second consideration was derived from both the focus groups and the in-depth interviews.

The design considerations involving *feelings* are: 1) to use packaging appearance to create positive expression and 2) to use clear indications to reduce impacts of negative opening experiences or warnings. The first consideration was drawn from the in-depth interviews. The second consideration was derived from the focus groups.

The design considerations concerning *package opening actions* are: 1) to optimise hand strength when opening packages, 2) to avoid using opening methods that require excessive hand functions or that cause hand and wrist pain and 3) to ensure that mechanisms permit successful opening as guided by indications. The first and third considerations were drawn from the focus groups. The second consideration was derived from both the focus groups and the in-depth interviews.

5.4 Summary

The summary of the discussion of the research results is presented in three sections. The first two sections contributed to the first and second study aims. The third section concerns the relationship of the design considerations to the stages of opening a package and the cognitive processes that occur at each stage.

5.4.1 Aim one: to understand the problems older people have when opening packages

Opening a novel package successfully requires co-ordination between sensory information, cognitive functions and hand functions. The model in Figure 14 below shows interplays between these three opening processes.

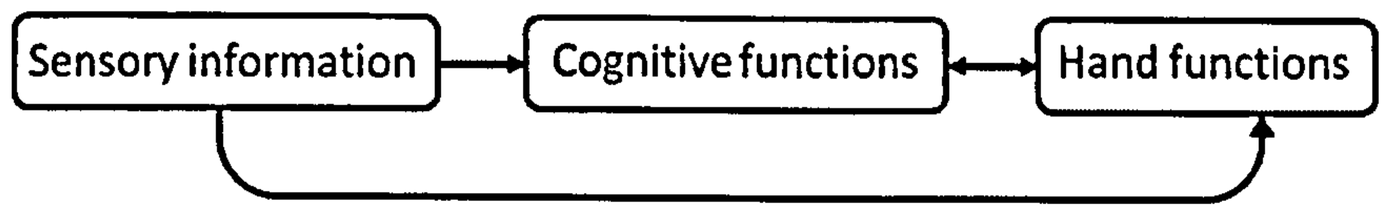


Figure 14: The interplays between sensory information, cognitive functions and hand functions

In Figure 14, it is shown that the quality of sensory information influences cognitive functions and hand functions; cognitive functions influence hand functions; and hand functions also influence cognitive functions (understanding and emotional responses). Therefore, sensory, cognitive and hand function impairments which can reduce older peoples' ability to open packaging should be taken into account when designing a package. The age-related needs caused by the decline of these three functions were used to create the design considerations. The key considerations concern: 1) indication visibility, 2) uses of familiar indications in describing opening methods and 3) reduction of hand strength required for opening packages. Ways to design indications that provide effective information for opening were sought in the in-depth interviews. These are summarised in the next section.

5.4.2 Aim two: to investigate the relative importance of 2D and 3D indications during the different stages of package opening

The data from the in-depth interviews were used to create design considerations concerning the use of combined 2D and 3D indications that played an important role in explaining opening methods. Packaging should provide three groups of indications: 2D full explanation, 2D and 3D memory trigger and 2D and 3D partial explanation. These indications should provide three types of information: hand positions, hand actions and hand directions. Additionally, full explanation indications should provide information that can be used to confirm how to open packaging. Partial explanation indications should provide information that can be used to confirm both how to open packaging and successful package opening.

5.4.3 The relationship of design considerations to the stages of opening and the cognitive processes that occur at each stage

The design considerations derived from the focus groups and the in-depth interviews were collated. A model was created to present the relationship of these design considerations to the stages of opening and the cognitive processes occurring at each stage. This model will be used to structure the development of a design framework in the next chapter.

Chapter 6

Development of the framework

The purpose of this chapter is to develop a design framework in order to fulfil the third aim of this study: *to produce a design framework which can be used by packaging designers to increase the understandability of packaging information for older people, with respect to openability.* To achieve this, the first section synthesises the design considerations for providing effective indications in regard to openability, drawn from: the focus groups, the in-depth interviews and the literature review. The second section presents the relationship of the design recommendations derived from the data synthesis to related factors. These factors include: the impact of age-related decline and the design elements that should be taken into account by designers when creating a package. The third section presents design problems and solutions developed to prompt designers on how to provide package openability.

6.1 Data synthesis

The key data drawn from the focus groups, the in-depth interviews and the literature review are shown in Table 15 below. These data are now explained through three categories: sensory functions, cognitive functions and hand functions.

Table 15: The data from different sources for developing the design framework

Experimental works		Literature
Focus groups	In-depth interviews	
Design considerations for providing effective indications with respect to openability	Design considerations concerning the use of combined 2D and 3D indications to provide effective opening information for older people	Existing design guidelines, recommendations and principles in relation to package openability concerning sensory, cognitive and hand functions

6.1.1 Sensory functions

Figure 15 below illustrates the combined data concerning sensory functions.

Stages of opening	Senses	Experimental works	Design recommendations: Provide alternative indications	Design recommendations: Make indications visible	Literature
Inspecting a package	Seeing, feeling and hearing	F, I			**Alternative formats** (CEN/CENELEC, op. cit.)
					Sensory affordances (Hartson, op. cit.)
					Consideration of user resources (Jordan, op. cit.)
	Seeing	F, I			**Visibility** (Norman, 2002, op. cit.)
		F			**Visual clarity** (Jordan, op. cit.)
		F, I			**Colour contrast** (CEN/CENELEC, op. cit.; Moore, 1993, op. cit.)
		F			
		F, I			**Size** (CEN/CENELEC, ibid.; Moore, ibid.)
		F			**Shiny surfaces** (CEN/CENELEC, ibid.)
		F			**Design layouts and typography** (Bix, op. cit.; Moore, 1993, op. cit.)
		F, I			**Position** (Moore, ibid.)
		F			
		F			**Print clarity** (Moore, ibid.)
	Feeling	F			**Shapes** (Cayton, op. cit.)
		–			**Surface textures** (Cayton, ibid.)
		–			**Size** (Cayton, ibid.)
		–			**Spacing** (Cayton, ibid.)
		–			**Position** (Cayton, ibid.)

= 2D indications
= 3D indications
= audible indications
= a line leads to data sources

F = focus groups
I = in-depth interviews
_= no data

Figure 15: Design recommendations for providing effective indications in relation to sensory functions

Figure 15 above shows two design recommendations regarding sensory functions drawn from the combined data from the experimental works (the focus groups and the in-depth interviews) on the left and to the literature on the right. The first column illustrates the applicable stage of opening concerning sensory functions (inspecting a package). The second column shows the senses used when receiving information for opening referenced to the different design recommendations offered.

6.1.1.1 Provide alternative indications

The design recommendation for alternative indications concerns opening information received by seeing, feeling and hearing. The data derived from both experimental works indicated that alternative indications presenting the same opening information to different senses should be provided. The data suggested that alternative indications helped participants, who had different kinds and degrees of sensory impairment; and who therefore may perceive indications differently; to better understand opening information. Corroborative literature includes: CEN/CENELEC (op. cit.), Hartson (op. cit.) and Jordan (op. cit.).

6.1.1.2 Make indications visible

The design recommendation for indication visibility relates to opening information received by seeing and feeling. The data derived from both experimental works showed that indications should be clearly seen. These data noted the importance of the visibility of 2D indications. In addition, the focus group data showed that the visibility of 3D indications should not be neglected. Supporting literature contains: Norman (2002, op. cit.) and Jordan (ibid.).

The data from both experimental works noted that colour contrast is essential in providing indication visibility. These data showed the importance of colour contrast on 2D indications. The focus group data indicated that this design attribute also affected the

visibility of small 3D indications such as indentations. Confirming literature includes: CEN/CENELEC (op. cit.) and Moore (1993, op. cit.).

The data from both experimental works indicated that size was an important design attribute for the visibility of 2D indications, in particular for written instructions and diagrams. Corroborative literature obtains: CEN/CENELEC (ibid.) and Moore (ibid.).

The focus group data noted that a shiny surface can reduce the visibility of 2D indications. Supporting literature includes CEN/CENELEC (ibid.).

The focus group data showed that design layouts and typography should be managed when providing written information, so that opening instructions are easy for older people to identify and read. Confirming literature obtains: Bix (op. cit.) and Moore (1993, op. cit.).

The data from both experimental works suggested that position was important for 2D indications such as single-word imperatives. The focus group data also showed that position was also important for small 3D indications such as tabs. Both 2D and small 3D indications should be placed near the package opening so that older people can easily notice them. Corroborative literature comprises Moore (ibid.).

The focus group data indicated that print clarity was needed to ensure that written opening instructions are readable. Supporting literature includes Moore (ibid.).

Information for opening can be received by touch. The focus group data showed that participants perceived the shape indications through their haptic sense. This helped them understand the opening method needed. Confirming literature obtains Cayton (op. cit.). Cayton (ibid.) also suggested that the feeling of the surface textures of closures can help users identify how to open packaging.

Well defined shapes should be applied to tactile information such as Braille, tactile danger warnings and embossed writing so that they can be easily identified and read. Standard sizes should be applied to Braille (Standard American) and tactile danger warnings (European Standard EN 272 and British Standard BS 7820). In addition, spacing for embossed writing should not be less than 3mm (Cayton, ibid.). Braille, tactile danger warnings and embossed writing are categorised as 3D indications. This is because these embossed indications are designed particularly for blind and partially sighted people so that they can feel the indications to understand the information.

Braille and embossed writing should be placed near the package opening, whereas tactile danger warning symbols should be placed at a standard location (EN 272 and BS 7820) so that they can be easily noticed (Cayton, ibid.). For example, an embossed triangle (a tactile danger warning) should be located not more than 50 mm above the bottom of a package (Cayton, ibid.).

Information for opening can also be heard. However, no data from the literature or the experimental works addressing indication audibility has been found.

6.1.2 Cognitive functions

Figure 16 below presents ten design recommendations related to cognitive functions arising from the combined data from the experimental works (on the left) and the literature (on the right). The first column illustrates the applicable stages of opening concerning cognitive functions (inspecting a package, releasing a lid or dispensing contents). The second column indicates the cognitive functions used (prior experience, understanding, learning or feelings) referenced to the different design recommendations offered.

Section *5.1.3.1 Cognitive processes used when opening a package* noted that cognitive processes including: prior experience, understanding, learning and feelings, occur when inspecting a package. Learning and feelings can also take place when releasing a lid and dispensing contents. However, the design recommendations offered in relation to feelings appear to be more useful when inspecting a package than when releasing a lid and dispensing contents. Therefore, the first and second columns of Figure 16 show that prior experience, understanding and feelings are associated with the stage of inspecting a package. Learning is associated with the stages of inspecting a package, releasing a lid and dispensing contents.

Stages of opening	Cognitive functions	Experimental works	Design recommendations										
			Use combined 2D and 3D indications	Communicate how to open packaging by using familiar design appearance	Avoid using ambiguous indications that mislead users about opening methods	Prioritise information for opening	Use clear language in opening instructions	Use logical opening methods	Prevent impossible manipulations	Confirm what has been done	Use packaging appearance to create positive expression	Use clear indications to reduce impacts of negative opening experiences or warnings	Literature
Inspecting a package, releasing a lid and dispensing contents	Prior experience and learning	I											I I

= 2D indications
= 3D indications

I = in-depth interviews
_= no data

Figure 16: Design recommendations for providing effective indications in relation to cognitive functions

Stages of opening	Cognitive functions	Experimental works	Design recommendations: Use combined 2D and 3D indications	Communicate how to open packaging by using familiar design appearance	Avoid using ambiguous indications that mislead users about opening methods	Prioritise information for opening	Use clear language in opening instructions	Use logical opening methods	Prevent impossible manipulations	Confirm what has been done	Use packaging appearance to create positive expression	Use clear indications to reduce impacts of negative opening experiences or warnings	Literature
Inspecting a package	Prior experience	F, I											**Description** (Monö, op. cit.) **Perceived affordances** (Norman, 2002, op. cit.) **Identification** (Monö, op. cit.) **Categorisation** (Muller, 2001, op. cit.) **Distinctive and familiar shapes** (CEN/CENELEC, op. cit.) **Product sign** (Monö, op. cit.) **Exhortation** (Monö, ibid.) **Construction of products** (Monö, ibid.) **Consistency and compatibility** (Jordan, ibid.) **Standardisation** (CEN/CENELEC, op. cit.)
		– I											**Relationship of information to actions to be undertaken** (CEN/CENELEC, ibid.)
Inspecting a package	Understanding	F – I											**Prioritisation of functionality and information** (Jordan, op. cit.) **Clear language in written information** (CEN/CENELEC, op. cit.)
		I											**Logical process** (CEN/CENELEC, ibid.)
Inspecting a package, releasing a lid and dispensing contents	Learning	F, I											**Physical constraints** (Norman, 2002, op. cit.)
		I I F, I											**Feedback** (CEN/CENELEC, op. cit.; Jordan, op. cit.; Krippendroff, op. cit.; Norman, ibid.)
Inspecting a package	Feelings	I											**Expression** (Monö, op. cit.)
		F											–

= 2D indications
= 3D indications
= audible indications
= opening methods
= a line leads to data sources

F = focus groups
I = in-depth interviews
_= no data

Figure 16: Design recommendations for providing effective indications in relation to cognitive functions (continued)

6.1.2.1 Use combined 2D and 3D indications

The novel design recommendation for combining 2D and 3D indications was created from the in-depth interview data. The design recommendation suggests how 2D and 3D indications could be designed in connection with prior experience and learning so that older people find opening easy to understand. This key finding was already discussed in chapter five.

6.1.2.2 Communicate how to open packaging by using familiar design appearance

The design recommendation for communications of opening methods concerns prior experience. The data derived from both experimental works showed that packaging appearance should be designed to explain how to open packaging. Corroborative literature involves: description (Monö, ibid.) and perceived affordances (Norman, 2002, op. cit.). The data from experimental works further indicated how to explain opening methods as below.

The data drawn from both experimental works suggested that package opening methods can be identified and categorised by its appearance including 3D indications such as the shape of a closure. The in-depth interview data revealed that opening methods can also be identified by 2D indications such as product names. Supporting literature concerns: identification (2D and 3D indications) (Monö, op. cit.), categorisation (3D indications) (Muller, 2001, op. cit.), distinctive and familiar shapes (3D indications) (CEN/CENELEC, op. cit.) and product sign (3D indications) (Monö, op. cit.).

The in-depth interview data indicated that the bottle shape of one of the packaging samples (a 3D indication) initially guided the participant to twist the lid. Confirming literature involves the design principle of exhortation (Monö, ibid.) which can be seen as

an initial stage of identification and categorisation guiding the users on how to interact with a package.

The in-depth interview data noted that the structure of packaging (a 3D indication) describes how to open the packaging. Corroborative literature concerns the design principle of construction of products (Monö, ibid.).

The in-depth interview data showed that similar indications (e.g. an arrow) should be used to describe similar manipulations required for opening packages. Corroborative literature involves: consistency and compatibility (Jordan, op. cit.) and standardisation (CEN/CENELEC, op. cit.).

The design principles of consistency and compatibility (Jordan, op. cit.) and the design guideline for standardisation (CEN/CENELEC, op. cit.) can also be used to explain how to open packaging. However, there is a difference between these and the design principles of description and perceived affordances addressed above. Consistency and compatibility (Jordan, op. cit.) and standardisation (CEN/CENELEC, op. cit.) relate to conventional indications such as symbols where users have learned the meanings. Norman (1999, op. cit.) noted that a convention is not an affordance. Also, a convention does not play a role in description (Monö, op. cit.).

6.1.2.3 Avoid using ambiguous indications that mislead users about opening methods

The design recommendation for using unambiguous indications involves prior experience. The in-depth interview data noted that indications should clearly describe the required opening methods. These data showed that a stereotypical relationship between indications (3D indications) and opening methods provided initial ideas of how to open the packaging sample. Familiar indications may mislead, if in reality unfamiliar opening

methods are required. Such misleading indications for opening should be avoided. Supporting literature includes CEN/CENELEC (ibid.).

6.1.2.4 Prioritise information for opening

The design recommendation for managing information for opening concerns understanding. The focus group data suggested that opening information should be prioritised for easy understanding. These data only showed that this design recommendation was relevant for 2D indications. Corroborative literature obtains Jordan (op. cit.).

6.1.2.5 Use clear language in opening instructions

The design recommendation for using language in instructions involves understanding. The in-depth interview data indicated that clear opening instructions (2D indications) should be provided. Confirming literature comprises CEN/CENELEC (op. cit.).

6.1.2.6 Use logical opening methods

The design recommendation for using simple opening methods relates to understanding. The in-depth interview data indicated that simple and straightforward opening methods should be used. Corroborative literature contains CEN/CENELEC (ibid.).

6.1.2.7 Prevent impossible manipulations

The design recommendation for reducing opening mistakes involves learning. The data from both experimental works showed that the resistance to particular hand actions when unsuccessfully opening the packaging sample helped participants identify impossible manipulations. Participants experienced several errors before finding out how to open the packaging sample. Clear 3D indications that prevent impossible manipulations should be

provided to reduce opening mistakes. Supporting literature includes Norman (2002, op. cit.).

6.1.2.8 Confirm what has been done

The design recommendation for confirmations of package opening relates to learning. The in-depth interview data showed that feedback to confirm successful opening was perceived in the form of shapes. The data from both experimental works revealed that feedback was perceived in the form of sounds. A participant in the in-depth interviews confirmed that the lid of the packaging sample was released when noticing a gap between the lid and body of the package (a 3D indication) and hearing an audible click. Additionally, other participants in the in-depth interviews confirmed their understanding of how to open the packaging sample by revisiting the diagrams (2D indications). Corroborative literature comprises: CEN/CENELEC (op. cit.), Jordan (op. cit.), Krippendroff (op. cit.) and Norman (ibid.).

6.1.2.9 Use packaging appearance to create positive expression

The design recommendation for creating packaging positive expression concerns feelings. The in-depth interview data revealed that packaging appearance (3D indications) has an impact on users' feelings towards the packaging. The data showed that packaging appearance should be designed to encourage positive feelings towards interactions with the packaging. One participant in the in-depth interviews explained that the soft and curved appearance of the packaging sample provided a *gentle sensation*. Confirming literature includes Monö (op. cit.).

6.1.2.10 Use clear indications to reduce impacts of negative opening experiences or warnings

The design recommendation for reducing negative impacts on older peoples' ability to understand how to open packaging relates to feelings. The focus group data showed that negative experiences when opening packages may influence older peoples' feeling that similar kinds of packages will be also difficult to understand how to open and to physically open. Additionally, older people may worry about dangers from potentially harmful contents identified in warnings, preventing them from fully concentrating on finding out how to open packaging. Clear 2D and 3D indications should be used to reduce such impacts.

6.1.3 Hand functions

Figure 17 below presents six design recommendations concerning hand functions derived from the combined data from the experimental works (on the left) and the literature (on the right). The focus group data revealed that opening methods requiring excessive hand dexterity should be avoided as they cause opening difficulty. *Excessive hand dexterity* can be seen as a subheading of the design recommendation *avoid using opening methods that require excessive hand functions, that cause hand pain or fatigue or that may injure the hand.* To indicate this, the term *excessive hand dexterity* was placed in parentheses in the experimental work column.

The first column shows the applicable stages of opening concerning hand functions (releasing a lid and dispensing contents). The second column indicates the design elements (design attributes or opening methods) that should be used when designing a package referenced to the different recommendations offered.

Stages of opening	Design elements	Experimental works	Design recommendations: Optimise hand strength	Optimise hand dexterity	Eliminate excessive hand stresses	Balance the quality of sealing and openability	Avoid using opening methods that require excessive hand functions, that cause hand pain or fatigue or that may injure the hand	Ensure that mechanisms permit successful opening as guided by indications	Literature
Releasing a lid and dispensing contents	Design attributes	F	▬						**Shapes of lids** (Berns, op. cit.; Crawford *et al.*, op. cit.; DTI, 1999b, op. cit.)
		F	▬						**Surface textures** (DTI, ibid.)
		–		▬					(CEN/CENELEC, op. cit.)
		–	▬						**Lid diameters** (Crawford *et al.*, op. cit.; Imrhan and Loo, op. cit.; Yoxall and Janson, op. cit.)
		–			▬				(Yoxall *et al.*, 2008, op. cit.)
		–	▬						**Diameters and lengths of nozzle tubes of squeeze bottles** (Blakey *et al.*, op. cit.)
		–	▬						**Shapes of squeeze bottles** (Blakey *et al.*, ibid.)
		–	▬						**Packaging materials of squeeze bottles** (Blakey *et al.*, ibid.)
		–		▬					**Size of a tab of a heat-sealed plastic/ foil lid** (Duizer *et al.*, op. cit.)
		–			▬				**Packaging shapes** (Tichauer and Gage, op. cit.)
		–				▬			**Sealing systems** (Langley, op. cit.)
	Opening methods	F					▬		**Excessive hand strength** (Janson *et al.*, op. cit.)
		F (Excessive hand dexterity)					▬		–
		–					▬		**Prolonged hand actions** (CEN/CENELEC, op. cit.)
		F					▬		**Excessive wrist movement** (CEN/CENELEC, ibid.)
		I					▬		**Simultaneous hand actions** (CEN/CENELEC, ibid.; Carse *et al.* op. cit.)
		–					▬		**Excessive pressure on the middle of the palm** (Tichauer and Gage, op. cit.)
		F						▬	**Opening mechanisms** (Real and perceived affordances) (Hartson, op. cit.; Norman, 1999, op. cit.)

▬ = 3D indications
▬ = materials
▬ = sealing systems
▬ = opening methods
▬ = opening mechanisms
- - - = a line leads to data sources

F = focus groups
I = in-depth interviews
_= no data

Figure 17: Design recommendations in relation to hand functions

6.1.3.1 Optimise hand strength

The design recommendation concerning hand strength for package opening involves uses of packaging design attributes. The focus group data revealed that square or angular lids (3D indications) were preferable. Corroborative literature includes: Crawford *et al.* (op. cit.) and DTI (1999b, op. cit.). Grooves on the lid of a jar (Berns, op. cit.) which provide a large contact surface with fingers (Lewis *et al.*, op. cit.), also aid package opening.

The focus group data showed that surface roughness of a lid (a 3D indication) should be used to optimise hand strength when opening a package. Supporting literature obtains DTI (1999b, op. cit.).

Yoxall and Janson (op. cit.) recommended a diameter (3D indications) of 7.30 cm for optimising hand strength when releasing a lid. Additionally, stiffness of squeeze bottles and diameter and length of nozzle tubes (all 3D indications) can be used in combination to optimise hand strength required for dispensing the contents from the bottles (Blakey *et al.*, op. cit.). Blakey *et al.* (ibid.) provided a useful set of equation for the calculation of these metrics. The stiffness can be used to identify the shapes and materials required to produce bottles that are easy to squeeze (Blakey *et al.*, ibid.).

6.1.3.2 Optimise hand dexterity

The design recommendation involving hand dexterity for package opening relates to uses of packaging design attributes. A large lid tab (a 3D indication) (Duizer *et al.*, op. cit.) and surface textures (3D indications) (CEN/CENELEC, op. cit.) can be used to optimise hand dexterity when opening packaging.

6.1.3.3 Eliminate excessive hand stresses

The design recommendation for reducing excessive hand stresses concerns uses of packaging design attributes. Lid diameters (Yoxall *et al.*, 2008, op. cit.) and packaging shapes (Tichauer and Gage, op. cit.) should be used to avoid potentially excessive hand stresses when opening packages. Lid diameters should not be larger than 5.00 cm (Yoxall *et al.*, 2008, op. cit.); packaging with curved edges is preferable (Tichauer and Gage, op. cit.).

However, a different diameter, 7.30 cm, was recommended for optimising hand strength required for releasing a lid (see section *6.1.3.1 Optimise hand strength*). Selecting appropriate lid diameters when designing packages was discussed in section *2.6.3.3 Eliminate excessive hand stresses*. Designers should prioritise the importance between joint stresses and hand strength to a particular product and package by considering other related design requirements such as convenient use and protection of the quality of contents.

6.1.3.4 Balance the quality of sealing and openability

The design recommendation for striking a good balance between the quality of sealing and older peoples' ability to gain access to the contents of packaging involves uses of sealing systems. Langley *et al.* (op. cit.) highlighted that this recommendation is necessary when designing a package.

6.1.3.5 Avoid using opening methods that require excessive hand functions, that cause hand pain or fatigue or that may injure the hand

The design recommendation for avoiding excessive hand functions, hand pain or fatigue or hand injuries concerns uses of opening methods. The focus group data showed that

opening methods should not require excessive hand strength. Supporting literature includes Janson *et al.* (op. cit.).

The focus group data showed that opening methods should not require excessive hand dexterity because this can cause opening difficulty.

CEN/CENELEC (op. cit.) showed that opening methods should not require prolonged hand actions because they can cause fatigue.

The focus group data indicated that opening methods should not require excessive wrist movement, as that can cause hand pain. Confirming literature includes CEN/CENELEC (ibid.).

The in-depth interview data revealed that opening methods requiring two simultaneous actions should be avoided because they can cause hand pain and can create difficulty when opening. CEN/CENELEC (ibid.) supported the data that concurrent opening actions can cause hand pain. Carse *et al.* (op. cit.) confirmed the data that such opening actions can make it difficult to open packaging.

The middle of the palm is a sensitive area (Tichauer and Gage, op. cit.). Opening methods that cause excessive pressure on the middle of the palm should be avoided because of the risk of hand injury.

6.1.3.6 Ensure that mechanisms permit successful opening as guided by indications

The design recommendation for successful opening involves uses of opening mechanisms. The focus group data showed that opening mechanisms should allow older users to successfully open packaging (real affordances) as guided by indications (perceived

affordances). Supporting literature includes: Hartson (op. cit.) and Norman (1999, op. cit.).

6.2 Relationship of the design recommendations to related factors

This section comprises three tables which set the design recommendations made in this study against the cognitive processes used when opening packages. These are: sensory information (Table 16), cognitive functions (Table 17) and hand functions (Table 18).

The tables also contextualise each design recommendation by recording: the related impact of age-related decline; a description of the recommendation itself; the design elements that should be taken into account when designing a package and the applicable stages of opening. Key literature underlying each recommendation is also shown.

Table 16: Design recommendations in relation to sensory information

Design recommendations	Impacts of age-related decline	Description	Design elements	Stages of opening	Key literature
1. Provide alternative indications	Visual acuity and brightness and darkness adaptation decline with ageing.	Opening information that can be received by different senses (e.g. vision, touch and hearing) should be provided. This helps old people who have different kinds and degrees of visual impairments and varied perceptions towards indications to understand the information.	2D and 3D indications and audible indications	Inspecting a package	**Alternative formats** (CEN/ CENELEC, op. cit.) **Sensory affordances** (Hartson, op. cit.) **Consideration of user resources** (Jordan, op. cit.)

Table 16: Design recommendations in relation to sensory information (continued)

Design recommendations	Impacts of age-related decline	Description	Design elements	Stages of opening	Key literature
2. Make indications visible	Visual acuity and brightness and darkness adaptation decline with ageing.	Indications for opening should be made easy for older users to notice, read, and identify by: Using high colour contrast between indications and background. Providing readable or standard sized indications (e.g. Standard American for Braille and EN 272 and BS 7820 for tactile danger warnings). Providing at least 3mm spacing for embossed writing. Avoiding placing indications on shiny surfaces. Managing the design layouts and typography of instructions. Placing indications near the opening of the package or at a standard location (e.g. EN 272 and BS 7820 for tactile danger warnings). Providing sharp print and well defined shapes. Using surface textures.	**2D indications:** Written instructions (colour contrast, size, shiny surfaces, design layouts, typography, position and sharp print) Diagrams (colour contrast, size and position) Surface symbols (colour contrast, size, shiny surfaces and position) **3D indications:** Lids (shapes and surface textures) Bodies (shapes) Indentations (colour contrast) Tabs (position) Braille and tactile danger warnings (size, well defined shapes and position) Embossed writing (size, well defined shapes, position and spacing)	Inspecting a package	**Visibility** (Norman, 2002, op. cit.) **Visual clarity** (Jordan, op. cit.) **Colour contrast** (CEN/CENELEC, op. cit.; Moore, 1993, op. cit.) **Size** (CEN/CENELEC, ibid.; Moore, ibid.) **Shiny surfaces** (CEN/CENELEC, ibid.) **Design layouts and typography** (Bix, op. cit.; Moore, 1993, op. cit.) **Position of indications** (Cayton, op. cit.; Moore, ibid.) **Print clarity** (Moore, ibid.) **Tactile information** (Cayton, op. cit.)

Table 17: Design recommendations in relation to cognitive functions

Design recommendations	Impacts of age-related decline	Description	Design elements	Stages of opening	Key literature
1. Use combined 2D and 3D indications	Working memory and fluid intelligence decline with ageing.	Combined 2D and 3D indications should be used in providing information for easy opening comprising: 1) hand positions, 2) hand actions, 3) hand directions and 4) confirmation of how to open packaging and of successful package opening.	2D and 3D indications	Inspecting a package, releasing a lid and dispensing contents	Findings from the in-depth interviews
2. Communicate how to open packaging by using familiar design appearance	Semantic memory and crystallised intelligence remain efficient with ageing.	Familiar indications should be used to help older people to: identify opening methods and understand the meaning of the indications.	**2D indications** e.g. product names and surface symbols **3D indications** e.g. lids, bodies, indentations, nozzles, atomisers and lid tabs	Inspecting a package	**Description** (Monö, op. cit.) **Perceived affordances** (Norman, 2002, op. cit.) **Identification** (Monö, op. cit.) **Construction of products** ((Monö, ibid.) **Consistency and compatibility** (Jordan, ibid.)

Table 17: Design recommendations in relation to cognitive functions (continued)

Design recommendations	Impacts of age-related decline	Description	Design elements	Stages of opening	Key literature
3. Avoid using ambiguous indications that mislead users about opening methods	Semantic memory and crystallised intelligence remain efficient with ageing.	A stereotypical relationship of indications to opening methods can be developed through prior experience of opening packages. Ambiguous indications may look familiar and suggest a particular method for opening a package. However, in reality a different method is required. Such indications should be avoided. Unambiguous indications are needed.	2D and 3D indications	Inspecting a package	**Relationship of information to actions to be undertaken** (CEN/CENELEC, op .cit.)
4. Prioritise information for opening	Working memory and fluid intelligence decline with ageing.	Information for opening should be prioritised so that older people find it easy to understand.	2D and 3D indications	Inspecting a package	**Prioritisation of functionality and information** (Jordan, op. cit.)
5. Use clear language in opening instructions	Working memory and fluid intelligence decline with ageing.	Use simple, straightforward and non-technical language when designing instructions for opening.	Written instructions	Inspecting a package	**Clear language in written information** (CEN/CENELEC, op. cit.)

Table 17: Design recommendations in relation to cognitive functions (continued)

Design recommendations	Impacts of age-related decline	Description	Design elements	Stages of opening	Key literature
6. Use logical opening methods	Working memory and fluid intelligence decline with ageing.	Using simple and straightforward opening methods for easy comprehension.	Opening methods	Inspecting a package	**Logical process** (CEN/CENELEC, ibid.)
7. Prevent impossible manipulations	Working memory and fluid intelligence decline with ageing.	Clear indications should be used to prevent impossible manipulations.	3D indications	Inspecting a package, releasing a lid and dispensing contents	**Physical constraints** (Norman, 2002, op. cit.)
8. Confirm what has been done	Working memory and fluid intelligence decline with ageing.	Indications that can be used to confirm understanding of how to open packaging and of successful opening should be provided.	**2D indications** e.g. written instructions and diagrams **3D indications** on a lid or a body **Audible indications**	Inspecting a package, releasing a lid and dispensing contents	**Feedback** (CEN/CENELEC, op. cit.; Jordan, op. cit.; Krippendroff, op. cit.; Norman, ibid.)
9. Use packaging appearance to create positive expression	This design recommendation relates to feelings.	Packaging appearance should be used to introduce positive feelings towards interactions with the packaging (e.g. soft or curved shapes).	3D indications: lids and bodies	Inspecting a package	**Expression** (Monö, op. cit.)
10. Use clear indications to reduce impacts of negative opening experiences or warnings	This design recommendation relates to feelings.	Clear indications should be provided to reduce impacts of negative opening experiences (e.g. with child-resistant bottles) or of warnings, on older peoples' ability to understand how to open packaging.	2D and 3D indications	Inspecting a package	Findings from the focus groups

Table 18: Design recommendations in relation to hand functions

Design recommendations	Impacts of age-related decline	Description	Design elements	Stages of opening	Key literature
1.Optimise hand strength	Hand functions decline with ageing.	Optimise hand strength when opening packaging by the following: Use square or angular lids. Use shapes of lids that provide a large contact surface with hands and fingers. Use a set of equations (Blakey *et al.*, op. cit.) to calculate stiffness of squeeze bottles and diameters and lengths of nozzle tubes required for dispensing the contents. The stiffness can be used to identify packaging shapes and materials needed. Use lid diameters such as 7.30 cm (Yoxall and Janson, op. cit.). Provide lids with surface roughness.	**3D indications:** Lids (shapes, diameters of screw top lids and surface textures) Nozzle tubes (diameters and lengths of nozzle tubes of squeeze bottles) Bodies (shapes and surface textures) **Others:** Materials (squeeze bottles)	Releasing a lid and dispensing contents	**Shapes of lids** (Berns, op. cit.; Crawford *et al.*, op. cit.; DTI, 1999b, op. cit.) **Diameters and lengths of nozzle tubes, shapes and materials of squeeze bottles** (Blakey *et al.*, op. cit.) **Lid diameters of screw top bottles** (Crawford *et al.*, op. cit.; Imrhan and Loo, op. cit.; Yoxall and Janson, op. cit.) **Surface textures** (DTI, 1999b, op. cit.)

Table 18: Design recommendations in relation to hand functions (continued)

Design recommendations	Impacts of age-related decline	Description	Design elements	Stages of opening	Key literature
2.Optimise hand dexterity	Hand functions decline with ageing.	Optimise hand dexterity required when opening packaging by using size and surface textures. For example, lid tabs in large size with surface textures aid gripping.	3D indications: Lids (surface textures) Lid tabs (size and surface textures) Bodies (surface textures)	Releasing a lid and dispensing contents	**Size of a tab** of a heat-sealed plastic or foil lid (Duizer *et al.*, op. cit.) **Surface textures** for gripping (CEN/CENELEC, op. cit.)
3. Eliminate excessive hand stresses	Hand functions decline with ageing.	Packaging shapes (with curved edge) and lid diameters (no larger than 5.00 cm) should be used to decrease excessive hand stresses that may occur when opening the packaging.	3D indications: lids and bodies	Releasing a lid and dispensing contents	**Shapes** (Tichauer and Gage, op. cit.) **Lid diameters** (Yoxall *et al.*, 2008, op. cit.)
4. Balance the quality of sealing and openability	Hand functions decline with ageing.	Packaging should maintain its sealing quality while permitting successful opening by older people.	Sealing systems	Releasing a lid and dispensing contents	**Sealing systems and openability** (Langley *et al.*, op. cit.)

Table 18: Design recommendations in relation to hand functions (continued)

Design recommendations	Impacts of age-related decline	Description	Design elements	Stages of opening	Key literature
5. Avoid using opening methods that require excessive hand functions, that cause hand pain or fatigue or that may injure the hand	Hand functions decline with ageing.	Opening methods should not lead to the following: The need for excessive hand strength and dexterity, which can be impossible for older people to open. A prolonged hand action which may cause fatigue. The need for excessive wrist movements, which can cause hand pain. The need for simultaneous hand actions (e.g. push and turn), which can cause hand pain. Excessive pressure on the middle palm which may injure the hand.	Opening methods	Releasing a lid and dispensing contents	**Excessive hand strength** (Janson *et al.*, op. cit.) **Excessive hand dexterity** Findings from the focus groups **Prolonged hand actions** (CEN/CENELEC, op. cit.) **Excessive wrist movement** (CEN/CENELEC, ibid.) **Simultaneous hand actions** (CEN/CENELEC, ibid.; Carse *et al.*, op. cit.) **Excessive pressure** on the middle of the palm (Tichauer and Gage, op. cit.)
6. Ensure that mechanisms permit successful opening as guided by indications	Hand functions decline with ageing.	Opening mechanisms should allow older people to successfully open packaging as guided by indications.	Opening mechanisms	Releasing a lid and dispensing contents	**Real and perceived affordances** (Hartson, op. cit.; Norman, 1999, op. cit.)

6.3 Design problems and solutions

A design framework is offered to prompt designers on how to provide effective indications with respect to openability. This framework consists of twenty matched design problems and solutions developed from eighteen design recommendations derived from the previous section. One of the eighteen design recommendation that concerns indication visibility was used to create three design problems and solutions as this recommendation suggested how to design three different kinds of opening information. These are: 1) tactile information, 2) Braille, tactile danger warnings and embossed writing and 3) visual information.

Table 19 below shows design solutions in response to 20 design problems. These are arranged in four categories: 3D design, 2D design, *other* design elements (such as audible indications, opening methods or materials) and combined design solutions. The latter category combines two or three of the other categories (e.g. 3D, 2D or *other*).

Table 19: Design problems and solutions

Example design problem	Categories of solutions	Example of appropriate solution
1. Older people whose sensory impairment and perception are individually different can find it difficult to understand opening information, if it can be only received by one sense (e.g. vision or touch).	**Using combined design solutions**	Provide **2D, 3D** and **audible** indications in explaining opening methods.
2. Older people can find it difficult to notice, identify or read tactile information e.g. indentations.	**Using 3D design only**	Use colour contrast, shapes, surface textures and position (e.g. a lid tab) to aid noticing, identifying or reading tactile information.
3. Older people can find it difficult to notice, identify or read Braille, tactile danger warnings and embossed writing (for blind and partially sighted users only).	**Using 3D design only**	Use size, well defined shapes and position to aid noticing, identifying or reading Braille, tactile danger warnings and embossed writing. Embossed letters should be at least 3mm apart.
4. Older people can find it difficult to notice, identify or read visual information e.g. written instructions, diagrams and surface symbols.	**Using 2D design only**	Use colour contrast, size and position to aid noticing, identifying or reading visual information. Avoid placing indications on shiny surfaces. Manage design layouts and typography. Provide sharp print.

Table 19: Design problems and solutions (continued)

Example design problem	Categories of solutions	Example of appropriate solution
5. Packaging designed without using combined 2D and 3D indications can be difficult for older people to understand how to open.	Using combined design solutions	Explain required hand positions, hand actions and hand directions by different kinds of 3D indications. The shape of a lid and a body can describe all such information. Others e.g. indentations explain particular information. Explain required hand positions, hand actions and hand directions by different kinds of 2D indications. Diagrams and product names can explain all such information. Others e.g. symbols explain particular information.
6. Older people can find it difficult to understand how to open unfamiliar packaging.	Using combined design solutions	Use familiar 3D indications e.g. indentations, nozzles and atomisers to explain opening methods. Use product names (2D indications) to trigger prior experience of opening similar packaging. Use familiar 2D indications e.g. arrows to explain opening methods.
7. Familiar packaging appearance may mislead, if the packaging requires unfamiliar opening methods.	Using combined design solutions	Avoid using ambiguous 3D indications that mislead users about opening methods. Provide additional 3D indications to clearly explain unfamiliar opening methods. Provide additional 2D indications to clearly explain unfamiliar opening methods.
8. Older people can find it difficult to discriminate opening information from different types of information on packaging.	Using combined design solutions	Prioritise opening information e.g. by using colour contrast (for 3D indications). Prioritise opening information e.g. by management of design layouts or using colour contrast (for 2D indications).
9. Ambiguous language in written instructions may mislead users about opening methods.	Using 2D design only	Use clear language in describing how to open packaging.
10. Unnecessarily complicated opening methods can be difficult for older people to understand.	Using other design elements	Use simple and straightforward opening methods.
11. Several unsuccessful attempts at trial and error when opening a package may cause frustration.	Using 3D design only	Provide clear 3D indications to prevent impossible opening manipulations.

Table 19: Design problems and solutions (continued)

Example design problem	Categories of solutions	Example of appropriate solution
12. Without confirmations of understanding how to open packaging and of successful opening, it may be more difficult for older people to understand the opening method.	**Using combined design solutions**	Provide 3D indications that can be used to confirm how to open packaging (e.g. a nozzle confirms a hand position required for squeezing a bottle). Provide 3D indications that can be used to confirm successful opening (e.g. a gap between a lid and a body of packaging which emerges when releasing the lid). Provide 2D indications (e.g. written instructions and diagrams) that can be used to confirm understanding of how to open packaging. Provide **audible** indications (e.g. a click sound) that can be used to confirm successful opening.
13. Packaging appearance can induce negative feelings towards interactions with the packaging (e.g. sharp-edged shapes).	**Using 3D design only**	Provide packaging appearance that induces positive feelings towards interactions with the packaging (e.g. soft and curved shapes).
14. Packaging with a stereotypical opening difficulty (e.g. child- resistant bottles) or with danger warnings about potentially harmful contents can negatively impact on older peoples' ability to understand how to open packaging.	**Using combined design solutions**	Provide clear 2D and 3D opening indications to reduce impacts of negative opening experiences or of warnings, on older peoples' ability to understand how to open packaging.
15. Older people can find it difficult to open packaging due to hand strength decline.	**Using combined design solutions**	Optimise hand strength when releasing a lid by using lid diameters, shapes and surface textures (3D indications). Optimise hand strength when dispensing contents from squeeze bottles by using diameters and lengths of nozzle tubes and bottle shapes (3D indications). Optimise hand strength when dispensing contents from squeeze bottles by using materials (bodies of squeeze bottles) (other design elements)
16. Older people can find it difficult to open packaging due to hand dexterity decline.	**Using 3D design only**	Optimise hand dexterity when opening a package by using size (e.g. lid tabs) and surface textures (e.g. lids, bodies and lid tabs).
17. Packaging with sharp edges and/or large lid diameters (screw tops) can lead to excessive hand stresses when opening.	**Using 3D design only**	Curve the edge of packaging. A lid diameter (screw tops) should not be larger than 5.00cm.
18. Packaging closures are too tight for older people to open.	**Using other design elements**	Strike a balance between the quality of sealing and openability.
19. Particular opening methods can be difficult for older people to open.	**Using other design elements**	Avoid using opening methods that require excessive hand functions, that cause hand pain or fatigue or that may injure the hand.
20. Particular opening mechanisms can be difficult for older people to open.	**Using other design elements**	Opening mechanisms should allow older people to successfully open packaging as guided by indications.

6.4 Summary

This chapter consists of three sections aimed at developing a design framework for designers to use in the creation of novel packaging so that the opening methods are easy for older people to understand. The first section synthesised data from different sources resulting in eighteen design recommendations. The second section presented the relationship of these design recommendations to related factors. The third section described twenty example design problems and offered solutions.

6.4.1 Data synthesis

The synthesis of data derived from the literature and from the experimental works resulted in the creation of design recommendations. These recommendations were placed into three categories: sensory information, cognitive functions and hand functions.

Sensory information is used when inspecting a package. The two design recommendations which were created in relation to sensory information are: 1) provide alternative indications and 2) make indications visible.

Cognitive functions are used when inspecting a package, releasing a lid and dispensing contents. The ten design recommendations which were created in association with cognitive functions are: 1) use combined 2D and 3D indications, 2) communicate how to open packaging by using familiar design appearance, 3) avoid using ambiguous indications that mislead users about opening methods, 4) prioritise information for opening, 5) use clear language in opening instructions, 6) use logical opening methods, 7) prevent impossible manipulations, 8) confirm what has been done, 9) use packaging appearance to create positive expression and 10) use clear indications to reduce impacts of negative opening experiences or warnings.

Hand functions are used when releasing a lid and dispensing contents. The six design recommendations which were created in connection with hand functions are: 1) optimise hand strength, 2) optimise hand dexterity, 3) eliminate excessive hand stresses, 4) balance the quality of sealing and openability, 5) avoid using opening methods that require excessive hand functions, that cause hand pain or fatigue or that may injure the hand and 6) ensure that mechanisms permit successful opening as guided by indications.

6.4.2 Relationship of the design recommendations to related factors

The design recommendations derived from the data synthesis were tabulated against the cognitive processes used when opening packages, namely: sensory information, cognitive functions and hand functions. The key contextual information in relation to each design recommendation was presented comprising: 1) the impact of age-related decline, 2) the design elements that should be taken into account when designing a package and 3) the stages of opening.

6.4.3 Design problems and solutions

Twenty example design problems were matched with solutions. The design solutions offered were presented in four categories: 3D design, 2D design, *other* design elements and combined design solutions. The information from this section will be used to create a design framework tool which will be presented in the next chapter.

Chapter 7

A design framework tool

This chapter presents the design framework tool created to achieve the third aim of this study: *to produce a design framework which can be used by packaging designers to increase the understandability of packaging information for older people, with respect to openability.* The framework tool represents a very tangible outcome of this study. It is useful to note that the framework tool does not include all the detailed findings from the study, but instead, seeks to distil the key conclusions into a tool, which can be used by designers as a prompt to action when designing a package. It does not seek to supplant the designer's creativity, but is intended to augment it.

Elements and information displayed on the framework tool are described before moving on to an explanation of how to use it. The framework tool can be found affixed to the inside back cover of this thesis. You are invited to inspect the tool as you read on.

7.1 Elements and information displayed on the framework tool

The framework tool is a set of concentric wheels displaying common design problems and suggested solutions for the effective design of packaging information for older people with respect to openability. Four paired wheels illustrate: 1) the design problems addressed by the framework and 2) associated design solutions in three areas: a) 2D design, b) 3D design and c) *other* design elements (e.g. audible indications, materials or opening methods) as shown in Figure 18 below. The largest wheel presents the design problems covered by the tool; the remaining three show the suggested solutions around 3D design, 2D design and *others*. The design problems are differentiated by colours which are matched to their design solutions.

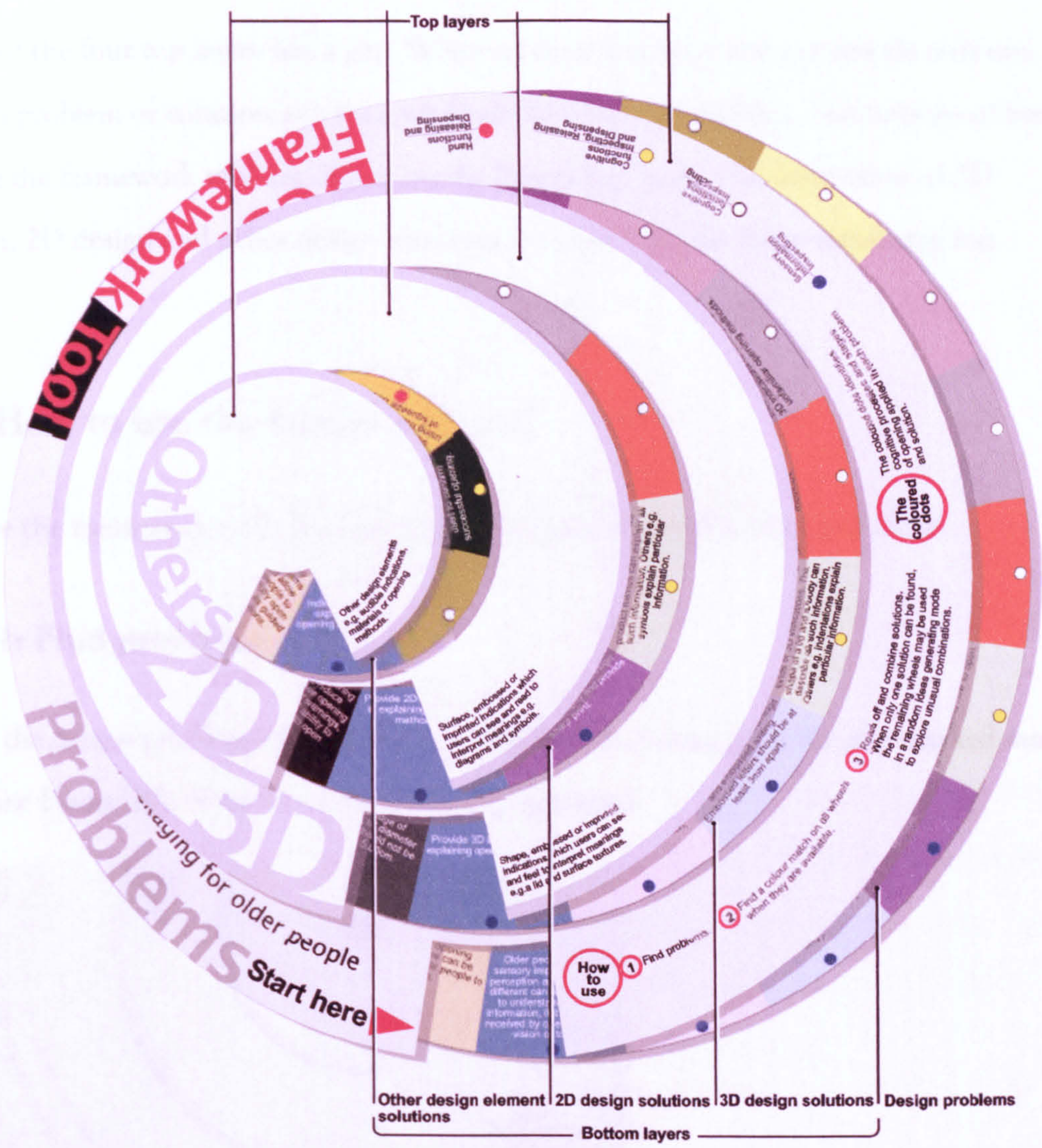


Figure 18: The elements of the design framework tool

Each pair of wheels has a bottom and top layer. The four bottom layers display the information as explained above: design problems and the three areas of design solutions (2D, 3D and *others*). There are twenty design problems, fourteen 3D design solutions, nine 2D design solutions and seven design solutions related to *other* design elements.

A coloured dot is displayed on each design problem and solution which is used to identify the associated cognitive processes and stages of opening. A key, explaining the coloured dot codes can be seen on the top, largest wheel.

Each of the four top layers has a gap. When turning this layer, the gap reveals only one design problem or solution at a time while all the others are hidden. Instructions of how to use the framework tool are shown on the largest top layer. The definitions of 3D design, 2D design and other design elements are shown on the three remaining top layers.

7.2 How to use the framework tool

To use the framework tool, there are three steps, which are described as follows.

Step1: Find problems

Turn the design problem wheel to select a problem by framing it in the gap marked *start here* (see Figure 19). Note the colour-coded background.

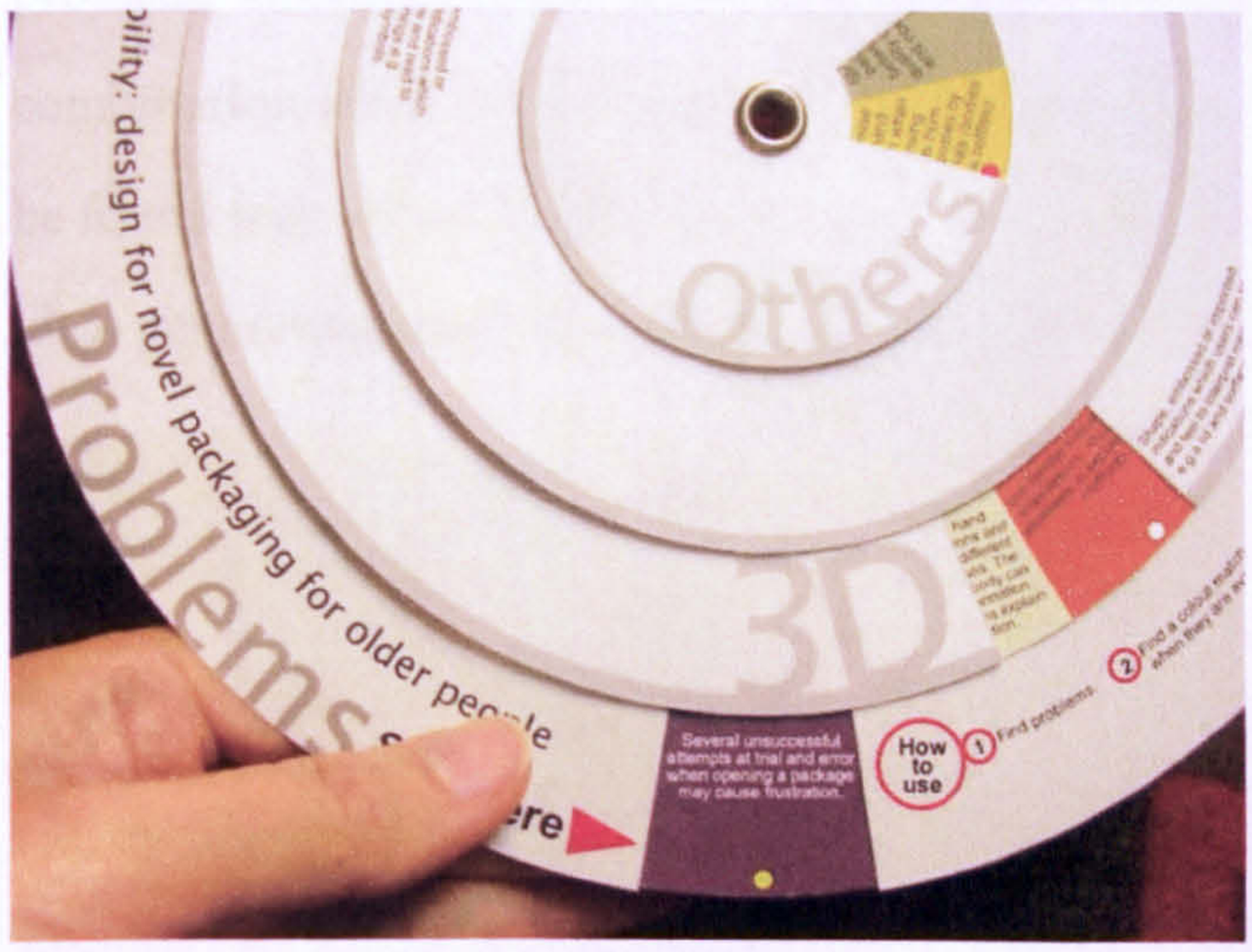


Figure 19: A selected design problem

Step2: Find a colour match on all wheels when they are available

Turn the three design solution wheels, until you have framed the matching colour-coded areas in the gaps. You have now found applicable solutions to the selected design problem (see Figure 20).

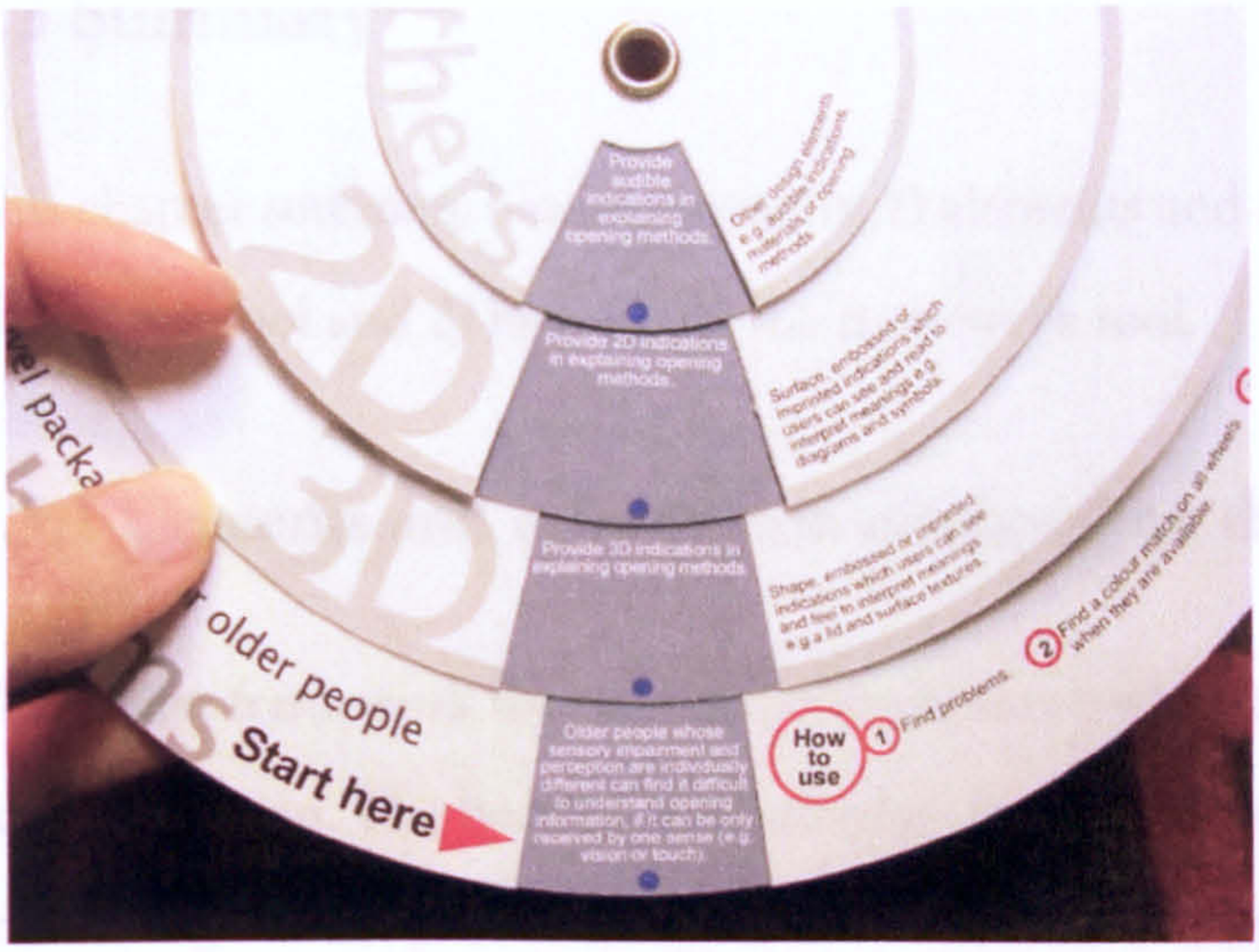


Figure 20: The matched design problem and solutions

Step3: Read off and combine solutions

The preceding steps provide suggested design solutions in response to the selected design problem. These solutions (3D design, 2D design or other design elements) can be used in combination when designing a package. In cases where only one suggested solution can be found (e.g. 3D or 2D design) then the remaining wheels may be used in a random ideas generating mode to explore unusual combinations (see Figure 21).

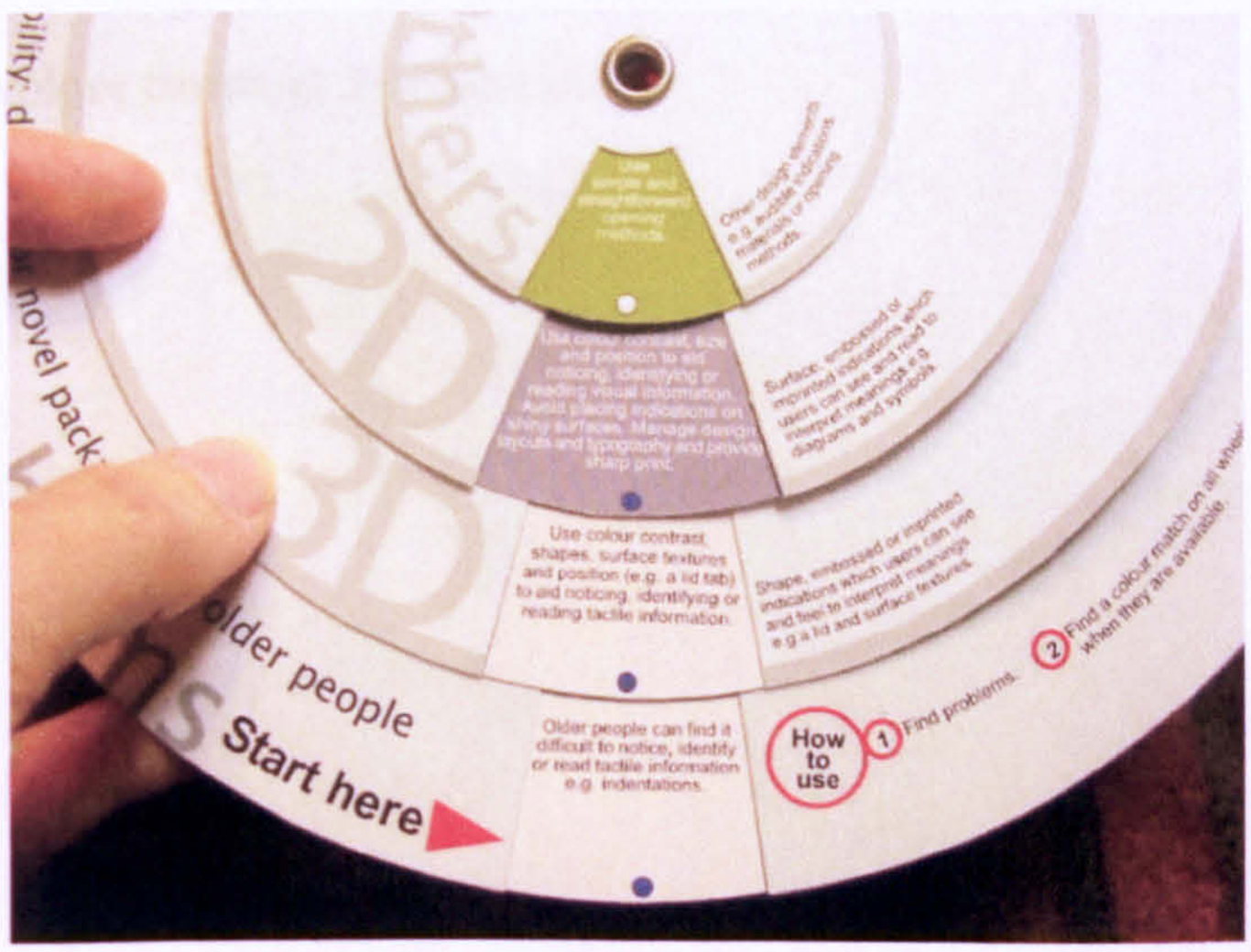


Figure 21: Where only one suggested solution can be found (e.g. 3D) then the remaining wheels may be used in a random ideas generating mode to explore unusual combinations

7.3 Summary

This chapter summary has two sections: 1) elements and information displayed on the framework tool and 2) how to use the framework tool.

7.3.1 Elements and information displayed on the framework tool

The design framework tool is made of four paired wheels, each of which has two layers, bottom and top. The bottom layers display design problems and suggested solutions concerning 3D design, 2D design and *other* design elements. The top layers with the gaps are used for revealing one design problem or solution at a time whilst covering the others.

7.3.2 How to use the framework tool

The three steps involved in using the framework tool are summarised as follows. Firstly, select a problem on the design problem wheel. Secondly, find the suggested solutions whose colour-coding matches that of the selected design problem. Thirdly, combine the solutions (3D design, 2D design or *other* design elements). If only one suggested solution can be found, the remaining wheels may be used in a random ideas generating mode to explore unusual combinations.

Chapter 8

Summary and conclusion

This chapter begins with the restatement of the study aims before moving on to a discussion about the extent to which the aims have been achieved. Limitations of this study and possible directions for future work are also described. The last section then summarises novel aspects created and contributions to knowledge made by this study.

8.1 The aims of this study

The three aims of this study are:

1) To understand the problems older people have when opening packages.

2) To investigate the relative importance of 2D and 3D indications during the different stages of package opening.

3) To produce a design framework which can be used by packaging designers to increase the understandability of packaging information for older people, with respect to openability.

8.2 The extent to which the aims of this study have been achieved

This section discusses the extent to which the aims of this study have been achieved by the methods employed.

8.2.1 Aim one: to understand the problems older people have when opening packages

This aim has been fully achieved. The data derived from the initial observations, the literature review and the focus groups provided understanding of the problems older people have when opening packages from broad to specific perspectives as explained below.

The data from the initial observations revealed that older people have specific and individual difficulties in performing everyday life activities. Such difficulties could also negatively affect their ability to open packaging.

The data drawn from the literature identified the impact of age-related decline in sensory, cognitive and hand functions on older peoples' ability to open packaging.

The data from the focus groups revealed the particular difficulties that older people have in: perceiving information for opening, understanding how to open packaging and performing package opening. This was confirmed also by the literature review.

Furthermore, the literature review of existing design guidelines, recommendations and principles identified a particular knowledge gap which this study addresses. This knowledge gap concerns the need for clear recommendations on how to design indications that effectively guide older people how to open novel packaging. Synthesis of the data from the focus groups provided design considerations concerning this need and specified that combined 2D and 3D indications helped older people understand package opening methods. This issue was examined further in the in-depth interviews.

8.2.2 Aim two: to investigate the relative importance of 2D and 3D indications during the different stages of package opening

The data from the interviews have fully met the second study aim in two regards. Firstly, the data revealed the role of 2D and 3D indications during the different opening stages. Secondly, the data showed that the combined use of 2D and 3D indications provided more effective opening information for older people. The literature review of existing design guidelines, recommendations and principles was also used in guiding the formulation of design considerations concerning the combined use of 2D and 3D indications.

8.2.3 Aim three: to produce a design framework which can be used by packaging designers to increase the understandability of packaging information for older people, with respect to openability

The third study aim has been fully achieved. The synthesis of the data from the focus groups, the in-depth interviews and the literature review, provided design recommendations used for the creation of the design framework. This design framework was developed as a tool for use by designers seeking to provide novel packaging that is openable by older people.

8.3 Limitations of this study

The limitations of this study relate to the following aspects.

8.3.1 The number of participants

The findings from the two experimental works (the focus groups and the in-depth interviews) were drawn from a small number of participants. Two focus groups, each of which had six participants, were conducted to meet the first aim of this study: *to*

understand the problems older people have when opening packages. Collecting data from two focus groups appears to raise a generalisation issue. Krueger and Casey (op. cit.) stated that one way to determine the required number of focus group sessions is by considering if the data have reached saturation. However, it was not the purpose of the focus groups to create generalisable findings, but instead to understand the problem area and to further specify the particular focus of this study. Although collecting the data from a larger number of participants would have been useful in providing generalisability of the findings to the existing older population, the data from this small number of participants were considered sufficient to illuminate the problem area and to indicate how to proceed with the in-depth interviews.

The in-depth interviews were carried out qualitatively with a small number of participants and therefore they cannot be generalised to the existing older population. However, the deep indicative insight into individuals' thinking processes when opening packages (see appendices C-2 and C-3 for details); which cannot be gained by employing a quantitative approach with a large population; was valuable in suggesting how indications should be designed to increase the understandability of opening information.

8.3.2 The selection of packaging samples

The limitation of this study in relation to the sampling of packages used in the focus groups and the in-depth interviews is discussed below.

8.3.2.1 Focus groups

The novel packaging samples were identified as packages having a different relationship of indications to opening methods from those presented in the reference list of standard opening methods (Table 10) in chapter three. The reference list contained 17 categories of relationships of indications to opening methods. This raises the question of whether

this reference list covered all varieties of common relationships of indications to opening methods.

The reference list produced however, did not include all kinds of packages, but only those packages with plastic closures. This was because the widest variety of indications and opening methods (which was a criterion used for selecting the packaging samples) can be found in packages with plastic closures.

The 17 categories represented in the reference list excluded inner closures (see Figure 22 below) such as plastic films, pieces or rings, provided for sealing.

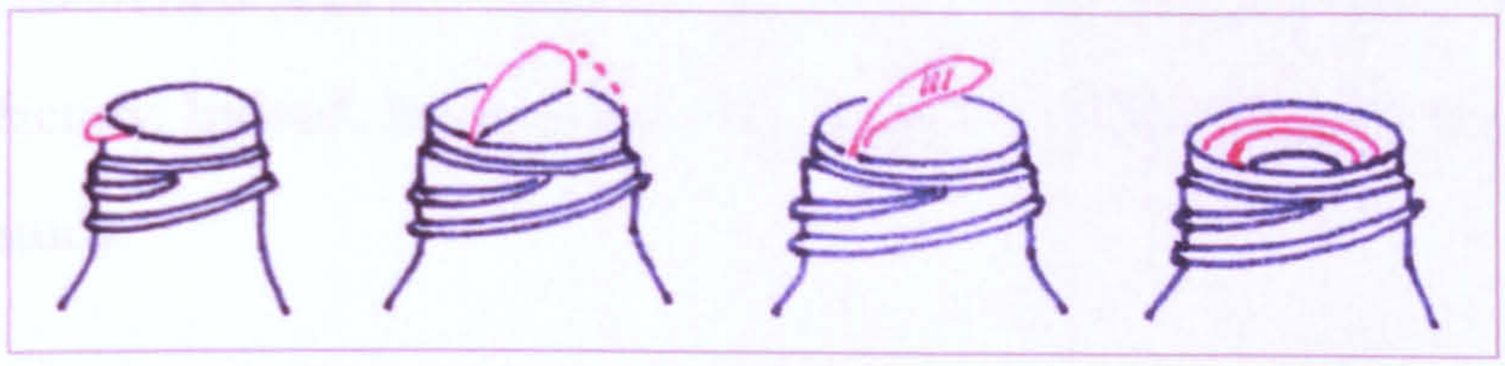


Figure 22: Different types of inner closures

The exclusion of these inner closures is unlikely to have negative implications for the findings of this study. Different indications on inner closures shown in Figure 22 describe the same types of opening information: hand positions, hand actions and hand directions. A tab or a ring on an inner closure explains where users must pick it or pull it up to remove it. It appears that removing the inner closures is easy to understand. This view was borne out in the in-depth interviews where it was shown that these three types of information provide effective package opening.

8.3.2.2 In-depth interviews

All five packaging samples selected for use in the in-depth interviews should have employed both 2D and 3D indications, as the interviews aimed to investigate how older participants used these indications when opening the packages. However, two of the five packages only featured 3D indications. The use of these two packaging samples in the in-

depth interviews is unlikely to have caused any negative implications for the data. This is because these two packaging samples were not selected by participants. In future research however, irrelevant packaging samples should be excluded to eliminate unnecessary procedures when collecting data.

8.3.3 The Hawthorne effect

The Hawthorne effect refers to the phenomenon wherein participants improve their performance because they realised that they are in a study. This is named after a study at the Hawthorne Works in Chicago during the 1920s and 30s (Mayo, 1933). The researchers took the view that workers' productivity was affected by lighting levels in the factory. Indeed, the workers were more productive because they knew that they were in a study.

In the in-depth interviews, participant 2ME realised that he participated particularly purposefully during the data collection for the study. Although, the researcher informed participants beforehand that the packaging samples were being evaluated, and not the participants' skill, participant 2ME improved his performance when opening the packaging samples. This caused a Hawthorne effect in two aspects.

Firstly, participant 2ME said that he tried harder than normal to find out how to open the packaging sample. However, participant 2ME's improved attempts to open the package benefited the research, because the data of how he used indications in response to the purpose of the in-depth interviews could be collected for analysis.

Secondly, participant 2ME explained that usually he read the instructions (diagrams) only when all attempts to find out how to use products failed. However, in the in-depth interviews participant 2ME read the diagrams before trying to open the packaging sample.

Reading diagrams, therefore, may not be the first step that he normally takes when releasing a lid on packaging on an everyday basis (in a natural setting). However, this did not affect the original finding that the importance of 3D indications was greater when releasing the lid than when inspecting the package and that the importance of 2D and 3D indications relied on individuals' prior experience.

To control for these influences of the Hawthorne effect, the researcher should have informed participants that they should try opening the packaging samples as they would normally do, on an everyday basis.

8.3.4 Data analysis

Two kinds of data sources were combined to maximise the validity of the data derived from the focus groups (questionnaires and discussions) and the in-depth interviews (observations and discussions). However, there were conflicts between the two data sources. It is helpful to discuss how this study dealt with the data conflicts during the data analysis.

In the focus groups, quantitative data were collected by using questionnaires. These data refer to the scores that participants gave when rating the packaging samples on the three factors: familiarity, understanding and how easy or difficult it was to physically open the packages. Qualitative data were collected from the participants' comments.

In respect of the data relating to the factor of understanding and how easy or difficult it was to physically open the packaging samples, there were a few cases of conflicts between the data from the scores and the participants' comments. However, no particular reason could be found to explain these conflicts. It would be helpful, if in the focus group sessions the researcher had confirmed the participants' views whenever there was a conflict between their comments and the scores provided. When data conflicts occurred,

qualitative data where participants verbally clarified their views were selected for use in analysis instead of quantitative data, in which participants' opinions were only represented by numeric scores.

In the in-depth interviews, two kinds of qualitative data were collected. These are observations of how participants opened the packaging samples (recorded by a video camera) and discussions with participants on how they opened the packaging samples.

There were a few cases of conflicts between participants' explanation and the data from the video recordings. For example, 1FB explained that she gripped the blue band instead of the indentations when releasing the lid of package no.2. However, the data from the video recordings showed that she gripped the indentations instead of the blue band. It would be helpful, if the video recordings were presented to participants before the discussions in order to recall what they did when opening the packaging samples. When data conflicts occurred, the data from the video recordings were selected for use in analysis instead of the participants' explanation as the video recordings presented the direct data of how they opened the packages.

8.4 Future work

Potential future work arising from this study would involve the following areas.

8.4.1 Evaluation of the design framework

Chapter three noted that design processes require both inductive and deductive reasoning. Inductive reasoning is applied during the design process when gathering users' needs, whereas deductive reasoning is applied during the design process when design solutions are evaluated (Archer, op. cit.). This study involved the area of inductive reasoning where the focus group data provided an understanding of older users' needs. The needs then were used to form design requirements to produce a design framework

for designers' use. Future work arising from this study would relate to the area of deductive reasoning which aims to evaluate the design framework tool created.

An evaluation of this tool with a large number of participants would be useful in determining to what extent the tool may be used in designing openable novel packaging for the wider population.

8.4.2 The use of the RIIO diagram representing the relationship between indications and information for opening

The RIIO diagram created in chapter four can potentially be used as a diagnostic tool by designers. This tool would require evaluation. In the evaluation, designers would use the tool when creating novel packaging to see how useful this tool is to review the understandability of opening indications. Additionally, it would be helpful to examine the use of this tool when designing novel packaging with simple opening (one opening step) as well as with the complex openings (two or more opening steps) that this study centred on.

8.4.3 Comparative study of the problems younger people have when opening packages

It appears that age-related decline has little impact on younger peoples' ability to open packages. However, a comparative study of the problems younger people have when opening packages can be used to confirm differences between older and younger peoples' design requirements. Such a study may provide additional user requirements for the development of design recommendations and a broader framework that can be used to create novel packaging that is easily openable for all.

8.5 Original aspects of this study

Original aspects gained from this study are described as follows:

• The design of indications to provide effective information to older people when opening novel packaging has not previously been investigated. CEN/CENELEC (op. cit.) made design guidelines for preferred characteristics of opening indications in order to accommodate age-related decline in sensory and cognitive functions. However, the guidelines did not recommend how to design indications for effective package opening.

• This study offered a novel design framework tool which can be used by designers to create novel packaging that is easy for older people to understand how to open.

• This study synthesised the data to produce a design framework for openability which has not previously been done. All aspects of openability design concerning three key functions: sensory, cognitive and hand, were incorporated.

• The interplays between sensory information, cognitive functions and hand functions used when opening packages (see Figure 14 in section *5.4 Summary*) have not been previously described. The literature (Goldstein, op. cit.; Welford, op. cit.) noted the interplays between these three functions, but in the context of general everyday life activities.

• This study formulated the RIIO diagram, a novel design tool which can be used by designers to review the understandability of opening information when creating novel packaging for older people.

• The combined use of 2D and 3D indications to increase the understandability of opening information has not previously been examined. CEN/CENELEC (op. cit.)

recommended desirable characteristics of indications including 2D and 3D, but did not suggest their combined use.

• The combined use of 2D and 3D indications offered a set of effective indications (full explanation, memory trigger and partial explanation) and information for opening (hand positions, hand actions, hand directions and confirmations of how to open packaging and of successful package opening) which has not previously been established. The literature described these indications (e.g. CEN/CENELEC, ibid.; Jordan, op. cit.; Monö, op. cit.; Norman, 2002, op. cit.) and information for opening (e.g. CEN/CENELEC, ibid.; Moore, 1993, op. cit.), but did not feature them as a set for providing novel packaging whose opening is easy to understand.

• This study carried out experimental work that gained understanding of older peoples' thinking processes on how they opened packages, which has not previously been done. Langdon *et al.* (2007) conducted a study that accomplished understanding of older peoples' thinking processes, but on how they used other products: a car and a digital camera.

8.6 Contribution to knowledge from this study

Key areas of the contribution to knowledge from this study are now described.

8.6.1 A design framework tool

A design framework tool, a set of wheels displaying design problems and solutions, represents a tangible outcome of this study that bridges the knowledge gap addressed in chapter two. This can be used by designers help to provide understandable packaging information for older people with respect to openability.

8.6.2 The RIIO diagram

A novel diagnostic tool was developed, visually representing the relationship between indications and information for opening, which can potentially be used by designers to evaluate the understandability of opening information.

8.6.3 A greater understanding of packaging design for older people

This study offers the following three areas of greater understanding involving packaging design for older people.

8.6.3.1 Older peoples' thinking processes when opening packages

The examination of older peoples' thinking process when opening packages provided understanding of how they used 2D and 3D indications during the different opening stages and of how these two indications can be successfully combined to provide effective opening. This examination also revealed the important role of tacit knowledge and action learning on participants' ability to understand how to open novel packaging. All knowledge addressed above was used to bridge a communication gap between designers and users enabling designers to provide packaging indications and packaging behaviour that stimulate effective opening for older users.

8.6.3.2 Communications of how to open packaging

Design principles such as product semantics (Monö, op. cit.) and affordances (Norman, 2002, op. cit.) drawn from the literature review concern communications of product use. The synthesis of these design principles and the data on how older people used indications to open the packaging samples drawn from the focus groups and the in-depth interviews provided understanding of how packaging communicated opening methods. This understanding has been used to bridge a knowledge gap concerning communicating how to open packaging which has been neglected in packaging design classrooms.

8.6.3.3 Impacts of age-related decline on openability

The combined data derived from the literature review and the focus groups provided understanding of the impact of age-related decline on openability. This particular combination can be used as background knowledge to potentially benefit research in design, packaging design practice and design education.

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Appendix A: Data from the initial observations

Appendix A

The initial observations took place at two local branches of lunch clubs for older people organised by Age Concern (Birmingham). At the outset, they were carried out from March to October 2006, for two days a week, at the first lunch club for the elderly, aged 80+ (ten to thirteen people per day). As this research covers older people after the age of 65, not 80, a further study was required. Therefore, observations at another lunch club where older people aged 60+ attended (twenty to twenty five people per day) were carried out from August to October 2006, for one day a week. These were conducted on every Thursday as younger older people (aged 60-80) attended.

The data from these observations related to the ability of older people to participate in activities at the lunch clubs. Also, the attendees at the two lunch clubs were asked to comment on package openability. These two issues are now presented.

The ability of older people to achieve the activities at the lunch clubs

The ability of older people to manage the activities at the clubs related to four kinds of functions: mobility, sensory (vision and hearing), cognition and hand dexterity. The results are shown in Table A1 below.

Table A1: The ability of attendees at the two lunch clubs to manage the activities

	Lunch club one: attended by older people aged 80+ (10-13 attendees)	Lunch club two: attended by older people aged 60+ (20-25 attendees)
Mobility	Seventy seven percent of them needed help for standing, walking and getting on and off the bus.	Nine percent of them needed help for walking.
Vision and hearing	Thirty one percent of them had difficulty in reading small print. Twenty three percent of them used hearing aids.	Nine percent of them had difficulty in reading small print, or hearing.
Cognition	Fifteen percent of them exhibited a decline in short-term memory. None of them exhibited a decline in long-term memory.	None of them exhibited a decline in short-term memory or long-term memory.
Hand dexterity	Twenty three percent of them exhibited a decline in hand dexterity.	One of them exhibited a decline in hand dexterity.

Mobility

Seventy seven percent of attendees aged 80+ found difficult to walk from the bus to the club and from one room to another. They also needed help to stand and step on and off the bus. Nine percent of the attendees aged 60+ needed help with walking. It was found that the attendees aged 60+ did not need help with standing, or stepping on and off the bus.

Vision and hearing

Thirty one percent of the attendees aged 80+ had difficulty when reading small print. They needed somebody to read it out loud for them to receive information. Twenty three percent of them also used hearing aids to improve their hearing. Only nine percent of the attendees aged 60+ had difficulty in reading small print or hearing.

Cognition

Fifteen percent of the attendees aged 80+ exhibited a decline in short-term memory. They repeatedly asked the same questions, told the same stories and forgot the location of their key and the toilet. However, it was found that they did not exhibit a decline in long-term memory. None of the attendees aged 60+ exhibited a decline in short-term memory or long-term memory.

Hand dexterity

It appeared that a greater number of the attendees aged 80+ than those aged 60+ had hand impairment. A greater variety of hand decline was also found in the attendees aged 80+ than in those aged 60+. For example, the attendees aged 80+ used the whole hand, instead of fingers, to hold a teaspoon when stirring a cup of tea. Also, it was not easy for the attendees aged 80+ to control their fingers to unfold a serviette provided for their lunch and to button their coat. One of the attendees aged 60+ used the whole hand to manipulate a fork when eating a salad.

Package openability

The attendees' comments on package openability in particular their understanding of how to open packaging, was related to: prior experience, indications, trial and error, feelings towards the shape of packaging and visual decline.

It was easy for the attendees to understand how to open packaging that was familiar to them. Negative or positive attitudes towards particular package opening methods retrieved from prior experience may have had an impact on understanding how to open packaging and the ability to physically open packaging. The attendees had previously experienced physical difficulties when opening packages, for example, a metal cap, a biscuit packet, a tin can, a film-wrapped packet and a child-resistant bottle. This may be one of the reasons why some of the attendees did not feel confident to try to open the packaging samples provided; they only shared their opinions on opening the packages. Others felt that they learned new skills and it was enjoyable when trying to open the packages.

Indications for opening played a key role in guiding the attendees about the opening methods. Trial and error also helped the attendees understand how to open the packages. In addition, the shapes of the packaging samples provided also influenced the attendees' feelings on whether it was physically easy or difficult to open these packages. For example, a ridged screw cap appeared to require more hand strength to open than a smooth screw cap. Furthermore, the attendees' visual decline affected their ability to identify and understand indications for opening.

Appendix B: Data from the focus groups

Appendix B-1

Appendix B-1presents 1) the opening method employed in each of the two packaging samples selected for use in the focus groups and 2) 2D and 3D indications employed on each of these packages. These packages were no.1 and no.4.

Package no.1 is a bottle of sun spray. The opening process of this package has two stages: 1) releasing the lock of the trigger by turning the white collar anticlockwise or clockwise (see Figure B1) and 2) dispensing the contents by pressing the trigger (see Figure B2).

Figure B1: Turning the white collar anticlockwise or clockwise

Figure B2: Pressing the trigger to dispense the contents

Package no.4 is a bottle of tablet sweeteners. The opening process of this package has two stages: 1) removing the seal on the base of the package (see Figure B3) and 2) dispensing the contents by pressing the lid (see Figure B4).

Figure B3: Removing the seal on the base of the package

Figure B4: Pressing the lid to dispense the contents

Two and three dimensional indications employed on packages no.1 and no.4 are shown in Table B1 below.

Table B1: Two and three dimensional indications employed on packages no.1 and no.4

Packaging samples	2D indications	3D indications
Package no.1	The product name The two-headed arrow	The ridges around the collar The trigger The grooves The nozzle
Package no.4	The product name	The lid and the body

Appendix B-2

Appendix B-2 presents the older peoples' design requirements in providing effective indications with respect to openability. The focus group data are structured by three functions required when opening packages: sensory, cognitive and hand.

Sensory functions

This section is discussed under two headings: 1) the participants' sensory impairment and 2) their comments on the ability to perceive opening indications.

The participants' sensory impairment

Seven out of the twelve participants had some kind of visual impairment: short-sightedness, long-sightedness, cataracts and diabetic retinopathy, as illustrated in Table B2 below. Additionally, six out of the twelve participants were partially deaf.

Table B2: The participants who had visual and hearing impairment

Group no.	Participants	Visual impairment				Hearing impairment
		Short-sightedness	Long-sightedness	Cataracts	Diabetic retinopathy	
1	1MA					
	1FB	•		•		
	1MC	•		•		•
	1FD	•				
	1ME		•	•	•	
	1FF					
2	2MA	•				
	2FB	•				•
	2MC					•
	2FD					•
	2ME	•	•			•
	2FF					•

Note: *• identifies the participants who had visual and hearing impairment. The participants' code names were created in reference to: the focus group number that participants belonged to (one or two), their gender (the first letter) and their sitting position in the focus groups (the second letter).*

Participants' comments

Participants commented on difficulties in noticing, identifying and reading indications when opening both *easy-rated* and *difficult-rated* packaging samples. The easy-rated packaging samples were the packages which participants rated as easy to understand how

to open (scores 1-3 from a seven point Likert scale). The difficult-rated packaging samples were the packages which participants rated as difficult to understand how to open (scores 5-7 from a seven point Likert scale).

Packages no.1 and no.4 were selected by the mean of the scores provided by participants for discussion in focus groups one and two respectively. With the lowest average score, package no.1 was the easiest packaging sample for participants to understand how to open. With the highest average score, package no.4 was the most difficult packaging sample for participants to understand how to open. However, other easy-rated and difficult-rated packaging samples were also discussed in each focus group. To ensure that all related data from participants were included, the participants' comments on all easy-rated and difficult-rated packaging samples were used during data analysis, instead of using only the data from packages no.1 and no.4.

Data from the easy-rated packaging samples

Participants commented on factors that made it difficult to notice, identify and read indications on the easy-rated packaging samples, although it was easy to understand how to open these packages. The factors were shown in Table B3 below. The table also describes factors that helped participants understand how to open these packages.

Table B3: The factors that made it difficult for participants to notice, identify and read indications on the easy-rated packaging samples and that helped participants understand how to open these packages

Group no.	Participants	Factors that made it difficult to notice, identify and read indications on the easy-rated packaging					Factors that helped participants understand how to open the easy-rated packaging	
		Small print	Low colour contrast	Shiny surfaces	Elaborate instructions	Indications positioned far from the opening	Feeling shape indications	Hearing audible indications
1	1MA	•	•				•	•
	1FB							
	1MC	•	•					
	1FD		•				•	•
	1ME	•	•	•			•	•
	1FF	•		•			•	
2	2MA	•						
	2FB	•	•		•	•		
	2MC							
	2FD		•					
	2ME		•		•			
	2FF		•					
Frequency		6	8	2	2	1	4	3

Note: *• identifies the factors affecting the ability to perceive opening indications. The participants' code names were created in reference to: the focus group number that participants belonged to (one or two), their gender (the first letter) and their sitting position in the focus groups (the second letter).*

The factors that caused difficulties in noticing, identifying and reading indications on the easy-rated packaging sample were: 1) small print, 2) low colour contrast, 3) shiny surfaces, 4) elaborate instructions and 5) indications positioned far from the opening.

The factors that helped participants understand how to open the easy-rated packaging samples were: 1) feeling shape indications and 2) hearing audible indications.

Data from the difficult-rated packaging samples

Participants only commented on difficulties in noticing, identifying and reading indications on the difficult-rated packaging samples received by seeing, not by feeling or hearing, as shown in Table B4 below.

Table B4: The factors that made it difficult for participants to notice, identify and read indications on the difficult-rated packaging samples

Group no.	Participants	Factors that made it difficult to notice, identify and read indications on the difficult-rated packaging samples			
		Small print	Low colour contrast	Blurred printing	Indications positioned far from the opening
1	1MA				
	1FB		•		
	1MC	•	•		
	1FD				
	1ME				
	1FF	•			
2	2MA				
	2FB				
	2MC		•		
	2FD		•		
	2ME			•	•
	2FF		•		
Frequency		2	5	1	1

Note: • identifies the factors affecting the visibility of opening information. The participants' code names were created in reference to: the focus group number that participants belonged to (one or two), their gender (the first letter) and their sitting position in the focus groups (the second letter).

The factors that made it difficult for participants to notice, identify and read indications on the difficult-rated packaging samples were 1) small print, 2) low colour contrast, 3) blurred printing and 4) indications positioned far from the opening.

Combined data from both the easy-rated and the difficult-rated packaging samples

Table B5 below shows the relative importance of the factors negatively affecting the indication visibility. This was ranked by a frequency count made from the participants' comments regarding both the easy-rated and the difficult-rated packaging samples.

Table B5: The relative importance of the factors negatively affecting indication visibility

No.	Factors affecting indication visibility	A frequency count made from the participants' comments
1	Low colour contrast	10
2	Small print	6
3	-Shiny surfaces -Elaborate instructions -Indications positioned far from the opening	2
4	Blurred printing	1

The most important factor was low colour contrast followed by small print. Shiny surfaces, elaborate instructions and position were all in third place. The least important factor was blurred print.

Cognitive functions

This section presents design requirements in connection with cognitive functions drawn from: 1) scores that participants provided for the packaging samples on openability and 2) the participants' comments. Participants did not disclose any cognitive impairment. The data on understanding how to open the easy-rated and the difficult-related packaging samples will now be presented.

Data from the easy-rated packaging samples

Table B6 below shows the strategies employed to understand how to open the easy-rated packaging samples.

Table B6: The strategies employed to understand how to open the easy-rated packaging samples

Groups no.	Participants	Prior experience	Indications	Trial and error
1	1MA	•	•	
	1FB	•		
	1MC	•	•	
	1FD	•	•	
	1ME	•	•	•
	1FF	•	•	
2	2MA	•		
	2FB	•		
	2MC	•		
	2FD	•		
	2ME	•	•	
	2FF	•		•
Frequency		12	6	2

Note: • shows the strategies employed to understand how to open the packaging samples. The participants' code names were created in reference to: the focus group number that participants belonged to (one or two), their gender (the first letter) and their sitting position in the focus groups (the second letter).

The strategies employed to understand how to open the easy-rated packaging samples were: 1) prior experience, 2) indications for opening and 3) trial and error.

Data from the difficult-rated packaging samples

Table B7 below shows the reasons why it was difficult for participants to understand how to open the difficult-rated packaging samples.

Table B7: The reasons why it was difficult for participants to understand how to open the difficult-rated packaging samples

Group no.	Participants	Unfamiliarity	Absence of indications	Low indication visibility	Impacts of prior negative opening experiences	Difficulties in performing package opening	Impacts of danger warnings concerning potentially harmful contents
1	1MA	•	•				
	1FB	•	•	•			
	1MC	•		•	•	•	
	1FD	•	•				
	1ME	•					
	1FF	•	•	•			
2	2MA	•					
	2FB						
	2MC	•		•			
	2FD	•	•	•			
	2ME	•	•	•			
	2FF	•		•			•
Frequency		11	6	7	1	1	1

Note: *• identifies the reasons for the difficulty to understand how to open the packaging samples. The participants' code names were created in reference to: the focus group number that participants belonged to (one or two), their gender (the first letter) and their sitting position in the focus groups (the second letter).*

The reasons that made it difficult for participants to understand the method to open the difficult-rated packaging samples were: 1) unfamiliarity, 2) absence of indications 3) low indication visibility, 4) impacts of prior negative opening experiences, 5) difficulties in performing package opening and 6) impacts of danger warnings concerning potentially harmful contents.

Combined data from both the easy-rated and the difficult-rated packaging samples

Table B8 below shows the relative importance of the factors affecting the understanding of the method of opening the packaging samples. This was ranked by a frequency count deduced from the participants' comments, derived from both the easy-rated and the difficult-rated packaging samples.

Table B8: The relative importance of the factors affecting the understanding of how to open the packaging samples

No.	Factors affecting the understanding of how to open the packaging samples	A frequency count made from the participants' comments
1	Prior experience	12
2	Indications	8
3	Indication visibility	7
4	Trial and error	2
5	-Impacts of prior negative opening experiences -Difficulties in performing package opening -Impacts of danger warnings concerning potentially harmful contents	1

The most important factor was prior experience, followed by indications, then indication visibility, then trial and error. Impacts of prior negative opening experiences, difficulties in performing package opening and impacts of danger warnings concerning potentially harmful contents were all in fifth place.

Hand functions

This section can be placed into two headings: 1) the participants' hand impairment and 2) design requirements regarding the participants' hand performance when opening the packaging samples.

Participants' arthritis

Six out of the twelve participants reported that they had arthritis in their hands, as shown in Table B9 below.

Table B9: The participants who had arthritis in their hands

Group no.	Participants	Arthritis in hands
1	1MA	
	1FB	•
	1MC	•
	1FD	•
	1ME	
	1FF	•
2	2MA	
	2FB	
	2MC	•
	2FD	•
	2ME	
	2FF	

Note: • *identifies the participants who had arthritis in their hands. The participants' code names were created in reference to: the focus group number that participants belonged to (one or two), their gender (the first letter) and their sitting position in the focus groups (the second letter).*

Design requirements regarding the participants' hand performance

The design requirements concerning the participants' physical ability to open the packaging samples were derived from: 1) scores that participants provided for the packaging samples on openability and 2) the participants' comments. The data drawn from the easy-rated and difficult-related packaging samples are now explained.

Data from the easy-rated packaging samples

There was a correlation between the participants' understanding of how to open the easy-rated packaging samples and their physical ability to open them. It was physically easy for participants to open the packaging samples, when it was easy for them to understand how to open these packages.

However, there were a few cases when understanding how to open the easy-rated packaging samples did not correlate with the participants' physical ability to do so. It was easy for participants to understand how to open the packages, but it was physically difficult for them to open them.

Table B10 below shows the reasons why understanding how to open the easy-rated packaging samples and the physical ability to open them did not correlate. These were: 1) limitations in hand strength and 2) limitations in hand dexterity and 3) hand and wrist pain.

Table B10: The reasons why understanding how to open the easy-rated packaging samples and the physical ability to open them did not correlate

Group no.	Participants	Hand strength	Hand dexterity	Hand and wrist pain
1	1MA	•		
	1FB	•		
	1MC			
	1FD			
	1ME			
	1FF	•		
2	2MA		•	
	2FB			
	2MC	•		•
	2FD			
	2ME	•		
	2FF			
Frequency		5	1	1

Note: • *identifies the reasons for the contradiction between understanding of how to open the packaging samples and the physical ability to open them. The participants' code names were created in reference to: the focus group number that participants belonged to (one or two), their gender (the first letter) and their sitting position in the focus groups (the second letter).*

Data from the difficult-rated packaging samples

Table B11 below shows the reasons why it was physically difficult for participants to open the difficult-rated packaging samples. These were: 1) difficulties in understanding how to open the packages 2) limitations in hand strength and 3) hand pain.

Table B11: The reasons why it was difficult for participants to physically open the difficult-rated packaging samples

Group no.	Participants	Understanding	Hand strength	Hand pain
1	1MA	•		
	1FB			
	1MC	•	•	
	1ME	•		
	1FD	•		
	1FF	•		
2	2MA	•		•
	2FB	•		
	2MC	•		
	2FD	•	•	
	2ME	•		
	2FF	•	•	
Frequency		11	3	1

Note: • *identifies the reasons for the difficulty to physically open the packaging samples. The participants' code names were created in reference to: the focus group number that participants belonged to (one or two), their gender (the first letter) and their sitting position in the focus groups (the second letter).*

Additionally, there were a few cases where understanding of how to open the difficult-rated packaging samples and the physical ability to open them did not correlate. These occurred whilst participant 1MC opened package no.6 (a shower gel), participant 1FD opened package no.2 (a shoe freshener) and participant 2FD opened packages no. 4 (tablet sweeteners) and no.6.

Participant 2FD provided scores of 7 and 2 for the factors of understanding how to open package no.4 and her physical ability to open it respectively. This showed that it was difficult to understand how to open this package, but it was physically easy to do so. However, in the discussion session, participant 2FD commented that it was also not easy for her to physically open this package. Accordingly, it was likely that understanding of how to open this package and the physical ability to do so correlated.

In the cases where participants 1MC and 2FD opened package no.6 and participant 1FD opened package no.2, no explanation has been found as to why understanding of how to open these packages and the physical ability to do so did not correlate.

Combined data from both the easy-rated and the difficult-rated packaging samples

Table B12 below shows the relative importance of the factors influencing the participants' physical ability to open the packaging samples. This was ranked by a frequency count derived from the participants' comments concerning both the easy-rated and the difficult-rated packaging samples.

Table B12: The relative importance of the factors influencing the participants' physical ability to open the packaging samples

No.	Factors influencing the physical ability to open the packaging samples	A frequency count made from the participants' comments
1	Understanding of how to open the packaging samples	11
2	Limitations in hand strength	8
3	Hand and wrist pain	2
4	Limitations in hand dexterity	1

An understanding of how to open the packaging samples was the most important factor, followed by limitations in hand strength, then hand and wrist pain and finally limitations in hand dexterity.

Appendix C: Data from the in-depth interviews

Appendix C-1

Appendix C-1presents 1) the opening method employed in each of the two packaging samples selected for use in the in-depth interviews and 2) 2D and 3D indications employed on each of these packages. These packages were no.1 and no.2.

Package no.1 is a bottle of deodorant. The opening process of this package has two stages: 1) releasing the lid by twisting it clockwise (see Figure C1 below) so that the outer part of the lid moves down and reveals the atomiser and nozzle (see Figure C2) and 2) dispensing the contents by pressing the atomiser (see Figure C3).

Figure C1: Twisting the lid clockwise

Figure C2: The outer part of the lid moving down

Figure C3: Pressing the atomiser to dispense the contents

Package no.2 is a bottle of shower gel. The opening process of this package has two stages: 1) releasing the lid by twisting it anticlockwise (see Figures C4-5) and 2) dispensing the contents by turning the bottle upside down and squeezing it (see Figure C6).

Figures C4-5: Twisting the lid anticlockwise to release it

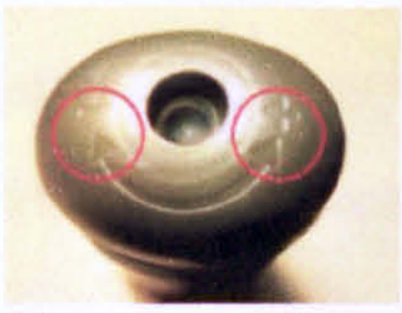
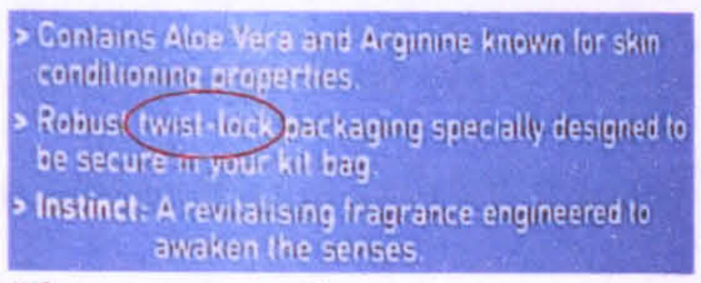
Figure C6: Turning the bottle upside down and squeezing it

Two and three dimensional indications employed on packages no.1 and no.2 are shown in Table C1 below.

Table C1: Two and three dimensional indications employed on packages no.1 and no.2

Packaging samples	2D indications	3D indications
Package no.1	The product name	The lid and the body
	The diagrams	The ridges on the top
	The arrows	The ridges around the lid
		The atomiser and the nozzle
		The indented base

Table C1: Two and three dimensional indications employed on packages no.1 and no.2 (continued)

Packaging samples	2D indications	3D indications
Package no.2	The product name	The indentations and the ridges
	The diagrams	The nozzle
	 The arrow and the plus and minus symbols	The gap between the lid and the body
	 The written information	The corresponding marks on the lid and the body
	The blue band	

Appendix C-2

Appendix C-2 presents the in-depth interview data concerning the role of 2D and 3D indications during the different stages of package opening.

Table C2 below shows 2D and 3D indications used during the three stages of opening the packaging samples: inspecting the packages, releasing the lid and dispensing the contents. These three stages are differentiated by colours: yellow, red and blue respectively.

The steps of the participant interactions with the packaging samples, for example, a) looked at the lid, b) read the diagram and c) pressed the indentations, are tallied in the first column.

Different symbols are used to represent the two types of interactions noted.

'•' indicates interactions in order to find and identify information for opening such as looking or reading. These interactions related to both 2D and 3D indications.

'■' represents interactions in order to release the lid or dispense the contents, for example, twisting the lid or pressing the atomiser. These interactions only related to 3D indications.

Table C2: 2D and 3D indications used when opening the packaging samples

Steps	Package no.1		Package no.1		Package no.2		Package no.2		Package no.2		Package no.2		Stages of opening
	2MA		2ME		1FB		2FD		2FF		2MC		
	2D	3D	2D	3D	2D	3D	2D	3D	2D	3D	2D	3D	
1	●			●	●	●	●		●		●	●	Inspecting the package
2	●	●		●		●	●	●	●		●		
3	●			●	●		●		●		●	●	
4	●		●		●		●	●	●		●		
5	●	●		●	●		●		●	●		○	
6	●		○			●	●	●	●			■	
7		○		■		○	●			●		■	Releasing the lid
8	○			○	○		●	●	●			■	
9		■		■	○		●			●		■	
10		■	○		○		●	●	●			■	
11		○		○	○		●		●	●		■	
12	○			■		■	●		●	●	○		
13		■		■		■		●	○			■	Dispensing the contents
14		■				■	●	●		○	○		
15		■			○		●		○			■	
16		■				■	●	●		■		■	
17					○		●		○			○	
18						■	●	●		■		■	
19						■	○	○	○	○		■	
20						■		■	○			■	
21							○		○	○		■	
22								■		■			
23								■		■			
24							○			■			
25							○	○	○	○			
26								■		■			
27								■		■			
28							○			■			
29							○		○	○			
30								■		■			
31								○	○	○			
32								■		■			
33							○			■			
34							○		○	○			
35							○		○				
36								■	○				
37								■		■			
38								■		○			
39								■	○				
40							○			■			
41									○				
42										■			

Inspecting the package

Two dimensional indications appeared to play an important role at the inspecting stage. This is validated by the indications which participants firstly and frequently referred to.

Table C2 above demonstrates that there were a greater number of participants who looked firstly at 2D than 3D indications. Participants 2MA, 2FD and 2FF looked firstly at the 2D indications; participant 2ME looked firstly at the 3D indications; and participants 1FB and 2MC looked firstly at both.

Table C2 above also shows that when inspecting the packages, participants looked at 2D indications more frequently than 3D indications, except participant 2ME. Participant 2ME looked at 3D indications more frequently than 2D indications.

Releasing the lid of the package

The importance of 3D indications appeared to increase at the releasing stage. This is validated by the indications which participants firstly and frequently referred to.

Table C2 above shows that there were a greater number of participants who looked firstly at 3D than 2D indications. Participants 2MA, 1FB and 2MC looked firstly at 3D indications; participants 2ME and 2FF looked firstly at 2D indications; and participant 2FD looked firstly at both.

Table C2 above indicates that when releasing the lid, there were a greater number of participants who frequently looked at 2D than 3D indications. Participants 2ME, 1FB, 2FD and 2FF looked at 2D indications more frequently than 3D indications. The frequency of looking at 2D indications, however, is slightly greater than that of looking at 3D indications, except for participant 1FB. Participant 1FB looked at 2D indications considerably more frequently than at 3D indications. Participant 2MC looked only at 3D indications. Participant 2MA looked at 2D and 3D indications equally.

Dispensing the contents

Table C2 above shows that participant interaction with the package can be placed into two groups, when dispensing the contents from packages no.1 and no.2. Participant 2MA used six steps when dispensing the contents from package no.1, whereas participant 2ME used three steps. In contrast, participants 2FD, 2FF and 2MC used 15-24 steps when dispensing the contents from package no.2. Participant 1FB tried eight steps when dispensing the contents from package no.2, but did not find this successful.

Three dimensional indications appeared to play a key role when dispensing the contents from package no.1. This is validated by the first indications that participants looked at. Both participants 2MA and 2ME looked firstly at the 3D indications. Participant 2ME then dispensed the contents straight away, whereas participant 2MA used another step, looking at the 2D indications, before dispensing the contents. In other words, participant 2MA looked at 2D and 3D indications equally.

Two dimensional indications tended to play an important role when dispensing the contents from package no.2. This is validated by the indications that participants frequently looked at. (Participant 2FF looked firstly at both 2D and 3D indications, whereas participants 1FB, 2FD and 2MC dispensed the contents immediately after releasing the lid.)

Table C2 above shows that when dispensing the contents, participant 1FB only looked at 2D indications, whereas participants 2FD, 2FF and 2MC looked at 3D indications too, albeit less frequently than 2D indications. This may be because there were no 3D indications, but the diagrams (2D indications) showed how to dispense the contents. However, the diagrams were too small to show clearly where to press the package when dispensing the contents. Thus, the participants used a number of steps, for example, revisiting the diagrams several times and pressing different places on the package (interactions with 3D indications), before dispensing the contents successfully.

Appendix C-3

The RIIO diagram in Figure 10 (chapter four) will be used to illustrate the use of 2D and 3D indications and information for releasing the lid (the white semi-circular segments) and for dispensing the contents (the grey semi-circular segments) of the packaging samples.

Releasing the lid of package no.1

The indications and information used when participants 2MA and 2ME released the lid of package no.1 are highlighted in black as shown in Figure C7 below.

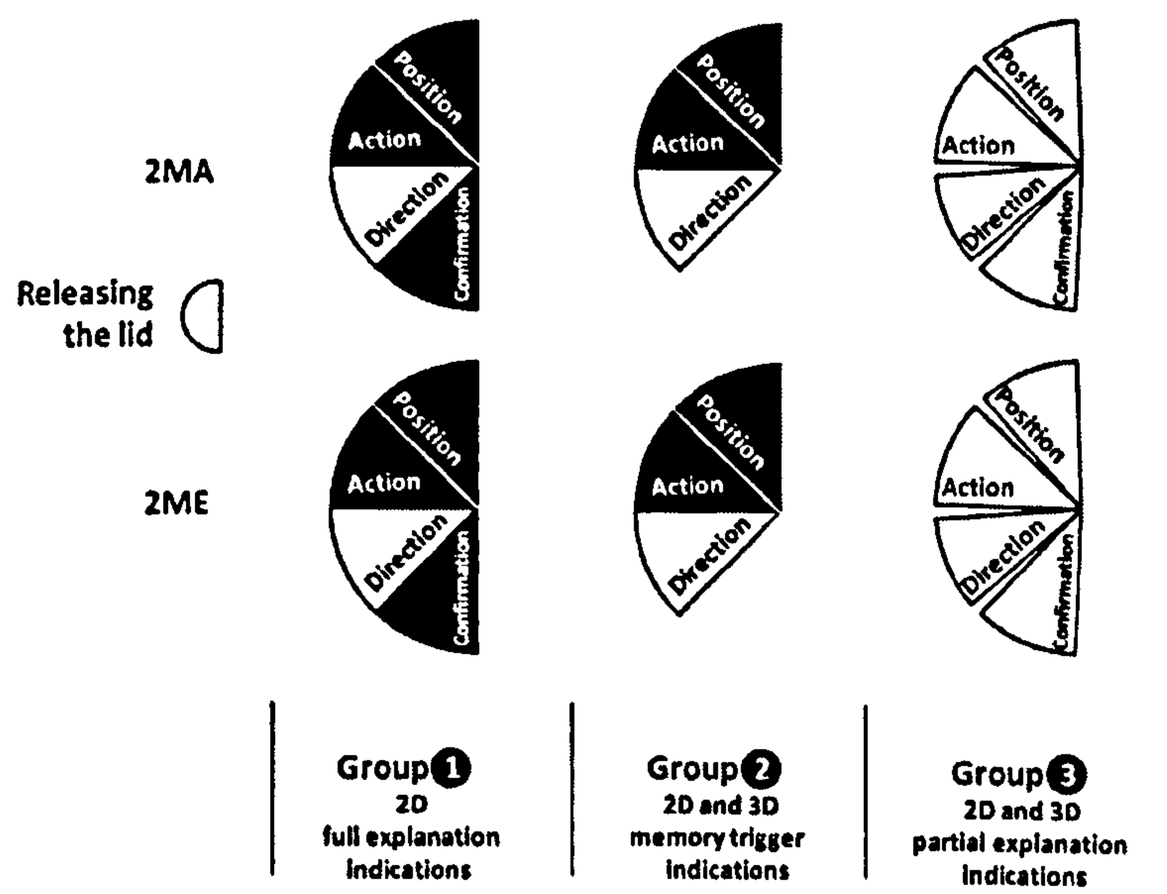


Figure C7: The indications and information used when participants 2MA and 2ME released the lid of package no.1

In group one, the full explanation indication, the diagram (a 2D indication), showed participants 2MA and 2ME the hand position and the hand action required for releasing the lid, but not the hand direction. Additionally, participants 2MA and 2ME used this indication to confirm the direction when twisting the lid, after learning this information by trial and error.

In group two, the memory trigger indications showed participants 2MA and 2ME the hand position and the hand action required for releasing the lid, but not the hand direction. The indications used by participant 2MA were the brand name and the word

anti-perspirant (all 2D indications) and by participant 2ME, were the shape of the lid and bottle and the surface texture around the lid (all 3D indications).

Participants 2MA and 2ME did not use partial explanation indications (group three) when releasing the lid.

Participant 2MA combined the 2D full explanation with 2D memory trigger indications, whereas participant 2ME combined the 2D full explanation with 3D memory trigger indications.

Dispensing the contents from package no.1

The indications and information used when participants 2MA and 2ME dispensed the contents from package no.1 are highlighted in black, as shown in Figure C8 below.

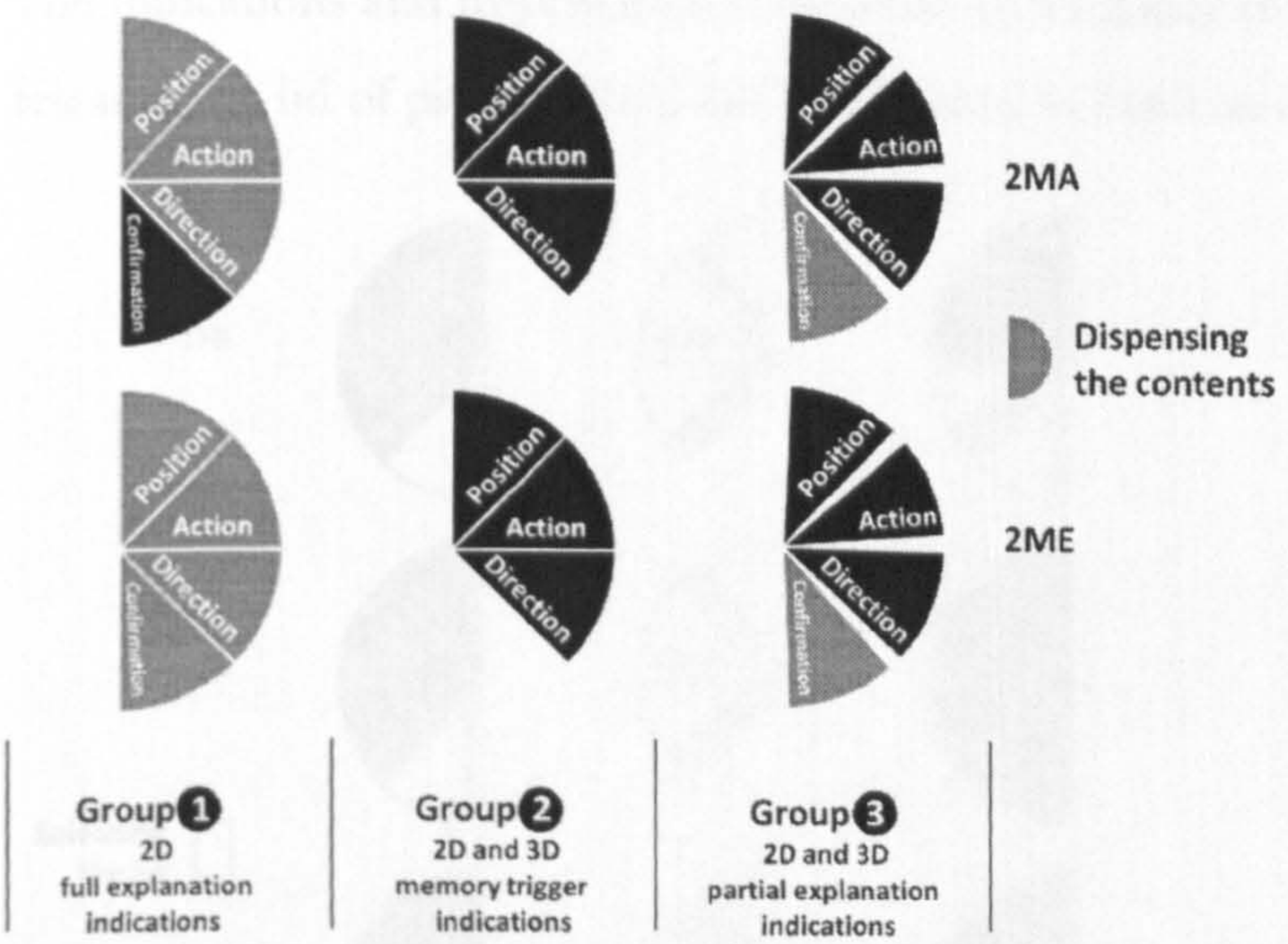


Figure C8: The indications and information used when participants 2MA and 2ME dispensed the contents from package no.1

In group one, participant 2MA used the full explanation indication, the diagram (a 2D indication), to confirm how to dispense the contents. Participant 2ME did not use this indication.

In group two, the memory trigger indications showed participants 2MA and 2ME the hand position, the hand action and the hand direction required for dispensing the contents. The indications used by both participants 2MA and 2ME were the atomiser and the nozzle (both 3D indications). Additionally, participant 2MA used the brand name

and the word *anti-perspirant* (both 2D indications), whereas participant 2ME used the indented base (a 3D indication).

In group three, the partial explanation indications showed participants 2MA and 2ME the hand position, the hand action and the hand direction required for dispensing the contents. The partial explanation indication used by both participants 2MA and 2ME was the surface texture on the lid (a 3D indication).

Participant 2MA combined the 2D full explanation, 2D and 3D memory trigger and 3D partial explanation indications, whereas participant 2ME combined the 3D memory trigger and 3D partial explanation indications.

Releasing the lid of package no.2

The indications and information used when participants1FB, 2FD, 2FF and 2MC released the lid of package no.2 are highlighted in black as illustrated in Figure C9 below.

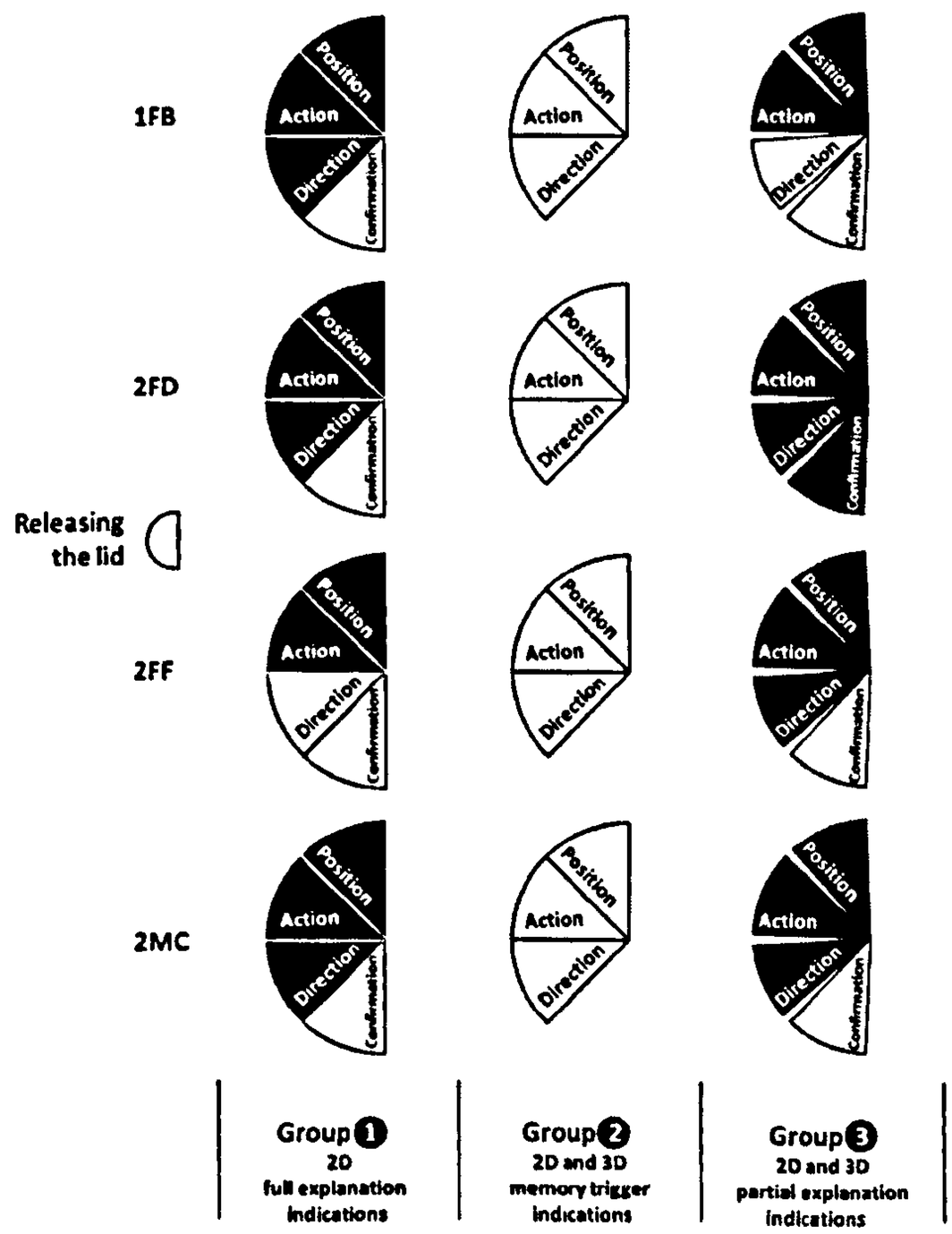


Figure C9: The indications and information used when participants 1FB, 2FD, 2FF and 2MC released the lid of package no.2

In group one, the full explanation indication, the diagram (a 2D indication), showed participants 1FB, 2FD and 2MC the hand position, the hand action and the hand direction required for releasing the lid. Participant 2FF did not see the hand direction.

In group two, the participants did not use memory trigger indications because the package was unfamiliar to them.

In group three, the partial explanation indications showed participant 1FB the hand position and the hand action required for releasing the lid and participants 2FD, 2FF and 2MC the hand position, the hand action and the hand direction. The partial explanation indications used by participant 1FB were the indentations on the lid (3D indications) and the written instructions (2D indications). Participants 2FD, 2FF and 2MC used the indentations on the lid (3D indications) and the indented symbols (2D indications). Additionally, 2FD used the vertical marks and the gap between the lid and main body of the package (all 3D indications) to confirm that the lid of the package was released.

Participants 1FB, 2FD, 2FF and 2MC combined the 2D full explanation with 2D and 3D partial explanation indications.

Dispensing the contents from package no.2

The indications and information used when participants 1FB, 2FD, 2FF and 2MC dispensed the contents from package no.2 are highlighted in black as demonstrated in Figure C10 below.

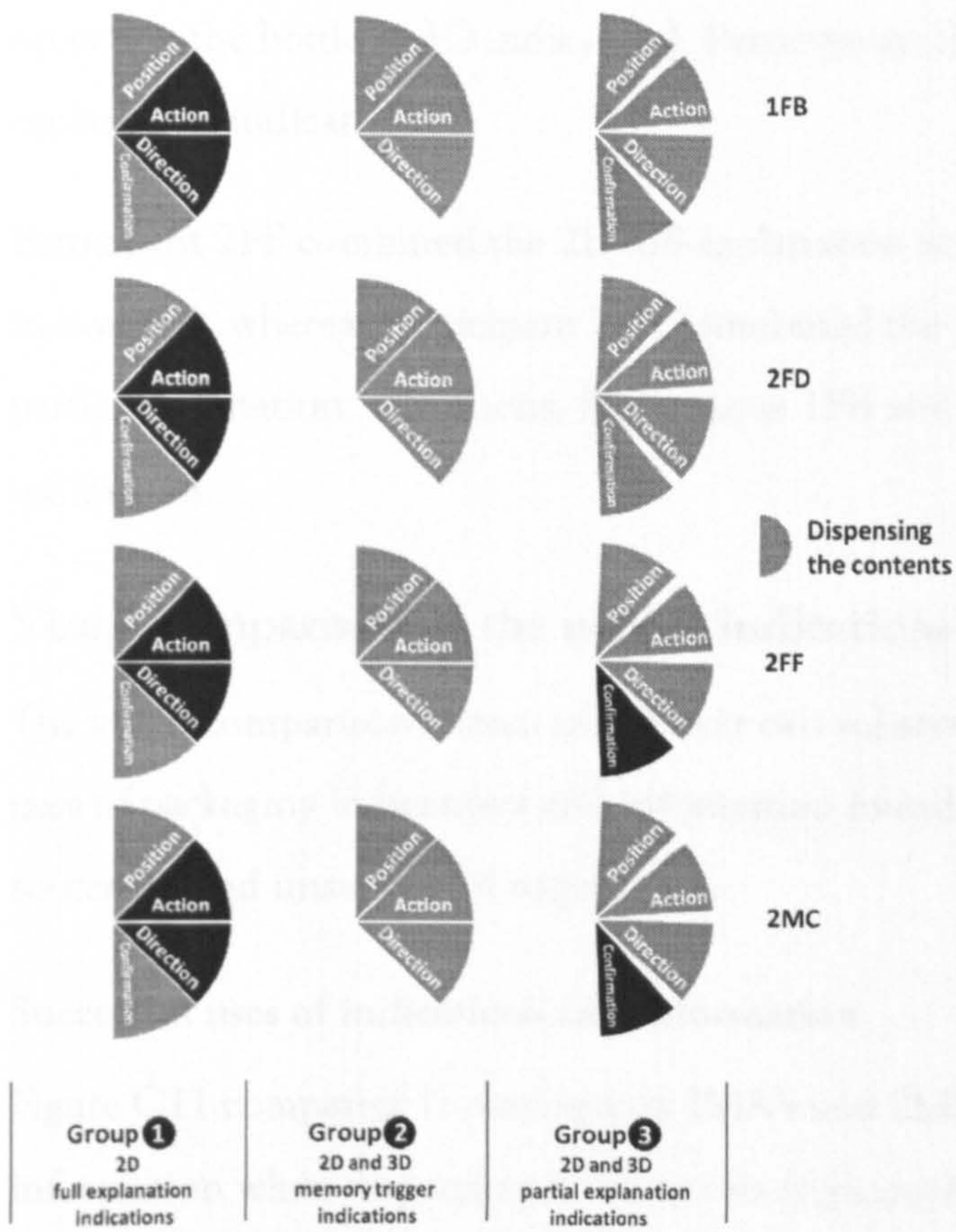


Figure C10: The indications and information used when participants 1FB, 2FD, 2FF and 2MC dispensed the contents from package no.2

In group one, the full explanation indication, the diagram (a 2D indication), initially showed participants 1FB, 2FD, 2FF and 2MC the hand action and the hand direction required for dispensing the contents, but not the hand position. Participants 2FD, 2FF and 2MC understood the hand position illustrated in the diagram after several opening mistakes. Participant 1FB could not understand this information.

In group two, the participants did not use memory trigger indications because the package was unfamiliar to them.

In group three, participant 2FF used the partial explanation indications to confirm the hand position and hand direction required for dispensing the contents. Participant 2MC used the partial explanation indications to confirm: 1) the hand position required for dispensing the contents and 2) successful dispensing of the contents. The indications used by participant 2FF were the blue band on the bottle (a 2D indication) and the nozzle (a 3D indication). Participant 2MC used the movement of the nozzle up and down when

squeezing the bottle (a 3D indication). Participants 1FB and 2FD did not use partial explanation indications.

Participant 2FF combined the 2D full explanation with 2D and 3D partial explanation indications, whereas participant 2MC combined the 2D full explanation with only 3D partial explanation indications. Participants 1FB and 2FD did not use combined indications.

Visual comparison of the uses of indications and information for opening

The visual comparison shown in the next two subsections illustrates the similarity of the uses of packaging indications and information found in cases where opening was successful and unsuccessful respectively.

Successful uses of indications and information

Figure C11 compares: 1) participants 2MA's and 2ME's successful uses of indications and information when dispensing the contents from package no.1 and 2) participants 1FB's, 2FD's, 2FF's and 2MC's successful uses of indications and information when releasing the lid of package no.2.

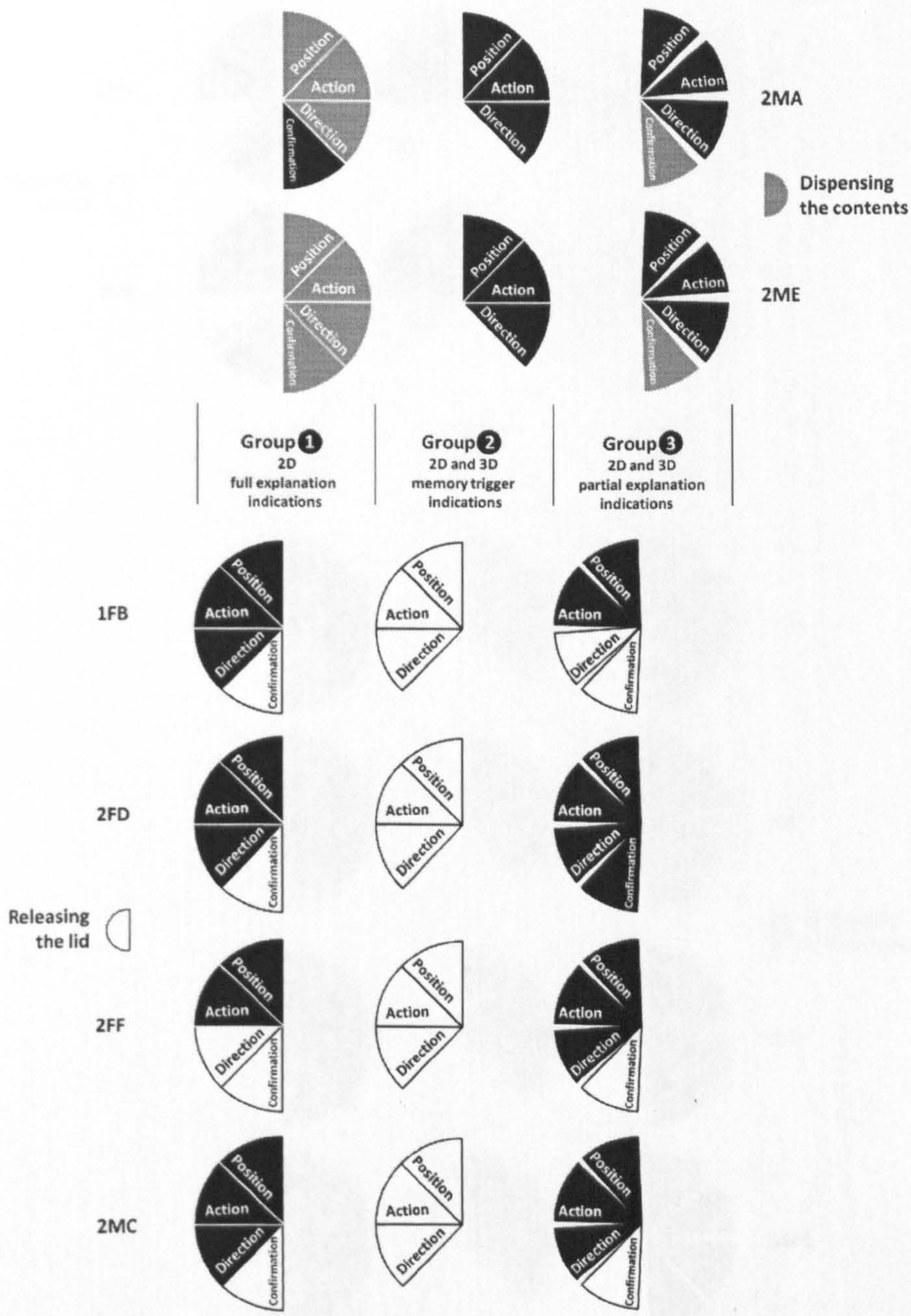


Figure C11: The comparison of the successful uses of the indications and information when dispensing the contents from package no.1 (above) and when releasing the lid of package no.2 (below)

Unsuccessful uses of indications and information

Figure C12 compares:1) participants 2MA's and 2ME's initially unsuccessful uses of indications and information when releasing the lid of package no.1 and 2) participants 1FB's, 2FD's, 2FF's and 2MC's initially unsuccessful uses of indications and information when dispensing the contents from package no.2.

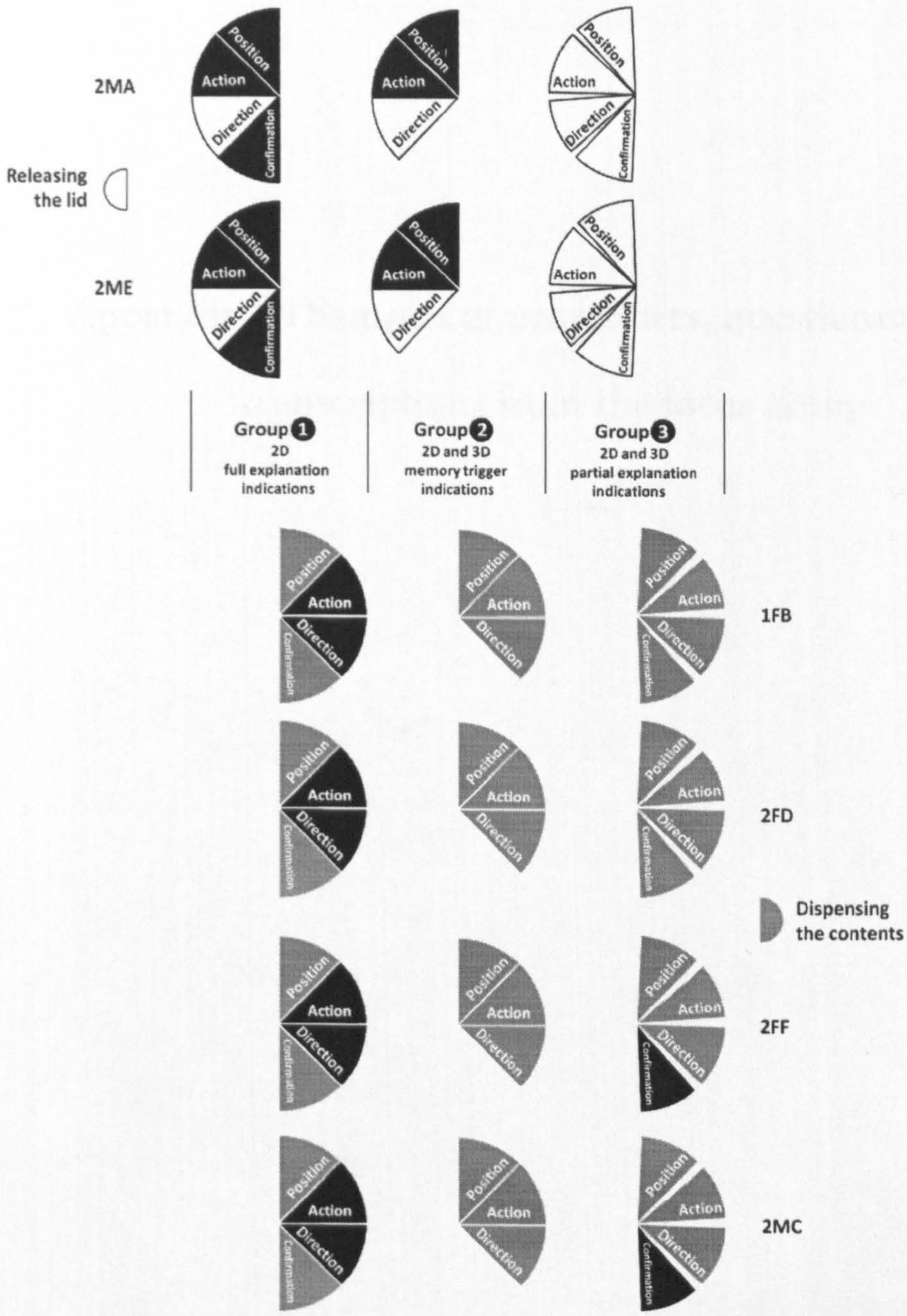


Figure C12: The comparison of the unsuccessful uses of the indications and information when releasing the lid of package no. 1 (above) and when dispensing the contents from package no.2 (below)

The similarity found in successful and unsuccessful uses of indications and information for opening (Figures C11 and C12) above permitted their characteristics to be drawn as presented in chapter four.

Appendix D: Samples of procedures, questionnaires and transcriptions from the focus groups

Moderator's guide				Page 1
Date:21 Nov 2007	Moderator: Dr. Andrew Saxon Researcher: Yada Chavalkul Focus group one : the Thousand Elders	Total		2.25 hrs
Topics	Description	Aids	Start at	Duration (mins)
Pre-meeting drinks (Dr. Laxman)	Introducing the purpose of the focus group Informing participants about voice recording Signing the statement of informed consent	Informed consent forms	10.15	10
Introduction (Yada)	This research is titled 'Package openability: design for novel packaging for older people'. **Packaging** Packaging in my research refers to packages for food and household use. **Openability** Openability is not only concerned with how you open a package by hand, but also your understanding of how to open it. In general, you know how to open packages because they are familiar, but how about newly designed packages. Some look familiar: others may look unfamiliar. When looking at unfamiliar packages, you may be not sure how they could be opened. Also, you may find some packages are easy and others are difficult to understand how to open. Openability in my research is concerned with how packaging guides you how to open it. We are going to discuss this today. We are going to do two things today, an individual session and a group session. In session one, we are going to put some screens up and ask you to look at some packages and fill in the forms that share you opinions on each package. At the end of session one, we will take the screens away. Then, we start session two. In session two, we will show you packaging that you have told us is easiest to understand how to open. We will then discuss it more. It's important to note that we are not measuring your own ability to open packaging. Instead, we are trying to understand how packaging could be designed so that it is easy for you to understand how to open it. Now, I would like to set the screen between you for the first session. Then, Dr. Saxon, my supervisor will be the moderator of the group.		10.25	10
Providing individual session (Yada)	Setting screens	Paper boards	10.35	5

Moderator's guide				Page 2
Date:21 Nov 2007	Moderator: Dr. Andrew Saxon Researcher: Yada Chavalkul Focus group one : the Thousand Elders	Total		2.25 hrs
Topics	Description	Aids	Start at	Duration (mins)
Part I: Individual session (Dr. Saxon)	There are three forms for you to fill in. The first two are related to your opinions to the packaging samples. Then, the last form is for your profiles. Shall we try?			
Form 1: rating the packaging samples by familiarity/ unfamiliarity of opening (Dr. Saxon)	Show six packages to participants. Explain what product is in each package. Then, give six packages to each participant. Please look at each package without opening it and rate how **familiar** or **unfamiliar** you are with that **kind of opening** by circling a number on the scale. **Please remember we don't open it at this stage.** '**Familiar**' means 'You know now how to open this package' '**Unfamiliar**' means 'You do not know now how to open this package'	Form 1 and the packaging samples	10.40	10
Form 2: rating the packaging samples by ease/difficulty to understand how to open them and to physically open them (Dr. Saxon)	Please try to open each package. **Please remember we don't open it to get a great volume of products, but just get it enough to use.** In form 2a, rate how **easy** or **difficult** it was for you to **understand** how to open it by circling a number on the scale. **Please remember in this form we are looking at how easy/difficult it was for you to understand how to open rather than how physically easy/difficult it was for you to open.** Then, in form 2b, please rate how **easy** or **difficult** it was for you to **physically open** it by circling a number on the scale.	Forms 2a and 2b and the packaging samples	10.50	30
(Dr. Saxon and Yada)	Three packages can be opened by two ways. The first one is for manufacturers to fill a great volume of products into the packages; the second one is for users to easily get products enough to use. Yada will now show you how to open these packages by the second way. If you opened any of them in different ways from what Yada showed you, it suggests that those packages cannot properly guide you how to open. In this case, please reconsider the scores that you have rated for those packages **in form 2a.**	Form 2a and the three packaging samples	11.20	15
Form 3: personal profiles (Dr. Saxon)	Form 3 collects some basic information about you that will be useful later on. Please fill in form 3.	Form 3	11.35	10

Date:21 Nov 2007	Moderator: Dr. Andrew Saxon Researcher: Yada Chavalkul Focus group one: the Thousand Elders	Total 2.25 hrs		
Topics	Description	Aids	Start at	Duration (mins)
Calculating the rated scores of form 2a (Yada)	(When participants fill in form 3, the researcher calculates the rated scores of form 2a in order to identify packaging that participants think the easiest to understand how to open)	Excel		
Providing group session (Yada)	Now, I would like to remove the screen out of the table for the next discussion.			
Part II: Group session (Dr. Saxon)	We have looked at the forms and here is the package that most people rated easiest to understand how to open. Now, we will discuss this package.	The packaging sample and voice recorders		
(Dr. Saxon)	**Q.1) How did you find out how to open this packaging?** -Have you seen this kind of packaging before? -Was it with this product or a different product? -Which that different product is?	The packaging sample and voice recorders	11.45	10
(Dr. Saxon)	**Q.2) Was there something on the package that helped you to understand how to open it?** (At the flip chart, write 'indications' at the top of the flip chart and list what participants said, e.g. shapes, surface textures, colours, texts, diagrams, illustrations and instructions.) -Did you **see** something that helped you to understand how to open this package? Can you tell me more? -Did you **feel** something that helped you to understand how to open this package? Can you tell me more? -Did you **read** something that helped you to understand how to open this package? Can you tell me more? -Did you **hear** something that helped you to understand how to open this package? Can you tell me more?	The flip chart, the packaging sample and voice recorders	11.55	10
(Dr. Saxon)	Q.3) All those things that you called out, I wrote down on the flip chart. We will call them 'indications'. Now, we will consider each indication that you call at. **Can you say if you have seen this indication about opening before on other packages? Can you explain where?**	The flip chart, the packaging sample and voice recorders	12.05	10

Date:21 Nov 2007	Moderator: Dr. Andrew Saxon Researcher: Yada Chavalkul Focus group one: the Thousand Elders	Total 2.25 hrs		
Topics	Description	Aids	Start at	Duration (mins)
(Dr. Saxon)	**Q.4) Now, I will give you a sticker. I am going to ask each of you to put your sticker on the indication that you think it is the most important.** **Can you explain why you think it is the most important?**	The chart and stickers	12.15	10
(Dr. Saxon)	**Q.5) Compared to the other easy samples, why was it easier for you to understand how to open this packaging?**	The three easy-to-understand packaging samples and voice recorders	12.25	10
Summary (Dr. Saxon)	All done with the planned questions now. We have talked about what helped you to understand how to open packaging and also rated the indications you found according to their importance. **Is there any thing we have not covered about understanding how to open packaging that you would like to bring up?**	The packaging samples and voice recorders	12.35	5

Moderator's guide				Page 1
Date:22 Nov 2007	Moderator: Dr. Andrew Saxon Researcher: Yada Chavalkul Focus group two: the Thousand Elders	Total		2.05 hrs
Topics	Description	Aids	Start at	Duration (mins)
Pre-meeting drinks (Dr. Laxman)	Introducing the purpose of the focus group Informing participants about voice recording Signing the statement of informed consent	Informed consent forms	10.15	10
Introduction (Yada)	This research is titled 'Package openability: design for novel packaging for older people'. **Packaging** Packaging in my research refers to packages for food and household use. **Openability** Openability is not only concerned with how you open a package by hand, but also your understanding of how to open it. In general, you know how to open packages because they are familiar, but how about newly designed packages. Some look familiar: others may look unfamiliar. When looking at unfamiliar packages, you may be not sure how they could be opened. Also, you may find some packages are easy and others are difficult to understand how to open. Openability in my research is concerned with how packaging guides you how to open it. We are going to discuss this today. We are going to do two things today, an individual session and a group session. In session one, we are going to put some screens up and ask you to look at some packages and fill in the forms that share you opinions on each package. At the end of session one, we will take the screens away. Then, we start session two. In session two, we will show you packaging that you have told us is most difficult to understand how to open. We will then discuss it more. It's important to note that we are not measuring your own ability to open packaging. Instead, we are trying to understand how packaging could be designed so that it is easy for you to understand how to open it. Now, I would like to set the screen between you for the first session. Then, Dr. Saxon, my supervisor will be the moderator of the group.		10.25	10
Providing individual session (Yada)	Setting screens	Paper boards	10.35	5

Moderator's guide				Page 2
Date:22 Nov 2007	Moderator: Dr. Andrew Saxon Researcher: Yada Chavalkul Focus group two: the Thousand Elders	Total		2.05 hrs
Topics	Description	Aids	Start at	Duration (mins)
Part I: Individual session (Dr. Saxon)	There are three forms for you to fill in. The first two are related to your opinions to the packaging samples. Then, the last form is for your profiles. Shall we try?			
Form 1: rating the packaging samples by familiarity/ unfamiliarity of opening (Dr. Saxon)	Show six packages to participants. Explain what product is in each package. Then, give six packages to each participant. Please look at each package without opening it and rate how **familiar** or **unfamiliar** you are with that **kind of opening** by circling a number on the scale. **Please remember we don't open it at this stage.** **'Familiar'** means 'You know now how to open this package' **'Unfamiliar'** means 'You do not know now how to open this package'	Form 1 and the packaging samples	10.40	10
Form 2: rating the packaging samples by ease/difficulty to understand how to open them and to physically open them (Dr. Saxon)	Please try to open each package. **Please remember we don't open it to get a great volume of products, but just get it enough to use.** In form 2a, rate how **easy** or **difficult** it was for you to **understand** how to open it by circling a number on the scale. **Please remember in this form we are looking at how easy/difficult it was for you to understand how to open rather than how physically easy/difficult it was for you to open.** Then, in form 2b, please rate how **easy** or **difficult** it was for you to **physically open** it by circling a number on the scale.	Forms 2a and 2b and the packaging samples	10.50	30
(Dr. Saxon and Yada)	Three packages can be opened by two ways. The first one is for manufacturers to fill a great volume of products into the packages; the second one is for users to easily get products enough to use. Yada will now show you how to open these packages by the second way. If you opened any of them in different ways from what Yada showed you, it suggests that those packages cannot properly guide you how to open. In this case, please reconsider the scores that you have rated for those packages **in form 2a.**	Form 2a and the three packaging samples	11.20	15
Form 3: personal profiles (Dr. Saxon)	Form 3 collects some basic information about you that will be useful later on. Please fill in form 3.	Form 3	11.35	10

Date:22 Nov 2007	Moderator: Dr. Andrew Saxon Researcher: Yada Chavalkul Focus group two: the Thousand Elders	Total 2.05 hrs		
Topics	Description	Aids	Start at	Duration (mins)
Calculating the rated scores of form 2a (Yada)	(When participants fill in form 3, researcher calculates the rated scores of form 2a in order to identify packaging that participants think the most difficult to understand how to open)	Excel		
Providing group session (Yada)	Now, I would like to remove the screen out of the table for the next discussion.			
Part II: Group session (Dr. Saxon)	We have looked at the forms and here is the package that most people rated most difficult to understand how to open. Now, we will discuss this package.	The packaging sample and voice recorders		
(Dr. Saxon)	**Q.1) How could this packaging be improved so it is easier to understand how to open it?** (At the flip chart, write 'indications' at the top of the flip chart and list what participants said, e.g., shapes, surface textures, colours, texts, diagrams, illustrations and instructions.) -what would help you to understand how to open this package?	The flip chart, the packaging sample and voice recorders	11.45	10
(Dr. Saxon)	Q.2) All those things that you called out, I wrote down on the flip chart. We will call them 'indications'. Now, we will consider each indication that you call at. **Now, I will give you a sticker. I am going to ask each of you to put your sticker on the indication that you think it is the most important.** **Can you explain why you think it is the most important?**	The chart and stickers	11.55	10
(Dr. Saxon)	**Q.3) Compared to the other difficult samples, why was it more difficult for you to understand how to open this packaging?**	The three difficult-to-understand packaging samples and voice recorders	12.05	10
Summary (Dr. Saxon)	All done with the planned questions now. We have talked about indications that would help you to understand how to open packaging and also rated the indications you suggested according to their importance. **Is there any thing we have not covered about understanding how to open packaging that you would like to bring up?**	The packaging samples and voice recorders	12.15	5

FORM 1

Please look at each package without opening it and rate how **familiar** or **unfamiliar** you are with that **kind of opening** by circling a number on the scale. **Please remember we don't open it at this stage.**

'Familiar' means 'You know now how to open this package'.
'Unfamiliar' means 'You do not know now how to open this package'.

For participants | For researcher

Package no.		
1	1 2 3 4 5 6 7 very familiar very unfamiliar	
2	1 2 3 4 5 6 7 very familiar very unfamiliar	
3	1 2 3 4 5 6 7 very familiar very unfamiliar	
4	1 2 3 4 5 6 7 very familiar very unfamiliar	
5	1 2 3 4 5 6 7 very familiar very unfamiliar	
6	1 2 3 4 5 6 7 very familiar very unfamiliar	

For researcher

Participant	A	B	C	D	E	F

FORM 2a

Please rate how **easy** or **difficult** it was for you to **understand** how to open it by circling a number on the scale.

For participants

Package no.		For researcher
1	1 2 3 4 5 6 7 very easy to understand — very difficult to understand	
2	1 2 3 4 5 6 7 very easy to understand — very difficult to understand	
3	1 2 3 4 5 6 7 very easy to understand — very difficult to understand	
4	1 2 3 4 5 6 7 very easy to understand — very difficult to understand	
5	1 2 3 4 5 6 7 very easy to understand — very difficult to understand	
6	1 2 3 4 5 6 7 very easy to understand — very difficult to understand	

For researcher

Participant	A	B	C	D	E	F

FORM 2b

Please rate how **easy** or **difficult** it was for you to **physically open it** by circling a number on the scale.

For participants

Package no.		For researcher
1	1 2 3 4 5 6 7 very easy to open — very difficult to open	
2	1 2 3 4 5 6 7 very easy to open — very difficult to open	
3	1 2 3 4 5 6 7 very easy to open — very difficult to open	
4	1 2 3 4 5 6 7 very easy to open — very difficult to open	
5	1 2 3 4 5 6 7 very easy to open — very difficult to open	
6	1 2 3 4 5 6 7 very easy to open — very difficult to open	

For researcher

Participant	A	B	C	D	E	F

FORM 3

Personal profiles

Please circle any that apply

Participant:	A	B	C	D	E	F
Age:	65-74		75-84		85+	
Gender:	Female		Male			

Do you have any health related condition?

No Yes

If yes, please tick any that apply

- [ ] Short sightedness
- [ ] Long sightedness
- [ ] Tunnel vision
- [ ] Cataracts
- [ ] Glaucoma
- [ ] Partially deaf
- [ ] Diabetic retinopathy
- [ ] Arthritis
- [ ] Other, please specify.

.....

Educational levels

Please state the highest level of qualifications or training attained.
If none, please leave blank.

.....

.....

.....

Focus groups for research project:
Package openability: design for novel packaging for older people

For researcher

Thank you for your time and help in the focus group. The information gained from the group will provide understanding of how packaging could be easy for older consumers to understand how to open so that this information can be used to develop design recommendations for packaging designers.

The purpose of this focus group is to develop directions for the research and questions for later in depth interviews.

All information will be confidential, and all information used arising from the research will be anonymous.

You have the right to withdraw from the session at any time, either before we start, during the meeting or afterwards. You won't be asked to explain your decision.

During the session, an audio recording will be made, so that we can recall what was said accurately.

If you have any questions, please feel free to ask them.

_____(sign) _____(date)
Researcher's signature
Yada Chavalkul
PhD research student
Birmingham Institute of Art and Design,
Birmingham City University
Corporation Street, Birmingham B4 7DX
appphd_yada@yahoo.com
0121 331 7850

For participants

We do need to ask for your consent to the recording, and the subsequent use of the information created, as explained above.

I consent to the audio recording of the focus group meeting I am about to participate in.

_____(sign) _____(print name) _____(date)
Participant's signature

Transcription

Focus group one on 21th November 2007

Question 1

Dr. Saxon: What we will do now is just asking you to discuss, so what I do we've got the recorder there and, then, recording. I've got basically a shortlist of questions and I am going to try to ask questions that go to the easiest one to understand how to open the package...and will spend ten minutes at the time per question asking you to discuss among yourselves really... and with me... your views on the particular package and the recorder will be recoding and Yada will make same notes as well to add a bit more information. Afterwards what has to happen is Yada sits down with the head phone on and she types it all up from the voice recorder. So, if we get to the point when many people speak at the same time... I might rap the table and say please could you go one at the time because otherwise it can confuse the voice of the recorder and important information could be lost. That's basically you gonna do. So, **the first question** we've got ten minutes for each question basically it's free for discussion and that one...the easiest to use package...**How do you find out how to open this package?**

1FF: The arrow.
1MA: The arrow on the top.
1FF: Turn it left.
1ME: Yes. That's right. The arrow.
1FD: Just follow the arrow.
1ME: Yes, that's fairy straight forward something, isn't it? I mean... in terms of getting it... actually opening... yes.
1FD: Just follow they are and then press down.
1ME: and press the lever.
Dr. Saxon: Yes. Was it...
1MA: The lever speaks for itself, doesn't it?
1ME: It does... yes.
1MA: <laugh>
Dr. Saxon: **Was it difficult or easy to find the arrow?...** because that's the most important thing.
1MC: No.
1FD: No. It's quite easy.
1MA: Straight forward.
1FF: It's easy.
1MA: It's as easy as possible because the arrow is actually cut out of the white... er... circle.
1FF: It's light enough to be seen.
1FD: Yes.
1FB: That's right.
1MA: You can press it either right or left, whichever you want.

1ME: Yes. You can also experiment where it relocks it when you circulate the thing and er...
Dr. Saxon: How did you get on with which way round in the hand it goes?
1ME: Well, the arrow's pointing to the right and oh it wasn't sorry.
Dr. Saxon: When you've unlocked the lock you probably...
1FF: Like in the shape of that.
Dr. Saxon:...got a position about how you hold it then, haven't you?
1ME: Yes, that's right.
1MA: The shape of it.
1FF: The shape of that...
Dr. Saxon: The shape.
1MA: You're obviously not to move... press it down with that facing you.
Dr. Saxon: Yeah.
1FF: Oh. I don't know.
1ME: It is also experimenting, isn't it? Cause I mean it... you've got a sort of...
1MA: You can do it in two ways. You're spraying somebody else. Or if you're spraying yourself as long as you keep it away from your face.
1FF: It tells you not to spray it on your face.
1ME: No. That's right...
1MA: And the again at the back, with anybody that is a bit er... short sighted or with eye problems. The printing is very small.
1FD: Emh... it's that blue, isn't it?
1FF: That's what I found... I've only got one eye at the moment.
1MA: It's too much information.
1FB: It is easy to break.<laugh>
Dr. Saxon: It's tiny writing, isn't it?
1FF: Yeah. It's tiny. Yeah... something as long as you can get the light on it... You're all right.
1MA: Unfortunately in this day actually they're having to put so much...
A participant: Human factor.
1MC: That one is quite easy icon. That would very easy. That was quite easy to understand and it was easy to operate.
1ME: Yes.
1FD: Yes, it was. Good.
1FB: It's easy to break.
Participants: <laugh>
1FF: Oh, you broke. Oh..dear.
1FB: I've just broken it.
1ME: That's another thing for the manufacture then, doesn't it?
Dr. Saxon: It is. Yes. What's happen there then... has the trigger come off...
1FB: I think it was trigger... yes... I pressed it too hard.
1ME: If you'd bought that... you'd be now sort of not able to use it as such?
1FB: It just broke. I can't see a way of getting it back on.
1ME: Send it back for replacement.
1FB: Do what I do at home, when I break thing, I give them to my husband... you can't. <laugh>

Dr. Saxon: OK! Thinking about the packaging on... em... the winning products...
1MC: That's the reason. Press that up, and then, you can open it underneath.
A participant: Tiny back up.
1FB: Yes, but it's still break.
1MA: And then press it back down again.
Dr. Saxon: It's all right. Don't worry.

Sub question 1

Dr. Saxon: Have you seen this kind of packaging ever before?
1FD and 1MC: No.
1ME: not terribly familiar... No, I don't think. No.
1FB: No.
1FF: And I don't go to Asda actually.
1FB and 1FF: No.
Dr. Saxon: Even on a different product?... No?
1FD and 1MC: No.
Dr. Saxon: Is that everybody saying that?
1MA: Oh. I dunno. Some of the... household cleaners... they've got this type of er...
1ME: Yes, they have actually.
1MA: And now a lot of household cleaners... they got this type of the...
1FF: That's right. The flashing like.
1MA: ... the spray in the cooker or the work surface.
1ME: That's right.
1MA: They got the spray on. Most of the... em...
1FB: Yes. But they're not quite...
1MA: Most of the... em...
1ME: They're bigger though. They're bigger than that.
1MA: Oh. Yes. But they got the same principle.
1ME: Yes. They have the same principle. That's right.
1MA: I mean that leaves it told you the story about... use it.
1FD: Yes.
1ME: Also...
Dr. Saxon: We thought about flashing in particular as the name of the product as the similar method of using and then household cleaners came up as a general category that uses this squirt...
1MA: And the window cleaners... you can buy the 'Windolene' (a brand name) or whatever it's called you squirt... spray your window with that type of the top.
1ME: Equally I think it needs to be said that this one is more delicate in terms of you know... it can come apart if you... you know sort of squeeze it... Whereas those bigger one you mentioned I think they are a bit more...
1FB: I never have problems.
1MA: More robust.
1ME: Do you not?
1FB: No. But I have with that... (unintelligible) a bit odd.

1FF: Yes. I mean, if you are very badly arthritic, that could be important to break as easily as that, couldn't it?
Dr. Saxon: If it broken in that way it will be beyond use, wouldn't it? Or you have to unscrew... using manufacturer opening... You'd be taking it back to the shop.
1FF and 1FB: Yes.
1ME: How do you find them?
1FB: Well perhaps I was heavy handed you know...
1FD: I found out that it quite good actually.
1MC: It is quite simple.
1FD: Absolutely... just follow the arrow.
1FB: It's simple, but then I was... mm...
1ME: You can read it quite ok! Yes. Aha... both ways...
1FD: Well... I think that pale blue knock you off a bit... you know...
1ME: The colour.
1FD: Yes... The colour. Unless they have the writing deeper, like real black writing or something.
1ME and 1FB: Yes.
1ME: Yes... More discernable...Yes... I agree with you.
1FD: Other than that it was quite good that.
1ME: Yeah. We're saying about what... one of the best... easier ones to sort of understand, you know, weren't we? If there was no label you can almost sort of follow the things and experiment without having read it... I mean the label... probably no... (unintelligible).
A participant: Yes.
Dr. Saxon: OK! Anything else to share with us on how you find out how to open packages or did we cover that... probably have...
1MA: I think it is...
1FF: Besides the printing to be a bit larger.
1MA: Instructions.
Dr. Saxon: Did everybody read the instructions first or not?
1FB: Tried to.
1FF: Yes. They are very small, aren't they?
1FB: Tried to. It's difficult.
1FD: Yes. You look, like, don't you, first. Then, I don't know you just think to yourself. Well, that's going that way.
1MA: I turned it over and looked at the instructions afterwards.
1MC: I couldn't read the instructions because of this type of write.
1FF: It is very common...
1FD: I just try this then.
1ME: Yes and it works.
1FB: I have to use a magnifying glass at home.
1MC: Yes. You would.
1FB: To read stuff like that.
1MA: Tilting it again that way.
1FF: Magnifier seems to be getting in smaller as well, don't they?
1FB: Yes.

1MA: Then, I've got read quite easy.
1FB: Not really.
1MC: They're trying to get too much information on to a package.
1FF: Yes. That's right.
1ME: Yes.
1MC: Because they use the different languages as well. It takes up such a lot of space.
1ME: Yes. If they simplify thing and kept it to a few words, it'd be essential.
1MC: Yes.
1ME: It's probably better giving a bit larger print.
1FB: I get out for manufacturers because they say they put the warning on... where... you know it is there, but you can't read it. It's no good.
1ME: No.
1FB: Not people like me.
1ME: Yeah. Quite...yeah.
Dr. Saxon: OK! I think we cover that one... That's excellent really useful information for us actually... very very good information.

Question 2

Dr. Saxon: The second task, Yada will be going to the flip chart and getting ready to write down... er... basically, she will be writing down the key parts of what you're saying, so although we're recording it she's gonna make notes of the things you chucking out to her now and, then we will ask you to consider that list that she made from what you say in the third activity that will go on the flip chart. So, Yada, if you write 'indications' at the top of the flip chart...We're still talking about this package. Mine is yellow. We're still talking about the winning package... the easiest to use package as voted by you all. Em... so, the question is again we've got 10 minutes... so, there is lot of time... em... **Was there something on the package that helped you to understand how to open it?** And because Yada is gonna write this down, if you call your items out one person by one...

1MC: I would have thought, but just looking at it... it's just common sense... you didn't need the instructions to open that.
Dr. Saxon: right...
1MC: Common sense will tell you... yes.
Participants (ME, FD, FF): Yeah.
1FF: Got the arrows there. You've got the lever there.
1MC: Yes. You've got the arrow.
1ME: There's very little in fact on the actual directions that I can see about how you would open the thing.
1FD: How to open.
1ME: How many.... we had person with the poor eye sight where they couldn't be here, but I mean.
Dr. Saxon: Yes...
1ME: There's not a great deal written down... as you say you can sort of figure it out by looking at it.

1MC: Or with a magnifying glass and the... light over your shoulder... you possibly would be able to read it, but that's about it.
1ME: Yeah. Yeah. That's right.
Dr. Saxon: Any other comment about...
1MA: They could print on the word 'press' or an 'arrow' there on the teeth. It is not really necessary.
1FF: No. not necessary a lot of those.
1MA: It's self-explanatory... If you're looking to increase the indication of how you work it, then, the only one worth thing I can find is the word 'press' or and the 'arrow' on the lip.
Dr. Saxon: Add an arrow to the lip.
1MA: Just the lip... on the arrow.
Dr. Saxon: where your finger goes...
1MA: But I mean when you look at it. It tells you what it is. It's self-explanatory...
A participant: <ask a question to FB>
1FB: I don't know. <laugh>
Dr. Saxon: So, basically, you see it and you understand it...
Participants: Yes.
1FB: I pressed something.
1ME: And I think it's fair to say that with the lady having some difficulties
and actually... em... the thing breaking... it wasn't her fault... emh... there needs to be... better...
1MC: You haven't broken it.
1FB: Haven't I?
1MC: No, you haven't... Oh you have.
1FB: I have broken it.
1ME: ... quality. It's easy done... Could happen to anyone, couldn't it?
1FF: If you get a child that's a bit ham-fisted that could.
1MC: It won't stick down anyway.
1ME: That's right. Yes.
1FB: It would go back. It's... that's useless. Go back to the shop.
Dr. Saxon: So... Yeah, it would have to go back to the shop.
1FF: You have to use it the manufacture way.
1ME and 1MC: Yes.

Sub question 2

Dr. Saxon: So, what I'm gonna do now is...
1FB: It doesn't say handle with care, does it?
Dr. Saxon: No...
1ME: That's right.
Dr. Saxon: Am just gonna sort of walk through really some trigger questions, if we can think about because it is a trigger question. So, on package on the winning package and we are talking about understanding how to open the package. **Did you see something on here that helped you to understand how to open the package?**
1FF: The arrow.

1MA and 1MC: The arrow.
Dr. Saxon: You saw the arrow... yeah.
1FD: Yeah, the arrow.
1ME: Yeah.
1FF: And then the trigger.
Dr. Saxon: And then you saw the trigger... yeah.

Dr. Saxon: Did you see anything else on the package that helped you to understand how to open it?

1MC: obvious
1MA: Yeah...it's the nozzle coming through that.
1ME: Yes. That's right.
1MA: The hole in them.
Dr. Saxon: You saw the nozzle...
1FD: Yes. It's all you knew that.
1ME: You knew which way to direct it, didn't you?
1FB: They helped that help.
1FF: Yes.
Dr. Saxon: The grooves.
1FB: Yes, the grooves help to... emh... hold it... emh. Yeah.
Dr. Saxon: So, the grooves in the side of the bottle, help you to hold it.
1MA: Yeah.
1FB: ... of the bottle. Yes. Help you to give it pressure.

Dr. Saxon: Did you see anything else on the package that helped you to understand how to open it?
1MC: No, that's it.
1FD: Reading.
1ME: Not for read it.
1MC: No, just common sense.
1MA: What about reading the instructions.
1ME: But, there was nothing but you could read.
1MC: No, nothing.

Dr. Saxon: OK! We're coming to reading. In fact, shall we do reading next? Did you read anything or did you read something that helped you to understand how to open this package?

1MA: No.
Dr. Saxon: I suppose that also includes could you read?
1MC: No.
1FB: No, not very well, no.
1FF: Very difficult.
Dr. Saxon: Very difficult to read.
1FF: Too small.

Dr. Saxon: The text was too small...
1MA: Well there is a paragraph here that says 'how to use'.
A participant: yes.
1MA: And the funny part of it 'how to use' is in white print.
Dr. Saxon: yes...
1MA: ... which is very very difficult to read on the blue.
1FB: Yes.
1FF: No, I found that easy to read.
1FB: No.
1MA: The rest is all in black. <laugh> All apart from the word ingredients underneath.
1FB: 'How to use' gets lost with the pale blue.
1MA: Oh, yes.
1FD: Yes, that blue.
1FB: Just whites.
1FD: I don't like that blue.
1FF: I just found it's too small.
1FB: Emh...
Dr. Saxon: So, the colour...
1ME: It tells you of the product in terms of usage, but it doesn't tell you about the opening...
1MA: No. No.
1FD: That's true. No.
Dr. Saxon: So, you're not told in writing how to open it.
1MA: No.
Dr. Saxon: Only how to use the stuff inside.
1ME: Right. Yes.
1FB: No reason why they couldn't put 'how to use' and the ingredient thing in the darker green. No reason why they shouldn't cause I get lost.
1ME: Red would have been a bit better, wouldn't it?
Dr. Saxon: So, the colours that they've use are not best for reading...
1MC and 1ME: No.

Dr. Saxon: Did you feel something that helped you to understand how to open the package?
1MA: Only in the... it's the two recesses at the side.
Dr. Saxon: The grooves? On the side of the bottle?
1MA: where you grip it in.
Dr. Saxon: Did anyone else feel like this as well?
1ME: Yes, I did. That's all.
1FD: Yes. Well you do feel that, don't you?
1FF: Like using a gun really.
Dr. Saxon: Yes. How many guns have you used?
1FF: I am not telling you.
Dr. Saxon and participants: <laugh>
1FF: But, if you're still here I've missed.
Dr. Saxon and participants: <laugh>

Dr. Saxon: Did you feel anything on the package that suggested to you... that helped you to understand how to open it? We have the grooves...
1MA: Just the actual shape of the lever on the top...
1FD: Not really. (This participant answered the question.)
1MA: You look at that and the first thing you say. Oh. That got to be pressed down to get it over there.
1FD: Yeah. You know that.
1ME: Yeah.
Dr. Saxon: Yeah.
1MA: And you...
Dr. Saxon: Yeah.
1ME: So, It's a matter of experimenting with the arrow when it works...
Dr. Saxon: Yeah.
1ME: and also how to lock it.

Dr. Saxon: What about the lock-unlock thing? Is that helpful?
1MA: That's self-explanatory, isn't it?
1MC: Self-explanatory.
1FB: The arrow.
1MA: The arrow.
1FD: Yes. That's good.
1FF: It's quite easy to move...
1MA: It shows you... either right or left... and it's open...
1FF: Yeah... opening
Dr. Saxon: Is it easy for everyone to do?
1MA, 1MC, 1ME, 1FF and 1FD: Yes.
1FB: I just go round and round.
1FD: Yeah.
1MA: They all do. They all go round and round.
1FD: Yeah.
1FB: And round and round.
1MA: Round and round the mulberry bush. <laugh>
Dr. Saxon: This one does, it just go round and round as well.
1MA: Yes.
1FB: Yes.
Dr. Saxon: Did you click into... place, where it's 'tick' 'tick'?... will go round...
1MA: Oh. Yes.
1FD: It stops at the back.
1ME: Yes.

Dr. Saxon: Did you amh... just finally again. Did you feel anything else? What have we had, we've had the grooves, the shape of the trigger. **Do you feel anything else on the package that helped you to understand how to open it?** Or have we covered that, do you think?
1MA: You're obviously after something, but I can't think what it is.

Dr. Saxon: I'm just after getting everybody's views, that's all. I don't want anybody's views left out. I'm giving everybody a chance to speak.
1FD: ah... After you've discovered that... that's it really, isn't it, you don't need to think.
1ME: No... The little arrows at the side.
1FD: When you discover that and you do that... You know that's it.

Dr. Saxon: You're off and running, aren't you? OK! Thank you very much...That's our question two. And you've got your flip chart notes ready with the indications Yada... So, we looked at did you see, did you feel, did you read, did you hear something about the package. **Did you hear something about the package, maybe?**

1MA and 1FD: No.
1MC: Not really, no.
1ME: A liquid. It tells you a liquid inside.
Dr. Saxon: So, you're aware that there's a liquid inside there too. It is a liquid form cause of what you heard...
1ME: Yeah.
1FD: Well, I think...When I try the nozzle...
1MA: The word 'spray' told you what it is.
Dr. Saxon: Say again, please.
1FD: When I try the nozzle, it's liquid that comes out.
1ME: But shake it...
1FD: Oh, you know that yes.
Dr. Saxon: So, you read the word 'spray'...
1MA: As soon as, you read the word 'spray' you know it's going to be liquid coming out of the top.

Dr. Saxon: So, we've done see, we've done feel, we've done read, we've done hear. **Any aspects that helped you to understand how to use the package...**

1FB: Well, I just look and I'm finding it difficult, but if you look at the first sentence... it says 'apply generously to the face and body'... amh... after what else.
1ME: Exposure to the sun.
1FB: Yes, that's right and then later on it tells you to avoid the face. First of all tells to put it on your face. But, I think that warning should be before that. I think the labelling isn't very good because you can look at that and spray before you do anything else, couldn't you?
Dr. Saxon: That's interesting...
1FF: They're really not telling you to spray on your hand and, then, put it on your face, are they?
1FB: But they don't say that.
1FF: No, they don't.
1FB: They say to the face and body.
1ME: That's right. Yes. It's a bit of a contradiction in turn.
1FB: Well, they tell you to spray it on, but they don't say spray.
1ME: 'Do not spray directly onto face'.

1FB: 'Apply generously'...
1FF: 'Apply generously to...' Yeah.
1FB: ... but then they tell you not to spray after.
1FF: Some people would, reading that, they would just spray it, wouldn't they?
1FB: I would be daft enough to do that.
1ME: What they should have said is keep away from eyes perhaps? You know...
1FB: To start with... yes try to the face... amh...
1FF: With the hands.
1FB: Well, yeah... apply generously...
1FF: Yeah, apply with the hands.
1FB: ... It seems at best misleading.
1FF: If it can, yes.
1FB: Misleading information on the label in my view.
Dr. Saxon: Yes. Your view is important to us.
1FB: And um.
1ME: Well, it's not quite as directive as it ought to be, in terms of safety.
1FB: Well, I think it's not really very good.
1ME: I mean if it says you shouldn't spray it on the face, then there must be some say it's... dodginess about say your eye getting near your mucous membrane or...
1FB: Because that's the first thing it says apply to the face.
1FD: Em, that's true. Yeah.
1MC: It sprays on your faces and it gets into your eyes and your mouth can't get it...
1ME: Yeah... yeah. It doesn't say... it's pointed nearer to the face than to the eyes...
1FF: I think most of us would hesitate to spray it onto our face, but there are some people that would...
1FB: Who would...
1FF: They'd just do it, wouldn't they?
1FB: Well, they would just do it.
Dr. Saxon: Are you all caught up with this? Yes.

Question 3

Dr. Saxon: So, what Yada has done it is make a note on the flip chart. The things that you called out, so we've got the indications on this package that helped you to understand how to open it. We've got a list of four. We've got the shape of the trigger. We've got the arrow on the little collar thing there. We've got 'could see the nozzle' and we've got the indentations in the bottle part. So, those are the four indications that Yada has got. Have we missed any? Or is that all of them? Have we missed any?... It's important to know if we missed any. OK! Amh... Now, we'll take each of these indications in turn... these four indications that you've generated. **Just asking really if you've seen that indication before on other packages and if you have, can you explain where or what the package what is that you saw?** We're gonna treat each of these four indications in turn one, two, three, four and ask, if you've seen that indication before ever on other packages...

1) Indication 'trigger'
1FF: On household cleaners, you get the trigger spray. I mean they're not identical to that, but they are triggers.
Dr. Saxon: Yes...
1FF: You know if I can mention names there's Mr. Muscle..er... what's the other one?... er...
1MA: Windolene...
1FF: Yes. Window cleaners.
1FB: On dangerous things like oven spray... very often you have to pull the trigger hard to release it... you know, er, you can't just... yes... and once you've released that little, it likes a little bit of plastic.
1FF: Yes, that's right.
1FB: You have to... that break... you have to break.
A participant: Yes.
Dr. Saxon: So, you break your way in.
1FB: Yes. That's right. This is what... what I try to do with that. <laugh>
Dr. Saxon: Then, you were saying...
1FF: 1MA
Dr. Saxon: 1MA... you were saying...
1MA: I say a Windolene.
Dr. Saxon: Windolene.
1MA: It is another one that it actually...
Dr. Saxon: You've got a trigger.
1MA: ... got a trigger spray to spray the windows.
Dr. Saxon: yes...
1FF: There's quite a lot of the household cleaners have a trigger spray as I say it's not identical to this, but it is that type of...
A participant: Yes.
1MA: I would say... fifty percent of the household sprays... this type... of trigger.
1FF: It just makes it easy because you... But I find it makes it easy, don't you?
1ME: It all depends as well on how 'liquidy', is it? If it's like watery liquid, it'll come out quite clearly. But say you had something like Windolene that can like concentrate over a period... and can probably make it quite sticky trying to get it out sometimes, if you leave it in the house for some time.
1FF: I think Windolene itself, maybe, but the one I have it isn't actual Windolene. It's a window cleaner and it's like...
1ME: Yes. The modern ones... I think are better than the old cream coloured thing that you used to get. Yes.
1FF: That's right. It's like... am... colourless liquid coming out.
1ME: Yes.
Dr. Saxon: Have you got anything you want to add in?
1FD and 1MC: No.
Dr. Saxon: OK?

Dr. Saxon: That's the first indication dealt with, so we've dealt with the shape of trigger. We move on the second indication. Just to say... just to remind you the question is can

you say if you've seen this indication before on other packages... indications about opening of other packages and can you explain where you saw it? This idea... of **the little cut out arrow** that you mentioned on this collar.

2) Indication 'arrow'
1FF: I can't remember.
1ME: No, I can't remember either.
1FD: I don't think so.
1MC: I've never seen it before.
1MA: I mean it is a good safety valve. I mean the way that operates. It's a very good safety valve and I've never actually seen that on any other product before.
1ME: No, neither have I.
1FD: No.
1ME: It's helpful.
1MA: Oh. Really helpful.
Dr. Saxon: Have you also seen it before?... or not?
1MC: No, never seen that before.
1FB: I don't think about it.
Dr. Saxon: This is actually something that interesting... you all found readily...
1FF and 1MA: Yes.
Dr. Saxon: You all found helpful...
1ME: Yes.
Dr. Saxon: And you've never seen this kind of ...
1MA: It is a good safety spray.
1FD: It is really good one, isn't it?
1ME: it is very good.
1FF: It is self explanatory.
Dr. Saxon: Yes, it is self explanatory
1FF, 1FD and 1ME: Yes.

Dr. Saxon: OK! So, the third indication. We'll move on to...
1ME: the nozzle.
Dr. Saxon: ... another indication which is 'could see the nozzle'
1MA: Speaks for itself. <laugh>
Dr. Saxon: Again we're saying have you seen this indication on other packages before that you could see the nozzle that will help you understand how to...

3) Indication 'nozzle'
Participants: Yes.
1FF: Household cleaners...
Dr. Saxon: Household cleaners...
1FF: Some of them have the thing that come down which you have to lift up before.
1ME: Oh.That's right. That's correct. Yes.
1FF: That is for safety to save... wasting it all.
Dr. Saxon: You actually have to sort of explore...
1FF: You just flip it up... and then... squeeze

1MA: Some of those... on the nozzle there... they've got a little 'turn, on and off'.
Participants: Yes.
1ME: That's it.
1FB: That's right.
1FF: That's another one.
1ME: I try to remember which one with that now.
1FD: Yes. I know that...
1MA: That's actually on the nozzle....
Participants: Yes.
1MA: When it's off... you obviously can't pull the lever down as soon as you turn it the other way. It's actually working unseenly to us in exactly the same way that this is the arrows point on this to operate the... er... on and off...
Dr. Saxon: This is a different kind of lock?
1MA: Yes.
Dr. Saxon: Any other comments about the 'can see the nozzle indication'?
1MC: No. It's the same as I said self explanatory, the whole thing. It's the simplest one of the lot.
1FD: Yes. That's very good.
1ME: It is. The simplest one of the lot.
Dr. Saxon: OK...

Dr. Saxon: Moving on then from the third indication to this fourth indication. The fourth indication is...
A participant: Grip.
Dr. Saxon: The groove on side of the bottle part and the question again is... **can you say if you've seen this indication about opening before...**

4) Indication 'groove'
1MC: Oh I have seen them before... I have seen that on quite a lot of different products.
Dr. Saxon: You have...
1MC: Yes.
1MA: A lot of the household products.
Dr. Saxon: Do you recall any particular one?
1FB: I can't.
1MC: There is a shower spray for instance called 'Shine'.
Dr. Saxon: It is the cleaning spray or...
1MC: It's cleaning spray... you spray it on... and it saves a lot of hard work. You spray on after each shower.
Dr. Saxon: Right...
1MC: And it has got grooves in where your fingers grip and on the front of the nozzle it's got a square shape at the front...and you turn that at right angles... and that turns it on or turns it off...
Dr. Saxon: Right. I see. Thank you.
1FF: That could help stop slipping when your hands are wet.
1ME: Where do you get that one? Where do you buy it?
1FF: It's smoother... (unintelligible)... You could go right the way round...

1MC: Morrison. It's called shower shine and it's brilliant.
1ME: Is that quite big?
1MC: Oh. Yes. As big as that. Athlete shower you just spray it on and...
1ME: on the wall of the shower.
1MC: On the wall of the shower and the shower curtain or whatever.
1ME: It's got a grip thing on it, it's got a grip thing like that.
1MC: Yes, a grip thing oh yes and you just spray it on... it's a very fine spray and you look that each time you leave the shower and it saves a lot of hard work.
Dr. Saxon: So, 1MA! Did you want, have something to say.
1MA: No, I said a lot of the em... larger bottles, they shape the top of the bottle, so you can grip it, but the... this is a straight up and down bottle. So, you know... it's obviously it... em...anybody with arthritis it... it... it does give you a good indication of where to hold it.
1FB: All your hands to work with.
1FF: If you've got some of this on your hand and, then, you pick that up it could slip through your fingers without that.
1MA: Oh.Yes.
1FB: This is obviously for left and right handers.
Participants: yes.
Dr. Saxon: Oh. Just start, you can tell actually that it took....
1FB: I don't think they all do for both. I don't know.
1ME: ... Cause it's... (unintelligible)..., on the other hand, you might have only one hand.
Dr. Saxon: Did you have any others in mind?
1FD: No. <laugh>

Question 4

Dr. Saxon: OK! So, that's the thrid question we've done the indications. Now, we need the flip chart off, can't we? Cause at the flip chart actually yes Yada will detach the flip chart now. We're going to give you a sticker each. Right. And with your sticker, what we'd like you to do is each of you cause Yada will bring the chart round to you and ask you to put your sticker on one of these indications. And when you put the sticker on the indication the idea is what we're asking is em... which of these indications that you sang out to us before has been the key indications. **Which one is the most important?** Is it one shape of trigger? Is it two could see the arrow? Is it the visible nozzle? or Four the indentations inside the bottle. So, as Yada comes round with the flip chart, a quick modification here, have you detached the flip chart there Yada. And, then, bring it round to each participant. So, what we're asking is please put your sticker on the indication that you think is the most important in terms of helping to understand how to open the winning package... and when you put your sticker on if you **could explain why you think it's the most important one** and then the recorder will capture what you say. Put your sticker on what you say the most important one and just explain why you'd say it's the most important one.

Dr. Saxon: OK! So, what we got is 1, 2, 3, 4, 5 out of 6 people think that the visible arrow on the collar is the most important indication that helps you to understand how to open it.
1ME: It's visual aid.
1FD: Yes.
Dr. Saxon: Now, if I can go round and ask 1MA can you say... why you choose the shape of the trigger?
1MA: As soon as you pick it up your finger automatically goes to there. It tells you what you gotta do.
Dr. Saxon: Right. So, that's...
1MA: Where it is you pick it up... Oh... you're straight onto the trigger...
Dr. Saxon: I've got it... understand.
1MA: It's obviously... in my mind... in my opinion the trigger's the first indication of how to use the bottle.
Dr. Saxon: Thank you... Amh... 1FB.
1FB: Well ah... to open it... erm... you'd need to find which way... to open it and then press the trigger.
Dr. Saxon: You said that the visible arrow is the most important one...
1FB: To me it was.
Dr. Saxon: because...
1FB: Well I think it's obvious that you use the trigger, but that's when you've opened it.
Dr. Saxon: So this comes first in a way before.
1FB: Yeah... the arrow comes first because you need to open it.
Dr. Saxon: Right... Yes... 1FF.
1FF: As 1FB said you know you've got to press the trigger. So, the arrow shows you which way to open it. You press the trigger to get the stuff out.
Dr. Saxon: I got you... 1ME.
1ME: The arrow is the key. Without the arrow in the right position both for opening it and locking it. That's the key.
Dr. Saxon: Amh..1FD.
1FD: Yes...The arrow you... soon as you look at the arrow you know you're going either one way or the other... you know and then you know you've gonna press.
Dr. Saxon: Yes. OK!... 1MC.
1MC: First of all, when you pick it up, you cannot move the trigger because it's locked, so you must er... work out what locks it. And once you find out what locks it, the lock is... What locks it is... the arrow... thing. You turn it round and you've got it all set up to use, but until you do that you can't use the thing.
Dr. Saxon: Got you. I understand.
1FB: You have got to know which way the arrows go.
1ME: Yes.
1FB: And you got to read it before you can decide which is open and which is close.
1ME: That's right. It's a matter... I found it's a matter of experimenting.
1MC: Yes. Exactly. It comes back to what I said before, common sense.
1ME: Yes. Visual presentation.
Dr. Saxon: Of the em...
1ME: Arrow.

Dr. Saxon: This indication. Great stuff. Thank you.

Question 5

Dr. Saxon: The last task.
1ME: Before lunch.
Dr. Saxon: Before lunch.
1FB: <laugh>
Dr. Saxon: So, taking the winning... Let me borrow yours... mine's yellow. Yours are blue, so...wanted to use the same one. Taking the winning package the last question is: comparing with the winning package to the other samples that you identified... the other packages that you identify as being easy to understand how to open. **Could you just say why this one you found it is easier to open...easy to understand how to open than these two?**
1FD: Well it was just the arrows, you see. They're already there and you automatically twist them, see... then press... and... you know that was it, like... you know. The other big one. They kind of... erm... sort around first, to see where you press to bring the opener up, you know.
1FF: Self explanatory really.
1FD: Yes.
Dr. Saxon: This one. The winning one...
1MC: Yes. The winning one.
1FF: I think so.
1MA: The powder wash... The explanation is there, but they can't be seen, because... it is all the one colour... and till you get right close to them... exactly where to press. If you don't actually press in those two spaces, you'll never open them.
Dr. Saxon: Right.
1ME: The big one requires a lot more experimentation than the little... that this one.
1MA: Oh.Yes.
1ME: Because this is so familiar with the arrows indicated and to experiment you can actually solve the problem within couple of seconds or whatever.
1FB: They are no good. Are they, to anyone who's got arthritis in the hands?
1ME: Yes.
1FD: It is a lot brighter as well you know. And that blue that dark blue (package no.3). Whereas this is there you know you see it straight away.
1ME: That's right. It's not as easy to...
1FD: It is you see you can't read... try to look.
1MA: The actual place where you actually put the pressure. It is very difficult to see where it is.
1MC: I can't do that... I cannot open... I cannot open that package.
1ME: No. You're right.
1FB: No, I can't. That's not about doing that... but the manufacturer's way... to me it is impossible...you know to press that to open it.
1FD: the arrow should be... you know... more em... more to see them more.
1FF: And the way I'm sitting now the arrows shine up in the light...
1ME: That's right.

Dr. Saxon: Yes.
1FD: You can't, all the same.
1ME: That's right. It takes a while to figure it out.
1FD: That's right. Yes.
1FF: It's shining up.
1ME: ...cause where the arrows are it tells you to press. It takes you while to understand that.
1FD: I think, what's that for?... you know.
1FF: And if your hands were wet being dish washer... powder. If your hands are wet, they just...
1MC: Slip off.
1MA: There is a slight indentation. A blind person or anybody who wants to feel it. Just about get your fingers into two positions.
1ME: You'd have problems, wouldn't you?
Dr. Saxon: We discussed this one, product three, quite extensively.
1FF: This is quite easy.
Dr. Saxon: Why... the question again is: why was it easier for you to understand how to open this one than this one.
1FD: Well, I just look at that.
1MC: My reason for picking this is easy. I use shaving foam and it's exactly the same thing all I did was press the trigger that's it.
1FD: Yeah.
1FB: That's easiest for me to open.
Dr. Saxon: You rated that one easy.
1FB: Yes.
1FF: The shape in a way...
1ME: You obviously don't use an awful lot of shaving foam.
1MC: Sorry?
Participants: <laugh>
1FF: The shape in a way.
1ME: I said you obviously don't use a lot of shaving foam.
1FF: If it goes round...
1MC: No, I don't use a lot, no. <laugh>

Dr. Saxon: The question again is why was it easier for you to understand how to open this one than this one? Unless you rated this one is easy to go.
1FF: It's self explanatory.
1MA: Just the trigger itself.
1FD: Yes. It's all there.
1MA: The shape and the trigger you pick it up. It shouts out to you press me.
Dr. Saxon: Yes.
1MA: This one (package no.3) is only the shape of the colour going down that tells you... you press it from that angle. If again people with poor eye sight. People might not realise that there is an indentation there to press down.
Dr. Saxon: Yes.
1FB: Is that Braille on the top?

Dr. Saxon: yes. That's Braille on the top.
1MA: It might be an indication probably on the top.
1FF: Lovely that I think that's very good idea.
1FB: Oh. Yes. On there.
1FF: Yes.
1FD: Oh. That's really good, isn't it?
1FF: Very good idea.
1ME: What is a good idea?
Participants: The Braille.
1FF: On the top there.
1ME: All right. I didn't realise that.
1FB: On the back.
1FF: You feel it the back there.
1ME: All right. Oh. That's Braille all right.
1FD: That's very good, isn't it?
1FB: A blind person probably understands that better than us. <laugh>
1FF: Something there. <laugh>Yes.
1FD: Lovely one.
1ME: Here you are just something with Braille on that ha.
1FF: It makes you wonder how much they can read... how often they...
1FD: I think we all passed on that.
1ME: The former home secretary to come and da... The member of Sheffield to use it for all this Braille and the house of common...

Open for any more suggestions

Dr. Saxon: OK! We've considered the final question. And really before we conclude. I'm just going to wrap up a little bit, so we're all done with the planned questions now and what's important is your opinions on what you've seen and done and that's what we've captured. There's no right or wrong answers in this because it is to each individual person according to their experience what... how they evaluate something. There is no right or wrong answer. What important to you is your individual opinions which we've been careful to catch. So, what we've done is we've really looked at and talked about what helped you to understand how to open packaging from the samples of packages that we brought and we've also asked you to score or rate the indications that you found on these packages according to their importance and there's been a lot of discussion about the way you feel about the openability of the packages both in terms of your ability to understand how to open the packages... In other words, sorry, the package ability to suggest to you how to understand how to open it. Also physically actually whether you can or cannot open it. That's what we've covered today. Now, clearly as well as doing our questions and our tasks and... activities, you may also have thoughts that come to you yourselves during the process about this about openability. I know some of you've voiced the thoughts as we've been going through which is great cause we've got them on the recorder, but is there anything else that any of you would like to add that you think hasn't been brought out or surfaced or covered about openability, understanding how to open packages.

1ME: I think the conclusion is that manufacturers should try if possible to make it easier in terms of what we've discussed this morning particularly the highlighting of some of the easiest ones and pay a lot more attention to perhaps some of this research if that's what it about. This is very very vital for the manufacturers to sort of listen and take notes of it these kinds of things that are important.
Dr. Saxon: Thank you.
1MC: I think that with regard to health and safety, they've gone too far in making these we say 'child proof' or what you have. When they make them child proof, they make them adult and elderly people proof as well.
1ME: Yes.
1MC: So, that where the problem is.
1ME: That's right.
1FF: They make them child proof and children can open them, can't they?
1MC: Oh. Some of them yes.
1ME: Probably they do it better than the adults.
1FB: Yes.
1FF: It's the adults that can't open them.
1MC: Yes.
1MA: Especially with medicines.
1ME: Yes, that's right.
1MA: Unfortunately, I asked this question early on and they said we're not talking about medicine, we're only talking about household goods... for our age group. Medicine is one of the most important things in my personal opinion.
1ME: Yes. It is absolutely.
1MA: Some of the containers that tablets are in. You look at tablets this size and you've got 25. They are in the box about that high... the next one you get is a box about that high...You can't even get your hand round it to open it, turn the tops.
1ME: No. Right.
1MA: But apparently that ta...
1MC: The push down top... I find the most difficult... You've got to push them down to unlock them and I think there are the most difficult of the lot.
1FF: The palm of your hand is the best. Yes.
1FB: The type of medicines my husband and me have though usually in foil... with the...
1ME: The blister packs.
1FF: Yes.
1MC: Blister packs are so much better.
1FB: With the... ah... day on when you should take.
1ME: That's right.
Participants: Yes.
1FB: We haven't apart from that cream that my husband has, we've got nothing else that goes in a bottle.
1FF: No. That's right.
1FB: I take various things.
1ME: So, these things you buy in the chemist's, for example, like these fish oil things, you know... the liquid form, I take that every morning. It tells you take a spoonful and dip the

spoon a tiny bit in that's enough because they want you to buy another one as quick as you can use it up...

Dr. Saxon: OK! Thank you very much for all your help.

Transcription

Focus group two on 22th November 2007

Question 1

Dr. Saxon: I'll make sure that everyone gets to say what they want to say. That's my job today. So, the question we'd like to discuss... **We'd like to have your feedback on is how could this package be improved, so it is easier to understand how to open. So, what should the manufacturer do to make the package easier to understand how to open?...**Yes...
2FB: Write instructions...a clear instruction.
Dr. Saxon: Clear instructions. Yes.
2FB: Yes. Because it's quite easy...once you know how to do. But a lot of people try unscrew.
2ME: Instead of having that to have a... paper thing with the tab on, so you actually see that there was something to pull off the bottom.
Dr. Saxon: That will pull ring the paper. So, a tab that let you pull off the paper ring at the bottom.
2ME: Yes.
2FF: I didn't have a paper on the bottom of mine... I don't know.
2ME: Oh, just that. That's all.
2FF: Did that stop it from coming...
2ME: Yes, it stops you from coming off...
2FF: Oh. Well, I don't tell when I am...
2FB: That's the dispenser part that allows just one saccharin to come out.
2ME: So what they are?
2FB: Yes.
2ME: All right.
Dr. Saxon: So, **any other of the indications** in your observation... **how could this packaging be improved so that it's easier to understand how to open?**
2MA: Well, I think the language should just be in English. Some of the languages here on the back and the printing is very very tiny. If it was reduced to just one language then that would be easier for people to read because we are talking about elderly people and glasses. It's probably their number one aid, isn't it?
Dr. Saxon: Yes. Indeed... So, that's one language with bigger text...
2MA: Yes.
2ME: This printing is actually not very clear.
2MA: No.
2ME: It looks so smudgy into... letters seem to be smudging into one other. I think with the clarity...with a clearer font. It would far more easy to understand.
Dr. Saxon: Are you saying that the print is smudgy?
2ME: Yes. I don't say that it is, but that's how it appears

Dr. Saxon: That's how it seems to be. Yes... So, clear font... not smudgy printing... **Any other of the comments or remarks on how could this packaging be improved, so it's easier to understand how to open?**
2FB: I think it could be... ah...just writing on the top... that 'press'.
Participants: Yes.
Dr. Saxon: So, the word 'press' written on the top. Instead of whatever that is...
2FB: Well no. You do have to have the date on, don't you? You could have 'press here' or something like that.
2ME: Or even indented into it.
2FB: Yes.
2MA: Amh.
Dr. Saxon: Indented into the plastic... **Anything else anyone like to suggest?** All these suggestions are valuable. There are no wrong answers at all. ...OK! Have I got everyone's contribution? I really don't want to miss anyone's ideas out. OK? Thank you. So, we've got all indications now... There we go. So, we've got clear instructions. Use the 'tab', so you can get the paper ring off the bottom. Do you think one language? Bigger text. Clear font.
2MA: Not so much.
2FB: Not so much printing.
Dr. Saxon: Not so much printing... Is that about smudgy printing?... not smudgy printing...Putting 'press' on the lid... and maybe indentation on the top something like that so you could see...Yes. It's OK... So, we got all these suggestions and we call them 'indications'. OK?

Question 2

Dr. Saxon: Now, what we're going to do is detach that page from the flip chart... We're going to bring it to you and we're going to give you each a sticker, so when you get your sticker, **all we would like you to do please is to stick your sticker on the indication that you think it's the most important one...** Yada will come round with the form and you stick your sticker on the one indication that you think is the most important one...
2MA: Yes. I think I would go for that one.
Dr. Saxon: just come round...Here we go... Thank you...It's the biggest question we have used today, isn't it? OK?
A participant (M): That here we are. I'll have that one.
2ME: Cause all the others subsidiary to it really.
Dr. Saxon: Yes. Indeed...
(Then, the vote on the flip chart was shown.)
Participants: <laugh>
2FB: That tells you something.
A participant (M): Yes.
2FB: The ladies have chosen the 'press'.
2FF: Did they?
2FB: ...which is visual really...and the gentlemen like the instructions.
Dr. Saxon: Yes, that's very interesting.

2FB: And that's interesting because I think in life that's quite true. Women are more visual, men more instructional.
Dr. Saxon: That's interesting.
2FF: And I found it's much easier for them to have instructions rather than the symbols.
2FB: For whom?
2FF: Ah...For some of them anyway.
Dr. Saxon: Right. That's an interesting point... We've got three gentlemen wanting clear instructions and three ladies wanting to have...
2ME: That might be worthwhile transmitting to them.
Dr. Saxon: Indeed it will.

Sub question 2

Dr. Saxon: Now, what we're going to do is...just ask each of you...remember... There are no wrong answers in this... all of your opinions and your opinions is valuable, so please feel free to give us your opinions. No way you can get this wrong. All I'm going to do is go around and ask each of you please give us an explanation why you put your sticker on the indication that you did, so why that indication is the most important one. So, start with 2MA?
2MA: Right. Well. If it is the first time you are using the thing, you really need to start from scratch, so it needs to explain it in very simple direct words... Yes.
Dr. Saxon: Yes. Thank you very much... Now, 2FB?
2FB: Amh.. Because it's very visual simple and clear and it's on the top of the product, so you know instantly what to do.
Dr. Saxon: Thank you... 2MC?
2MC: I think the instructions cover it all.
Dr. Saxon: would you like to expand on that?
2MC: No. The instructions are clear. That should be sufficient.
Dr. Saxon: Job done. Yes, thank you very much... 2FD?
2FD: I bet I am very lazy about reading the small print, if it's obvious from the... how to do it in one guide. Just leave it at that.
Dr. Saxon: Right. Yes... 2ME?
2ME: I really think the instructions are fundamental. All the other things are subsidiary to it none of them by themselves tell the whole story and, therefore, a clear instruction maybe a diagram will do the job without necessary any words at all.
Dr. Saxon: Right. Thank you... 2FF?
2FF: Well, I was in the position where by I knew that was going to open it one of two ways. I didn't know which one, so perhaps if it has had the 'press' on the top. That would have given me the answer.
Dr. Saxon: Yes. Indeed... Thank you very much. These are all really really important views. Thank you for them.

Question 3

Dr. Saxon: Further information, although this was the most difficult one to understand how to open, the others were these two. The other you rated difficult to understand how to open were no. 3. This one where the other that you rate it difficult to open, although that one no.4 the most difficult for you to open, so what I just like you to do is to ask you to sort of compare... compare to the other difficult samples that are difficult to understand how to open those samples. **Why was it more difficult for you to understand how to open this package?** You see? **So, compared with no.3 why was it more difficult for you to open no.4?**
2FB: Because it wasn't obvious... that there was a screw top.
Dr. Saxon: This one wasn't obvious.
2FB: Pardon.
Dr. Saxon: It wasn't obvious this one how to... screw top.
2FB: No, that one.
Dr. Saxon: Oh. Did no.4.
2FB: That one has no top to unscrew or pull off really. That those two whether you could do it or not, they were quite obvious ... they were to be turning some way...
Dr. Saxon: These two. Yes.
2FB: ...and all press. Yes.
Dr. Saxon: Any other comment on why this one is more difficult than these two?
2ME: For me, not having come across that sort of thing before I had no idea... how... I knew what it has inside... had no idea how to get them out.
Dr. Saxon: Right. So, you just completely... because you've never seen it before. That was baffling.
2ME: Yes, it was. I have to experiment quite a bit. I've got 3 out in the end. How you put them back by the way?
2FB: You can't.
2FF: Yes, I wondered that.
2FB: You can't put them back.
2ME: All right.
Dr. Saxon: Probably put it in your tea or somebody else's tea...
2ME: <laugh>
Dr. Saxon: Any other remarks or observations on why this one no.4 was more difficult to open than the runners-up?
2MA: In my case, I didn't find it difficult because I do use sweeteners and I'm used to that type of container.
Dr. Saxon: Yes. Right. OK!...
2FB: Maybe for other people amh... those tops specially the smaller container... there are many different shampoos and they are probably quite used to turning... you know pressing and turning, but those, people aren't so much used to... containers like that, are they?
Dr. Saxon: Perhaps not...
2FB: It... even other brands don't quite like that... 'Sweetex' (a brand name) is totally, a bit different. It's obvious you know. That isn't obvious.
Dr. Saxon: It's not obvious...

2FB: No.
2MC: I'm just gonna say that they're all easy to me from past experience. It's the past experience, that does it, of course.
2FF: Yes.
Dr. Saxon: It is very important consideration...
2MC: I couldn't meet any of them the first time. If I had, I might have found it different.
Dr. Saxon: That's important point actually. Yes...
2ME: Didn't know you know how use shoe freshener?
2MC: No. But similar sort of thing I mean shoe polishes sometimes dispense that way.
2ME: I encountered one similar to that shoe polish in the other day I figured out in the end how to do it. That was rather similar, but I had never come across that sort of thing before.
Dr. Saxon: The no.2 product.
2ME: Yes. Right.
A participant (M): Amh.
Dr. Saxon: But did you find that your experience with the shoe polish help to operate this package?
2ME: Yes.
Dr. Saxon: You did?
2ME: Yes.
Dr. Saxon: Any other comments on why this one no.4 was more difficult to open than the runners-up?
2FD: I didn't find it at all easy, but...with the thumb like that. It wasn't too easy to get open?
A participant (M): Oh. yes.
2ME: Once you know how to do it, it was easy, but it was the question of how to get into it. That was the question.
Dr. Saxon: 2FD, would you able to exert enough pressure to do it? Did you use another method?
2FD: I used the other hand.
Dr. Saxon: The other hand. Is that a stronger hand?... Yes. I see... Any other remarks on why this one is harder to operate than the runner-up? <quite>Thank you very much...

Dr. Saxon: Yada just asked if we can think about this one the product no.2 which was the fourth hardest to use. So, in comparison to that one? Or to talk about that or just about this one?
Yada: Only this one.
Dr. Saxon: We talk about this one.
Yada: Yes.

Sub question 3

Dr. Saxon: So, can we go round the table top why people find this one hard to use, if you did? Maybe you rated it easier or harder...
2ME: The instructions were difficult to see.
Dr. Saxon: Yes.

2ME: Once I read them I could understand how to do it. It's not a problem after that, but they were not easy to read and they're quite elaborate.
Dr. Saxon: So, the instructions are hard to see... hard to read and quite elaborate ...
2ME: Yes. Perhaps a diagram would do the job better.
Dr. Saxon: Yes.
2MA: I think as well. Some of that is in the form of warnings... It is pressurised you got to keep it below a certain temperature... keep it away from children etc. I think those needs to be reinforced in a bigger print.
Dr. Saxon: Yes. Again the size of the print is sort of ...
2MA: Well. Here again we got Polish and Czechoslovak I think on the package. Well. This is...but of course if we put every blessed language on... it would be impossible to read.
2FF: I think the colour is a disadvantage.
2FB: I think it is.
2FF: dark blue.
Dr. Saxon: Yes.
2FF: It makes very difficult to read.
2FB: I think dark blue is difficult to have print on top of.
2FF: Also, it's surprising when you know nothing how you can misinterpret ...I mean it said push down and I was pushing that. You see.
Dr. Saxon: So, you pushed it hard.
2FF: Instead of the...you could actually press the whole thing.
Dr. Saxon: So, you were pushing the cap. And what they meant you to do was push the whole thing down.
2FF: Yes.
2FB: But it has got a little diagram.
2ME: It does.
2MA: Amh.
2FF: Has it? Oh, I didn't even see it. Oh..Yes, it has... <laugh> but I still couldn't do it. It was one of those, I couldn't do at all. And of course I found that one so easy to me... <laugh>
Dr. Saxon: I think everyone's mileage varies. You know. What we've done and what we're used to... **Any other observations about what make this one hard to use how to understand how to use?**
2FF: Perhaps if you actually doing it in a shoe. It would of all.. fitted together better?... but to be doing it on the table and telling you not to put it near your face you know.. you sort of look and think which way is it... <laugh>
2MC: One over all interesting point... if you've got arthritis in your hands or fingers. They're all difficult.
A participant (M): Amh. Yes.
Dr. Saxon: Yes.
2ME: I don't think that one would be, would it? It was very easy to move.
2MC: It is ... you've got to push it.
2ME: Oh.Yes.
2MC: You got to push it and it's in your wrist. If you got arthritis in your wrist, it's quite difficult.

2FB: Yes. It's difficult...
2MC: You have to use two hands to...
Dr. Saxon: So, that will create pain in your wrist when you're operating it.
2MC: Yes.
2FD: Wasn't very clear to me what they're referring to when they talked about the two openings and I thought I could see a little opening on the top.
Dr. Saxon: Yes.
2FD: And... I presumed the bigger one was at the bottom.
Dr. Saxon: So, you're wondering whether the mark on the top was an opening as well as the one on the bottom. Yes. OK! Thank you very much indeed. Is that ok? Right.

Open for any more suggestions

Dr. Saxon: We're all done with the planned questions now. Just to summarise what we've done and we talked about today. We talked about what helped you to understand how to open packaging and you also rated those indications that you found... according to your views on their importance. So, we've looked at your familiarity with different types of packaging. Household packaging closures... the easiness or difficulty of understanding how to open packages... the easiness or difficulty of actually physically opening packages. And also we've had some excellent discussion on matters concerning the most difficult packages in the set of packages that you were provided with. Now, we've had loads and loads of questions, but during that process maybe that you got observations about the packages that you've been using today that we've not asked about. So, if you want to share those observations if you've got anything else that you want to add to the questions that we've asked and the remarks that you've made... we would certainly value that...

2FB: I think am...like the gentlemen said... that nothing to do with these products, but sometimes packaging is extremely difficult to open especially, if you've got pain in your finger...
A participant (M): Em
2FB: ...or wrist extremely difficult and this container (no.2) has tops on them that you have to press down to let the air...is extremely difficult for someone who can't and there is no way of...you know... of opening it other than pressing down and some of these tins with the rings on...eh... they often pull off the ring and it quite quite can be quite dangerous I think. So, I think a lot of thought should go into packaging not just for older people, but for everyone because accidents do happen in the home, don't they?
A participant (M): Em
Dr. Saxon: Yes. Indeed. That's very important point.
2MA: Well. I found this one difficult to open...
Dr. Saxon: No.5...Yes.
2MA: If anybody has brought this one and they were biting their nails...
2FF: < laugh>
2MA: I would shudder to think how they would open it.
2ME: Well, that's right.
2MA: It needed a little tab on this that you could gently peel it off.
Dr. Saxon: A non sticky tab.

2MA: Yes, a non sticky tab ... that would have made all the difference... I did find it difficult to get the thing started, but once you started it was fine... but it was just that initial starting.
2MC: I chose the wrong label... The label on the top.
2MA: Oh!
Participants: <laugh>
2MC: I tried to get it up...pen knife and also... never occurred to me it was the label around the thing... I never even bothered.
Dr. Saxon: It didn't tell you...
2MA: No. No.
2FF: It isn't very obvious, is it?
2MC: All the rest had tabs on them.
2FB: I don't think it is obvious.
2FF: No. It blends in the colour of the tin you see.
2FB: I did put it down as easy because once you actually realise the label, then, it is easy, but I suppose... like you said that could be the label.
2MC: Yes, I tried to get it off.
2FB: No, I think it part of the printing on the top.
2FF: I think I tried the top first, then, I realised that it wasn't a label... I don't consider I've got arthritis badly at all, but I've obviously got it in odd fingers because I found the dish washer powder...
Dr. Saxon: no.3
2FF: ...very difficult to press in. I can't do it at all.
2ME: Yes. I found that difficult.
2MA: Yes, I think somebody with arthritis ... so self force try to the... whether mine was a bit obstinate, but I...
2ME: All right. Yeah. That was what I found difficult.
2MA: And when it went I thought I'd almost cut my finger.
2FB: Yes, it's horrible.
2MA: It's not a very good top. This is very sharp.
Dr. Saxon: So, you thought that it had injured you. Yes. Did anyone else have that experience?
2FF: And because you've got to be able to read... notice the sort of the indentation cause there's no instructions, is there anywhere? And as I say on this blue I don't think.
2FB: Not very clear.
2ME: The thing I found difficult about it...was these arrows... with the fore part of it and it's on the sort of where it begins to close... when you begin to see it closer and I found if it had been there, it would have been a lot easier.
Dr. Saxon: On the white bit.
2ME: Yes, on the white bit. Yes.
2FF: I can't do it now.
2FB: I found it's easy you see I suppose... it's to do with... I haven't got arthritis.
2FF: Domestos opens like this, doesn't it? But I still can't do it at home. <laugh>
2MA: I would have thought that an ordinary screw top... would have been better.
2ME: Yes. Why is it necessary to have the other one anyway?
Dr. Saxon: So, if we just have...the manufacturer's opening and the consumer as well.

2ME: Yes, why not.
A participant (M): Amh
ME: It adds to the complication... add to the cost of producing it.
Dr. Saxon: Yes...
2FF: It isn't as if it's got to come out in small little drops, is it?
2MA: No.
2MC: I use two hands... it's easy then.
Dr. Saxon: You use two hands to do the squeezing...
2MC: Yes.
2FF: But then how do you open it?
2MC: Pardon.
2FF: If you're using two hands to squeeze it... you haven't got a third hand to open it... <laugh>
2MC: If you hang on to it with... the... where it's now with one hand and then lift the lid... It seems easy.
2ME: Oh.
2FF: I can't...
2ME: It is 2MC. You're right... try to do with one hand and of course some people only have one hand.
2MA: Amh...
2MC: By the way it hurts. <laugh>
Dr. Saxon: So, when you open the package, it hurts you...
2FB: Does it?
2FF: I don't think I'll have a dish washer.
2MA: Yes, of course this is one of the problems... if a person is opening a container with one of these grips... OK... that maybe then you got a hold on to the thing like they like... So, it's really a two handed operation... you almost need something where you can clamp the thing you're opening and possibly use the opening tool... with both hands if necessary...
2FD: Put it between your feet.
2MA and 2FB: Yes.
2MC: On my bench in the garage I've got an engineer's vice.
2FB: <laugh>
2MC: I open jars of pickles with that and so on... I can't do it any other way.
2MA: No.
2MC: Put the thing in the vice and use two hands on it otherwise you couldn't do it.
2MA: No.
2MC: Be careful not to tighten the vice too much. Your pickles have gone.
2ME: Yes, quite. <laugh>
2MA: You almost need something in a kitchen which is a simple form of vice... Just two blocks of wood with... a screw thread between it.
Dr. Saxon: Is that attached to something?
2MA: Yes. Screwed on to the bench or something like that.
2FB: That would be a good invention.
Dr. Saxon: A kitchen vice.
2FB: Yes.

Dr. Saxon: Very interesting. Yes.
2MC: My wife can't open any of these and she said don't go and die before me because she will be struck you see... She can't open any of them.
2FF: I have heard of friends who line up all the things that they can't open... when their husbands come in they say 'can you open these for me?'
Dr. Saxon: Really?
2MA: And of course to open something in a vice which was square, triangular any shape but round... would be much easier... I mean obviously a round thing can spin in itself... if you've got something square... no problem.
Dr. Saxon: Yes. Indeed.
2FD: You could do it to the door hinge, but it's not very good for the paint work.
2ME: No, It isn't.
2MA: No, and if the top come off... suddenly and it's a jar of pickles...
Participants: <laugh>
2MC: It's all over your carpet... yes.
2ME: I mean there's one thing about... about... jars of... marmalade and pickles and so on. We often my wife can't open at all. I don't usually have a problem, but sometimes I do and the only way I can do it is pop an elastic band around the top and get that extra bit of pressure.
Dr. Saxon: So, it makes it more gripping.
2ME: So, it makes it more gripping now... if the top was coated it with a non slip..er...edge.
Dr. Saxon: Yes...
2ME: That would make such a difference to lot of these things...Yes... All the corrugated edges you can get a grip of it... because so often they just slip around.
2FB: that's a good idea I'll try that one.
2MC: Driving gloves can sometimes do it.
2ME: Yes. OK. Yes.
2MA: Em.
Dr. Saxon: Yes. That's a good idea...Thank you very very much for your comments. And thank you very very much for taking part in this research. The information that you shared with us today about your views and your experience and opinions is really valuable to us. It will so benefit Yada's study and hopefully... the guideline for designers that Yada's study will generate will be used by future generations of designers of packaging. So, that will make the difference...
2ME: Can I mention one other thing?
Dr. Saxon: Please do.
2ME: It's not about opening, but I've never come across this stuff before
Dr. Saxon: Product 6.
2ME: There is nothing on it that tells you how to use it or what it's to be used for.
Dr. Saxon: No.
2ME: Nothing on it at all. If your skin is alright... well... fair enough, so it is, but it doesn't say what it's to be used for, how much to use... whether it is dangerous... or anything like that.
Dr. Saxon: It tells you nothing.

2ME: It tells you nothing at all. So I haven't a clue what to... If I had some of that in the bath room I wouldn't have a clue what to do with it.
Dr. Saxon: Yes...
2ME: Would you use it as a shower gel or would you use it as something else?
2FF: Well, it is an exfoliate you see. I think that sa...
2MA: It gets rid of dead skin.
2FF: Yes.
2FB: That's it for the dead skin.
2MA: Well I think that what it means...
2FB: Is it?
2MA: ...a little diagram here.
2FF: It's sort of must be I mean usually that's an abrasive thing, isn't it ?... to sort of get rid of dry skin... so I am not sure.
2FB: I don't think that's a very good product, do you?
2FF: I can't imagine I would ever buy this.
2FB: Constantly removing skin.
2MC: Sixty years ago we had carbolic soap.
Participants: Yes. <laugh>
2FB: Exactly.
2MC: That did everything.
2FD: Or pumice stone.
2ME: Lot of pumice stone. <laugh>
2MC: Yes.
Dr. Saxon: What we'll do now is remove the things that you can't eat and I think we've got luncheon coming... So, bring some luncheon through and please carry on talking.

Appendix E: Samples of procedures, questionnaires and transcriptions from the in-depth interviews

Interviewer's guide				Page 1
Date:	Researcher/interviewer: Yada Chavalkul Participant/ interviewee:	Total		1.05 hrs
Topics	Description	Aids	Start at	Duration (mins)
Informed consent	Participants will be asked to consider the statement of informed consent.	Informed consent forms	10.00	5
Introduction	**Introduction** This research is titled 'Package openability: design for novel packaging for older people'. Packaging in my research refers to packages for food and household use. Openability in my research refers to how to design packages that are easy to understand how to open. Information from the focus groups suggested that indications for opening are important to make it easy to understand how to open a package. Therefore, today we are going to discuss the indications. **'Indications'** refer to anything about the package that helps you to understand how to open it. Indications can be divided into surface indications and shape indications. **'Surface indications'** refer to what you can see and read, for example, words or sentences of instructions, a symbol and a diagram. **'Shape indications'** refer to what you can see and feel, with your hands, for example, the shape of a bottle, a lid or a grip, of packaging even a surface texture. In this interview, I will be trying to find out: 1) How surface indications help you to understand how to open packaging? 2) How shape indications help you to understand how to open packaging? 3) Is there a combination of surface and shape indications to help you to understand how to open packaging? The interview will take around 1 hour. There are 2 sessions to this interview. For the first session, I am going to ask you to fill in two forms related to the packaging samples that I will show you. Then, I will use your answers to select one package for you to discuss in the second session. With your permission, I will use a voice recorder to record what you say during the interview so that later, I can work with your comments in more detail. Also, I will use a video camera to record when you are opening and discussing the package. Only your hands and the package will be recorded, but not your face. It's important to note that I am not measuring your ability to open packaging. Instead, I am trying to understand how a package could be designed so that it is easy for you to understand how to open. Therefore, there are no right or wrong answers, but just your opinion that will be very helpful for the research.	–	10.05	5

Interviewer's guide				Page 2
Date:	Researcher/interviewer: Yada Chavalkul Participant/ interviewee:	Total		1.05 hrs
Topics	Description	Aids	Start at	Duration (mins)
	Before we get started, would you like to ask me any question?			
Session 1: Packaging sample assessments and observations	**Form A** [Show five packages to the participants. Explain what product is in each package.] Please look at each package without opening it and rate how **familiar** or **unfamiliar** you are with that **kind of** opening by circling a number on the scale in form A. **Please remember we don't open it at this stage.** **'Familiar'** means 'You know now how to open this package' **'Unfamiliar'** means 'You do not know now how to open this package' [Start doing observations: take a note of what they looked at and how they inspected the packages]	Form A, the packaging samples, a voice recorder, a video recorder and a journal	10.10	10
	Form B In this stage, I'm going to ask you to work with form B and the packages. There is no rush, so please take your time to think about opening the packages. First, please try to open and use each package, so that you get at the product inside. Then, rate how **easy** or **difficult** it was for you to **understand** how to open it by circling a number on the scale in form B. **Please remember we don't open it to empty the packages, but just open it to use a normal amount of the product.** **In this form, we are looking at how easy or difficult it was for you to understand how to open the packages rather than how physically easy or difficult it was for you to open them.** [Observations: take a note of how they opened the packages]	Form B, the packaging samples, a voice recorder, a video recorder and a journal	10.20	10
	[A tea break will be provided for the participant. Researcher calculates the score provided in forms A and B in order to select one package which was the most familiar and the most difficult for the participant to understand how to open for later discussion. Researcher watches the video to confirm the observations of what the participant looked at and did when opening the selected package.]	Forms A and B, a video recorder and a journal	10.30	10

Interviewer's guide				Page 3
Date:	Researcher/interviewer: Yada Chavalkul Participant/ interviewee:	Total		1.05 hrs
Topics	Description	Aids	Start at	Duration (mins)
Session 2: Post-opening discussion	Now, we are going to discuss 'surface and shape indications' for opening this package. 'Indications' refer to anything about the package that helps you understand how to open it. 'Surface indications' refer to what you can see and read, for example, words or sentences of instructions, a symbol and a diagram. 'Shape indications' refer to what you can see and feel, with your hands, for example, the shape of a bottle, a lid or a grip, of packaging even a surface texture. I would like to know the steps you took when opening this pacakge. So, it would be very helpful, if you can slowly think about the package opening.	The packaging sample and a voice recorder	10.40	5
	Q.1) Before you rated the score for the first form, you inspected the package without opening it. I noticed that you looked at different places on the package such as... (e. g. on the top, at the side and in the front of the package). Could you explain about what you looked at on the package for each of these different places?	The packaging sample and a voice recorder	10.45	5
	Q.2) Before you rated the score for the second form, you tried to open the package. Did you look around the package first before you opened it? If yes, thinking about the surface and shape indications, what was the first thing that you looked at on the package? Could you explain why you looked at that first? Then, you ... (e.g. lifted the lid.) What made you do that? Could you explain why you did that? [Continue the same pattern of questions for each opening method employed]	The packaging sample and a voice recorder	10.50	5

Interviewer's guide				Page 4
Date:	Researcher/interviewer: Yada Chavalkul Participant/ interviewee:	Total		1.05 hrs
Topics	Description	Aids	Start at	Duration (mins)
	Q.3) I noticed that there are (a number) indications that you used to open this package. The first one is _ The second one is_ [and other indications] I understand that you already explained how you opened this package, but I'd like to know how you used these indications when opening the package. Could you explain step by step how you used these (a number) indications to open this package? How about the first indication? Can we consider the second indication? [Continue the same pattern of questions for each indications used] Among these indications, is there any kind of connection between them? [For example, if the first indication led you to the second indication. Or, if the second indication told you something about the third indication.]	The packaging sample and a voice recorder	10.55	5
Further suggestions	Q.4) We are all done with the planned questions now. Thank you very much for your participation. We have talked about how you used indications when opening the package. This will be very helpful for the research. Before we finish, is there anything we have not covered about understanding how to open packaging that you would like to bring up or share with me?	The packaging sample and a voice recorder	11.00	5

FORM A

Please look at each package without opening it and rate how **familiar** or **unfamiliar** you are with that **kind of opening** by circling a number on the scale. **Please remember we don't open it at this stage.**

'Familiar' means 'You know now how to open this package'.
'Unfamiliar' means 'You do not know now how to open this package'.

For participants		For researcher
Package no.		
1	1 2 3 4 5 6 7 very familiar very unfamiliar	
2	1 2 3 4 5 6 7 very familiar very unfamiliar	
3	1 2 3 4 5 6 7 very familiar very unfamiliar	
4	1 2 3 4 5 6 7 very familiar very unfamiliar	
5	1 2 3 4 5 6 7 very familiar very unfamiliar	

For researcher

Participant	A	B	C	D	E	F

FORM B

Please rate how **easy** or **difficult** it was for you to **understand** how to open it by circling a number on the scale.

For participants

Package no.		For researcher
1	1 2 3 4 5 6 7 very easy to understand — very difficult to understand	
2	1 2 3 4 5 6 7 very easy to understand — very difficult to understand	
3	1 2 3 4 5 6 7 very easy to understand — very difficult to understand	
4	1 2 3 4 5 6 7 very easy to understand — very difficult to understand	
5	1 2 3 4 5 6 7 very easy to understand — very difficult to understand	

For researcher

Participant	A	B	C	D	E	F

In-depth interviews for research project:
Package openability: design for novel packaging for older people

For researcher

Thank you for your time and help in the interview. The information gained from the interview will provide understanding of how packaging could be made easy for older consumers to understand how to open. The information will be used to develop design recommendations for packaging designers.

The purpose of this interview is to examine how you used 2D and 3D indications when opening a package.

All information will be confidential, and all information used arising from the session will be anonymous.

You have the right to withdraw from the session at any time, either before we start, during the meeting or afterwards. You won't be asked to explain your decision.

During the session, an audio and video recording will be made, so that we can recall what was said accurately and review what you did when opening the package(s) provided.

If you have any questions, please feel free to ask them.

_____(sign) _____(date)
Researcher's signature

Yada Chavalkul
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This research is conducted under the supervision of Dr. Andrew Saxon

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For participants

We do need to ask for your consent to the recording, and the subsequent use of the information created, as explained above.

I consent to the audio and video recording of the interview I am about to participate in.

_____(sign) _____(print name) _____(date)
Participant's signature

Transcription

The in-depth interview on 26th November 2008

Participant 2MA (Normal texts) Researcher (Bold texts)

Question 1

We are going to discuss this package.
Yes.
Yes. Before you rated the score for the first form, you inspected the package without opening it. I noticed that you looked at different places on the package such as you looked around this package and you looked at the top of the package. And then you turned to look around this package again.

Question 1.1

So could you explain about what you looked at on this package for each of these different places? We can start with first you looked around this package, so would you please tell me what you looked at?
Well, I ... I was looking to see if ... if there were any directions as to opening it. It was quite unfamiliar to me.
Yes.
... And I was looking to see if there were any directions. ... Er ... I looked, more or less, all the way round it and couldn't see anything. So I started to look again and then I found it under the ... er ... top ...
Yes.
... Er ... Extremely small ... erm ... and very difficult to ... er ... read. Now, I would imagine anybody that ... er ... perhaps was ... er ... you know ... that sight wasn't very good ... would have an extreme difficulty in seeing this ... er ... these directions. Why on earth it couldn't be printed much larger ... Erm ... But this is so tiny ... erm ... I ... I really sort of gathered ... er ... from ... from just one, little thing I saw on it as to probably how it opened. ... Er ... It does say, first of all, 'Twist' and, secondly, 'Press'. ...
Yes.
... But, believe me, I've had to look at that very, very hard indeed. I wouldn't have thought this was a good package for anyone ... er ... who ... er ... was having difficulty in reading or seeing or following directions. ... Erm ... When ... When you've twigged it, yes, okay, it's quite easy. ... Er ... It goes round quite easy ... erm ... and then, obviously, you just ... er ... press it and out comes the ... er ... the gel. But that really is very bad, I think.

Question 1.2

So, after you looked around the package and, you looked at the top of the package ... er ... could you explain what you looked at on the top of the package, please?

Well, I was looking to see whether there were any arrows, indicating perhaps direction of ... er ... twisting ... er ... to open it, or whether this serrated edge, here ... er ... there was perhaps a 'P' or something to say, 'Press'. ... Erm ... But the directions for that were, literally, here – on the side – but extremely small. And you can ... You can just about see it but, as I say, if you were in a dim light and somebody hadn't got a ... a good pair of glasses, I doubt whether they would ... er ... They'd probably struggle and twist and pull at it and, haven't known what they would do with it!

But ... er ... when you looked at the top ... er ... could you find any kind of indications on the top of this package?

Well ... I'm not sure whether this is meant to be an arrow or not. ... Erm ... I think you obviously turn it round ...

Yes.

... Er ... But these are ... er ... really just indentations. And, if ... You wonder whether it's part of the grip. ... Erm ... Would they not be better if they were, perhaps ... er ... embossed in white or, at least, a different colour that you could see definitely those arrows ... er ... indicating ... well, you twist round? But, certainly, it's ... it's not very easy to see.

Yes.

No.

Question 1.3

And, after you looked at the top and then you ... you ... er ... went back to look around the package again and, at this stage, could you explain what you looked at, please?

Well, when I went back to it again, I was looking to see where you press to get the ... er ... jet coming out. And, obviously, you say, 'Well, it's opposite to where the jet is.' But it doesn't say on there, 'Press'. ... Erm ... I think, if you'd got a 'P' on this, that would be useful. But, certainly, I think ... er ... with the amount of ... er ... space you've got on the label ... er ... here, you could take a chunk of the label off, for example there – this is only just ... er ... well ... a... a nothing really ...

Yes.

... and, obviously, increase the size of that. ... Erm ... Make it obvious down here.

When you looked around the package again, could you explain in a little bit more detail about what you looked at? I mean, when you looked around the package?

Well, I ... I ... I think, when I looked at the ... the ... the first time, I got the idea that you twisted the top ...

Yes.

... And, the second time, I was looking to see if ... well – you know – 'Where does it squirt out?' And then I was looking to see ... And then I found it. ... Er ... And then ... 'Well, do I press this?' And it was a bit tentative ...

Yes.

... Er ... as to whether – you know – that was the way to do it. ... Erm ... As I say, I think it wants, perhaps, a mark on that – 'P' – or just 'Press' ... er ... the word, 'Press' put on. But, in a different colour from the black of the ... er ... plastic ... er ... lid.

Yes.

Then ... Then ... Yes, fine: it would ... it would be easy. No problem, I think, as far as gripping and turning. ... Erm ... That was quite easy. A good size ... er ... to press down on.
Yes.
But just the directions are not good at all – I don't think.

Question 2

Yes. Before you rated the score in the second form, you tried to open the package ... er ... did you look around the package first, before you opened it?
Yes, I looked around it ... erm ... all the way around. ... Erm ... Obviously ... er ... it was something that I wasn't familiar with. And I looked around and couldn't really see anything. I think I was looking for something much bigger and then suddenly spotted these little directions underneath the ... erm ... the ... the top ...
Yes.
... which were extremely tiny.
Yes.
... Er ... And I would have thought, for a ... er ... erm ... a package likes this, you could afford to, as I say, reduce the label size and increase the size of the ... er ... er ... the directions to open it.

Question 2.1

Yes. So, when you looked around this package, thinking about the surface and shape indications, what was the first thing you looked at on this package?
... Er ... I think I looked at the lid. ... Erm ... Obviously, I saw it there. And I wondered whether the lid unscrewed, lifted off ... er ... or ... or what. ... Erm ... But I must admit ... erm ... seeing that it was an aerosol, I thought, 'Well, no, there must be some way in which you spray it but – how?' I couldn't see the ... er ... jet anywhere or any ... erm ... sort of knob to press down. ... Er ... And then I thought, 'Well, hang on ... erm ... It must be ...' And then, as I say, I found this and it gave me the directions to unscrew that one first. And then ... er ... I think commonsense more or less said, 'Well, if that's the jet, you press there ...'
Yes.
... But ... erm ... not particularly obvious. I mean, it could have been something else.
Yes. It's quite interesting, when you say that this one is the aerosol. Did it ... er ... tell you something about how to open this?
... Er ... Well, I think all with ... with aerosols, there is a lid on them. ... Er ... And I've been used, I think to ... the majority of them ... to lifting the lid off and then exposing ... er ... a button which you press down. And then you put the lid back on again. Here the lid's part of the ... the whole top ...
Yes.
... which is ... er ... which is rather different. I hadn't seen one like this before ...
Yes.

... This was new to me.
Yes.
As I say, all right – cracked it after a ... a little while but I could imagine somebody who wasn't very agile with their seeing ... er ... could get into a bit of a mess with it.
Yes. What told you that this package is an aerosol package?
Well, I ... I ... think ... er ... seeing the name, 'Lynx' ...
Yes.
... Er ... It is ... er ... a popular ... erm ... men's product. ... Erm ... Aerosol, deodorant, shave foam and what-not. They make a whole lot of stuff. So I think it was knowing the name, 'Lynx' ... er ... that said, 'Oh, no. It's an aerosol.'
Yes. When you say that the first thing you looked at ... er ... on this package was the lid ... er ... could you explain why you looked at the lid first?
... Erm ... Well, if I was going to get ... er ... at the contents, obviously, the lid's got to come off ...
Yes.
... And ... er ... I think it was just ... er ... looking at it and think ... 'Well, I can unscrew ...' But, going this way, it didn't. And I thought, 'Well, no, no. That ... That's going to tighten it, if I go anticlockwise ...'
Yes.
... So ... er ... 'Hang on, does it tell me what to do?' And then I ... As I say, I looked and ... er ... it ... it showed me the directions that I've got to screw that down ...
Yes.
... Er ... But I hadn't, quite honestly, looked at the second picture ...
Yes.
... which would have told me to press it and out it would come.
Yes.
But, having got the first one ...
Yes.
... Just ... er ... as I say, a little indication of 'Press' or 'P' would make all the difference ...
Yes, as you say ... Yes.
... And those arrows definitely want to be ... er ... highlighted.

Question 2.2

Yes. First, you looked around the package and then you tried to press the top lid.
Mm.
Yes? For that ... er ... moment, so will you please tell me what made you do that?
I ... I think my experience of using aerosols ... er ... prior to this one.
Yes.
... Er ... But ... er ... every one I've used prior to this one has been different – with a detachable lid and then ... er ... a button to press down.
Yes. Would you please ... er ... explain to me about ... er ... why you tried the anticlockwise first before you turned the other way round?
Well, the ... the stoppers on bottles and jars nearly always unscrew anticlockwise, screw down clockwise.

Yes.
So – years of experience
Yes.
I was hoping that that would undo this ...
Yes.
... Er ... But then, as I say, I ... it just went round ... So 'That doesn't work ...'
Yes.
... 'So, hang on, there must be ... We've got to go the other way.'
Yes.
But ... er ... I think, normally, you would expect, if you've got a bottle of anything, you unscrew it anticlockwise
Yes.
... Er ... but this one is the reverse.
Yes.

Question 2.3

After you twisted the lid and then you saw the nozzle.
Yes.
Yes? And then ... er ... you twisted it back.
Yes.
And read ... er ... the instructions again. So could you ... you explain to me about what made you do that, please?
Well, wh... When I unscrewed it and I saw that ... er ... I tried pressing this down initially ...
Yes.
... and nothing had happened ...
Yes.
So, when I went down there, I thought, 'Well, that doesn't work. 'What's the next direction? Ah! Well, when that's down, that *will* work.'
Ah!
Okay?
Yes.
Right.
... And ...
Bit complicated, this!

Question 2.4

I know, yes. And, when you saw the nozzle and then you twisted it back and ... and after that, I also asked you ... er ... if you can try to use the product. You twisted it first and then you pressed the lid?
Yes.
Could you explain what made you press the lid, please?

Well, I think it was ... er ... obviously seeing that ... erm ... this must be something to do with ... er ... squirting the ... er ... product out.
Yes.
... Erm ... But not sure that that was right. So you think, 'Well, hang on. Let's ... Let's see what it's ... Ah! It is that!'
Yes.
Now you go back and do it. But, initially ... er ... when you ... you're trying to get ... 'No, that doesn't work.'
Yes.
But, now ... *Whoops!* ... it does.

Question 3

Yes. There were a number of indications that you used to open this package. Please, correct me if I'm wrong – so the first indication was instructions – I mean the illustration.
Yes.
And the second one was ... er ... the lid ...
Yes.
Yes? And third one was the product name – I mean the aerosol.
Yes.
And the last one was the nozzle. Yes?
Yes,
And ... er ... is there anything else that I didn't cover?
No. No. I think that ... that covers it completely. I think ... er ... if you put the word, 'Lynx' across that way ...
Yes.
... then you'd certainly have that much space to put a couple of really obvious ... er ... little diagrams ...
Yes.
... as to ... er ... open it.

Question 3.1

Yes. So, could you explain, step by step, how you used these indications to open this package?
... Erm ... Well, first of all, you ... you see the whole thing complete ... er ... and ... erm ... 'antiperspirant, dry' – so forth ... Obviously, it's an aerosol so 'How do I get to it?' 'Well, I can't see the nozzle anywhere, so I'll unscrew the top, which is ... erm ... traditionally the way you get at the thing ...'
Yes.
... Er ... 'Hang on: that isn't working. ... Erm ... Now, are there any instructions anywhere?'
Yes.

... Er ... 'I can't see any ...' 'Oh, yes! Ah! What's ...? Ah, yes! Very, very tiny: it says, "Twist". Ah! "Twist", but it doesn't ... Oh! Those little arrows! Oh! Can just about see them.' Twist it ...
Yes.
Right? 'Now, hang on. I pressed that down before and nothing happened. So let's go back to the instructions. Ah, yes: when that's opened, then you can press that down and ... er ... get a spray.'
Yes.
Yes. ... Er ... And then ... er ... all in the garden's lovely! But ... er ... not very good, I would have thought, as a package for anybody with poor eyesight ...
Yes.
... and, also ... erm ... I would have thought ... er ... anyone using it, it would be quite all right, even if it was somebody who'd got quite rheumatic fingers. It's very easy to ... to work when once it's opened.
Yes.
... Er ... And it's easy; it's ... it's not stiff or anything like that. You don't need any tools to open it. But it is just the directions, because it is different from 99% of other aerosols.
Yes.
Yes.

Question 3.2

Thank you. Among these indications, was there any kind of connection between them or a combination between them – for example, if ... er ... one of these indications led you to another indication and, if that indication led to another indication to tell you about how to open it?
Yes. I think, if you ... if you had the instructions which said ... er ... er ... 'To use, 1] ... er ... Turn lid – or ... er ... collar or whatever you want to call it ... er ... anticlockwise'. ... Erm ... Sorry '... Turn ... Turn the lid clockwise ...'
Yes.
... Er ... '2] Press the serrated edge ...'
Yes.
... or ... or ... or ... er ... whatever ... It ... It could be just ... er ... er ... a different colour ... er ... 'and point in the direction that you want to use it.' ... Er ... '3] To close, turn lid anticlockwise.'
Yes, just those things. I think it would be better than these tiny, little ... er ... illust... They are *so small!* God! Squint! You know ...
Yes.
Well, I mean, without glasses, that's ... that's just ... er ... just a little blur.
Yes. ... Er ... For this package, was there any kind of link? For example ... er ... if, firstly, it was about the lid that was a kind of indication for you and then ... er ... you went to the ins... the illustration ...
Mm.
... and tried the lid again or something like that. ... Er ... Was there any kind of link between ... er ... these indications in the way that you tried to open it?

Yes. I mean ... It's ... It ... It's ... erm ... When you'd read the instruction, then, 'Okay. Fine.' But you ... you ... you look at it and you're looking for instructions ... er ... but this little bit of stuff up here ... er ... it doesn't really stand out enough ... Erm ... You ... You really need something: 'To open' or 'To use' - fairly obvious. ... Erm ... But that really is ... You see, you ... you get a 'Lynxvc.com' ... er ... er ... It ... It just is bad, that.

And ... But when you used these indications to understand this package, you just used them ... er ... separately or you used them as a combination of the indications that all ... all together told you something about how to open it.

Mm. Yes. Well, of course, it ... it ... it's perhaps having experience of similar products ... erm ... where you just unscrew it, press it ...

Yes.

... push the lid on ... erm ... that you ... you ... you don't stop to think ... er ... 'Now, is this going to be different ... er ... from the previous ones?' ... Er ... And you just assume, 'Well, it's a packet, isn't it? Is it going to unscrew?' ... Er ... 'Hang on! Well ... blazes! Hang on! There must be something ... I'm going to wreck this if I ... Oh! Ah! It said, "screw the other way". Ah! Now, hang on, I tried that when that ... That wouldn't work. Now, wait a minute ... What ...? Oh, I've got to read a bit ... Ah! I see now! Yes.'

Ah! Yes.

Self-education in a way! But ... But ... er ... No, no, I'm surprised at Lynx ... er ... doing this. ... Erm ... Yes. Well, there we are!

Question 4

Yes. Okay. Is there anything we have not covered about understanding how to open packaging that you would like to bring up or share with me?

No. Actually, when ... when you got those others over there ... Erm ... Now that was ... er ... Now this one, I think was ... er ... was very ... very ... very straightforward ... erm ... the ... the soup. ... Erm ... But, here, now ... Can you ...? Can you read that?

Yes.

Okay. If you tilt it but, if you're looking at that now, can't read it. So, it really ... If they're putting directions on, they need to be in a different colour from the background colour. And, also ... erm ... it's much easier ... er ... to see black printing against white, rather than white on black. ... Erm ... These ... These others were ... were fine. I mean, that one was ... er ... was a dead easy one. ... Erm ... But ... er ... I ... I certainly think, with this, when once you ... 'To open, squeeze ends and turn'. Yes, okay. That ... That's no problem. But you've got to read that. ... Erm ... I think ... erm ... And there ... there was another one as well. Yes, this one: 'Insignia' ...

Yes.

I mean, it's printed at the top in English; then we go onto ... erm ... French ... Hello, that's Spanish; ... in German ... er ... God knows what the other languages are! ... Er ... If it's for the home market, do we have to have all those things on? You see how tiny those are? If it was just in English ...

Yes.

... erm ... all... although, the point is, I suppose the makers can just send it off anywhere. But ... er ... whether - you know - if it's ... erm ... destined for the English market, could

you put an ... an extra sticker on the front? ... Er ... Because, I mean, that is, again, so tiny. That's the main thing, I would say. But, that ... that one was dead easy. Except that this is French, down the side.

Yes.

Jolly good!

Appendix F: A copy of the publication from this thesis

Combining 2D and 3D Design for Novel Packaging for Older People

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There has been little research conducted into packaging design recommendations aimed at helping older people understand how to open novel packaging. When developing novel packaging, designers may use their own judgment to provide indications for package opening. Despite this, age-related decline brings about further design needs. Therefore, packaging created by designers may not, at present, be fully appropriate for older people. The study used a participatory methodology which provided rich insights into the process of interaction with novel packaging. Detailed experiential data was collected during participant engagement in opening a range of packaging samples. A combination of qualitative and quantitative data from focus groups further informed the study. Specific relationships between 2D and 3D indications, which appear not to have been previously considered, were examined through semi-structured face to face interviews. The study produced new insights into the use of combined 2D and 3D indications by older people when opening packaging. Both 2D and 3D indications should be combined to present four types of information for package opening. These are: 1) hand positions, 2) hand actions, 3) hand directions and 4) confirmation of both how to open packaging and whether the packaging has been successfully opened. The indications should be provided in three different groups: 1) to fully explain package opening methods, 2) to trigger older peoples' prior experience of similar package opening methods and 3) to explain particular information for package opening.

Keywords – Packaging Design, Design for Older People, Open Ability, Cognitive Processes, Affordances, Design Recommendations.

Relevance to Design Practice – Combining selected 2D and 3D design approaches provides design recommendations for designers to consider when designing novel packaging. Adopting these design recommendations makes it easier for older people to understand how to open novel packaging.

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Introduction

Studying the ability to open packaging is crucial because it contributes directly to users' ability to access the contents. For older users whose physical ability has declined, opening a package can be increasingly difficult. Opening difficulties have been observed in relation to age-related decline in sensory (Cayton, 1995; Moore, 1993), cognitive (Carse, Thomson, & Stansfield, 2007; CEN/CENELEC, 2002; Mawle, 2003; Woodcock, Torrens, & McDonagh, 2004) and hand (Blakey, Rowson, Tomlinson, Sandham, & Yoxall, 2009; Janson, Yoxall, & Hayes, 2005; Lewis, Menardi, Yoxall, & Langley, 2007; Yoxall, Kamat, Langley, & Rowson, 2010) functions. However, there is a paucity of research into the cognitive functions concerned with older peoples' ability to understand how to open packaging. This study revealed that the use of combined 2D and 3D indications plays a significant role in helping older people understand how to open novel packaging.

In this study, 2D and 3D indications are identified by senses used to perceive indicated meanings. Two dimensional indications (2D) refer to surface, embossed or imprinted indications which users can see and read to interpret meanings. These indications are, for example, written instructions, a diagram or an embossed arrow. Three dimensional indications (3D) refer to shape, embossed or imprinted indications which users can see and feel to interpret meanings. These indications are, for example, the shape of a trigger, ridges around a lid or the imprinted marks corresponding between the lid and the body of packaging, suggesting that the packaging is open. An embossed arrow is defined as a 2D indication because its meaning is perceived by seeing rather than feeling. Those imprinted marks are seen as 3D indications because their meaning can be perceived by feeling.

Older People, Packaging and Opening Ability

Aesthetics and safety are important design requirements for packaging (Moore, 1993; Oostendorp, Bode, Lutters, & Houten, 2006). Aesthetics is a fundamental design requirement for attracting consumers' attention and for presenting the quality of contents. Safe packaging closures protect the quality of contents (e.g., food and drink) (Berns, 1981; Duizer, Robertson, & Han, 2009) and ensure that particular groups of contents such as medicines are not accessed accidentally by children (de la Fuente & Bix, 2005).

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However, closures designed for packaging aesthetics and safety may be problematic for older people. For example, it is difficult for some to see precisely where to start removing a transparent plastic film wrapped around the lid of a jar (Keates & Clarkson, 2003). A child-resistant closure, which requires users to squeeze the lid first and then to turn it, presents older people with particular difficulties (Carse et al., 2007; Moore, 1995).

The importance of package opening ability was highlighted by the then UK Department of Trade and Industry' (DTI) (1999) reporting that in the UK, 39% of accidents related to packaging in 1994 were associated with opening. The DTI (1999) stated that users used inappropriate tools such as knives, pliers and screwdrivers to open difficult packaging. Compared with younger users, older users have greater physical decline and therefore, appear to be at greater risk of having accidents when using such tools. Winder, Ridgway, Nelson, and Baldwin (2002) suggested that unclear indications for opening can cause user frustration, leading to adoption of risky opening strategies. Experiencing opening difficulty can also lead to negative feelings about packaging and contents. Galley, Elton and Haines (2005) noted that users may not repurchase a package that was difficult for them to open.

Design measures that increase opening ability taking into account sensory (Cayton, 1995; Moore, 1993) and hand impairments (Blakey et al., 2009; Janson et al., 2005; Lewis et al., 2007; Yoxall et al., 2010) are well established. Previous research into the cognitive functions of opening ability relates to emotions (Woodcock et al., 2004), attitudes (Carse et al., 2007) and remembering (Mawle, 2003), but not specifically to *understanding* how to open packaging. In Europe, CEN/CENELEC Guide 6 (CEN/CENELEC, 2002) suggested certain characteristics of indications for opening required in relation to older peoples' sensory and cognitive impairment. However, these guidelines did not address how to design such indications in order to create effective package opening for older people.

A newly designed opening mechanism may offer new packaging features, for example, safety or ease of use. Moore and Nayak (1992) noted that unfamiliar packaging with unfamiliar opening mechanisms may be difficult for older people to understand. Therefore, it was also essential to study older peoples' requirements to ensure that such packaging is easy for them to open (Moore & Nayak, 1992).

Novel Packaging and Older People

Novel packaging refers to a package whose appearance is unfamiliar to consumers. One of the commonly held stereotypes about older people is that they are not willing to change and are not likely to try new experiences (Stroud, 2005). Such views falsely maintain that older peoples' resistance to change may form a barrier, preventing them from trying new products in novel packages.

Stroud (2005) suggested that older people are unlikely to try new brands. Cole and Balasubramanian (1993) noted that older people have higher brand loyalty than their younger counterparts. Thus, they tend to buy a product with a brand that they know and a package that they are familiar with.

There is however, another view, that older people try new products just as younger people do, but are driven differently (Leventhal, 1997; Thompson & Thompson, 2009). Younger people may look for new products that are trendy, whereas older people tend to look for new products that meet their personal, specific needs (Leventhal, 1997).

Stroud (2005) stated that older peoples' willingness to try new brands may decline, but not in all cases. Older people are also willing to try new brands that meet their needs (Ambrosius, 2010).

Furthermore, self-perceived age tends to be more useful than chronological age in understanding older people's product and brand consumption (Wilkes, 1992). Gana, Alaphilippe, and Bailly (2004) stated that self-perceived age refers to how old a person feels she or he is. Older people with a younger self-perceived age tend to be open-minded in trying new products and brands (Schiffman & Sherman, 1991).

Despite older peoples' preferences for products with tried and tested branding, it is unlikely that they can completely avoid experiencing new products. All products have a life cycle (Onkvisit & Shaw, 1989); even though some products may survive in the market for many years, finally, they will become less and less popular (Onkvisit & Shaw, 1989). Outdated products are replaced by new ones, often with enhanced packaging. In the first stage of product decline, a brand owner may employ a minor change to extend product life by changing its packaging: marketing an old product and brand in a novel package for example. In this case, older consumers may have to accept a novel package, if they prefer to continue using the same brand and product with which they are familiar.

Yada Chavalkul is a doctoral researcher at Birmingham Institute of Art and Design, Birmingham City University. Her design practice and research areas are in graphic and packaging design. Yada's masters degree research related to the use of 2D design composition to communicate characteristics in graphic design. This paper, drawn from her doctoral research, focused on the use of 2D and 3D design to communicate to older people how to open novel packaging.

Dr. Andrew Saxon is Director of e-learning at Birmingham City University Institute of Art and Design, and a University Senior Learning and Teaching Fellow. His research interests lie in the application of arts-based models of designing to software user interface development, and the evaluation of the software user interface and user experience design for software. The main focus of this work has been toward web and multimedia software. He is also involved in the development of e-learning initiatives within the Institute Learning and Teaching Centre, which he leads. These include the design and evaluation of reusable learning objects, and research into e-pedagogies for art and design. He supervises Doctoral and Masters students in the School of Visual Communication, where he is research coordinator.

Dr. Robert N. Jerrard is the Emeritus Professor of Design Studies, previously Director of the Research Centre for Design and the Creative Industries at Birmingham City University (BCU), Institute of Art and Design. He has published widely on theoretical and social aspects of design and technology. He is a Fellow of the Design Research Society, an Associate Editor of the Design Journal and a member of the Arts and Humanities Peer Review College. Dr. Jerrard was the Principal Investigator of the major AHRC research project concerning Risk, Risk Perception and Design. He has directed major research into Fashion Culture and Consumption and Work-based Learning in Art and Design. He is a research consultant for a number of international publishing groups and several UK and overseas universities.

Older People and Their Demography

Older people in this study were defined by chronological age and are all 65+. Three kinds of ageing are typically defined: biological (Birren, 1964; Birren & Renner, 1977), psychological (Birren, 1964; Birren & Renner, 1977) and chronological age (Clarke, 1993; Tinker, 1997; Windmill, 1990). However, defining the biological and the psychological age of a person is likely to be highly problematic, for example, by measuring the ageing of each organ (e.g., the brain) and body system (Stokes, 1992).

In gerontology, there are various opinions on the start of *old age* including age 55 (Neugarten, 1974), 60 (Stuart-Hamilton, 2000), and 65 (Stokes, 1992; Victor, 2005; Whitbourne, 2001). Older people aged 65+ are more likely to be affected by age-related decline and to have greater difficulty in opening packaging than those 5-10 years younger.

The World Health Organization (WHO) (2002) reported that by 2025, one third of the population in developed countries will be aged 60+. In the UK, the Office for National Statistics (ONS) also estimated that there would be a 63 % increase in people aged 65+ in the next 21 years (Dunnell, 2007). In the UK, there has been an increase in the number of older people living alone (ONS, 2005). Thompson and West (1984) and Coleman (1996) noted that it is very important for older people to be independent. This is because being physically dependent on others can cause older people anxiety (Coleman, 1996; Fiske, 1980).

Packaging Opening

The interaction between consumers and packaging comprises three stages: purchasing, using and disposing. The *using* stage can be divided into: carrying, storing, opening, dispensing and closing. The interaction between consumers and packaging in this stage can vary, lasting from only a few minutes after purchase to up to a month, depending on product types; for example, a chocolate bar or a bottle of washing up liquid. In some cases, the using stage can be further sub-divided into: initial opening and reopening, dispensing and re-dispensing, and closing and reclosing (Winder, 2006), as shown in Figure 1.

In some packages, the boundary between opening, dispensing and closing is relatively blurred. For example, the appearance of some trigger spray bottles does not clearly show whether or not the bottle is open. In such cases, dispensing the contents is the only reliable way for the user to confirm that the bottle is open or closed and whether the contents are accessible. Consequently, opening in this study also included the stage of dispensing contents. Closing can be seen as a reverse stage of opening.

Older Peoples' Age-Related Decline in Relation to Opening Ability

Opening a package tends to involve both strength and movement of hands and fingers. Thus, physical limitations in relation to hand strength or dexterity can lead to difficulty. However, before a package is physically opened, other processes, for example, receiving information from the package and thinking about how to open it, are also required. Therefore, the major processes of opening a package may involve three stages: 1) receiving the information, 2) thinking about how to open it and 3) performing package opening. The first stage uses sensory organs as a combined channel for information input. The second stage relates to cognition, leading to the last stage where the package is physically opened.

Sensory Functions

The sensory functions used when opening packaging are vision, hearing and touch. Impairment, which can adversely affect older peoples' ability to understand how to open a package, concerns these three sensory functions, identified respectively as follows:

- Visual acuity, colour perception and brightness and darkness adaptation
- Hearing sensitivity
- Tactile and pressure sensitivity

Decline in visual acuity makes reading difficult (Watkinson, 2005) especially small print (Pirkl, 1994). Changes in colour perception may reduce the ability to distinguish the colour of indications for opening on a package. As a result of declining brightness and darkness adaptation, high colour contrast (Pirkl, 1994) between indications and background is needed to make it easy to identify the indications.

Decline in hearing sensitivity caused by ringing, hissing or buzzing noises in the ear (Kart, Metress, & Metress, 1978; Parsons & Felton, 1990) may hinder the ability to receive audible information from packaging that would otherwise aid opening.

Decline in tactile and pressure sensitivity may reduce the ability to receive information from packaging for opening. Tactile sensitivity is concerned with the shape and texture of an object (Pirkl, 1994), for example, when feeling a recessed shape on a lid. Pressure sensitivity involves how hard or soft an object is as users press on it with their fingers or hands (Pirkl, 1994). For example, users can feel through their fingers the soft pressure reaction when pressing an unlocked trigger.

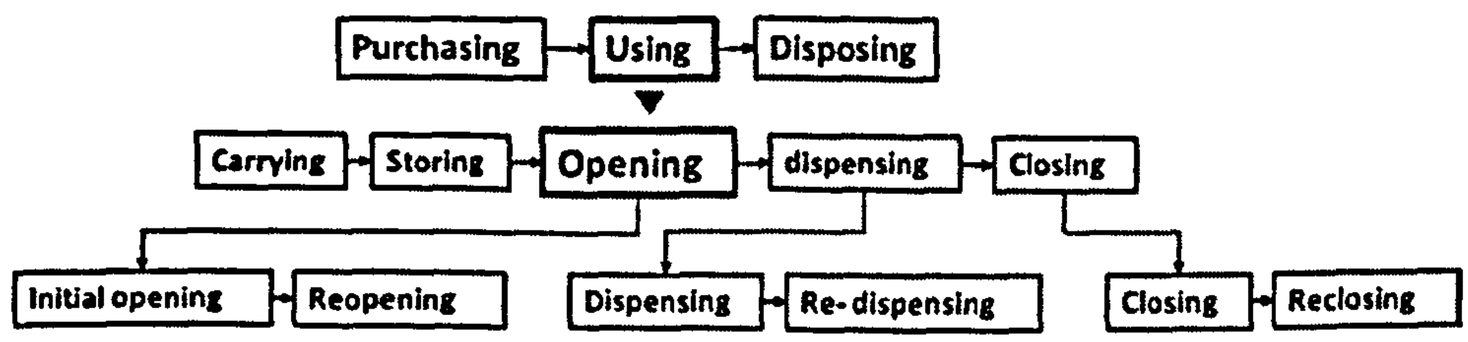


Figure 1. The stages of using packaging.

Cognitive Functions

Cognition in this context comprises a number of processes, seen differently by different authors (Benjafield, 1992; Smyth, Collins, Morris, & Levy, 1994; Solso, 2001). However, cognitive processes described by Smyth et al. (1994), Solso (2001) and Welford (1980) all include: perception, memory and understanding. Perception is the stage by which a person examines sensory stimuli before making the decision whether or not to respond (Cunningham & Brookback, 1988). Through application of memory, previous knowledge helps a person classify old and new information (Benjafield, 1992; Smyth et al., 1994). Understanding then takes place through the integration of old and new information (Smyth et al., 1994; Welford, 1980). From this integration, ideas are constructed for decision making (Smyth et al., 1994; Welford, 1980). Subsequently, the experience from these cognitive processes can be used as a basis for future packaging use (Smyth et al., 1994).

Perception

Age-related impairment of seeing, touching and hearing is likely to contribute to the deterioration of perception. Therefore, stronger sensory stimuli are required for older people (Stokes, 1992). For example, larger text sizes and high colour contrasts between text and background will help older people read written instructions.

Memory

Semantic memory which refers to knowledge and facts about the world (Smith, Norris, & Peebles, 2000) tends to be stable with ageing (Stokes, 1992), declining eventually at 75+ (Bäckman, Small, Wahlin, & Larsson, 2000). White (1993) explained that semantic memory, or what a person has learned, helps a person learn new things. Semantic memory, therefore, may be useful when opening both familiar and unfamiliar packaging.

Working memory is used to manipulate stored information in the planning of a task (Kensinger & Corkin, 2003; Stokes, 1992) and declines with ageing (Craik & Bosman, 1992; Kensinger & Corkin, 2003; Stokes, 1992). Kensinger and Corkin (2003) explained that the decline of working memory in older people may be caused by three kinds of cognitive limitations. Firstly, older people take longer to process information. Secondly, they find it difficult to simultaneously store different types of information. Thirdly, it is difficult for them to distinguish relevant from irrelevant information. Therefore, a complex opening task may be difficult for older people because they have to store, update and retrieve information from a number of indications, for example, diagrams, symbols and shapes, in order to understand how to open the package.

Understanding

The Oxford English Dictionary defined intelligence as *the faculty of understanding* (Simpson & Weinar, 1989). Cattell (1963) and Bäckman et al. (2000) indicated that there are two kinds of intelligence: fluid and crystallised. Fluid intelligence involves the ability to reason, acquire new ideas (Stokes, 1992) and solve new problems (Bäckman et al., 2000). Crystallised intelligence is concerned with specific knowledge and methods for solving problems (Cunningham & Brookback, 1988).

Fluid intelligence declines with ageing (Bäckman et al., 2000), but crystallised intelligence appears to be efficient (Stokes, 1992) until around the age of 75 (White, 1993). Therefore, older people may successfully draw on previous knowledge to help them understand how to open a familiar package, whereas understanding how to open an unfamiliar package may not be easy.

Hand Functions

Decline of hand functions mainly relates to physical impairment of the hand structures, for example, in muscles, tendons and bones (Carmeli, Patish, & Coleman, 2003). Additionally, osteoarthritis (Aigner, Haag, Martin, & Buckwalter, 2007; Estes, Bochenek, & Fassler, 2000) and rheumatoid arthritis (Reginster, 2002); which both affect certain joints, are commonly found in older people. Osteoarthritis (Altman et al., 1990) and rheumatoid arthritis (Symmons et al., 2002) cause pain, swelling, stiffness and deformation of fingers. This makes it difficult to move wrists and fingers (Carmeli et al., 2003). Hand impairment can also lead to limitations in the hand strength available to squeeze a lid or restrictions in hand movement sufficient to prevent turning the lid of a jar.

Inclusive Design and Design for Older People

Packaging design practice for older people within the terms of this study appears to subscribe to the principle of inclusive design. Keates and Clarkson (2003, preface) suggested that "Inclusive design is about maximising the market potential of your products by making sure that the maximum number of people can use them". Although this study specifically excluded older people who have severe impairments such as blindness, the design recommendations offered herein can be used to design packaging so that a greatly expanded range of users will be able to open packaging. As the motto of the Centre of Applied Gerontology at the University of Birmingham, which collaborated in this study, states: "design for the young and you exclude the old; design for the old and you include the young".

User-centered and participatory design are important aspects of inclusive design in which user needs are taken into account during the design process. The difference between participatory design and user-centered design may be recognised through the different degrees of user involvement. In participatory design, users are seen as co-designers (Abras, Maloney-Krichmar, & Preece, 2004). In user-centered design, users provide design requirements for designers, but do not make design decisions (Iivari, 2004).

In this study, design can be used to improve packaging, compensating for older peoples' decline in visual, cognitive and hand functions. Thus, older users' involvement during the design

process as co-designers is important in ensuring that packaging meets their needs.

Participatory Design Methods

Data were collected from participants through three stages: initial observations, focus groups and in-depth interviews.

Initial Observations

The purpose of the initial observations was to gain better understanding of how older peoples' reduced ability affects their everyday activities. The initial observations were conducted in social settings (two lunch clubs where older people aged 80+ and 60+ attended), during activities provided by the UK charity, Age Concern[2]. During these sessions participants exhibited limitations in varying degrees in terms of vision (Ah-Chan & Downes, 2006; Chivers, 2003; Watkinson, 2005), hearing (Gates & Mills, 2005; Stuart-Hamilton, 2000), short-term memory, mobility (Daley & Spinks, 2000; Metz, 2000) and hand dexterity (Carmeli et al., 2003), when taking part in lunch club activities. Such limitations may affect their ability to open packaging. Decline in short-term memory was only found in a few of the attendees aged 80+. Short-term memory can be described as limited-capacity storage of information over a very short duration (Kensinger & Corkin, 2003). However, Kensinger and Corkin (2003) suggested that ageing is unlikely to negatively affect short-term memory, consequently the observed memory limitations may have other causes.

The attendees of lunch club one (80+) tended to have more severe degrees and various kinds of age-related impairment than those in lunch club two (60-80). The older people become, the more vulnerable and dependent they are likely to be (Minkler, 1994; Tomassini, 2005). To ensure that participants with different levels of limitations were accommodated in this study, they were categorised by age groups. The researcher also learned that opening ability related to prior knowledge of how to open packaging and indications. This was examined further in the focus groups.

Focus Groups

The purpose of the focus groups was to identify design requirements that would increase the intelligibility of package indications for older people.

Participants

Twelve participants, six females and six males from three age groups (65-74, 75-84 and 85+), were selected for two focus groups from the members of *the Thousand Elders*[3] at the Centre for Applied Gerontology .

Packaging Samples

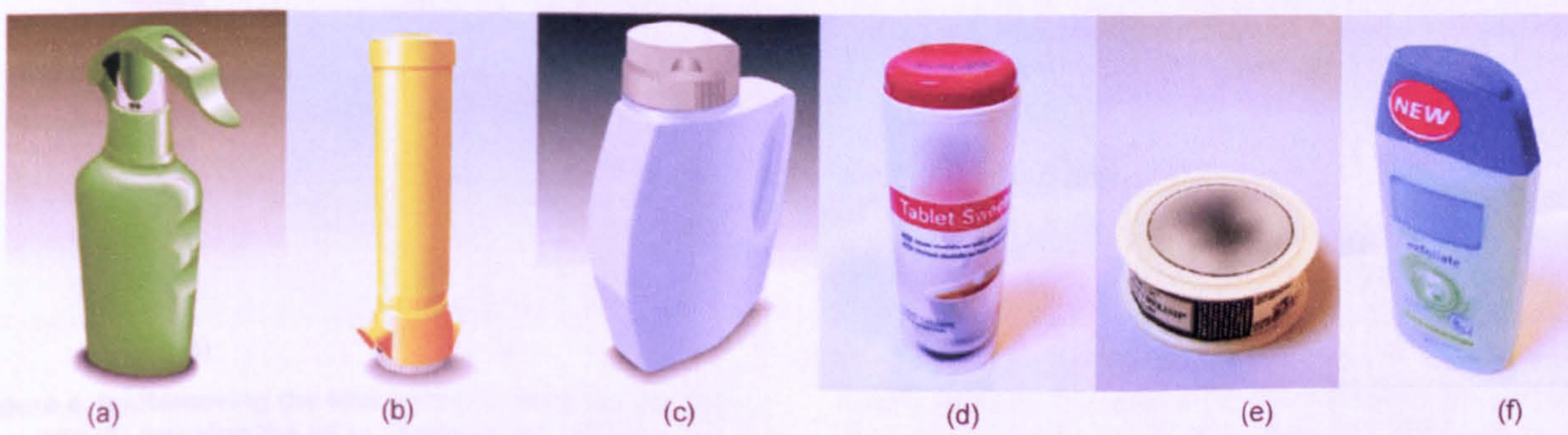
Three criteria used for selection of packaging samples were: 1) types of packaging most used by older people, 2) unfamiliar relationships of indications to opening methods and 3) a variety of indications and opening methods.

The types of packaging most used by older people appeared to be packaging for food and household products (e.g., household cleaning and personal care products). Older people spend a greater proportion of their total expenditure on these product categories than others (ONS, 2008).

This study focused on how to design indications that effectively explain to older people how to open novel packaging. Hence, packaging with an unfamiliar relationship of indications to opening methods was examined. To identify such packaging, the relationship of indications to opening methods commonly found in different types of existing packages in supermarkets was categorised and indexed. Packaging where the relationship of indications to opening methods was different from the categorisation index was selected for use in the focus groups.

Also, the packaging samples in this study were all plastics because the greatest variety of indications and opening methods was found in this material.

There were 13 different kinds of opening methods among the 23 packaging samples selected. In each of these, the sample whose appearance differed most from the packages in the categorisation index explained above was selected. Full discussion of all 13 packaging samples may cause older participants to tire when contributing during the session; this could have negative implications for the data. Therefore, six of the 13 samples were chosen at random for use in the focus groups. The remaining seven were used in the in-depth interviews. After careful consideration, these were felt to provide a true-to-life representation of everyday experience for the research which was unlikely to be altered by the use of different selection criteria. The six samples are shown in Figure 2 below.

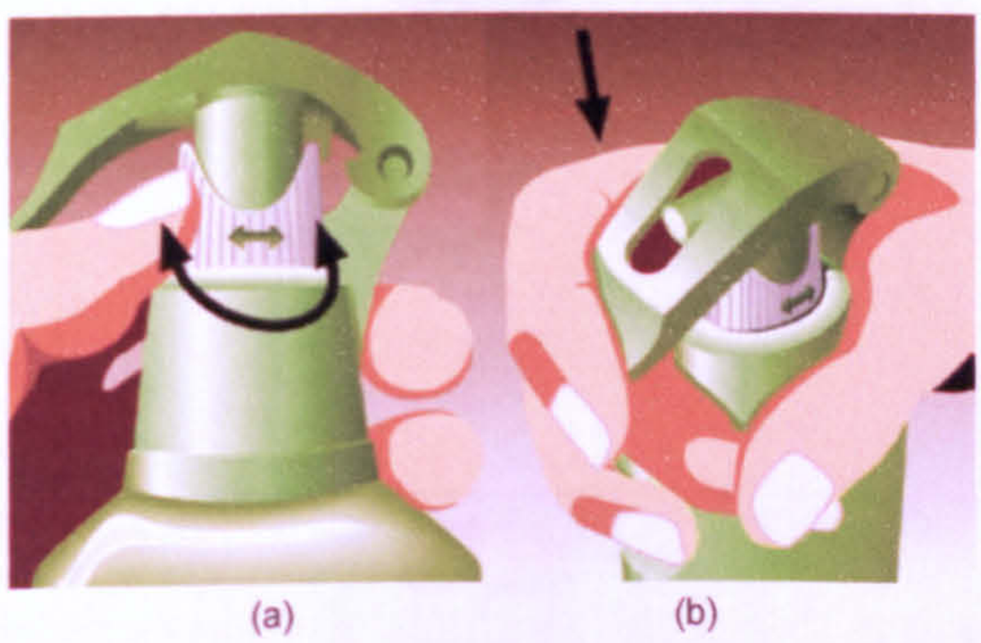


(a) (b) (c) (d) (e) (f)

Figure 2. Six packaging samples for the focus groups.
(Illustrations were used to show packages in Figures 2(a), 2(b) and 2(c) as permission of using the photos was not granted.)

Two focus groups were conducted. The first group discussed packaging that its participants found the easiest to understand how to open. The second group, in contrast, discussed packaging that its participants found the most difficult to understand how to open. The average score value provided by participants for the factor of *understanding* was used to identify these two packages. Participants were asked to try opening the same six packaging samples to provide the score. Therefore, all participants had experience of opening whichever packaging sample was subsequently selected for discussion. The easiest and most difficult packaging samples appear as Figures 2(a) and 2(d) above.

Package 2(a) is a sun spray bottle. The opening process of this package has two stages: 1) releasing the lock of the trigger by turning the white collar anticlockwise or clockwise (see Figure 3a) and 2) dispensing the contents by pressing the trigger (see Figure 3b).



(a) (b)

Figure 3. (a) Turning the white collar anticlockwise or clockwise and (b) pressing the trigger to dispense the contents. (Illustrations were used to show how to open package 2(a) as permission of using the photos was not granted.)

Package 2(d) is a tablet sweetener bottle. The opening process of this package has two stages: 1) removing the seal on the base of the package (see Figure 4a) and 2) dispensing the contents by pressing the lid (see Figure 4b).

(a) (b)

Figure 4. (a) Removing the seal on the base of the package and (b) pressing the lid to dispense the contents.

Procedure

There were two sessions in each of the two focus groups. In the first session, participants were asked to complete two questionnaires, both of which collected quantitative data. The first questionnaire concerned participants' health-related conditions affecting their ability to open packaging, for example, visual impairments or arthritis. The second questionnaire asked participants to use Likert scales to rate the six packaging samples on three factors: familiarity, understanding and ability to physically open the packages. The score provided by participants for the factor of *understanding* was used to select the easiest package for discussion in focus group one and the most difficult package for discussion in focus group two. This discussion took place in the second session; mostly qualitative data were collected.

Two and three dimensional indications on the selected packaging samples used in the focus groups are shown below in Table 1.

Results and Discussion

The literature showed that ageing affects visual (Ah-Chan & Downes, 2006; Chivers, 2003; Watkinson, 2005), cognitive (Craik & Bosman, 1992; Kensinger & Corkin, 2003; Stokes, 1992) and hand functions (Carmeli et al., 2003). The findings from the focus groups indicated that age-related decline in these functions negatively influenced the participants' ability to understand how to open the packaging samples.

The findings from the focus groups showed that there are interplays between sensory information, cognitive functions (understanding) and hand functions (Benjafield, 1992; Birren, 1964; Goldstein, 1980; Schonfield, 1980; Smyth et al., 1994; Solso, 2001; Stokes, 1992; Welford, 1980). The quality of sensory information influences cognitive functions and hand functions; cognitive functions influence hand functions and hand functions also influence cognitive functions (understanding and emotional responses) as illustrated in Figure 5 below.

The findings from the focus groups also provided insights into sensory, cognitive and hand functions that led to the formulation of design recommendations aimed at helping older people understand how to open packaging.

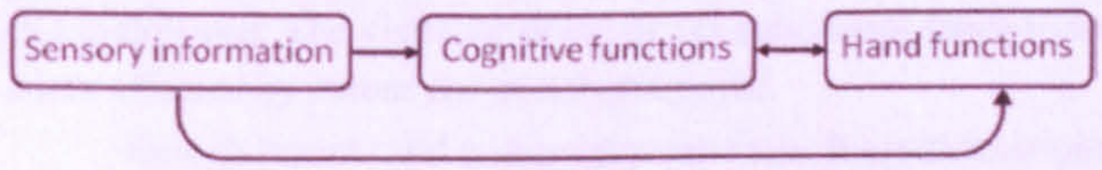


Figure 5. The relationship between sensory information, cognitive functions and hand functions.

Sensory Functions

The data from the focus groups revealed that the key design recommendation concerning sensory functions is *visibility of indications* (CEN/CENELEC, 2002; Jordan, 1998; Norman, 2002). The data from the focus groups also showed that visibility of indications can be achieved by using colour (CEN/CENELEC, 2002; Moore, 1993), size (CEN/CENELEC, 2002; Moore, 1993), position (CEN/ CENELEC, 2002; Galley et al., 2005; Moore,

Table 1. Two and three dimensional indications on the selected packaging samples used in the focus groups.

Packaging samples	2D indications	3D indications
Package 2(a)	The product name The two-headed arrow	The ridges around the collar The trigger The grooves The nozzle
Package 2(d)	The product name	The lid and the body

Note: Illustrations were used to show 2D and 3D indications on package 2(a) as permission for using the photos was not granted.

1993), design layouts and typography (Bix, 2002; Galley et al., 2005; Moore, 1993), but avoiding placing indications on shiny surfaces (CEN/CENELEC, 2002). Further design solutions concerning the visibility of 2D and 3D indications drawn from the focus groups are now summarised.

Colour contrast and position are important design attributes for both 2D and 3D indications, whereas size, design layouts, typography and shiny surfaces are likely to be important for 2D indications.

Because of the limited space on packaging, 2D indications such as written instructions tend to be small. Three dimensional indications can be divided into large and small sizes. Large indications might include the lid or the body of a package. Small indications might include indentations in the body of a package. Colour contrast between indications and background and position (e.g., near the opening) are likely to have more of an effect on the visibility of 2D indications and small 3D indications than they are on the visibility of large 3D indications. Indication size appears to have more of an effect on the visibility of 2D indications than it does on small and large 3D indications. No participants commented that size affected the visibility of small 3D indications. The visibility of small 3D indications tends to be more affected by colour contrast than by size.

Design layouts and typography can make long instructions (2D indications) easy to read and understand. A shiny surface, negatively affects the readability and visibility of 2D indications. For example, embossed arrows (2D indications) are identified with difficulty when they are on a shiny surface.

The data from the literature suggested that alternative indications formats, received by feeling and hearing (CEN/CENELEC, 2002; Hartson, 2003; Jordan, 1998) should be provided for older people who may find it difficult to see or read indications. It should be noted that older people who have severe visual impairment were excluded from the focus groups, so that cognitive processes related to participants' understanding of how to open packaging could be fully explored with no data skewing

due to such impairments. Participants appeared to mainly rely on the visual indications followed by the tactile indications then the audible indications when opening the packaging samples.

Cognitive Functions

The data from the focus groups revealed that key design recommendations to promote the understandability of packaging information for opening related to a) the explanation of how to open packaging (Monö, 1997; Norman, 2002), b) the prioritisation of information for opening (Jordan, 1998) and c) the relationship of indications to required opening methods (CEN/CENELEC, 2002).

The literature reviewed (Monö, 1997; Norman, 2002; Jordan, 1998) includes communications of how to use products. The findings from the focus groups provided specific design recommendations concerning the communication of how to open packaging.

The data from the focus groups showed that explanations of how to open packaging related to a) the identification of packaging types which suggest required opening methods and b) detailed information for opening (e.g., required hand directions). Prioritisation of information for opening involved a) highlighting the importance of indications by using colour and b) prioritising information on packaging labels, including opening instructions, by using design layouts: for example, sizing text instructions, grouping information spatially and sequentially numbering the opening steps.

The relationship of indications to the required opening methods related to older peoples' interpretation of indications on how to open packaging. Older peoples' prior experience formed stereotypes of past relationships of indications to opening methods. It is easy for older people to understand how to open packaging when the stereotypes are familiar because they recognise that particular packaging, from its appearance (indications), requires certain opening methods. The data from the focus groups also showed that familiar packaging appearances (indications) misled participants that a particular opening method was required, when it was not. Additional indications are needed for novel packaging which employs a new method for opening, to help older people understand how to open it.

Hand Functions

The findings from the focus groups indicated that the shape of packaging affects older peoples' ability to physically open packaging (Berns, 1981). Opening methods that require excessive hand actions should be avoided (CEN/CENELEC, 2002) and opening mechanisms should allow users to physically open packaging as guided by indications (Norman, 1999). In the focus groups, the grooves on one packaging sample allowed participants to hold the bottle firmly and exert hand strength to open it. Additionally, the hand action required to dispense the content from another packaging sample, pressing the whole package down onto the atomiser at the bottom of the package, caused a participant hand pain as this required an excessive wrist movement. Such hand actions may inhibit older peoples' ability to successfully open a package and to evaluate their understanding of how to open it. Furthermore, the data from the focus groups revealed that in some cases, indications successfully guided participants on how to open the packaging sample, but opening mechanisms did not allow them to open it easily.

The focus groups highlighted the crucially related roles of 2D and 3D indications in guiding participants' understanding of how to open the packaging sample. The use of 2D and 3D indications was examined further in the in-depth interviews.

In-depth Interviews

The purpose of the interviews was to identify in detail how participants used 2D and 3D indications to understand how to open packaging.

Participants

Six participants, three females and three males; in three age groups, 65-74, 75-84 and 85+, were selected from the focus group participants. Different packaging samples were provided for the participants in the interviews. Therefore, the experience gained by the participants from the focus groups was unlikely to negatively affect any new data. In contrast, the participants' understanding of the broad context of the study from the focus groups may have helped them contribute in-depth data about opening ability.

Packaging Samples

The two criteria used for selecting packaging samples were unfamiliarity and difficulty in understanding how to open packaging. In the focus groups, the researcher noticed that the participants commented more on the packages which they had difficulty understanding how to open than the ones they found easy. Additionally, packaging samples with two or more opening steps or unfamiliar opening methods tended to demand more cognitive processing. Unfamiliar opening methods were defined as the packaging samples whose opening methods were different from the ones presented in the categorisation index established in the focus groups.

Accordingly, seven out of the original 13 packaging samples which were not used in the focus groups were shortlisted. Afterward, five out of the seven packaging samples which have two or more opening steps or unfamiliar opening methods were chosen for use (see Figure 6).

Only one of the five packaging samples was selected for the in-depth discussion. This package was the most unfamiliar to each participant and the most difficult for them to understand how to open. This discussion was to provide insights into cognitive processes employed when older people used indications to open packaging. Package 6(a) was selected for two participants; package 6(b) was selected for the remainder.

Package 6(a) is a deodorant bottle. The opening process of this package has two stages: 1) releasing the lid by twisting it clockwise (see Figure 7a) so that the outer part of the lid moves down to reveal the atomiser and nozzle (see Figure 7b) and 2) dispensing the contents by pressing the atomiser (see Figure 7c).

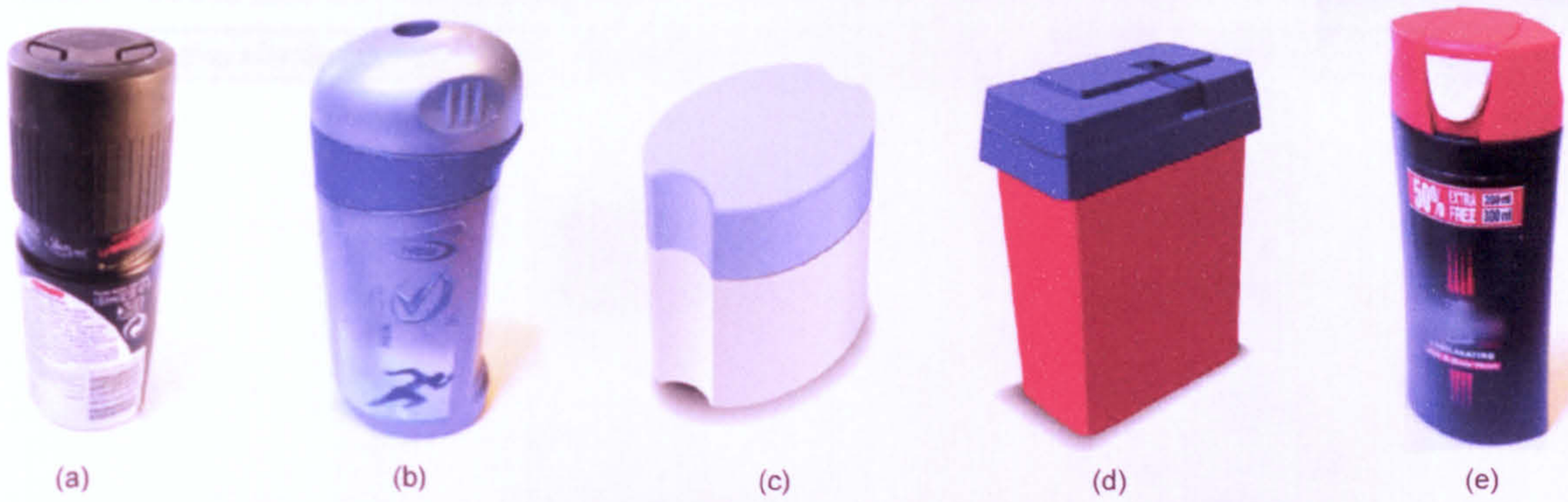


Figure 6. Five packaging samples for the in-depth interviews.
(Illustrations were used to show packages in Figures 6(c) and 6(d) as permission for using the photos was not granted.)

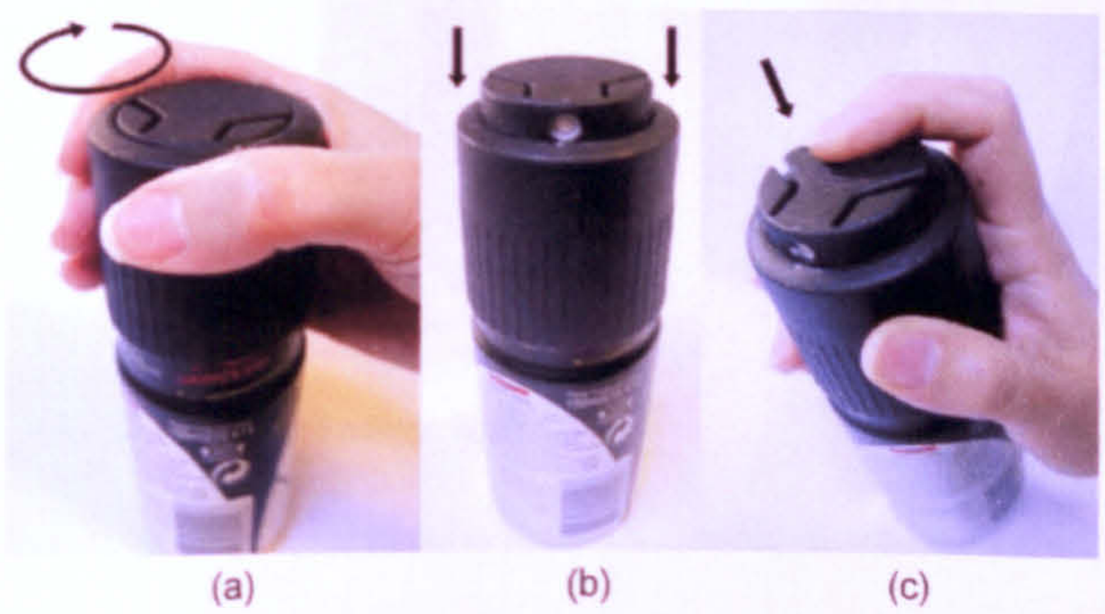


Figure 7. (a) Twisting the lid clockwise, (b) the outer part of the lid moving down and (c) pressing the atomiser to dispense the contents.

Package 6(b) is a shower gel bottle. The opening process of this package has two stages: 1) releasing the lid by twisting the lid anticlockwise (see Figures 8a-8b) and 2) dispensing the contents by turning the bottle upside down and squeezing it (see Figure 8c).

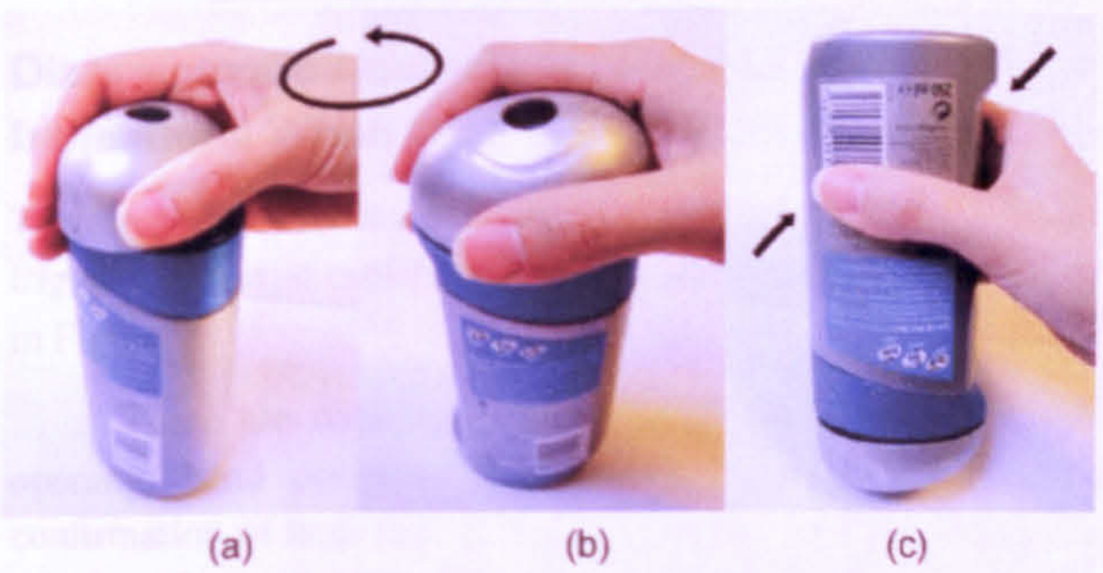


Figure 8. (a) and (b) Twisting the lid anticlockwise to release the lid and (c) turning the bottle upside down and squeezing the bottle.

Procedure

Qualitative data were collected in the two individual interview sessions. In the first of these, observations were made during the participants' interactions with the packaging samples. The researcher made careful journal notes and video recordings of all aspects of the interactions for later use. Participants were also asked to complete two questionnaires using Likert scales to rate the packaging samples on two factors: familiarity and understanding. The score was used to select the package that the participants found the most unfamiliar and the most difficult to understand how to open.

In the second session, the information derived from the journal and confirmed by that from the video recorder was used to inform specific inquiries into the participants' interactions with the selected package in the subsequent discussion.

Two and three dimensional indications on the selected packaging samples used in the in-depth interviews are shown below in Table 2.

In both the focus groups and the in-depth interviews, the researcher informed the participants that the purpose of trying to open the packaging samples was not to test their ability to open the packages, but to gather their comments to develop design recommendations for packaging related to older people and opening ability. Designing the questionnaires required specific considerations around the page layout, the font and the type size to ensure that it was easy for participants to read and respond to.

Results

The findings from the in-depth interviews referred to the use of 2D and 3D indications that helped participants understand how to open the packaging samples. The indications can be categorised into three groups according to the types of information that the indications present.

- Group one refers to 2D *full explanation* indications (e.g., diagrams and written instructions), showing all hand positions, hand actions and hand directions required for opening and confirmation of how to open packaging.
- Group two relates to 2D and 3D *memory trigger* indications (e.g., product names and atomisers), identifying methods of opening by triggering users' prior experience and showing all hand positions, hand actions and hand directions required to release the lid and/or dispense the contents.
- Group three refers to 2D and 3D *partial explanation* indications (e.g., arrows and indentations), partially showing information for opening a package, for example, hand positions and hand actions required for releasing the lid, but not hand directions.

Table 2. Two and three dimensional indications on the selected packaging samples used in the in-depth interviews.

Packaging samples	2D indications	3D indications
Package 6(a)	The product name The diagrams The arrows	The lid and the body The ridges on the top The ridges around the lid The atomiser and the nozzle The indented base

Diagrammatic Analysis of the Use of 2D and 3D Indications When Opening a Package

The categories of 2D and 3D indications (full explanation, memory trigger and partial explanation) are represented diagrammatically in Figure 9.

There are four types of information linked to package opening: hand positions, hand actions, hand directions and confirmation of both how to open packaging and how to assess whether the packaging has been successfully opened. Full explanation and partial explanation indications include these four, whereas memory trigger indications comprise only hand positions, hand actions and hand directions required for opening a package (see Figure 9).

Full explanation and memory trigger indications show complete information for opening, including hand positions, hand actions and hand directions, whereas partial explanation indications only partially achieve this. Hence, the pattern in Figure 9 demonstrates a connection of four segments in the first semi-circle (full explanation indications) and of three segments in the middle semi-circle (memory trigger indications), but a slight separation of four segments in the third semi-circle (partial explanation indications).

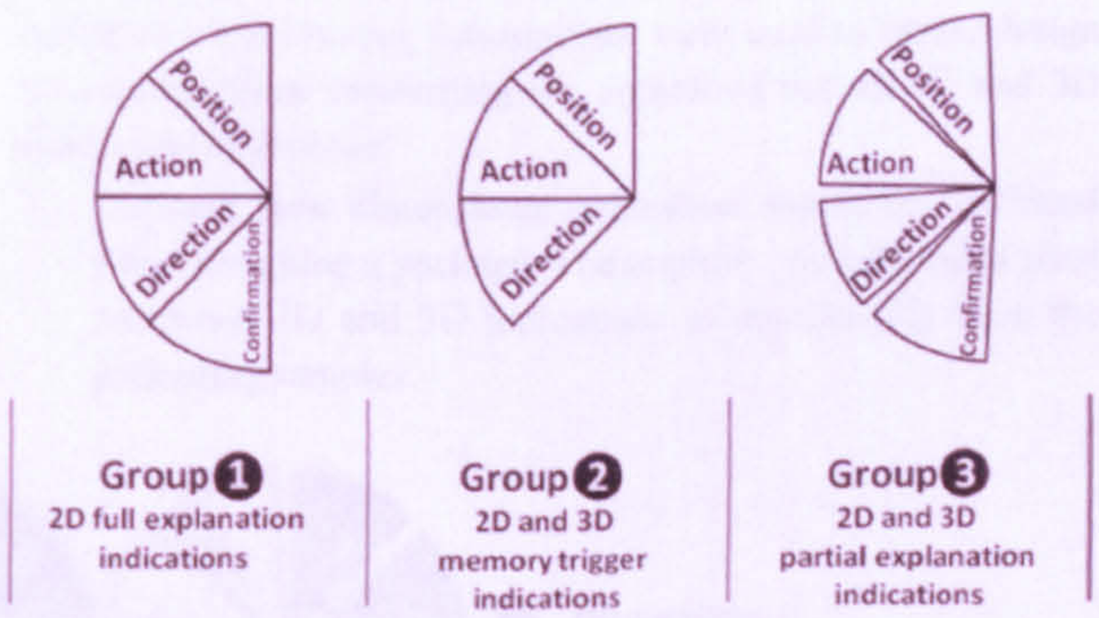
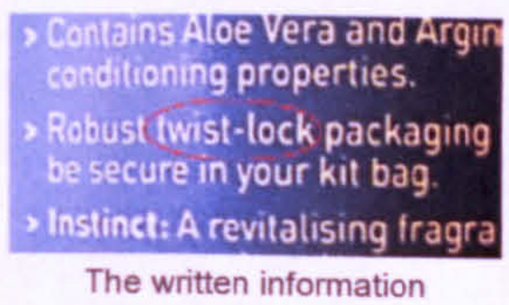


Figure 9: The pattern presenting the use of 2D and 3D indications.

There are two stages involved with opening a package: releasing the lid and dispensing the contents. Consequently, each semi-circle in Figure 9 was repeated on the left and right as

Table 2. Two and three dimensional indications on the selected packaging samples used in the in-depth interviews (continued).

Packaging samples	2D indications	3D indications
Package 6(b)	The product name	The indentations and the ridges
	The diagrams	The nozzle
	The arrow and the plus and minus symbols	The gap between the lid and the body
	 The written information	The corresponding marks on the lid and the body

shown in Figure 10 below to represent the two stages of opening. Additionally, different colours are used to differentiate these two stages: white for releasing the lid on the left and black for dispensing the contents on the right.

This visual tool was used to record successful and unsuccessful uses of indications and information for opening the packaging samples evaluated. Through a comparison of the patterns from successful cases, their similarity permitted conclusions to be drawn regarding successful uses of indications and information. Equally, it was possible to draw conclusions on unsuccessful uses of both indications and information.

Design Recommendations of Combined 2D and 3D Indications to Provide Effective Information for Opening Novel Packaging for Older People

The conclusions about the successful and unsuccessful use of indications and opening information were used to create design recommendations concerning the combined use of 2D and 3D indications as follows:

1. Two and three dimensional indications should be combined when designing a package. The majority of participants used combined 2D and 3D indications to successfully open the packaging samples.

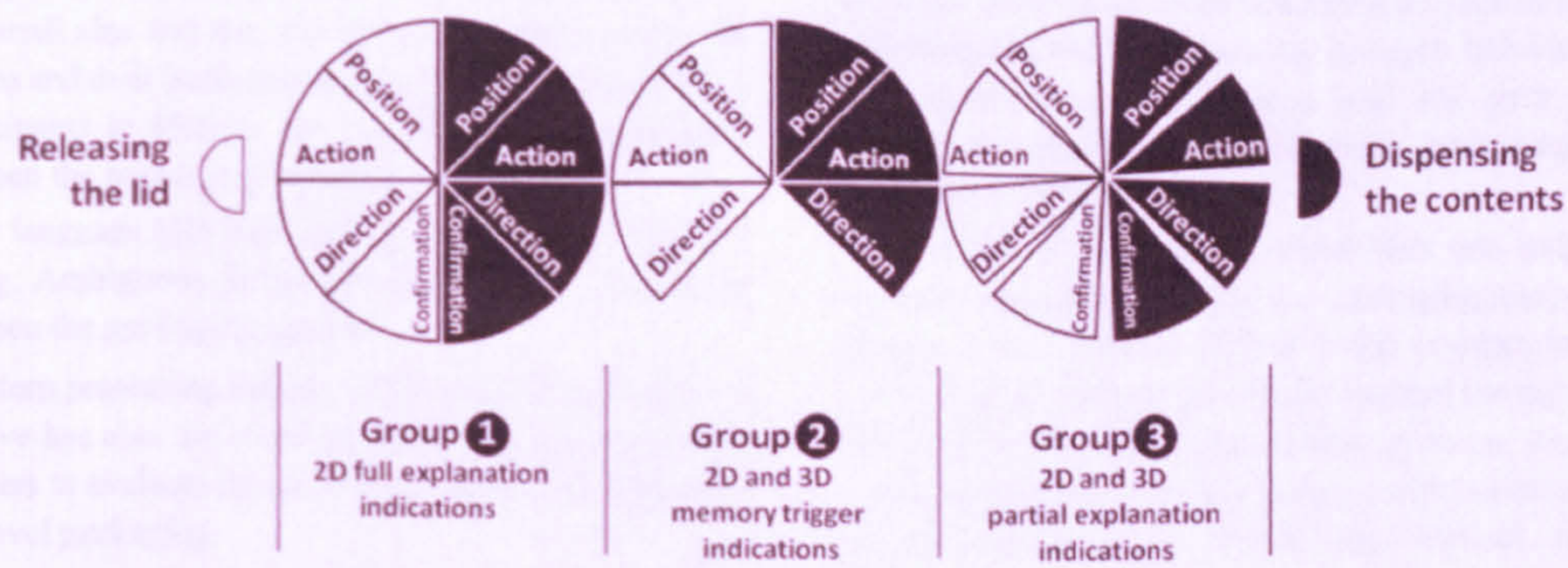


Figure 10: The pattern presenting the use of 2D and 3D indications when releasing the lid and dispensing the contents.

2. When designing memory trigger and partial explanation indications, both 2D and 3D indications should be provided on a package. Participants used different indications to understand how to open the packaging samples. Alternative indications, as well as different indications showing the same information, appeared to help participants to understand how to open the packaging samples, regardless of their varying visual or perceptual impairments.
3. Designers should utilise the three groups of indications: full explanation, memory trigger and partial explanation when communicating how to open packaging. All participants used at least two out of these three groups of indications to effectively understand how to open the packaging samples.
4. Each of the three indications (full explanation, memory trigger and partial explanation) should present three types of information: hand positions, hand actions and hand directions required for opening packaging. All participants used at least two types of information (e.g., hand positions and hand actions) from at least two groups of indications (e.g., full explanation and memory trigger) to understand how to open the packaging samples.
5. Full or partial explanation indications should also be provided for older users to confirm how to open packaging and to confirm successful package opening. Most participants used full or partial explanation indications to confirm how to open the packaging samples and/or whether the packages had been successfully opened.
6. The appearance of unfamiliar packaging does not normally identify potential opening methods. In other words, there are no memory trigger indications. Both full and partial explanation indications should be provided to show the three types of information (hand positions, hand actions and hand directions). Without memory trigger indications, participants relied on full and partial explanation indications. The more information provided, the more easily participants understood how to open the packaging samples.
7. Designers should avoid using ambiguous 3D memory trigger indications that may mislead. In some cases, these familiar indications presented misleading information on how to open the packaging samples. Additional indications are needed to clearly explain how to open the packaging samples.
8. Indications should be easily noticed, identified and read (visibility). Although there were indications on some of the packaging samples, participants did not notice them because of their small size and the low colour contrast between the indications and their background. Accordingly, it was difficult for participants to identify the indications and understand how to open the packaging samples.
9. Use clear language (2D indications) to explain how to open packaging. Ambiguous language misled participants about how to open the packaging sample.

The pattern presenting the use of 2D and 3D indications in Figure 10 above has also the potential to be used as a diagnostic tool by designers to evaluate the understandability of information for opening novel packaging.

Discussion

Older peoples' design requirements linked to sensory, cognitive and hand decline cannot be isolated because there is a constant interplay between these functions. For hand impairment, the data from the focus groups revealed that a decrease in hand strength significantly limited participants' ability to physically open the packaging samples (Carse et al., 2007). Therefore, shapes (for gripping and holding) as well as methods and mechanisms used for opening packaging have to be carefully considered and tested with older people.

The data from the focus groups showed that impairment of visual acuity and brightness and darkness adaptation negatively affected participants' ability to notice, identify and read indications for opening. Brightness and darkness adaptation (including colour contrast) appears to have a greater impact on older peoples' ability to identify indications than colour perception alone. More attention is needed when designing 2D indications and small 3D indications because their visibility is significantly influenced by colour contrast. Uses of size tended to play a key role in providing 2D indication visibility. Although the data from the focus groups showed that participants mainly relied on information received by seeing, alternative formats (CEN/ CENELEC, 2002; Hartson, 2003; Jordan, 1998) of indications received by touch and hearing should be provided so that older people with a wide range of sensory impairment can understand information. Indication visibility is particularly important for older people when packaging appearance is unfamiliar.

The data from the focus groups and the in-depth interviews indicated that unfamiliar packaging samples tended to be more difficult for participants to understand than familiar ones. This supported the data from the literature that ageing impairs both working memory (Craik & Bosman, 1992; Kensinger & Corkin, 2003) and fluid intelligence (Bäckman et al., 2000) when carrying out complex and unfamiliar tasks. The data from the focus groups showed that indications play an important role in helping users understand how to use products (Monö, 1997, Norman, 2002) (e.g., to open novel packaging). Prior knowledge significantly helped participants recognise and understand indications. This confirmed the literature that semantic memory and crystallised intelligence (Bäckman et al., 2000; Stokes, 1992) involving prior knowledge both appear to maintain efficiency with ageing. However, the focus groups and the in-depth interviews revealed that prior knowledge led to participants' misinterpretation of required opening methods due to the absence of clear indications. Additionally, the data from the in-depth interviews showed that participants relied on repeated trial and error attempts before finding out how to open unfamiliar packaging samples when indications were unclear.

Uses of 2D and 3D indications that helped participants to understand how to open the packaging samples in the focus groups were examined further in the in-depth interviews. Three groups of indications were recommended for use when designing novel packaging: full explanation, memory trigger and partial explanation. How to open a package with considerably unfamiliar appearance, in other words one without memory trigger

indications, is more understandable when clear full explanation indications (e.g., diagrams) and familiar partial explanation indications (e.g., an arrow or an indentation) are provided. When unfamiliar opening methods are used due to the employment of novel opening mechanisms, ambiguous memory trigger indications that may mislead should be avoided. Full explanation and familiar partial explanation indications that clearly explain the opening methods should be provided.

The interviews showed that participants used different combinations of 2D and 3D indications to understand how to open the packaging samples. These combined indications were mainly received by seeing and therefore their visibility was crucial. Although only one participant used audible indications (as feedback when releasing a lid), indications received by alternative senses such as hearing should not be neglected when designing a package.

The data from this study were drawn from a small number of participants. Therefore, the findings of this study cannot be generalised to a wider population. However, this study offers an opportunity to gain detailed and rare insights into individual perspectives "to illuminate the general by looking at the particular" (Denscombe, 2007, p.36). The use of 2D and 3D indications, derived from this in-depth examination provides important, new considerations for designers when designing novel packaging for older people.

The data from the focus groups and the in-depth interviews showed that the stereotypical relationship of packaging appearance (indications) to opening methods, played a key role in understanding how to open packaging. It would be useful for future work to establish the stereotypical relationship recognised by different user generations. This would help designers provide understandable opening indications for all.

The quantitative information about health related conditions collected in the focus groups was used to identify possible reasons behind any difficulties that participants had when opening the packaging samples. It would be useful for future work to investigate the impact of age-related decline on opening ability, in particular to see if older people who have visual impairment and/or arthritis overcome opening difficulties differently. This investigation would further help in designing openable packaging for older people.

Conclusions

Age-related needs in sensory, hand and especially cognitive functions should be taken into account when designing novel packaging to ensure that the packaging is openable by older people. Design attributes for a package fundamentally comprise 2D and 3D elements. However older people may find it difficult to understand how to open packages that have both 2D and 3D indications if these indications are not designed co-jointly to respond to older peoples' perception and understanding. This study offers design recommendations around the use of combined 2D and 3D indications for designers to consider when designing novel packaging for older people.

Acknowledgments

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Endnotes

1. The DTI was replaced by the Department for Business, Enterprise and Regulatory Reform (BERR) in 2007 (the Department for Business, Innovation and Skills (BIS, n.d.). In 2009, the BERR was replaced by the BIS (2009).
2. Age Concern England and Help the Aged joined together in April 2009. They are now known as Age UK (Age UK, 2010).
3. The Thousand Elders is a nationwide panel of older people age 50+ drawn from various socio-economic backgrounds (Nayak, 1998). At the time when the focus groups were conducted, there were around 3,000 members.

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Glossary

Glossary

A neutral zone of hand movement	The dimension of hand and wrist movements without a risk of injury (Hedge, op. cit.).
Age-related macular degeneration	An eye disease that causes the damage of the macula, a region of the retina (Goldstein, op. cit.), which performs a significant number of seeing functions, for example, object identification in terms of shape, size and colour (Watkinson, op. cit.), visual acuity (Evamy and Roberts, op. cit.; Watkinson, ibid.), central vision (Chivers, op. cit., Evamy and Roberts, ibid., Goldstein, op. cit.; Watkinson, ibid.), brightness and darkness adaptation and sensitivity to glare (Watkinson, ibid.).
Alternative formats	Different indications describing the same information of how to use a product (CEN/CENELEC, op. cit.) to different senses (vision, touch and hearing).
Cataracts	An eye disease that causes opaque lens which reduce visual acuity (Ah-Chan and Downes, op. cit.; Evamy and Roberts, op. cit.; Goldstein, op. cit.; Watkinson, op. cit.).
CEN/ CENELEC Guide 6	The guideline for developing design standards for older and disabled people issued by the European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (CENELEC) (ANEC, 2007).
Child-resistant closures (CRCs)	Closures designed to make it difficult for children to open packaging to prevent them from accessing potentially harmful contents.

Cognition	Mental processes to acquire knowledge. These processes mainly comprise perception, memory, understanding (Smyth *et al.*, op. cit.; Solso, op. cit.; Welford, op. cit.), learning (Solso, ibid.) and feelings (Solso, ibid. ;Benjafield, op. cit.).
Compatibility	The use of the same indications to explain product use across different kinds of products (Jordan, op. cit.).
Confirmations	The use of indications to show what has been done when using products (Jordan, ibid.; Krippendroff, op. cit.; Norman, 2002, op. cit.) or to confirm how to use products.
Consistency	The use of the same indications to explain product use across similar kinds of products (Jordan, ibid.).
Construction of products	The use of products' detailed structures to explain product use (Monö, op. cit.), e.g. a hinge suggests that the section of a product can be lifted up from the main body.
Description	The use of product appearance (indications) to explain a purpose of a product, its function and how to use it (Monö, ibid.).
Diabetic retinopathy	An eye disease that causes leaking and swollen capillaries at the retina leading to blurred vision (Evamy and Robert, op. cit.; Goldstein, op. cit.)
Episodic memory	A kind of memory involving with prior personal experience in relation to time and space (Kensinger and Corkin, op. cit.; Tulving, op. cit.).

Exhortation	A product signal of a direct message of doing a particular action (Monö, op. cit.) e.g. a watch is for wearing and a chair is for sitting.
Explicit memory	A kind of memory where a person memorises information with awareness and attention (Steenbekkers and Beijsterveldt, op. cit.)
Expression	The use of product appearance to induce users' feelings towards a product before using it; for example, light or heavy and soft or hard (Monö, op. cit.).
Feedback	Products' responses to users' interactions showing what has been done (Jordan, op. cit.; Krippendroff, op. cit.; Norman, 2002, op. cit.).
Full explanation indications	Two dimensional indications such as written instructions or diagrams describing full information of how to open packaging. This kind of indication can also be used to confirm how to open packaging.
Glaucoma	An eye disease that causes high pressure in the inner structure of the eyes which damages the optic nerve leading to the loss of peripheral vision (Evamy and Roberts, op. cit.; Goldstein, op. cit.)
Hawthorne effect	A term referring to the phenomenon where participants improve their performance because they realised that they are in a study (Mayo, op. cit.).
Identifications	The use of product appearance that indicates brand names, product families, product categories and their purposes. These make the product recognisable (Monö, op. cit.).

Impairment	Negative changes of body functions and structures (WHO, 1999, op. cit.).
Implicit memory	A kind of memory where a person memorises information without awareness and attention (Steenbekkers and Beijsterveldt, op. cit.).
Inclusive design	A design concept which attempts to maximise the market potential of products by making sure that the maximum number of people can use them (Keates and Clarkson, op. cit.).
Intuitive use	The use of product appearance that triggers users' prior experience to explain product use (Blackler *et al.*, op. cit.).
Learning	A cognitive stage where one's behaviour is developed through experience (Birren, op. cit., Schonfield, op. cit.).
Long-term memory	A cognitive function used as permanent storage of information (Steenbekkers and Beijsterveldt, op. cit.).
Memory	Cerebral storage in which information is retained (Steenbekkers and Beijsterveldt, ibid.) and retrieved for later use (Stokes, op. cit.).
Memory trigger indications	Two or three dimensional familiar indications describing an opening method required comprising hand actions, hand positions and hand directions.
Normal ageing	Ageing processes influenced by a common physical and psychological decline occurring in human being (Atchley, op. cit.).
Novel packaging	A package where the relationship of indications to opening methods is unfamiliar to consumers.

Openability	Characteristics of packaging that make it easy for older people to: understand how to open packaging, to physically open packaging and to access the contents of packaging.
Partial explanation indications	Two or three dimensional indications describing partial information of how to open packaging, e.g. hand actions or hand positions.
Participatory design	A design approach which users are involved in design decision making during the design process as co-designers (Abras *et al.*, op. cit.).
Pathological ageing	Ageing processes influenced by physical and psychological diseases (Atchley, op. cit.; Hayslip and Panek, op. cit.)
Perceived affordances	The use of product appearance to explain a purpose of a product, its function and how to use it (Norman, 2002, op. cit.).
Perception	A cognitive stage by which a person examines sensory stimuli before making a decision to whether or not to respond (Cunningham and Brookback, op. cit.)
Physical constraint	The use of product appearance (indications) to prevent impossible manipulations when using a product (Norman, 2002, op. cit.).
Presbycusis	Age-related hearing impairment (Gates and Mills, op. cit., Pirkl, op. cit., Stuart-Hamilton, op. cit.) caused by the deterioration of ear structures (Gates and Mills, ibid.; Goldstein, op. cit.; Stuart-Hamilton, ibid.) and of the central auditory system (Gates and Mills, ibid.).

Presbyopia	A long-sightedness in older people caused by the loss of elasticity of the lens and the eye muscles (Goldstein, op. cit., Pirkl, op. cit.).
Pressure sensitivity	The ability to feel how hard or soft an object is as a person press on it with their fingers or hands (Pirkl, ibid.).
Primary memory and short-term memory	Limited-capacity storage of information over a very short duration (Kensinger and Corkin, op. cit.; Steenbekkers and Beijsterveldt, op. cit.)
Prioritisation of functionality and information	The use of only the key information of product use, to reduce over loaded information (Jordan, op. cit.).
Procedural memory	A kind of implicit memory concerning the knowledge of how to perform everyday activities (Smith *et al.*, 2000, op. cit.) associated with motor and cognitive skills (Craik and Bosman, op. cit., Smith *et al.*, ibid.).
Product semantics	The study of product messages communicating through product appearance (Monö, op. cit.).
Product sign	The use of a particular product element to describe the product purpose and method of use (Monö, ibid.).
Real affordances	The property of a product where users can successfully use it as guided by perceived affordances (Norman, 1999, op. cit.).
Semantic memory	A kind of explicit memory referring to knowledge and facts (Smith *et al.*, 2000, op. cit.) which have previously been learned.

Sensory affordance	The property of a product where information of product use can be received by different senses: vision, hearing or touch (Hartson, op. cit.).
Tactile sensitivity	The ability to feel shapes and surface textures of objects (Pirkl, op. cit.).
Tamper evident closures (TE)	Closures with a feature to let users know if a package has previously been opened to prevent them from using contaminated contents.
Visibility (Norman, 2002, op. cit.) and **visual clarity** (Jordan, op. cit.)	The design principle of making indications visible.
Working memory	A kind of explicit memory used to manipulate a set of temporarily stored information in planning a task (Kensinger and Corkin, op. cit.; Stokes, op. cit.).