If at first you don't succeed : older consumers and hospital food & beverage packaging – a matter of try, try and try again!

BELL, Alison, WALTON, Karen, WESTBLADE, Nicola, MORSON, Kate, CHEVIS, Jacqueline, HARRIES, Leire and YOXALL, Alaster

Published version

BELL, Alison, WALTON, Karen, WESTBLADE, Nicola, MORSON, Kate, CHEVIS, Jacqueline, HARRIES, Leire and YOXALL, Alaster (2014). If at first you don't succeed : older consumers and hospital food & beverage packaging – a matter of try, try and try again! In: 19th IAPRI World Conference of Packaging, Victoria University, Melbourne, Australia, 15th-18th, June 2014.

Repository use policy

If At First You Don't Succeed: Older Consumers And Hospital Food & Beverage Packaging – A Matter Of Try, Try And Try Again!

Alison Bell[1*], Karen Walton[1,] Nicola Westblade[1], Kate Morson[1], Jacqueline Chevis[2], Leire Harries[3] and Alaster Yoxall[4]

[1] *School of Health Sciences, University of Wollongong, Australia*

[2] *School of Health Sciences, University of Wollongong, Australia*

[3] *Department of Mechanical Engineering, University of Sheffield, UK*

[4] *Art and Design Research Centre, Sheffield Hallam University, UK*

[*] *Corresponding author. Email: abell@uow.ed.eu*

Abstract: 'Openability' of food and beverage packaging has been shown to be problematic for older consumers. Pressure on resources has seen the use of packaged food and beverages increase in Hospitals within the NSW region of Australia. Studies at the University of Wollongong have shown that not only is Hospital food & beverage packaging problematic, difficulty opening it was identified as a barrier to nutritional intake.

Given the serious nature of the problem, a series of studies have been undertaken by the University of Wollongong and Sheffield Hallam University, to evaluate the issues surrounding the 'openability' of this packaging in an attempt to understand in detail the issues leading to difficulty in use.

Amongst the poor performing packs were seen to be water bottles, drink cartons and cheese portions. Whilst issues surrounding strength were seen to be linked to accessed to bottled water, all other pack types were significantly affected by dexterity and in particular the fine control needed to pinch and peel tabs or remove drinking straws.

Sound ergonomics indicates that products should be designed for the user population, yet the experience of our consumers indicates that this is not necessarily the case. Work is ongoing to understand in more detail the effects of ageing such a reduced dexterity on packaging 'openability' as well as the effects of age and posture. The eventual aim of this work is to collaborate with packaging designers, manufacturers and brand owners to develop and produce effective and reliable packaging for both the healthcare and retail environments.

Keywords: inclusive design, malnutrition, packaging.

1 Introduction

Society is ageing; in 2011 16% of United Kingdom's population was above 65 years of age [1] and is predicted to rise to 19% in 20 years [2]. This is not just a UK phenomenon, the UN predicts the population of over 65's to rise to over 1.5 billion in 2050 from 486 million in 2006 (UN, 2008). A society in which a large proportion of its citizens are aged creates a major public health problem for government, health practitioners and other stakeholders. As we age, the likelihood of living with some form of chronic illness is significant. The prevalence of disability from the US Census in 2005 demonstrates that for individuals over 75, the proportion of people who need assistance was 55.9% rising to 71% for those 80 and over [3].

Health services across the world are under severe pressure due to this increase in longevity and associated likelihood of chronic illness, older people are more likely to visit hospital and stay for longer. However, many of the illnesses previously associated with old age have more recently been attributed to poor diets and there is undisputed evidence that diet and nutrition are directly linked to many of the chronic diseases afflicting older adults [6].

Researchers have estimated that 40% of UK hospital patients were malnourished [7] and further studies have shown that elderly patients are five times more likely to be at risk of malnutrition than younger patients [8,9].

A series of researchers [7,10,11], have identified inability to access food and beverage packaging as a contributing factor to malnutrition among the elderly and disabled in hospitals. Work by Bell et al., [12] looked at the issue of packaging accessibility in hospitals in the NSW region of Australia. This work used a patient and staff questionnaire along with pinch and grip strength measurements to assess reasons surrounding inability to access food and beverage products in the hospital environment. A typical meal tray with packaged items is shown in the Figure 1 below.

Figure 1: Typical meal tray in the study by Bell et al., [12]

In the study by Bell et al., [12], approximately 140 participants under took the packaging questionnaire along with 60 staff. The mean age of the sample was 72 years (±15 years); 46% male and 54% female. The patient interviews in this initial study identified five forms of packaging that could not be opened: 23% could not open convenience dinners, 17% water bottles, 17% cereal, 12% tetra packages and 10% condiments (jam). The problematic packaging types are shown in Figure 2.

Of those patients who could open the products, approximately 50% of patients had some difficulty opening the convenience meal, the milk and the cereal pack. Nearly 40% of these patients also had difficulty opening the water bottle and tetra packs. All staff reported that patients ask for help opening food and beverage packaging and 39% of staff reported some difficulty opening certain food and beverage packaging items themselves. Figure 3 below shows that items that participants were unable to open were also those items that took the longest time to open where the item could be opened. The work showed that for water bottles the accessibility issue was related to strength, whereas for the cereal packages and tetra packs the issue appeared to be a problem of both dexterity and strength. Hence it was decided to study the issues surrounding poor openability in further detail using a range of ergonomic techniques and analyse the effect of posture on strength and dexterity.

Figure 2: Problematic packaging types

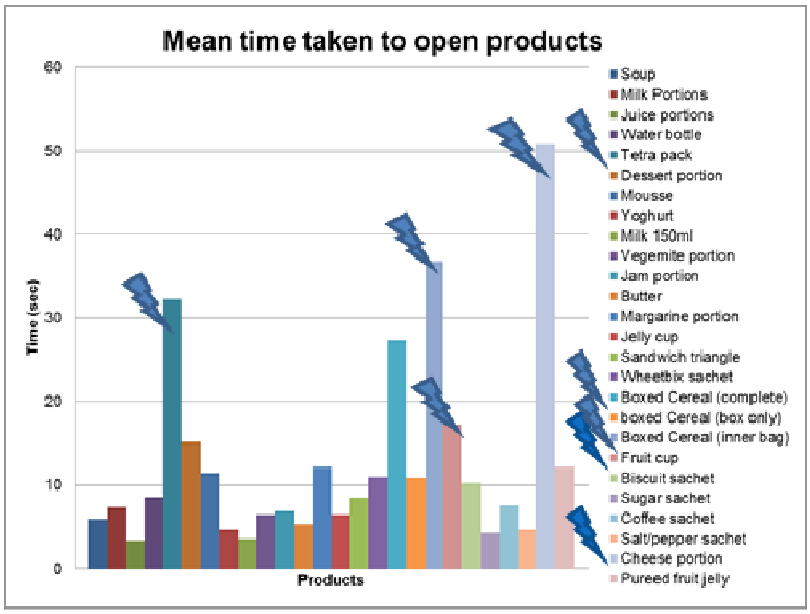

Figure 3: Time taken to open various packaging items

2 New Studies

A series of studies using a range of ergonomics assessment techniques was undertaken to understand dexterity in more detail and to further analyse the effect of posture on strength and dexterity.

2.1 Task Analysis: opening supermarket items

In order to gain a wide insight to the type of tasks needed to access standard packaging products available, the product range of a supermarket was chosen, as they sell many different types and varieties of food products. The supermarket chosen was the UK supermarket Tesco due to their significant presence with more than 3000 stores in the UK [13] and their website has an online grocery section which contains thousands of products, representative of what consumers are expected to open.

Using the images on the website it was possible to identify how certain products were opened. If the images were not detailed enough or unavailable, a store was visited for identification. If the product was not available in

store, its method of opening was left unidentified. This was possible as after identifying the first several hundred products, few new types of packaging were documented, in all likelihood unidentified packaging types will have already been documented.

The process itself involved using a tally chart, for each product that matched a type of packaging a tally was added. The type of packaging was dependent on the design of the packaging and not the method by which it is opened, as the opening techniques vary from one person to another.

2.2 Grip and Pinch Strength Testing: well elderly adults in a hospital environment

A total of 37 people (14 male [38%], 23 female [62%]) responded to the invitation, with each being randomly allocated a time slot on one of the two days of testing. Participants were to be over 65 years of age, independently living in the community and considered to be well. Each participant was tested in either the bed or chair first, depending on their allocated time slot. In each position, grip strength, pinch strength and dexterity were measured using validated testing procedures. Grip strength was measured using a Jamar Dynamometer [14]. Participants were tested on their dominant hand first for both the grip and pinch strength measurements. Pinch strength was tested with a Jamar Hydraulic Pinch Gauge [14] using three different tests; tip pinch, three point pinch and a lateral pinch. Both instruments were calibrated for the testing days. Dexterity was tested using the Perdue Pegboard [15], followed by the participants having to identify and open seven packaged items commonly found in the hospital setting.

2.3 Dexterity Testing: well elderly adults in a hospital environment

Dexterity of participants was analysed using the Purdue Pegboard Test first proposed by Tiffin in 1948 [15]. The Purdue Pegboard Test can be used for numerous purposes including testing for the presence and/or extent of brain damage, learning disabilities and dyslexia. There are four individual tests that are carried out when using the Purdue Pegboard. Normally, for all of these tests, the participant sits at a table that is at comfortable height and all standard data 'norms' such as those provided by Lafayette Instruments [14] and Desrosiers [16] have previously been measured in this way. However, given that the study by Bell [12] identified that 'fidliness' was a major factor; participants were also tested sitting in a chair and lying in a bed (as per the grip and pinch study described in section 2.2). The pinch, grip and dexterity tests were undertaken in a hospital training facility at The School of Health Sciences at the University of Wollongong, Australia, as shown in Figure 4. An example of a participant undergoing testing is shown in Figure 5.

Figure 4: Hospital training environment used to study posture effects

Figure 5: Posture analysis for grip strength and dexterity

2.3 High Speed Video Analysis of package opening

Participants were also analysed using High Speed Video (HSV) analyses to study finger motion in greater detail. This analyses is able to film at speeds significantly higher than a standard video camera (60 thousand frames a second, a standard camera films at 25 frames per second) using both a 'Phantom' SA3 camera and a pair of Phantom V4.2 cameras (Photron.com). Six participants were analysed opening a range of 'fiddly' packaging and their dexterity videoed and analysed using equations calculating joint motions.

Figure 6: participant opening packaging whilst being filmed using HSV

3 Results and Discussion

3.1 Task Analysis

After studying the packaging items available online and undertaking a task analysis it was found that packaging in general required one, or a combination of the following methods to open:

- Press and Dispense
    - Pressing down on a component allows for release of the product
- Bag

    - A pulling apart action allows for the bag to be opened at the seal
    - A tearing action produces an opening
- Tab Removal/ Interaction
    - A component that has to be snapped away from the packaging in order to open the packaging, it may also be snapped then peeled
    - A seal of the packaging must be pierced to allow for access
    - A component of the packaging may have to be: bent, pulled apart, unwound or torn away in order to remove it.
- Lid and Cap
    - A lid or cap that has to be twisted and lifted away from the rest of the packaging.
    - A lid that peels away from the rest of the packaging.
- Box and Unwrap
    - A box that is torn to be opened
    - Packaging that must be unfolded with little force as the packaging has no form of seal.

It can be seen from the list that certain forms of packaging facilitate a number of precision actions to open the pack (see Figure 7). The aim here was to attempt to categorise pack formats by tasks needed and to identify pack forms and that actions that may be problematic. Packaging that has multiple functions to open such as a tetra pack, drinks carton or boxed cereal scored badly in the original survey by Bell et al., [12]. By taking a task analysis approach to packaging we can select items that have fewer manipulations to use, for example cereal in pots rather than in boxes with a separate bag.

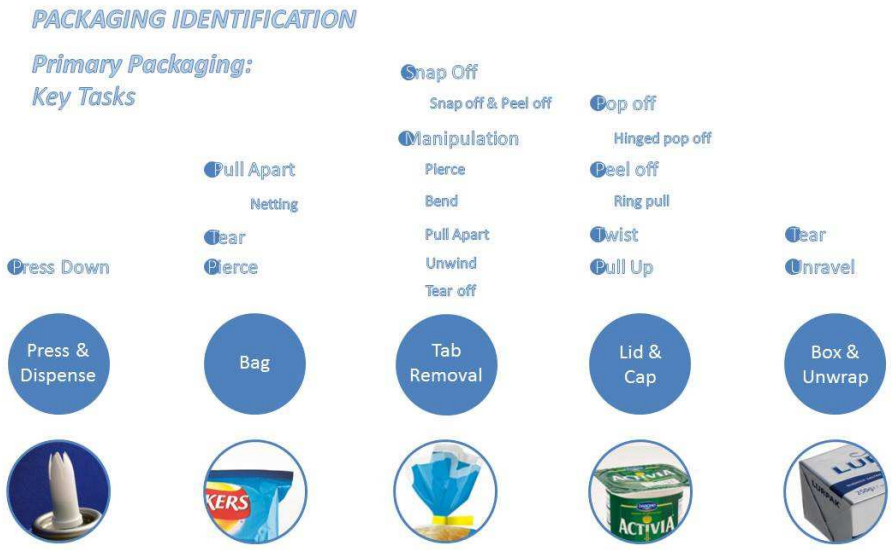

Figure 7: packaging identification by task analysis

3.2 Grip and Pinch Strength Testing

Given that many hospitalised patients access food in bed or from a chair it was necessary to examine the effect of posture on grip and strength. Using the instrumentation and the methods described in section 2.2 the results of grip and pinch are shown are shown in Table 1 for both the bed and the chair postures, (Mean (standard deviation [SD]) and median (interquartile range [IQR]) grip and pinch strength scores). A Shapiro-Wilk test for normality showed varied distributions for each variable; therefore both the mean and median have been reported.

Table 1: Mean (standard deviation) and median (interquartile range) for grip strength test, tip, three point and lateral pinch strength tests in the bed and chair posture.

	Grip strength	Tip pinch	Three point pinch	Lateral pinch
Bed				
Mean (SD) R Hand	**29.2 (10.7)**	**3.8 (1.5)**	**5.4 (2.1)**	**6.8 (2.3)**
Median (IQR) R Hand	**27.7 (20.9-37.2)**	**4.0 (2.5-5.1)**	**5.3 (3.9-6.5)**	**6.9 (4.9-8.6)**
Mean (SD) L Hand	**27.4 (11.4)**	**3.8 (1.5)**	**5.4 (1.9)**	**6.2 (2.5)**
Median (IQR) L Hand	**24.6 (18.9-33.6)**	**3.5 (2.5-4.8)**	**5.3 (3.7-7.1)**	**5.5 (4.4-8.3)**
Chair				
Mean (SD) R Hand	**28.8 (10.4)**	**24.3 (1.3)**	**6.2 (2.1)**	**7.3 (2.3)**
Median (IQR) R Hand	**26.5 (21.4-34.4)**	**4.5 (3.0-5.3)**	**6.0 (4.4-7.8)**	**6.9 (5.5-9.3)**
Mean (SD) L Hand	**27.4 (10.7)**	**4.2 (1.3)**	**5.9 (1.8)**	**6.7 (2.5)**
Median (IQR) L Hand	**24.3 (21.1-34.9)**	**4.0 (3.2-4.8)**	**6.0 (4.5-7.1)**	**6.4 (4.8-8.0)**

Table 2 is a collation of all the significant results found when testing for a correlation between each of different tests and the various food products. As illustration in the table, there was a consistently significant correlation found with both the time and number of attempts to open the bag within the cereal box, as well as the time to open the foil sealed thickened water. The strongest correlations were found between the bed grip left (r=-0.710), bed tip pinch right (r=-0.712), the chair tip pinch right (r=0.889) and the chair three point pinch right (r=0.795) with the time taken to open the foil seal water. No significant correlations were found in relation to the other packaged food products.

Table 2*:* Significant correlations between grip strength, tip, three point and lateral pinch strength tests for the right and left hands in the bed and chair posture.

Test	Food Item	Correlation Coefficient	Sig. (2-tailed)	Significant
Bed Grip Right	**Box cereal – no attempts to open bag**	**-0.352**	**0.044**	**Yes (moderate)**
Bed Grip Left	**Foil Sealed water – time**	**-0.710**	**0.032**	**Yes (strong)**
Bed Grip Left	**Box cereal – no attempts to open bag**	**-0.401**	**0.021**	**Yes (moderate)**
Bed Pinch Tip Right	**Foil sealed water – time to open**	**-0.712**	**0.031**	**Yes (strong)**
Bed Pinch Tip Right	**Box cereal – attempts to open bag**	**-0.345**	**0.049**	**Yes (moderate)**
Bed Pinch 3 Point Pinch Right	**Box cereal – attempts to open bag**	**-0.377**	**0.030**	**Yes (moderate**
Bed Pinch3 Point Pinch Left	**Box cereal – time to open bag**	**-0.345**	**0.049**	**Yes (moderate)**
Bed Pinch 3 Point Pinch Left	**Box cereal – attempts to open bag**	**-0.410**	**0.018**	**Yes (moderate)**
Chair Pinch Tip Right	**Foil Sealed water – time**	**0.889**	**-0.001**	**Yes (strong)**
Chair 3 Point Pinch Right	**Foil Sealed Water – time**	**0.795**	**0.01**	**Yes (strong)**

Figure 8 illustrates the median, minimum and maximum times taken to open each of the packaged food items in the two postures. No significant differences were found between the two postures, however Figure 8 illustrates that the most problematic packages to open in both postures were the tetra pack, honey sachet, the boxed cereal and the cheese portion.

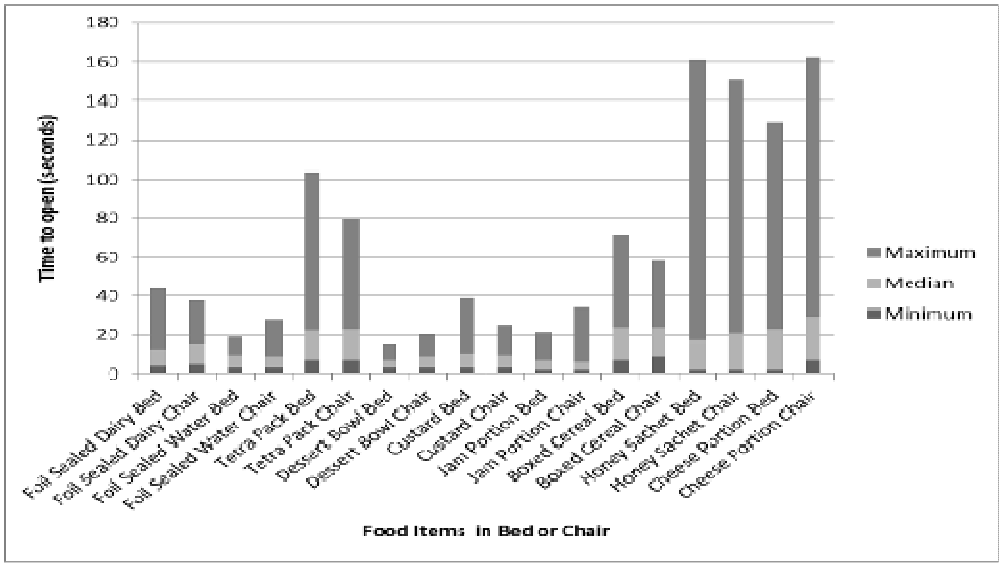

Figure 8: Median, minimum and maximum times taken to open food packages in the bed and chair posture strength test, all pinch strength tests were found to be significantly different, with laying down consistently proving to be the more difficult posture.

3.3 Dexterity Testing

As for grip and pinch strength testing above, dexterity was measured in both sitting and laying down postures to replicate the hospital environment. Using the instrumentation and the methods described in section 2.3 the results for the effect of posture on dexterity scores (Table 3) as well as the correlation between dexterity, time taken and number of attempts to open a package was determined (Table 4). Both these tables are shown below. This study demonstrated that the laying down posture adversely affected the Subject's dexterity scores. Additionally, there was an inverse correlation between dexterity and time taken to open the tetra-packs, custard (foil sealed cup) and the inner bag of the boxed cereal.

Table 3*:* Differences in dexterity scores between sitting and laying down postures

Dexterity measure pair	Mean	Std. Deviation	t or Z score†	Sig. (2-tailed)*	Sig difference?‡
Bed Left- Chair Left	-.667	1.493	t= -2.565	.015	✓
Bed both- Chair both	-.909	1.182	t= -4.417	.000	✓
Bed right+left+both- Chair right+ left +both	-3.152	3.114	t= -5.814	.000	✓
Bed assembly- Chair assembly	-1.273	3.979	t= -1.838	.075	×
Bed right – Chair right	-	-	Z= - 3.775	.000	✓

†- t score for evenly distributed data where t-tests were utilised, and Z score recorded when Wilcoxon Signed Ranks Test was utlised
*- Significant when P value <0.05 (two-tailed)
‡- ✓ indicates there was a statistically significant difference. × indicates there was not a significant difference

Table 4*:* Significant correlations between time and attempts to open a product and dexterity

Food Product	Subject Posture/ time or attempts	Dexterity measure	Correlation Coefficient†	Significance	Strength of Correlation‡
Tetra pack	Bed/time	Both hands	-.369	.041	✓
		Right+left+ both	-.452	.010	✓✓
	Chair/time	Both hands	-.446	.011	✓✓
		Right+left+both	-.448	.010	✓✓
Custard	Bed/ time	Both hands	-.861	.000	✓✓✓
		Right+left+both	-.824	.001	✓✓✓
	Chair/time	Both hands	-.812	.001	✓✓✓
		Right+left+both	-.796	.001	✓✓✓
Boxed cereal	Bed/ time	Both hands	-.536	.002	✓✓
		Right+ left +both	-.446	.010	✓✓
	Chair/time	Both hands	-.463	.007	✓✓
Boxed cereal-inner packet	Bed/ Time	Both hands	-.623	.000	✓✓
		Right+left+both	-.535	.002	✓✓
	Chair/time	Both hands	-.410	.039	✓✓
	Bed/ attempts	Both hands	-.439	.012	✓✓
		Right+left+both	-.434	.013	✓✓
Cheese	Bed/attempts	Both hands	-.363	.038	✓
	Chair/attempts	Both hands	-.360	.036	✓
honey	Bed/time	Right+left+both	-.377	.031	✓
	Chair/time	Both hands	-.581	.000	✓✓
		Right+left+both	-.651	.000	✓✓
Foil dairy	Bed/ time	Both hands	-.501	.029	✓✓
		Right+left+both	-.462	.047	✓✓
jam	Bed/ time	Both hands	-.661	.000	✓✓
		Left+right+both	-.634	.000	✓✓

† - Correlation is significant at the 0.05 level (2-tailed).
‡- One tick indicates a weak/small correlation, two ticks indicate moderate correlation, three ticks indicates a strong correlation

Of particular concern is the finding for Tetra packs as they are used in hospitals to provide high energy, high protein supplements for patients with low appetites, are malnourished or are at risk of becoming malnourished. A previous study by Wilton et al. [17] also identified Tetra packs as the most problematic type of packaging for patients to open.

3.4 High Speed Video Analysis

The software Check3D was used for calibration and digitisation of the points of interest on the hand by selecting the points of interest in each frame. This software gives the (x, y, z) coordinates of each point during the opening task. Figure 9 is an image still of the process.

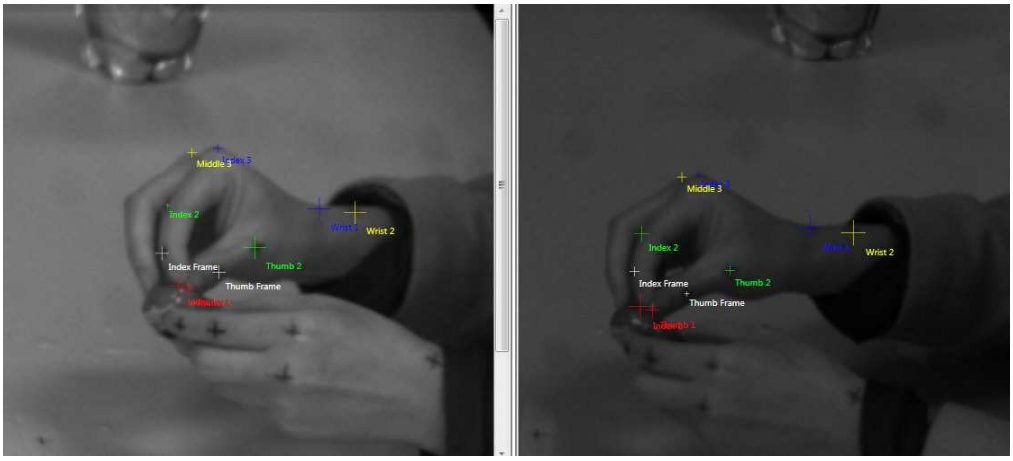

Figure 9: A frame from the Check3D software showing the points on the hands for a recording opening the cheese portion.

These points had to be determined. The different variables that were measured using Check3D included the total distance travelled and the angles of the hand. The middle, little and ring finger were not considered. To evaluate the total distance covered three points were chosen: the tip of the index finger, the tip of the thumb and a point on the wrist. The joint angles considered are shown in Figure 10 below.

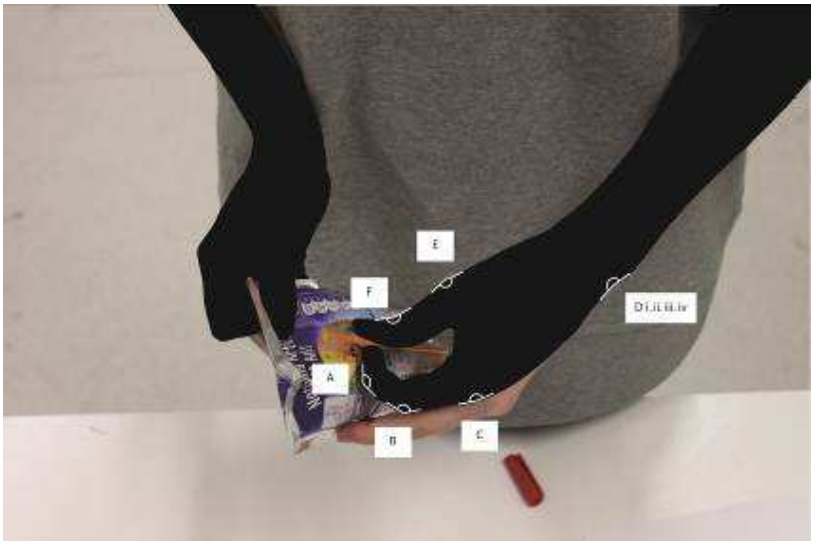

Figure 10: Joint angles considered for pack items

Figure 11 below is a graph showing the size of the angles of the index finger for the drinks packaging with a straw. As there was a lot of noise in the data, the moving average was calculated to see clearly the trends of the movement. Information about events occurring have been plotted, with time zones covering areas which are defined by the task description from section 3.1, with key events, shaded and separated by vertical lines. This aids to identify stages of more difficulty.

There are horizontal lines plotted which relate to the Range Of Motion (ROM). Knowing the expected ROM it was believed that proximity to this limit could suggest a difficult position. From this a ROM limit zone was created, where the zone was 75% to 100% of the expected range of motion of the different joints [18]. If the moving average crosses the line of the ROM limit zone, it could suggest an angle of difficulty.

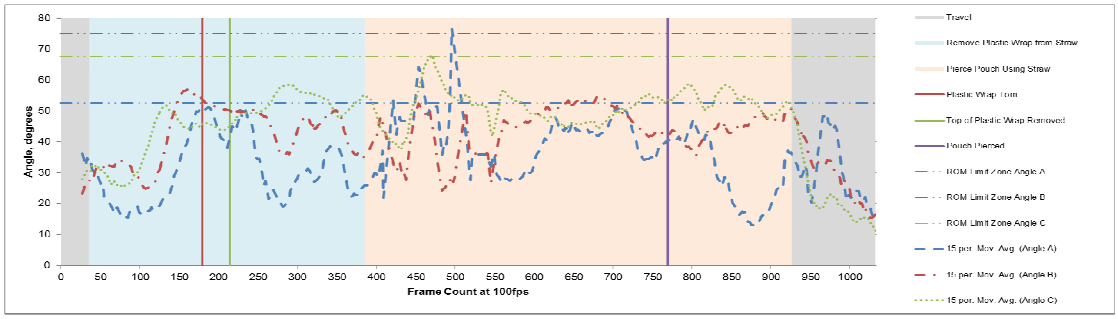

Figure 11: The angles of the finger when opening drinks pack with straw

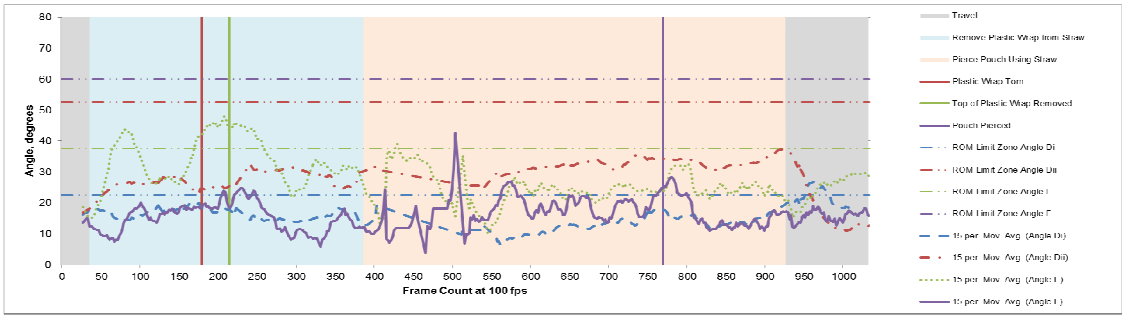

Figure 12: The angles of the thumb when opening drinks pack with straw

In studying the ROM of the fingers the authors also calculated the distance travelled between the fingers, i.e. the degree of separation between the index finger and middle finger at any time. Combined with the results from the above Figures we are able to establish whether the 'fidliness' was associated with the amount of joint movement or finger separation. When combined with the task analysis initial results suggest that 'fidliness' is not associated with the amount of movement of the fingers but the development of a precision grip (the fingers moving together) and the amount of tasks need to complete the opening of the pack.

3 Conclusions

Several ergonomic techniques have been brought to bear to study and analyse the opening of packaging in detail and in particular to study and understand the elements patients termed in a questionnaire by Bell et al [12] as 'fiddly'.

In measuring grip strength and dexterity it was found that grip strength is affected by posture whilst understanding dexterity was more complex. Initial results suggest that measured dexterity is less effected by posture than grip strength. Further HSV analysis suggests that the issues surrounding 'fidliness' are associated with the number of task involved and the difficulty of forming a precision grip pinch grip.

If we view the design of hospital packaging through the prism of 'inclusive' or 'universal' design whereby the packaging should be assessed against the following principles [19];

- equitable use, provide the same means of access for all users
- flexibility in use, provide alternative means to access
- simple and intuitive to use
- perceptible information
- tolerance for error
- low physical effort
- size and space for approach and use

It can readily be seen that several key themes emerge, current packaging doesn't not facilitate low physical effort or tolerance for error. The formation of precision grips to access tabs and peelable lids causing difficulty to those questioned whilst relatively significant strength is needed to open water or peel the lid once (and if) the grip is formed.

Further, results suggest that posture can affect the degree of pinch strength produced and dexterity leading to issues around the use of packaging in hospitals. This work suggests that either the design of truly inclusive packaging is driven by the hospital environment whereby users will have low strength, or that hospital packaging is designed especially for that environment. The authors would suggest the former since specialist packaging does not meet the inclusive design agenda and would lead to increasing costs for health care services.

4 Future Work

It is anticipated to undertake further work on dexterity, strength and posture along with more detailed analysis using HSV.

Acknowledgements

The authors would like to thank Professor Elena Rodriguez for her help and Daniel Ura, Victor Gonzalez for their assistance with work on the high speed cameras.

References

1. Office for National Statistics. 2011 Census: Population Estimates for the United Kingdom. 27 March 2011.
2. Table A2-1, Principal Projection- UK Population in Age Groups, 2012-based. 2013.
3. US Census Bureau (2010). Population division 1-886-758-1060. <http://www.census.gov/cgi-bin/broker> Accessed 14.05.14.
6. National Research Council (US), Committee on Diet (1989). Diet and health. Implications for reducing chronic disease risk. Washington: Academy Press.
7. Schenker, S. (2003). Undernutrition in the UK. Nutrition Bulletin, 28(1), 87–120.
8. Lazarus, C., & Hamlyn, J. (2005). Prevalence and documentation of malnutrition in hospitals. A case study in a large private hospital setting. Nutrition & Dietetics, 62(1), 41–47.
9. Vivanti, A., Banks, M., Aliakbari, J., Suter, M., Hannan-Jones, M., & McBride, E. (2008). Meal and food preferences of nutritionally at-risk inpatients admitted to two Australian tertiary teaching hospitals. Nutrition & Dietetics, 65(1), 36–40.
10. Walton, K., Williams, P., & Tapsell, L. (2006). What do stakeholders consider the key issues affecting the quality of foodservice provision for long-stay patients? Journal of Foodservice, 17(5–6), 212–225.
11. Tsang, M. F. (2008). Is there adequate feeding assistance for the hospitalised elderly who are unable to feed themselves? Nutrition & Dietetics, 65(3), 222–228.
12. Bell, A.F., Walton, K., Chevis, J.S., Davies, K., Manson, C., Wypych, A., Yoxall, A., Kirkby, J., Alexander, N. (2013). Accessing packaged food and beverages in hospital. Exploring experiences of patients and staff. Appetite, 60 (1), pp. 231-238.
13. Tesco PLC. Tesco PLC Annual Report and Financial Statements 2013.
14. Desrosiers, J., Hébert, R., Dutil, E., & Bravo, G. (1993). Development and reliability of an upper extremity funtion test for the elderly: The TEMPA. *Canadian Journal of Occupational Therapy , 60*, 9-16.
15. Tiffin, J., Asher, EJ. (1948). The Purdue Pegboard: Norms and Studies of Reliability and Validity. Journal of American Psychology, 1948, Vol. 32.
16. Lafayette Instruments Company, http://lafayetteinstuments.com , Accessed 12/05/2014
17. Wilton A, Burton L, Cavanagh R, Higgins R, McDougall K, Appleton J. Assessing the ability of patients to access their meal trays 22nd National Conference of the Dietitians Association of Australia. Melbourne: Dietitian Association of Australia; 2004.
18. Mulligan, E P. Range of Motion Measurements. *Continuing ED.* [Online]2011.http://www.continuing ed.cc/hsgoniometry/goniometrystandards.pdf. Accessed 14/05/2014
19. The seven principles or Universal design, NC University, The Center for Universal Design http://www.ncsu.edu/ncsu/design/cud/about_ud/udprinciplestext.htm, Accessed 14/05/2014