

**Voces aisladas: Reflexiones de adultos mayores sobre el uso y la accesibilidad del packaging durante el confinamiento**

YOXALL, Alaster <<http://orcid.org/0000-0002-0954-2725>>

Available from Sheffield Hallam University Research Archive (SHURA) at:

<https://shura.shu.ac.uk/28000/>

---

This document is the Published Version [VoR]

**Citation:**

YOXALL, Alaster (2020). Voces aisladas: Reflexiones de adultos mayores sobre el uso y la accesibilidad del packaging durante el confinamiento. RChD: creación y pensamiento, 5 (9), p. 1. [Article]

---

**Copyright and re-use policy**

See <http://shura.shu.ac.uk/information.html>

# Isolated voices: Older adults' reflections on packaging use and accessibility during lockdown

*Voces aisladas: Reflexiones de adultos mayores sobre el uso y la accesibilidad del packaging durante el confinamiento*

**Abstract.** Packaging used by older adults is a complex, multifaceted event. It is a complex multifaceted event in normal times. As we age, our strength, dexterity and cognitive ability all naturally decline, and we are more likely to be ill. Isolated and removed from normal support networks, many older adults would have to adapt in order to access food.

Previous work by the author showed that the influences of purchase could be split into three areas: packaging attributes such as size, shape or weight, familiarity indicating whether a person had bought the brand before, and environmental factors such as the weather, that affect the ability to shop or the proximity of family or friends.

This small study of 30 respondents showed that the Covid-19 pandemic distorted these influences for all the respondents, reducing their opportunity for choice and increasing their reliance on others. In earlier work, the author had split the coping strategies to deal with these physical (the use of knives, etc.) and emotional (the use of relatives, friends, etc.) issues. The pandemic also increased the need for these strategies where respondents had to use knives on unfamiliar items or use ad hoc support networks such as asking for a tin opener through a window.

**Keywords:** Coping, Covid-19, inclusive Design, networks, packaging.

**Resumen.** El uso de envases por parte de adultos mayores es un evento complejo y multifacético. Es un evento multifacético complejo en tiempos normales. A medida que envejecemos, nuestra fuerza, destreza y capacidad cognitiva disminuyen naturalmente, y es más probable que tengamos problemas de salud. Aislados y retirados de las redes de apoyo normales, muchos adultos mayores tendrían que adaptarse para acceder a los alimentos. El trabajo previo del autor mostró que las influencias de compra se podían dividir en tres áreas: atributos de empaque como tamaño, forma o peso, familiaridad indica si una persona había comprado la marca antes, y factores ambientales como el clima que afecta la capacidad de comprar o la proximidad de familiares o amigos.

Este pequeño estudio de 30 encuestados mostró que la pandemia de Covid-19 distorsionó estas influencias para todos los encuestados, ha reducido su oportunidad de elección y aumentado su dependencia de los demás. En trabajos anteriores, el autor había dividido las estrategias de afrontamiento para tratar estos problemas, tanto físicos (el uso de cuchillos, etc.) como emocionales (el uso de parientes, amigos, etc.). La pandemia también aumentó la necesidad de estas estrategias en las que los encuestados tuvieron que usar cuchillos en artículos desconocidos o usar redes de apoyo *ad hoc*, como pedir un abrelatas a través de una ventana.

**Palabras clave:** Afrontamiento, Covid-19, Diseño inclusivo, embalaje, redes.

---

Fecha de recepción: 08/07/2020

Fecha de aceptación: 21/08/2020

Cómo citar: Yoxall, A. (2020)

Isolated voices: Older adults' reflections on packaging use and accessibility during lockdown.

RChD: creación y pensamiento, 5 (9), 1-11

<https://doi.org/10.5354/0719-837X.2020.57923>

Revista Chilena de Diseño,

RChD: creación y pensamiento

Universidad de Chile

2020, 5(9)

<http://rchd.uchile.cl>



**Figure 1.** Older adults requiring fine manipulation to access a pack.

Source: author's image.



**Figure 2.** Older adult using knife to open packaging.

Source: author's image.

## Background

As we age our strength naturally declines, as does our ability to undertake dextrous tasks requiring fine manipulation (Yoxall et al., 2006; Desrosiers, 1995). A cursory observation of any supermarket shelf shows a myriad of packets, jars, plastic bags, and containers, many of which require some degree of strength and/or dexterity to gain access, as shown in Figure 1.

Where tabs and access information on packaging do exist, natural declines in visual acuity and/or memory can make finding or understanding the information difficult.

The problem is further compounded: as we get older, we are more likely to live with some form of chronic illness. The prevalence of disability from the US Census in 2014 demonstrates that for individuals over 75 years of age, the proportion of people who had severe disability was 53.9% (US Census Bureau, 2014). In the UK, the prevalence of some form of chronic illness such as diabetes, chronic obstructive pulmonary disease (COPD), arthritis and hypertension results in over 50% of doctors' appointments, 64% of hospital outpatient appointments and 70% of all inpatient bed days (UK Department for Health, 2012). Society is also ageing; in 2011, 16% of the United Kingdom's population was above 65 years of age and was predicted to rise to 19% in 20 years (UK Office for National Statistics, 2011). However, this is not just a UK phenomenon, the UN predicts the world population over 65 to rise to over 1.5 billion in 2050 from 486 million in 2006 (United Nations, 2008). Hence, we have a society in which a large proportion of citizens will have some issues related to a loss of strength, dexterity, and possibly locomotion, sight and cognition, and are likely to be in poor health.

Public acknowledgement of people with disabilities has changed significantly over recent years, with three parallel drivers: legislation such as the UK Disability Discrimination Act (1995), advances in assistive technology and rehabilitation, and lastly, the understanding in the Design community of the need for a change in the way in which products are designed. The Design community has developed a concept called *inclusive* or *universal* Design, promoted by various organisations, notably the Royal College of Art, in the UK. The British Standards Institute (2005) defines inclusive Design as "the Design of mainstream products and/or services that are accessible to, and usable by, as many people as reasonably possible... without the need for special adaptation." Underlying this is the principle of independence: inclusive Design should allow individuals to utilise and operationalize goods, services and technology themselves without intervention from others.

One area that receives much media attention with regards to the aged is the accessibility and usability of packaging. That packaging openability is perceived to be a difficult task is acknowledged in the term *wrap rage* that has been coined to describe it (BBC, 2004). In their frustration many people resort to alternative strategies to access the packaging (see Figure 2).

The drivers of changes in legislation, demographics, greater demand for independence and reduced strength or underlying health conditions has led to significant work by researchers to understand packaging accessibility



Figure 3. Older adults attempting to read packaging information.

Source: author's image.

Figure 4. Orbit Closure.

Source: author's image.

in older adults and in particular looking at the grips used (Rowson & Yoxall, 2011) and the strength needed to open certain packaging (Smith et al., 2010; Voorbij and Steenbekkers, 2002). Much of the work has concentrated on food packaging and jars that typically contain jam, pickles or sauces (Yoxall et al., 2014; Carse et al., 2011; Su, 2009; Kuo, 2009). Researchers are likely to have concentrated on the issue of accessing the contents of jars as the problem is considered (whether true or not) reasonably obvious, i.e. not having sufficient grip strength to twist off the lid. Less work has been undertaken to understand dexterity and issues to access packaging relating to fine manipulation, but recent studies have sought to redress this (Yoxall et al., 2019; Yoxall et al., 2018).

Similarly, less published work has been undertaken about older adults and cognitive issues and affordances around packaging and/or visual acuity, which is a significant issue for older adults (see Figure 3). However, Becker et al (2015), Becker et al. (2016) and de la Fuente et al. (2015) have undertaken a number of studies in this area looking at font size, including access to medical packaging where access difficulties are often exacerbated by the use of child resistant packaging (CRCs) involving a squeeze, turn and push to access the contents. Often this type of packaging may also have instructions for use moulded onto the cap to aid adults understand the mechanism needed.

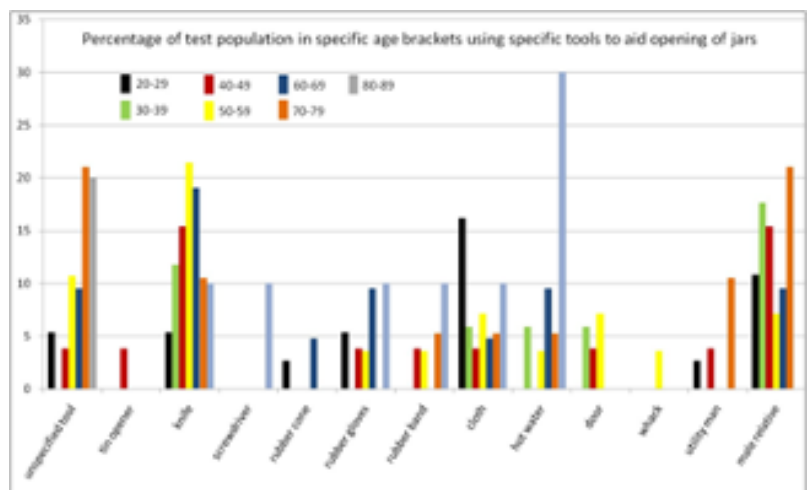
The realisation of the need to develop new, easier to use packaging is reflected in the development of ISO guidelines in this area, notably ISO 17480 *Guidelines For Accessible Packaging* (ISO, 2015) and ISO 22015 *Guidelines For Accessible Packaging, Manipulation and Handling* (ISO, 2019). With this change, there has been a slow development of *easy open* packaging. Examples include the Orbit closure launched in 2011 (see Figure 4) where the removal torque is reduced by the action of the outer rim moving separately from that of the lid. Developments in laser etching techniques have made accessibility of items such as resealable cheese packs easier, where previously the pack would need to be cut with scissors it can now be easily torn.

Figure 5. Older adult using a knife to access a jar.

Source: author's image.

Figure 6. Percentage of the test population using specific tools to open jars.

Source: author's image.



Despite this progress, problems remain and *wrap rage* is still with us; many consumers still complain that there is too much packaging and what exists is difficult to use. It is likely that this progress is slow since many consumers and older adults find strategies to cope. In their study “Husband, Daughter, Son and Postman, Hot-water, Knife and Towel: Assistive Strategies for Jar Opening” (2010), Yoxall, Langley, Musslewhite, Rodriguez-Falcon and Rowson interviewed over 200 people, examining their strategies for accessing jars. The premise for the study was that while much of the earlier work described in the literature centred on physical decline, little work had previously been done to understand what consumers do when faced with difficulties to open packaging, jars in this case. When consumers (of all ages) experienced difficulties in accessing jars they resorted to what the authors have termed *coping strategies*, i.e. alternative methodologies for accessing the contents of the jar. These strategies can broadly be termed as physical strategies, i.e. the use of a towel or a knife, or social strategies, i.e. the use of a relative, partner or neighbour (see Figure 5).

The second most common answer when looking at the accessibility of jars of this type was actually the use of a relative (husband, partner, boyfriend, son, etc.) with 12% of the total test population (all female) giving this response (see Figure 6). A further 2% of the total test population suggested using other males (non-related) such as utility men or neighbours, to aid opening jars. Again, these were all female respondents. This gives a total of 14% of the test population (all female) seeking help from other people (all male) to aid in the opening of jars.

Given that a significant number of older female consumers using a male relative or indeed relying on delivery or utility personnel to access packaging, the Covid pandemic raised questions about how older people would access and use packaged food during lockdown, wherein the UK many were unable to leave their homes and were isolated from family and friends. With the experiences demonstrated in the work of Yoxall et al. (2010) regarding the physical and emotional coping strategies of older adults when accessing jars and how much this relied on social strategies as well as physical strategies for accessing packaging, there was an opportunity to revisit these strategies in the time of crisis that the Covid-19 pandemic had created.

### Methodology

Attempts were made initially to reach out to a wider, older consumer base through social media such as Twitter and Facebook. While there was significant distribution and viewing of this video and accompanying questions, there was only minimal engagement, and it is unclear why. So another route was undertaken whereby church groups known to the author were contacted and a short questionnaire distributed via email from church group contacts. The questionnaire was also posted through the letterboxes of older adults living near the author. A project information sheet and a note were included with the questionnaire to explain that by replying they were agreeing to use the information for research purposes and allow for dissemination. Participants were asked to provide only their age and gender, and all answers were collated into a document, numbered and the e-mail subsequently deleted. The short questionnaire asked older consumers their experiences in the use of packaging during the recent Covid-19 pandemic. In the UK, vulnerable older adults had been asked to self-isolate for up to 12 weeks from the end of March 2020, and all adults except key workers (doctors, nurses, etc.) were asked to limit their movements and time outside the house, with an allowance of one hour for exercise. Entry into other people's homes was prohibited for anyone other than key workers. Specifically, the questionnaire asked:

- Which pieces of packaging have you found difficult to open or use during the pandemic?
- What were the problems with the packaging?
- Did you successfully get into the package, and if so, how did you do it? Was it different than to how you usually open it? For example, if you couldn't get help, what did you do instead?
- Have you had to buy items that you don't normally buy? And if so, has this caused you any problems?
- Have you changed the items you buy because of not being able to open or access the contents?

Thirty responses were received during June 2020 from twenty households. Eight responses were delivered back to the author through the post and two responses were narrated to other participants and e-mailed on their behalf. The average age of the respondents was 74 years old, with a standard deviation of 6 years (both numbers rounded to the nearest year). Of the thirty responses nineteen were female and twelve responses were provided by residents living alone, ten of which were female.

### Discussion

While the sample size is small, it is still possible to find some qualitative standout observations. Firstly, though the questionnaire was specifically about Covid-19 and packaging experiences during lockdown, all respondents took the opportunity to complain about a broad range of packaging. Much of which consumers have previously complained about and are listed in surveys (McConnell, 2004) and work by the author and others. Tins, including ones with ring-pulls, jars, milk, items with child resistant closures and tamper evidence were amongst the items listed. The stories were all too familiar:

“I have found difficulty with packaging for bacon and cooked meats over the last few months. It seems the little tab that is supposed to allow you to pull the top away from the main packaging often tears before allowing any opening of the top. Or, the tab just doesn’t open it at all – it seems to be too strongly glued down. I end up having to get a sharp knife to go round the inside edge of the main tray to open it. Not very safe really but I try to be careful. I would think anyone with poor dexterity of the hands would find it very dangerous. I’m not sure but it may be because the top layer in some cases is too flimsy and tears before it starts to open the top layer. The other thing my husband and I have noticed is that some tins are difficult to open. The paper surrounding the tin seems to clog up the tin opener and it needs that paper removing before it can be opened again successfully. Also tins like sardine tins I find difficult because you have a very sharp edge near you when pulling the lid to open it. The pull ring sometimes comes off in your hand too. It’s been the same design for years and I can’t imagine why they haven’t changed it as I’m sure there must have been plenty of accidents.” (Participant 4).

As an industry where we have tried to improve things, we have not necessarily been too successful:

“There is a perennial problem with things in cellophane packaging, like rice, pasta etc. Though some noticeable improvements have been made in ease of opening and options for re-sealing, on some bags, the corners are so well stuck together that they won’t pull apart, and I need to cut them off. If I try to pull them open, quite often the bag just splits down the side, or front, and then I have to find another container for the contents. Otherwise I have to clip them closed with clothes pegs, or specially bought clips if I have them the right size.” (Participant 1).

However, one respondent did note some good news:

“The opening of some cheese packs has improved, with a tear-off strip and a reseal fastening. This is used on a number of other items (eg. dried fruit, some frozen veg) and is very good.” (Participant 10).

While attempts to improve the accessibility of packaging have been made since the author wrote “Husband, Daughter, Son...” in 2010, the results are quite mixed, and items that have elements to aid opening, such as cooked meats and ring pull tins, are often seen as a source of frustration.

Clearly, this is the *background noise* of general frustration at poorly designed packaging and not specific to lived experiences of the pandemic per se. However, stories did emerge to show that the pandemic and isolation caused issues around access to food and people’s relationship with packaging.

“I managed to break my can opener, and normally I would just get another one but as I’m sheltering I couldn’t get one and relied on Asda [UK supermarket] food deliveries or friends and ended up with lots of cans without ring pulls. The milk that was brought to me was in cartons and tends to splash more and doesn’t last as long as a bottle.” (Participant 25).

The participant went on to say that she had ended up with a lot of unopened tins and had tried to use a knife but was scared that she would hurt herself. The issue of tins was raised by 28 of the respondents, who had difficulty with ring pulls and had to use tin openers where possible. Typically, the complaint would be:

“Ring pull tops on tins. In theory these are great, if you have the strength the pull them all the way off. I struggle with the last bit. The contents either finish up being spilt with the force of me pulling, or I get splattered with the contents from the lid.” (Participant 13).

Again, pandemic related issues did emerge in the narrative of some respondents. Several of the respondents had received food parcels through foodbanks and these also contained more tinned food than they would usually buy.

“I get more tins than normal. I’m having to use a knife and I’m scared I’m going to hurt myself. I don’t want to go to hospital.” (Participant 15).

Use of foodbanks, sheltering and isolation meant that many were shopping differently than they had before, either online, or having someone shop for them or food delivered to them by a charity. From the responses, it was apparent that informal networks had sprung up to help isolated older people get access to food and this had become a social coping strategy.

“A neighbour who is shielding has managed to get a delivery slot from Sainsbury’s and orders some items for us.” (Participant 1).

“I’m having chemotherapy and have no nails. I get my food from foodbanks but I can’t get in the tins. My neighbour passes a tin opener through the window.” (Participant 12).

“My neighbours shop for me and leave the food on the doorstep. I’d be lost without them.” (Participant 20).

However, these informal networks (or lack of them) did create issues for isolating individuals.

“As someone else is shopping for me I can’t choose the things I would normally do and have had a lot more non-recyclable packaging than I would like.” (Participant 25).

“I plan my shopping around when I get a visitor. I don’t buy things I can’t open. If I know my son is coming, I buy the things so he can open them for me. Typically, it’s mouthwash, bleach, things with a child proof top. As I don’t have any visitors I can’t buy or use these things.” (Participant 13).

The issue that they were using more packaging was identified by most participants and this was generally seen as a bad thing.

“I personally have been struggling with the amount of packaging during lockdown. It seems overwhelming. Before lockdown I estimate I ate about 40 percent of my meals out. For instance, a meal deal for lunch and 1-2 coffees a day, plus additional snacks or social meals out. Now that 100% of the food and drink I consume is bought from the supermarket, I have begun to realise how much non-recyclable packaging I go through in a week.” (Participant 10)

During the pandemic, the purchase, use and disposal of packaging was a multifaceted, complex issue. Respondents using foodbanks or informal shopping networks did not necessarily have agency over the type of food they had delivered and the type of packaging it came in. Similarly, those respondents that moved their shopping online experienced having to buy unfamiliar items, since they were unable to go to a local butcher or greengrocer. Further, in moving to online shopping they were buying more packaged items than they would normally, and this gave rise to respondent’s frustrations about the environment and recycling.

In 2012, the author undertook some consultancy work for a major brand owner to assess issues of accessibility across a range of packaging formats including tins, jars, cartons, squeezable packs and ready meals. A total of 118 consumers were tested between the ages of 60 and 90 years old. Of those 118 users, 79 were female (11 over 75 years of age) and 39 males (all between 60 and 75 years of age).

The responses were split into *younger participants* those under 70, and *older participants*. The *influences on purchase* for the two groups is shown schematically in Figure 7 below, with the top panel being the response of the *younger participants*.

In this study, the influences of purchase were split into *pack attributes* such as weight, price or brand; *familiarity* such as ease of use, pack Design; and *environmental* issues such as family. For the *younger participants* in this survey, price and brand were extremely important in the purchase of packaging goods. The pack format was also strongly influenced by familiarity and prior experience. Several participants indicated that they would try (or had tried) unfamiliar pack formats through their grandchildren. For the *older participants* (>70), the influences on purchasing behaviour become more varied as their needs become more complex. They had to consider the weight of the pack or the simplicity of the Design, for example, since they were less likely to be working, to have transport, and more likely to have issues with strength, dexterity and cognition.

In this smaller survey, what became apparent was how the nature of these elements changed their importance due to enforced isolation. Pack attributes such as brand, size, weight and recyclability might be nice, but if the brand is out of stock or someone is buying your food for you, these choices become out of your control. Since someone might be buying your food for you, or you might be getting it online from a supermarket (where previously you had shopped locally), or delivered from a foodbank, issues around unfamiliarity were also seen to rise. Lastly, environmental factors in the 2012 study were an issue for only some of the oldest participants; in this study it was a significant issue for many of the respondents. In 2012, the younger participants would buy for their grandchildren; the role would be reversed for the older participants, particularly those over 80, with children and grandchildren buying their parent or grandparents' shopping. In the pandemic, the use of relatives and informal networks to undertake shopping or access food was common. In several instances, nominally isolated respondents may have broken lockdown rules: when asked what they had done if they couldn't open the pack, they replied that they had family members open it for them, despite living alone. Of course, this may have been achieved by passing the items through a door or window. On the reverse side of this, other people were more cautious: one 85 year old respondent (who had had a stroke in December) was seriously hospitalised after becoming malnourished by spending days living on biscuits, the only item she felt like eating and the only item she could easily get into, and had not informed relatives of the situation. The author had heard of this issue occurring in other situations prior to lockdown but this was the first time he had not been told it anecdotally. More generally, the situation is probably best described by Participant 3:

"I and most of my friends (in the 70+ brigade) tend to work things out for ourselves when the packaging creates a problem (where there's a will there's a way). However, it is annoying, and if the problem cannot be solved, that product is rejected at the next shop."



Figure 7. Influences on purchase .

Source: author's image.

Losing customers due to an inability to access your packaging is not the greatest marketing strategy. Neither is making people malnourished or hospitalised. In 2015, ISO 17480 *Packaging-Accessible Design-Ease of Opening* was launched. In that document, packaging designers, brand owners and marketers, were asked to consider among other things the context in which the packaging was to be used. Section 4.1.1 “Context of Use” in particular asks for the following:

- specify intended users, taking into consideration the variety of physical, psychological, and cultural characteristics.
- specify the environments in which the package is (or is intended to be) used. Those attributes of the physical or social environment are likely to have impacts on achieving the goals.

The Covid-19 pandemic has largely highlighted an issue that was already a problem, that of isolated older adults attempting to access food. The work presented here shows that older adults had to be extra resourceful to find ways to access their packaged food. Following the Covid-19 pandemic, it is clear that the context in which packaging could and is likely to be used in the future is complex and the likelihood of packaging being used by isolated older adults should be considered more urgently.

### Conclusions

Previous work by the author showed that the *influences of purchase* could be split into three areas: *packaging attributes* such as size, shape or weight; *familiarity*, whether a person had bought the brand before; and *environmental* factors such as the weather affecting the ability to shop or the proximity of family or friends.

This small study showed that the Covid-19 pandemic distorted these influences for all the respondents, reducing their opportunity for choice and increasing their reliance on others. In earlier work, the author had split the coping strategies to deal with these physical (the use of knives, etc.) and emotional (the use of relatives, friends, etc.) issues. The pandemic also increased the need for these strategies, where respondents had to use knives on unfamiliar items or use *ad hoc* support networks such as asking for a tin opener through a window.

At the extreme, there is a question as to how food packaging and nutrition work for very vulnerable, independent-living, older adults highlighted in this study, and it is likely that more cases like this will unfold as the full story of the pandemic develops.

## References

- 'Wrap Rage' hitting the over 50s. (2004, February 4). BBC News. <http://news.bbc.co.uk/1/hi/business/3456645.stm>
- Becker, M.W., Bello, N.M., Sundar, R.P., Peltier, C. and Bix, L. (2015). Front of pack labels enhance attention to nutrition information in novel and commercial brands. *Food Policy*, 56, 76-86.
- Becker, M.W., Sundar, R.P., Bello, N., Reem, A., Weatherspoon, L. and Bix, L. (2016). Assessing attentional prioritization of front-of-pack nutrition labels using change detection. *Applied Ergonomics*, 54, 90-99.
- Carse, B., Thomson, A. and Stansfield, B. (2011). A novel device for evaluating forces during the dynamic jar opening action—Do older and younger adults do things differently? *Medical Engineering & Physics*, 33(4), 521-525. <https://doi.org/10.1016/j.medengphys.2010.11.017>.
- De la Fuente, J., Gustafon, S., Twomey, C. and Bix, L. (2015). An Affordance-Based Methodology for Package Design. *Packaging Technology and Science*, 28(2), 157-171.
- Desrosiers, J., Hébert, R., Bravo, G. and Dutil, E. (1995). The purdue pegboard test: Normative data for people aged 60 and over. *Disability and Rehabilitation*, 17(5), 217-224.
- International Organization for Standardization. (2015). *Guidelines for Accessible Packaging* (ISO Standard No. 17480). [http://www.iso.org/iso/catalogue\\_detail?csnumber=63787](http://www.iso.org/iso/catalogue_detail?csnumber=63787)
- Kuo, L.C., Chang, J.H., Lin, C.F., Hsu, H.Y., Ho, K.Y. and Su, F.C. (2009). Jar- Opening Challenges. Part 2: Estimating the Force-Generating Capacity of Thumb Muscles in Healthy Young Adults During Jar-Opening Tasks. *Proceedings of Institution of Mechanical Engineers, Part H. Journal of Mechanical Engineering in Medicine*, 223 (577-588). <https://doi.org/10.1243/09544119JEM504>
- McConnell, V. (Ed.). (2004, January 30). Pack it in! – Just say no to impossible packaging. *Yours Magazine*.
- Rowson, J. and Yoxall, A. (2011). Hold, grasp, clutch or grab: Consumer grip choices during food container opening. *Applied Ergonomics*, 42(5), 627-633. <https://doi.org/10.1016/j.apergo.2010.12.001>.
- Smith, S., Norris, B. and Peebles, L. (2000). *Older Adultdata: The Handbook of Measurements and Capabilities of the Older Adult: Data for Design Safety*. United Kingdom: Department of Trade & Industry.
- Su, F.C., Chiu, H.Y., Chang, J.H., Lin, C.F., Hong, R.F. and Kuo, L.C. (2009). Jar-opening challenges. Part 1: An apparatus for assessing hand and finger torques and forces in a jar-opening activity. *Proceedings of the Institution of Mechanical Engineers, Part H: Journal of Engineering in Medicine*, 223 (121-129). <https://doi.org/10.1243/09544119JEM422>
- United Kingdom Department of Health. (2012). Long-term conditions compendium of information: Third edition. [http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH\\_134487](http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_134487) on June 7, 2020.
- United Kingdom Office for National Statistics. (2011, March 27). Census: Population Estimates for the United Kingdom.
- United States Census Bureau. (2018). *Americans with Disabilities: 2014*. <https://www.census.gov/library/publications/2018/demo/p70-152.html> on June 7, 2020.
- Voorbij, A.I.M. and Steenbekkers, L.P.A. (2002). The twisting force of aged consumers when opening a jar. *Applied Ergonomics*, 33(1), 105-109.
- Yoxall, A., Gonzalez, V. and Rowson, J. (2018). Analysis of Finger Motion Coordination during Packaging Interactions. *Packaging Technology and Science*, 31(6), 389-400.
- Yoxall, A., Janson, R., Bradbury, S.R., Langley, J. and Wearn, J. (2006). Openability: Producing Design Limits for Consumer Packaging. *Packaging Technology and Science*, 19, 219-225. <https://doi.org/10.1002/pts.725>.
- Yoxall, A., Langley, J., Musslewhite, C., Rodriguez-Falcon, E. and Rowson, J. (2010). Husband, Daughter, Son and Postman, Hot-water, Knife and Towel: Assistive Strategies for Jar Opening. In P. Langdon, P. Clarkson and P. Robinson (Eds.), *Designing Inclusive Interactions* (pp. 187-196). SPRINGER. [https://doi.org/10.1007/978-1-84996-166-0\\_18](https://doi.org/10.1007/978-1-84996-166-0_18)
- Yoxall, A., Rowson, J. Talking about torque: Measuring pack accessibility - A review. (2015). *Packaging Technology and Science*, 28(1), pp. 1-14. <https://doi.org/10.1002/pts.2079>