

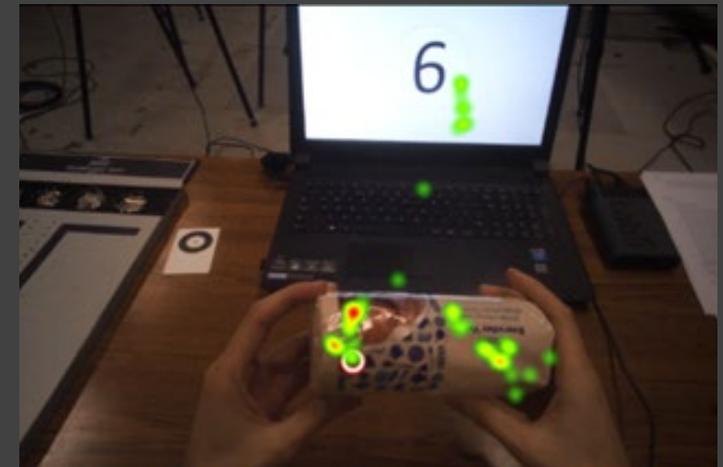
Significant previous research has been undertaken looking the demands that packs place on consumers in terms of their physical attributes, such as strength and finger manipulation and also their ability to perceive and understand the information that the pack provides the user. These demands are usually studied in isolation. This study looks at these factors in combination using a range of methods including observation, motion capture, questionnaires along with dexterity and cognitive distraction tests combined with ergonomic analysis to understand the relationship between the pack form, hand manipulation and cognition.

Six common packs were selected for testing including crisps, chocolate, Weetabix, pens, biscuits and noodles, to provide a range of physical and cognitive demands. The participants were asked to open the packs whilst wearing eye-tracking glasses and read random numbers displayed on a screen. This enabled the researchers to see what the participants were looking at and measure the cognitive demand of each pack. The researchers also measured the dextrous demand when opening the packs using infra-red cameras tracking the finger movements. From this work researchers were able to determine which packs were more physically and cognitively demanding.

The results confirmed that the dexterous demands of a task can be linked to the cognitive demands. Further, the paper developed the concept of the 'Design Model' of packaging use and the 'User Model' where the design model is using the pack how the designers intended and the user model how it is actually used. Packs were rated most easily openable where the design model most closely matched the user model. This concept of understanding the design model and user model was instrumental in Britvic developing user test panel protocols for its New Packaging Development process.



Above: Participant calibrating the eye tracking glasses.



Above: 'Heat Map' of participant gaze when opening biscuits and undertaking the cognitive distraction test.

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As you like it: Understanding the relationship between packing design and accessibility

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Above: As you like it: Understanding the relationship between packing design and accessibility.

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The research process utilised a mixed methods approach to the study, including semi-structured interviews with participants about packaging difficulty, assessment of dexterity using the Purdue Pegboard test, a Cognitive Distraction Test combined with Eye-Tracking Glasses, Motion Capture tracking and analytical analysis in Matlab. Six common packs were selected for testing including crisps, chocolate, Weetabix, pens, biscuits and noodles, to provide a range of physical and cognitive demands.

The test was designed in order to establish the ability of various packaging to distract a user from a secondary task. Distraction can be broadly categorized into visual and cognitive demand. The setup of the CDT enabled measurement of both of these elements in order to build a picture of the level of mental effort required to open each of the various packages. Visual task loading and the visual demands of packaging were measured using eye tracking equipment.

For the experimental protocol a screen was placed in front of subjects and random numbers from 1-10 would appear on the screen in intervals of 1.5 seconds. Firstly, a control test was completed and subjects were asked to verbally repeat the numbers on the screen as soon as they appeared. This did not involve opening any packaging. Their verbal responses were recorded and the response times (the time between the number appearing on the computer screen and them verbally announcing the number) was measured to understand how quickly and consistently they were able to respond.

The test was then subsequently repeated, with packaging introduced as the primary task in a dual task scenario. Subjects were asked to attempt to open packaging whilst also attempting to verbally repeat the numbers as they appeared on the screen in the same format as they had completed in the control described previously. Further, eye tracking equipment was used to support a greater understanding of the visual demands of packaging by tracking gaze data enabling measurement of the number of times a user deviated from the screen and the amount of time they spent looking at various packaging. The eye tracking equipment used was the Tobii eye tracking glasses version 2.0 with the Tobii Pro Glass analyser. Combined with the response times and response rates, these measurements helped build a picture of the cognitive demands of various packaging and the level of mental effort exerted in each case.



Above: Participant undertaking cognitive distraction test whilst wearing Eye Tracking glasses.

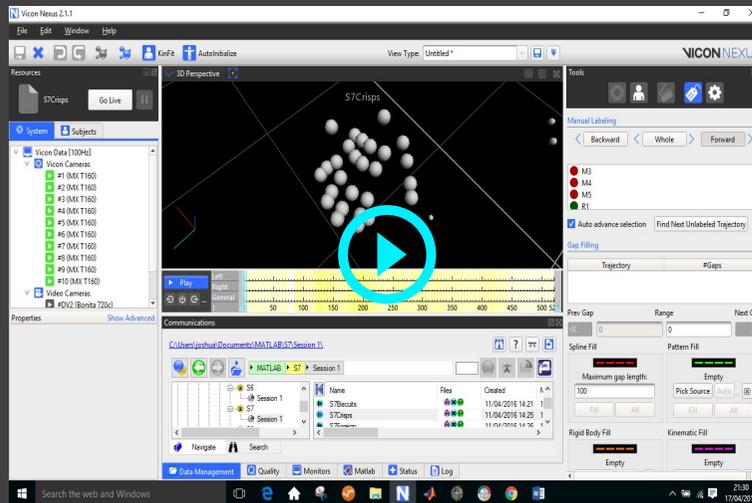


Above: Gaze tracking whilst participant opens chocolate packaging

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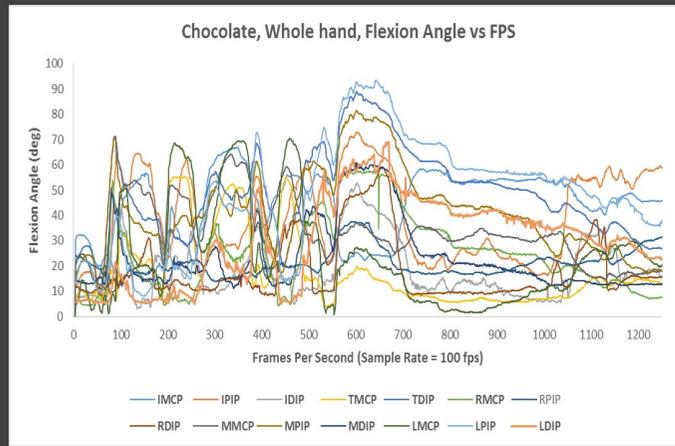
A motion capture study to measure the dexterous demands of the various packing through a kinematic analysis of the flexion angles in the joints of the hand and the correlation of finger movements was undertaken. Data was collected via motion capture, with a ten-camera Vicon T-160 system recording the movements of reflective markers placed on a set of anatomical hand landmarks. Markers were placed on specific areas of the dominant hand, located such that the flexion angles for the individual fingers and thumb could be calculated in conjunction with the correlation between the various joints. The video shows the finger motions of a participant opening crisps.



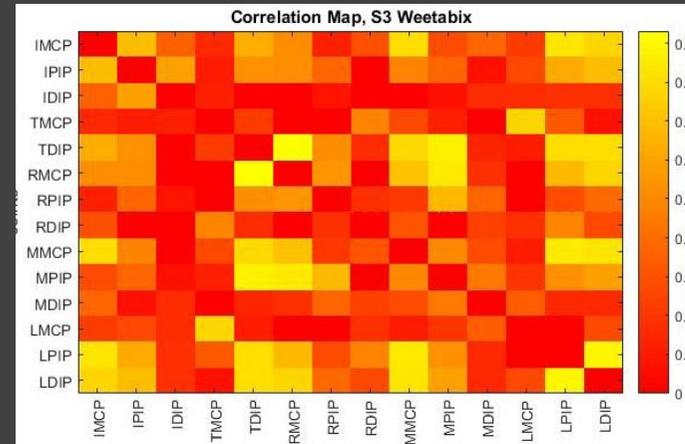
Above: Edited motion capture analysis. Please click play to watch



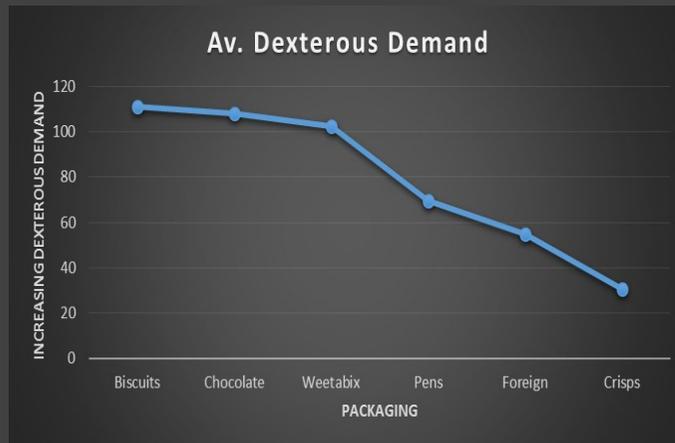
Above: Participant about to undertake motion capture analysis of biscuit opening.



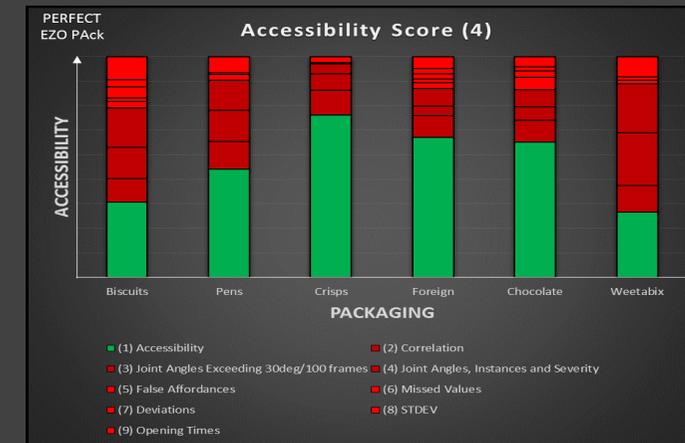
Above: Joint flexion angle vs FPS for all fingers whilst opening a chocolate bar.



Above: Correlation map of finger joints whilst opening a Weetabix packet.



Above: Average dexterous demand for each pack type studied.



Above: Calculated packaging accessibility score.

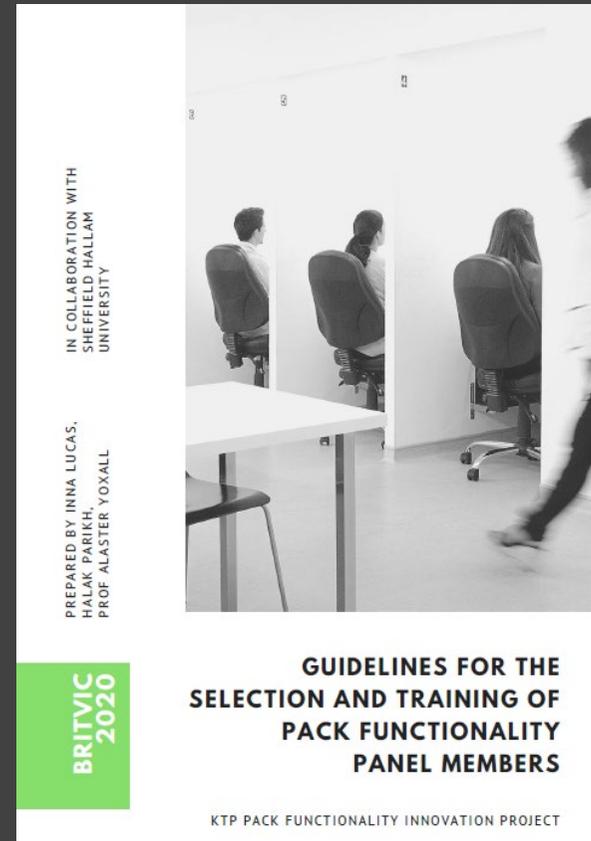
Using a series of methods for quantifying the data the research team were able to calculate packaging accessibility scores for the different pack types studied.

The concept of understanding the difference between a ‘design model’ and a ‘user model’ was disseminated into a project for Britvic Plc, whereby a user panel trained in describing attributes and terminology of beverage packaging can give feedback on their opening strategies to insight teams on new beverage packaging as part of the New Product Development (NPD) process. Documentation was produced for training the panellists and informing the Britvic NPD insights team of the process.

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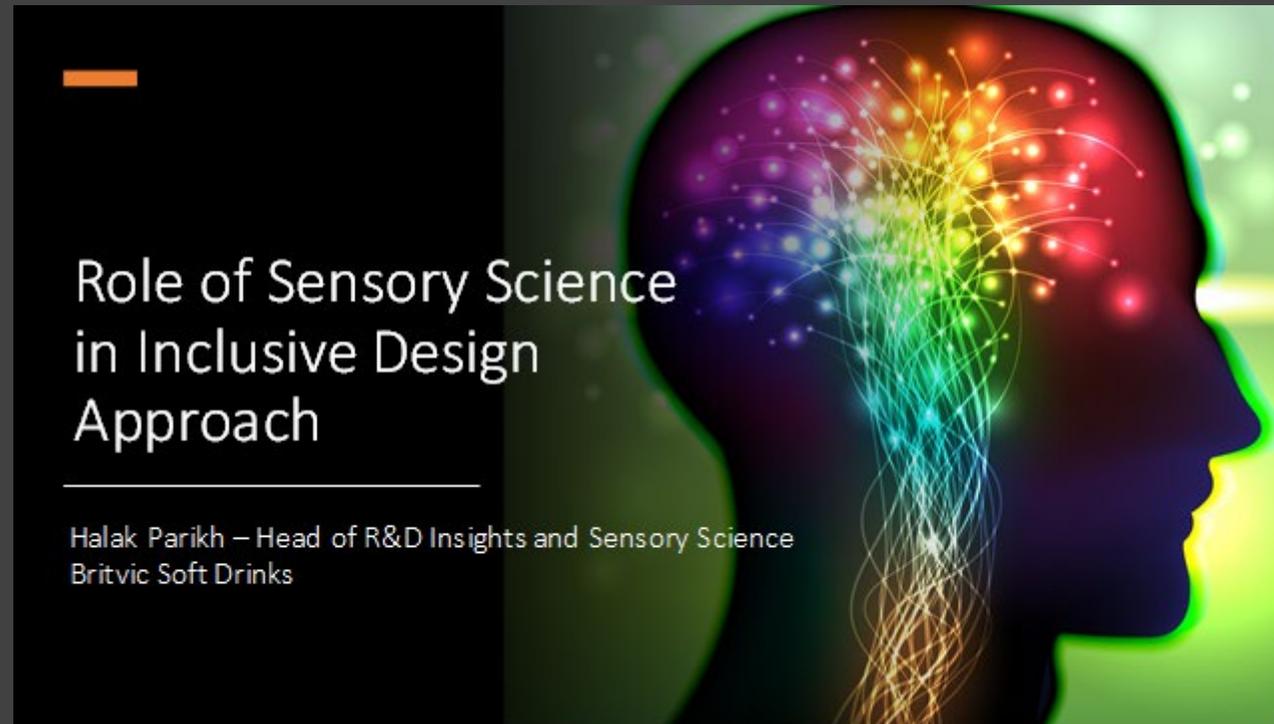
Above: Inclusive design of packaging. Understanding beverage pack functionality booklet produced for Britvic Plc.



Above: Guidelines for the selection and training of panel members to examine pack functionality.

The work was also presented at the 9th Eurosense conference on sensory and consumer research in December 2020.

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Above: Home slide of Eurosense presentation given by Halak Parikh
Head of R&D Insights and Sensory Science at Britvic Plc.