

10. INTERNATIONAL SYMPOSIUM GRAPHIC ENGINEERING AND DESIGN



# **Research methodologies for assessing the ergonomics** of packaging products - A review

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## Introduction

The packaging has reached high quality in terms of the functions it needs to fulfil: protection from external influences, barrier properties, aesthetic functions, providing information and presenting the product that is packed in, etc. However, there is another requirement that packaging should fulfil and that is the ease of opening and use of the product packed in it (Figure 1).

To design and produce a packaging that will solve these problems, it is necessary to define the most important factors affecting consumers when opening and using packaging. When the factors are defined, it is necessary to create a packaging design that will be in accordance with these factors. This paper will cover all the important factors that need to be considered during the development of an ergonomic packaging: • Physical qualifications and consumer capabilities for easy product handling,

# **Critical aspects of packaging**

The most critical factors influencing the ease of opening a packaging are visibility and clarity of the opening mechanism, the position of the opening mechanism relative to the holding position, tightness/brittleness and fragility of the opening mechanism, the strength required to open packaging, the need to use both hands when opening, the strength and slipperiness of the packaging material, required grip of the packaging, breakage of the packaging during the opening and the degree of retention of the product in the packaging after opening (Kroemer Elbert, Kroemer and Kroemer Hoffman, 2018).

#### **OBJECTIVE METHODS**

Objective methods are a combination of subjective and mechanical methods. Objective methods help to provide scientific logic and the reason behind subjective answers. The choice of parameters to be collected is based on the type of research being conducted and on the parts of the body involved in performing the task. Measuring the anthropometry of the hands is a key activity that is usually performed in various research papers dealing with any research in which the user uses the hands. Researchers have conducted various studies such as examining the optimal grip span concerning an individual's anthropometry for isometric power grip exertion (Eksioglu, 2004). Various researches have been performed in the field of ease of opening packaging. Packaging that has torque-requiring closures (Heinö et al, 2008; Yoxall et al, 2006; Yoxall et al, 2008) that require a coordinated two-handed procedure are assessed as particularly challenging.

• Critical aspects when using the product,

• Methods for researching consumer opportunities and critical aspects when using products and for evaluating the ergonomic characteristics.



Figure 1 Examples of ergonomically designed packaging

# **Consumer capabilities**



# **Ergonomics research methods**

### **SUBJECTIVE METHODS**

Subjective comfort and discomfort in the case of products subject to manual manipulation are usually assessed using questionnaires using rating scales to assess the characteristics examined (Boyles et al, 2003; Chandra and Chandna, 2011; Lee and Chen, 2008; Carse et al, 2007). Also are used pain maps, measurement of pain and discomfort assessment (Kihlberg et al, 1995; Trejo et al, 2006; Lin and McGorry, 2009). Subjective evaluations have some disadvantage: they require a large number of participants and therefore require a lot of time (Lee et al, 1993), and they are influenced by personal preferences (Chen et al, 1994). Therefore, it is advisable to use objective measurements in addition to subjective measurements (Bisht and Khan, 2013).

#### **MECHANICAL METHODS**

The mechanical method implements a mechanical test and it is quite fast and easily reproducible. Mechanical testing measures only one dimension (force) that is used for a particular job/action and requires certain equipment. The measurements aim to provide the lower limit of force required when consumers perform the required action using the product. However, as the measurements do not mimic the human use of the product, they can only be used as an indicator of the required level of force, and the measurement failure caused by this varies from package to package. The method does not involve human perception. The level of force depends on factors such as adhesion, the slipperiness of the material and the type of mechanism and these factors are not included in the mechanical test.

## **USABILITY METHODS**

In addition to subjective and objective methods of product evaluation and tasks, usability methods are widely used to study user performance while using a product. Various metrics such as safety, reliability, ease of use (Woods and Buckle, 2005; Wu et al, 2008; Vanderwal et al, 2011), task efficiency, precision, stability, duration (Lee and Chen, 2008; Wu et al, 2009; Jung and Hallbeck, 2005; Chang et al, 2007), etc. researchers have used it in the past to assess the usability of different types of products. To measure the parameters of different metrics that are responsible for assessing the usability of a test, the parameters would have to be both subjective and objective in nature. Data can be collected using various rating scales and ranking procedures, direct observation or using equipment such as algometer, dynamometer, goniometer, heart rate monitor, accelerometer, etc. (Bisht and Khan, 2013). Usability tests are more complexed since sometimes special equipment needs to be built, but the results that can be obtained can better represent a real human interaction with the packaging.



#### Figure 3

Experimental setup used in research based on usability metods (Wei-Ting et al, 2016; Carse et al, 2011)



grip strength, wrist-twisting strength, and pressure and pull strength (Peebles and Norris, 2003). When the ease of use of a product is viewed from the user's point of view, several factors can be defined that can affect the ease of use of the product: strength in hands, skin sensitivity, dexterity, left-handedness/right-handedness, coordination, pain, cognition, sight, attention, memory and problem solving, personality. When using the product, consumers are required to use different movements and apply force. Some of the movements that are necessary to avoid are "key grip", "power grip", twisting or rotation of the wrist (Heinö et al, 2008). The position of the whole arm and spine must be considered, especially when it comes to frequent lifting of loads so that muscle and spine injuries can be avoided (Moore et al, 2011).



## Figure 2

Experimental apparatus used in research based on mechanical methods a) the 1. step b) the 2. step (Heinö et al, 2008)

Each of these methods can be useful for ergonomic research of packaging products. If the research goal and research hypotheses are clearly defined and if the research setting is defined in accordance with the rules proposed by the type of selected method, then the research results will be of high quality.

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