Usability Evaluation of Products - A Survey on Methods and Techniques Used In Analysis of Consumer Packaging

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ABSTRACT

Usability studies are concerned with identifying the level of interaction between the product or system and its user,
in order to achieve their efficiency, effectiveness and satisfaction in a specified context of use, as defined by ISO
9241-11 (1998). When referring to packaging we find that are common occurrences of various problems regarding use. The packaging is a product of regular or daily use, which, in most cases, a single model can be targeted to various kinds of procedures: age, sex, level of experience and different needs. As regards the analysis of the usability of packaging, there are a number of issues that require constant research, namely: "What methods are used and how the tests are conducted?", "Which are the effectiveness/efficiency of existing methods, their limitations and difficulties of application?", "Which technology trends for this type of analysis?", among others. Therefore, the aim of this article is to present a survey on methods, techniques and tools (whether physical or virtual) used in academic research to evaluate the usability of packaging. Therefore, the survey was conducted in journals and scientific events related to ergonomics, design and usability. For the survey, were primarily selected articles published between 2009 and 2013.

Keywords: Usability, Packaging, Methods and Techniques of Analysis

INTRODUCTION

The packages are increasingly representing a differential in today's society on production and marketing of products. Its importance goes beyond aesthetics, functionality, safety and security, involving intangible issues to the user very often - the allure, charm, identification with the product and the brand. Besides the classic functions of packaging, Poças & Moreira (2003) added as one of the functions of packaging - the service - that is, in general terms, from the perspective to the end of use and consumption of the product, in other words, the package must also contributes to product safety should be considered not to be a hazard to the consumer. However, this premise

has not always been respected in the design of consumer packaging. There are several problems caused during the use of a packaging for different types of users, such as cuts, punctures, lack of information on the use or how to dispose of the packaging, explosion , improper opening or without lock at dangerous product. (PRO TEST; AMB, 2005) Such difficulties and

consequences can be revealed in public as children, the elderly, people with reduced mobility in th e upper and left- handed members. Some systems, for example, are created to ensure the safety of children, but can also encumber the access by adults, especially the elderly. According to Zunkic (2011), a failure in the design of a package may have fatal consequences for consumers, as drug packaging case.

To subsidize usage analysis of a particular product, in this case packaging, and understand the reason of the problems about its use, it is important to understand the principles of usability as a point of paramount importance for the design of products. Is meant by usability in products such as "the practice of engineering of products, where users can perform the required use, operation, service and support tasks with minimal stress and maximal efficiency". (Woodson apud Ferres, p.16, 2007)

According to Falcao & Soares (2013, p.2),

> usability starts with a philosophy, a belief in designing to meet user needs, by focusing on creating an excellent experience for it. A usability process begins by looking at who uses the product, understanding their needs and objectives, selecting the right techniques to answer t he following question: This product meets the requirements of use by users?

Many of the problems of current packaging comes from inadequacies of usability and, in general terms, it is perceived that usability issues in packages are not simple to be evaluated and materialized mainly by the heterogeneity of its customers, a wide range of shapes, templates and volume of materials and products designed. Brazil is the second country that more launches new packaging per year, just behind the United States, thus being the second most innovative country in packaging. (REMADE, 2009)

In the realization of analyzes of products, in general, and this would not be different in relation to aspects of usability, it is necessary to adopted adequate methods and tools to the user, the product category to be analyzed and its context. According to Merino et al (2012) many methodologies have been developed within the design with a view to implementation of usability requirements in projects.

Freire & Soares (2006) assert that the definitions of usability suggest the researcher to reflect on ways of evaluation of usability. Since, in general, some of the methods and heuristic evaluation have an indication for use somewhat " generalist". The challenge therefore is to understand the best method/dimensions/metrics/heuristics must be adopted in analyzes of such products - the packaging.

Therefore, this paper presents a survey on methods, techniques and tools (physical or virtual) used in academic research to evaluate the usability of packaging. It is hoped that the results of this research can contribute to the expansion of theoretical and practical knowledge about the usability of packaging, contributing to a better performance, safety and comfort of the user of these products.

THEORIC REFERENCIAL

Product Usability

According to Falcão & Soares (2012) the concept of usability with a focus on product design was first envisaged in the early 1990s by companies such as Thomson Consumer Electronics, Apple Computer and Northern Telecom. Patrick Jordan (1998) puts the focus on issues related to usability and advancement of publications and conference area from that period. He mentions the importance of this, the growing number of professionals (specialists in human factors, interaction designers, product designers and programmers and software) concerned with the production of easy to use products, seeking to put the user at the center of the process project.

A classical concept of usability is proposed by ISO (International Organization for Standardization) 9241-11 (1998) conceptualizes usability as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specific context of use". The ISO (NBR 9241-11 , 2002 , p.3) details the terms used in its classical definition of usability, as follows:

> Effectiveness: Accuracy and completeness with which users achieve specific goals.
> Efficiency: Resources expended in relation to the accuracy and completeness with which users achieve goals.

> Satisfaction: Absence of discomfort and the presence of positive attitudes towards the use of a product.
> Context of use: Users, tasks, equipment (hardware, software and materials), and the physical and social environment in which a product is used.
> Work system: system consisting of users, equipment, tasks and the physical and social environment, in order to achieve specific goals. (Note: the use context consists of those components of the work system that are established when the specification or Measuring usability).
> User: A person who interacts with the product.
> Objective: Desired outcome.
> Task: Set of actions (the physical cognitive) necessary to achieve a goal.
> Product: Part of the equipment (hardware, software and materials) for which usability is specified or evaluated.
> Measure (noun): the resulting measurement value and the process used to obtain that value.

Moraes apud Tanure and Okimoto (2008) introduced the term as related to usability and its scope: ease of learning, effectiveness, attitude, flexibility, perceived usefulness of the product; suitability to task, task characteristics and characteristics of users.

Regarding to the process of product developing Catecati *el al* (2011, p.565) provides a definition of product usability Usability Professionals Association (UPA) - "an approach to product development that incorporates direct way, user feedback throughout its development cycle in order to reduce costs and create products and tools that meet the needs of users".

Regarding the analysis of products and softwares Jordan e Han et al (apud Falcao & Soares, 2013)

> argue it is necessary to consider a less performance-oriented approach when considering the usability of consumer products as a consequence of their voluntary use. Therefore, a consumable product is not a tool in which develops only a task, but is also a three-dimensional artifact, used for decoration in an environment which can represent a lifestyle of the user. This means that physical interfaces need to be included in a review, and that they should not only be efficient and easy to use, but at the same time need to look good.

To measure the result of usage, the NBR 9241-11 (2002) based on ISO ISO 9241-11 (1998) presents an example of some shapes to get measures of usability:

- Measures of overall usability: Effectiveness (Percentage of goals achieved; Percentage of users completing the task successfully; Average accuracy of completed tasks), efficiency (time to complete a task; tasks completed per unit
time, monetary cost of carrying out the task) and satisfaction (satisfaction scale, frequency of use, frequency of complaints) can be specified for global objectives (eg produce a letter) or smaller goals (eg perform search and replace). When selecting usability measures for the most important user goals may be ignoring many functions, but probably this is the most practical approach.
- Measures to desirable product properties: additional measures to particular desired product properties that contribute to usability can be: As an example for Effectiveness (number of important tasks performed, percentage of words read correctly in a normal viewing distance, number of learned functions, among others), Efficiency (time to
learn to criterion, time spent correcting errors, time to correctly read a specific number of characters, among others)
and satisfaction (frequency reuse; Scale for error handling, Scale for visual discomfort, among others).

Regarding more geared dimensions for evaluation of products some authors add more dimensions to those described previously. However, in general terms, there is a consensus among authors about the objectives attributes: efficiency, effectiveness, and subjective: satisfaction.

Rebelo et al (2011) present some objective attributes to evaluate the usability of consumer products: learnability, efficiency, flexibility, comprehensibility, storage, and reliability, and subjective attributes refer, for example, th e attractiveness of the product, which affects the positive attitude toward the product.

Kim & Han (apud Falcão & Soares, 2013) have eighteen dimensions of usability for consumer electronic products: simplicity, consistency, modeling, locus of control, direction, feedback, helpfulness, forgiveness, error prevention, adaptability, accessibility, learning ability, memory, familiarity, predictability, informative, effectiveness and

efficiency.

Jordan (1998) states that the user experience is individual, i.e., a person can have a positive user experience while another does not. And so it points to some user characteristics that must be considered in relation to the usability of a given product, the prior user experience with the product and the knowledge that it has on the independent task of used product, cultural background, limitations, age and gender.

On the usability evaluation, Macedo *et al* (2012) states that this can occur in several ways, which may result in a huge range of results. In general terms, for the analysis of usability some elements are important - know your product user, both physical and behavioral/cultural aspect, looking also know their previous experience of using the product, the product features (components, tasks, scaling, among others) and the context in which it is used (physical factors/environmental/psychological, etc.), and the definition of what kind of methods, tools and evaluation that will be adopted in the analysis environment.

To Catecati *et al* (2011) another aspect to be considered in choosing the method of assessing the usability of a product is the stage of development that it is. For example, in the conceptual stage based expert user and methods may be used, different informational which is mainly based on experts. Karat (apud Catecati el al, 2011) presents another issue that can influence the process of choosing a method - also consider the time required to conduct the evaluation, the cost of achievement, confidence in obtaining data, among other topics.

Roepke et al (2012) reported that, the selection of assessment methods also depends on the context in which the product is being used. With respect to the type of product to be evaluated, those whose practical function (or technique) predominates. The authors suggest methods that provide more quantitative results, such as tests and experiments with the user with products such as a drill or cash machine, for example, and more subjective methods: interviews, focus groups, among others, for products that lead to a greater experience of use - cell phones or even cars, for example.

According to Catecati *et al* (2011) review methods usability of products can be divided into two classes: Methods based on observations and measurements about users, where typical users (actual or potential) methods perform everyday tasks with the software product or system (or its prototype) and the evaluators use the test results to analyze how the interface supports these users in performing their tasks; Methods based on the knowledge of experts
- where experts analyze the usability aspects of user - product or system interface. There are two main methods of
evaluation of usability that are based on experts: Footsteps Cognitive (Cognitive Walkthrough) and Heuristic
Evaluation (Heuristic Evaluation).

Usability tests can be applied at various stages of product development, including aftermarket launch. To Cybis et al (2010) usability testing has focused evaluation the quality of interactions that take place between users and the system. And as objective to notice the problems, measure its negative impact on the interactions and identify their causes. The tests may involve real users or representative of the target population of the system.

Falcão & Soares (2012) present a classification of the types of usability testing in accordance with the development phase of the product: 1. Formative tests - while the product is under development, aiming to diagnose and fix problems, usually based on small studies, repeated during development, 2. summative tests - after the product is finished, in order to establish a baseline metric or validation that the product meets the requirements, generally requires a larger number of statistical validity.

Packaging

The packaging is a product that involves the life of people of different ages, genders, social classes and in many situations, very early, through a variety of types, shapes and functions. Brazilian packaging industries produce over seven thousand different items (Negrao & Camargo, 2008).

About its functions, in general terms, Etzel et al (2001) present purposes as a container: protect the product on its way to the consumer; provide protection after the product has been purchased; help to gain acceptance of the product by intermediaries and persuade the consumer to buy the product. As regards the protection directed to

the product, sometimes it is not applied to its user. The packaging itself can promote inappropriate use, or mislead when manipulated, or even with proper use, cause discomfort and/or even accidents.

To Roncarelli and Ellicott (2010 , p.12) "ideally, a model of packaging contributes to a positive interaction between a product and the consumer". However, it is noticed that the application of this assumption is not always considered in the design of various products, including packaging design. Or, the performance goals established for the product and for the user, not cater to the target audience as a whole, being privileged just part of it. Ie, are several interface problems, which can present a package. Usability issues related to the cognitive and physical aspects -
understanding of textual and pictorial information labels , difficulties in understanding and manipulation of opening and closing, handling difficulties related to inadequate way, dimensional, surface and material of packaging systems, among others.

Regarding the use of packages for different audiences, mostly elderly and children, some difficulties are commonly experienced as open or close, hold, understand the information on the label, among others. Some packaging clearly present difficulties to be manipulated. Usability problems related to opening/closing a packaging system can be an example (Figure 1). Other packaging components also are difficult to use for all its users, such as handles and seals that burst in his hand, or the need for assistance from some sharp instrument. According to the IDEC (2011, p.23) "the packages are responsible for 7.5% of consumer accidents recorded by INMETRO" (Institute of Metrology, Standardization and Industrial Quality - Brazil).

Figure 1 - Opening devices of some packaging

Zunkic (2011) presents as a cause of recurrence of the problems faced in ergonomic incompatibility of packaging, the fact that manufacturers are often not aware of the dimensions of the problems consumers have when interacting with the packaging. However, even when they are aware of the problem, often do not know how to solve them.

METHODOLOGY

The survey presented here was conducted to identify papers that address directly the usability applied to packaging in one or more aspects related to it. The research was structured as follows:

- Articles of specialized journals about several issues related to ergonomics, design, usability and related areas. Data on periodicals, such as the impact factor, qualis, editor, and others were presented. According to Thompson (2005) the impact factor (Factor Impact) identifies the frequency with which the average article in a journal is cited in a particular year. Some information from each paper was presented: title, author(s), journal, goal(s), analysis methods and techniques adopted;

- For the realization of this survey were used as means of search: the journal portal of CAPES (Coordination of Improvement of Higher Education Personnel, Brazil), websites of journals, proceedings of scientific conference HCI and printed editions of the Journal Ergonomics. Primarily with articles published between the years 2009 to 2013 were selected. Were used as keywords to identify the papers: analysis/evaluation/testing usability/in packs.

The following journals were searched: Applied Ergonomics (ISSN: 0003-6870); Ergonomics [(0014-0139 (printed),
1366-5847 (online)]; International Journal of Industrial Ergonomics (0169-8141); Human Factors (0018-

7208); Human Factors and Ergonomics in Manufacturing & Service Industries [1090-8471/ 1520-6564 (on line)]; Design Studies (0142-694x); Computer-aided design (0010-4485); Computers & Graphics (0097-8493); Engineering Design (0954-4828-printed; 1466-1837-on line); Packaging Technology and Science (1099-1522); Universal Access Information Society (16155289-printed; 16155287–on line). The congress HCI 2013 was added by owning a publication directly connected with the subject in question.

Table 1 presents the general information of journals of which were selected some of the article(s) described in this paper.

Table 1: Description of surveyed journals (JCR, 2012; CAPES, 1012; SICAPES 2012; Database's websites)

JOURNAL/ISSN	**APPLIED ERGONOMICS** (0003-6870)
General Information	Editions per year: 6 / England / Coverage: since 1969 / Publisher: Elsevier LTD SCI / Database: Science Direct.
Areas/subject	Engineering, Industrial.
Impact Factor	1.428 / 5-Year Impact Factor: 1.586
Qualis classification	A1 (Engineering I, Architecture), A2 (Engineering III, Nursing), B1 (Collective Health, Physical Education), B2 (Computer Science, C (Teaching).
JOURNAL/ISSN	**INTERNATIONAL JOURNAL OF INDUSTRIAL ERGONOMICS** (0169-8141)
General Information	Editions per year: 12 / Netherlands / Elsevier LTD SCI / Official journal of the Institute for Ergonomics and Human Factors / Database: Science Direct.
Areas/subject	Industrial and occupational ergonomics, design of systems, tools and equipment, measuring and modeling of human performance, human productivity, humans in technologically complex systems and security.
Impact Factor	1.260 / 5-Year Impact Factor: 1.290
Qualis classification	A2 (Architecture and urbanism, Interdisciplinary, Engineering III), B1 (Engineering I and II, Nursing, Physical Education), B2 (Public Health, Medicine I, Computer Science).
JOURNAL/ISSN	**PACKAGING TECHNOLOGY AND SCIENCE** (1099-1522)
General Information	Editions per year: 8 / Coverage: since 1988.
Areas/subject	Food packaging, medical and pharmaceuticals, electronics, machi ne tools, agricultural chemicals, fragile goods, high value, hazardous substances migrating from packaging materials, machinery and engineering packaging, testing, analysis and quality control new processes and manufacturing techniques; environmental factors in packaging and transport packaging, among others.
Impact Factor	0.737
Qualis classification	B2 (Food Science)
JOURNAL/ISSN	**UNIVERSAL ACCESS INFORMATION SOCIETY** (16155289-print; 16155287–on line
General Information	Publisher: Springer-Verlag / Germany / Coverage: since 2004.
Area	Computer Science
CONGRESS	**HCI 2013**
General Information	15th International Conference on Human-Computer Interaction. 21 - 26 July 2013, Las Vegas, Nevada, USA. Anais. 2nd International Conference on Design, User Experience and Usability. Publisher Springer-Verlag Berlin Heidelberg 2013.

SURVEY

From the survey were selected according to criteria established nine articles of journals and an article of Congress. In general, items that had some kind of test users, whether quantitative and/or qualitative nature, were selected. Table 2 describes the articles presenting the following information: title, authors, journal, goal(s), analysis methods and techniques adopted in usability analysis.

Table 2: Description of articles researched

Title	**Requirements for Packaging from an Ageing Consumer's Perspective**
Authors/Journal	L. M. Duizer; T. Robertson; J. Han (2009); Packaging Technology and Science
Keywords	Ageing consumer; packaging closures; consumer survey; focus groups
Aim(s)	Explore attitudes of elderly consumers about the importance of packaging attributes in the choice of food in New Zealand
Type of packaging	Packaging for food products.
Participants/ methods and techniques usability	Participated ninety-nine people aged over 60 years, the majority of participants were female (67%). The sample was defined by convenience. W ere made two kinds of analysis: qualitative – focus group (discussion about the packaging attributes, difficulties and improvements) the sessions were filmed; and quantitative – a questionnaire (shopping habits, encountered difficulties, the importance of packaging attributes and demographics of participants). The resulting data from questions of consumer research were coded and analyzed using SPSS s oftware.
Title	**Designing packaging to support the safe use of medicines at home**
Authors/Journal	W ard, J.; Buckle, P.; Clarkson, J. (2010, 41, pp. 682–694); Apllied Ergonomics.
Keywords	Inclusive Design; Labelling; Medication error; Methotrexate; Medicines; Older adult; Packaging; Patient safety; Usability.
Aim(s)	The research aimed to investigate current practice in the UK healthcare system with solid oral medicines (tablets), with a focus on the experiences of rheumatology and dermatology patients in using methotrexate. To realize this aim, the following obj ectives were formed: 1. Investigate patients' practice in using solid oral medicines and determine how and why patients currently take, and sometimes fail to take, the right dose of their medicines; 2. Develop recommendations as to how the safe use of medicines by patients can be encouraged through the design of medicines packaging and labeling; 3. Present problems associated with packaging and labeling design to manufacturers of methotrexate, to encourage new developments, where necessary. 4. Investigate the healthcare system associated with methotrexate packaging and labelling and determine where it can fail to support patient safety.
Type of packaging	Bottles with push-down-and-turn closures (a type of "child-resistant closure" or CRC) and in blister packs.
Participants/ methods and techniques usability	The health systems were evaluated by health professionals (10) and patients (12). W ere used as research tools to healthcare professionals: unstructured interviews , and with patients: semi - structured interviews in their homes, shoot the use of drugs, and patients were encouraged to report their difficulties through the use of description their thoughts during the year of observation. A mapping of drug delivery was made and process maps were developed for risk analysis. Two different methods of risk analysis were chosen to maximize the chances of identifying risks: HAZOP and RPN. From the information collected concepts were generated, using the technique of brainstorming (in four sections: tablet design, packaging, labeling and action potential for the project in the health system level design). Subsequently basic design requirements were developed for future packaging and labeling.
Title	**Understanding the use of tools for opening packaging**
Authors/Journal	A. Yoxall; J. Langley; J. Luxmoore; R. Janson; J. C. Taylor; J. Rowson (2010, 9:273–281) Univ Access Inf Soc.
Keywords	Packaging; Design; Openability.

Aim(s)	Evaluate some of the common tools which were designed to help the elderly in opening packaging, in order to understand its effectiveness.
Type of packaging	Eight openers bottle caps.
Participants / methods and techniques usability	Participated in the tests 18 younger subjects (aged 21 to 25 years with 10 males and 8 females) and 64 elderly participants (aged 66-94 years, mean age 82 years). The volunteers were tested individually. The research presented a quantitative character: an equipment used to measure opening torques that could be applied to the different tools was built. The equipment is a measurement device comprising a bottle instrumented with a torque sensor. The sensor device was coupled to a computer; And a qualitative character: questions about the satisfaction of use after the tests were made.
Title	**Consumer reaction to new package design**
Authors/Journal	Holmes, G. R.; Paswan, A. (2012, 21/2, pp. 109–116); Journal of Product & Brand Management.
Keywords	Packaging, Design, Consumer experience, Evaluation, Product design, Consumer psychology.
Aim(s)	Explore the reaction of consumers to a new package design through differing levels of experience.
Type of packaging	Three packages of tomato products - Italian tomato sauce, diced tomatoes and crushed tomatoes.
Participants / methods and techniques usability	461 questionnaires were distributed to parents who had children in kindergartens and participated in the program mother-day-out, as well as graduate students and professors from the Midwest and Southwest United States. Through the questionnaires was possible to categorize the following user data such as gender, age, family income, marital status, frequency of purchase of the products (tomato) and the frequency with which respondents cook at home. 354 questionnaires were collected, 347 were reused (42% male and 58 % female, age range 31-40 years), of whom 116 received a sample of the new packaging and were asked to answer a pre-test just by looking the handling of the package , and then were instructed to take the pack for home, use it with any meal and complete a post-test . For data comparison with the first respondents in the pre-test and posttest, 231 people completed the pre-test by looking to an image of the package. W as used a scale developed by Ratneshwar and Chaiken (1991). After conducting in-depth interviews with members, the majority of pre- existing items were kept and some items were added based on suggestions of the respondents. Thereafter purchase intention was measured using items developed by Dodds et al (1991). The items measuring attitude toward packaging, expected product quality and purchase intention were measured using a Likert scale with five points between "strongly disagree (1)" and "strongly agree (5)".
Title	**Consumer Attention to an Over-the-counter Warning in Four Different Styles of Design**
Authors/Journal	Gawasane A., Bix, L.; Fuente J.; Sundar R. P.; Smith, T. J. (2012, 25: pp. 385–396); Packaging Technology and Science.
Keywords	Conspicuous; Over-the-counter; Labels; W arning; consumer.
Aim(s)	(a) to test the relative prominence and conspicuousness of a warning required by US law to be conspicuous; (b) to explore whether or not the conspicuousness of the said warning can be enhanced graphically; and (c) to develop preliminary dat a for power analysis that would guide decisions related to sample size in future studies.
Type of packaging	Nine containers were used for the experiment, which were tested for each package label each with 4 variations of warning information (W arning 1 -no outline and no fill; W arning 2 - outline and no fill; W arning 3 - no outline and fill and W arning 4 - outline and fill).
Participants / methods and techniques usability	One stage of a perception of warning test was realized: the one related to consumer attention. Participants were 17 students aged between 18 and 25 years. The visual acuity of each participant was tested and filmed using a card manufactured by Dow Corning Ophthalmic in an approximate distance of 16 inches from their eyes and they were asked to read the lowest line possible. An Applied Science Laboratories 501 head mounted bright pupil system (Boston, MA, USA) was used to record participant's eye movements. After equipment calibration, participants were asked to review a number of items that appeared on a list of purchases that had been given . After this statement, the packages were delivered for display in an order that was counterbalanced across subjects. The participants had a time of 10 seconds for a package at a time. Finally, a stat istical analysis of the understanding of users was taken. Eye tracking data were collected in the form of video files and analyzed using the eye-tracking Gaze Tracker.

Title	**Using Virtual Reality to Examine Hazard Perception in Package Design**
Authors/Journal	H. Ayanoğlu; F. Rebelo; E. Duarte; P. Norieg; L. Teixeira. (2013); HCI 2013.
Keywords	Package Design, Virtual Reality, Virtual Prototyping, Hazard perception.
Aim(s)	Present the results of a pilot study on the effectiveness of using a methodology based on virtual reality to examine the influence of the characteristics of a container (forms) in the user's perception of dangerousness.
Type of packaging	Eight containers of household hazardous liquids with different shapes.
Participants/ methods and techniques usability;	Experimented with 10 people (age 18-24 years) in Portugal. Used the virtual environment to view the 3D prototypes of packaging, according to the following criteria: 1. Ease to discern the details of 3D prototypes; 2. Participants should be able to easily observe packaging, as well as freely navigate the virtual environment (VE), VE should be presented in stereoscopy, to provide the participant depth information; 4. Give the participant the opportunity to browse and change their point of view in VE 5. The task that participants would need to comply within the VE should not be so complex that would prevent them from responding verbally to questions while they are interacting with the VE.
	W ere used as tools: video projector Lightspeed DepthQ 3D Glasses 3D APG6000 MacNaughton Inc., a mouse and a questionnaire. Virtual prototypes were designed using Rhinoceros and then exported to Unity.
Title	**Critical Factors in Opening Pharmaceutical Packages: a Usability Study among Healthcare Workers, Women with Rheumatoid Arthritis and Elderly Women**
Authors/Journal	Sormunen, E.; Nevala, N.; Sipilä, S (2013); Packaging Technology and Science
Keywords	Pharmaceutical packaging; Consumer packaging; Participatory design; Ergonomics; Usability; Openability.
Aim(s)	The aim of this study was to compare the usability of pharmaceutical packages and determine the critical usability factors of packages with different opening mechanisms among healthcare workers, women with rheumatoid arthritis and elderly women.
Type of packaging	Four types of pharmaceutical packages - glass bottle with screw cap, box with a pill plate, disposable plastic dropper with its envelope-like container and plastic jar-like container with hinge cap.
Participants / methods and techniques usability	45 women participated in the survey (nurses - aged 47-62 years; healthy elderly women - 69-79 years, and women with rheumatoid arthritis - 39-67 years). W ere evaluated subjective (ease of opening) and objective (time to open the package, the electrical muscle activity and ranges of motion of the upper extremities) measures. Health status was determined by the application of a self-report questionnaire. The following instruments/equipments were used: EMG to measure muscle activity; tape measure to measure the hands; electrogoniometer to measure the range of motion of the wrists and arms; dynamometer to measure the strength of apprehension hand. The uses of packages of each participant were filmed. After the training session, the tests to each package were performed twice. After use, questionnaires on satisfaction of use were applied. Statistical tests were performed and analyses were treated statistically using SPSS software for Windows (version 18.0).
Title	**Carpe diem, Carpe ampulla: a numerical model as an aid to the design of child-resistant closures**
Authors/Journal	A. Yoxall; E.M. Rodriguez-Falcon; J. Luxmoore (2013, 44, pp 18-26; Applied Ergonomics.
Keywords	Openabilit; Packaging; Biomechanics.
Aim(s)	Present the results of an ethnographic study in order to identify the types of grip used to use a packaging system known as closing childproof CRC or "squeeze and turn", known to present particular difficulties also for the elderly, and commonly used in medicines and cleaning products.
Type of packaging	Two types of bottles with CRC closure system.

Participants / methods and techniques usability	Ethnographic research with 57 individuals (random sample). The purpose of the experiment was to identify areas of discomfort and pressure of hands on manipulation, using the following measuring and recording instruments: Thin-film sensors to measure force, pressure maps where the hands were raised; numerical models, in which were modeled 3D hands, and the packaging. The tasks performed by the users use were videotaped and later questionnaires about discomfort levels were applied using the index McGill classification. To test the joints and measurement of forces and registration areas of contact with the packaging three models of hand sizing were generated: one average male hand, an average female hand and a 5th percentile female hand.
Title	**Rating Accessibility of Packaging: A Medical Packaging Example**
Authors/Journal	Rowson,j.; Sangrar, A.; Rodriguez-Falcon, E.; Bell, A. F.; W alton, K. A.; Yoxall, A.; Kamat, S. R. (2013) Packaging Technology and Science.
Keywords	Blister packaging; inclusive design; dexterity.
Aim(s)	Evaluate the ease of access to medicines for blister pack.
Type of packaging	Two types of blister pack.
Participants / methods and techniques usability	The experimental methods used were: analysis of adhesion and dexterity analysis and analysis of motion capture. Participated in the experiment in classification analysis 57 people (almost the same number of men and women, aged 21 to 91 years - average age 45 years); Of the 57 persons: 54 attended the dexterity test, 08 participated in motion capture (ages 56 to 83 years). To perform the
	experiment were performed: measurement of the participants' hands; photographic record of the task of opening the blister, shoot hands during the task, timing of the task, the application of dexterity Purdue Pegboard (Tiffin Joseph) test; Motion capture was undertaken using a Hawk Digital RealTime System (Motion Analysis Corporation, USA) that consisted of seven Hawk Digital Cameras connected to a computer running EVA REAL-TIME (EVART) software (Motion Analysis Corporation, USA).
Title	**Evaluation of reusable cardboard box designs: Biomechanical and perceptual aspects**
Authors/Journal	Silva, L. C. C. B.; Oliveira, A. C.; Silva, D. C.; Paschoarelli, L. C,; Coury, H. J. C. G. (2013, 43, PP. 154-160); International Journal of Industrial Ergonomics.
Keywords	Ergonomic design; usability; electrogoniometry; electromyography; grip perception.
Aim(s)	Evaluate comparatively a regular commercial cardboard box with prototype cardboard boxes designed for alternative bottom and handles graspings.
Type of packaging	Four models cardboard Box.
Participants / methods and techniques usability	Thirty-seven male university students without load-handling training participated in the study. Cardboard boxes were filled with a load of 15 kg. W ere used for the analysis: fixed and adjustable supports placing the boxes; for each test were used synchronously a electrogoniometer (SG65/SG110) - was used for flexion and extension of the wrist and elbow; a inclinometer (INC) - used to measure elevation angles relative to the line of gravity; and a electromyographic activity (EMG) - used for recording the movements of flexion, extension and amplitude of the wrists right and left and scale. An event marker was used to indicate the start and end time of each task. All tests were filmed for a better control. After testing was applied a subjective scale of comfort that has a horizontal line 100 mm length in which the leftmost point represents "lack of comfort" and the rightmost point the "utmost comfort" perceived.

CONCLUSIONS

Among the articles selected for this survey, it was observed that about 70% of the evaluated packages are drugs or dangerous products. Analysis packages which contents pose risks to consumer health has grown in recent years, especially with certain audiences, such as the elderly. The others studies described were about food packaging, packaging of transport and tools to open bottles. Half of the articles were targeted or involved the elderly public. Virtually all surveys, except one, used complementary quantitative and qualitative methods in order to measure efficiency, effectiveness and user satisfaction. Most tests were performed in laboratories or in public places. Only in one research the test was performed in the real environment of use.

From the survey it is possible to identify the increase of publications on usability and packaging, and even the growth of new technologies both in quantitative and qualitative methods. As an example, one of the studies described the use of virtual reality tools for the analysis of risk perception of packaging.

It's also possible to signal, by the conclusions of the research analyzed, that further studies are needed, with a larger user population sample, behavioral studies across the new habits of life, on the use of new technologies for the tests besides the need to conduct usability testing in the product development process, not just when it is already on the market, among other open questions.

This research subsidizes a doctoral thesis on methods of assessment and guidance for the use of consumer packaging, and therefore the items described were selected under the criterion approach the topic of the thesis in question. And even assuming that the usability of a package can be evaluated by severa l aspects (physical/ cognitive/behavioral) and different areas of knowledge, this survey is not designed to exhaust the possibilities of research, i.e., the instruments researched and selected items do not constitute the totality of the theme "usability packaging". Some articles were not described, as presented analyzes, review methods and/or instruments very similar to the others.

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