

Comparing study between people with reduced hand function and children

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Abstract. This study was conducted in collaboration with Tetra Pak® [1] measuring the hand strength, grip ability, hand size and judgement how easy it was to open three packages with a group of 10 people with reduced hand function and 14 children, six years old. The result showed that the hand strength between the group with reduced hand function and the children was quite similar. Also the results from the grip ability test and their judgement of how it was to handle the package was similar. The size of the participant's hands was the only thing that really differed between the groups. This is an interesting input for designers developing products and packages that should be easy to use for children, but maybe even more interesting input for developing products where there is a need to exclude children or child protective packages.

Keywords: user studie, universal design, design for all, inclusive design, hand function, packaging design, product design, child safety

1 Introduction

Inclusive design often focuses in how a product is to use for people with different kind of impairments. Seldom are children involved in the user studies to confirm the ease of use for them. Sometimes we are facing a situation where we really want to include or exclude children. Milk and juice packages are examples of products we want children to be able to handle while dangerous products such as packages for pharmaceuticals or detergents can cause the need of exclusion. The traditional way to exclude children to open packages is by a design that requires a lot of strength and good coordination in the hands. The problem is that the target group for pharmaceuticals often consist of sick, weak or elderly people with reduced strength and/ or coordination in their hands. Pharmaceutical products that are hard to use can be a great problem for the users. In this study we measured the hand strength, hand function, hand size and judgement how easy it was to open three packages from Tetra Pak with screw cap. The test groups consisted of 10 people with reduced hand function and 14 children, 6-7 years old.

1.1 Goal

The goal of this study was to investigate the similarities and differences in the conditions for people with reduced hand function and six years old children to handle every day things and packages.

1.2 The adult group

The adult group consisted of ten people with reduced hand function. Eight had rheumatic diagnoses, either osteoarthritis, rheumatoid arthritis or both and one with systemic sclerosis. One suffered from a neurological disease, Multiple Sclerosis and one was born with four fingers on each hand where the index fingers have been transferred to thumbs by surgery. The age span in the adult group where between 32-77 with an average age of 61. Two men and eight women participated in the study.

1.3 Child group

The child group consisted of fourteen children all born the same year with an age between 6-7 years. They were attending the Swedish preschool, in between kindergarten and elementary school. Six boys and eight girls participated in the study.

2 Method

The study was performed individually with one test person and one test leader.

2.1 Hand size

The hand size was documented by drawing the outline at the test occasion. Afterwards measurements of the palm with, hand length, thumb, index and middle finger were measured with a ruler.

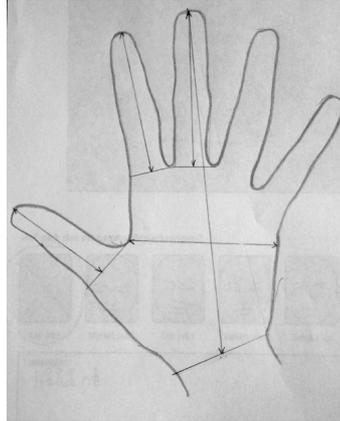


Fig. 2. This figure is an example of an outline of a hand from one of the test persons to show how the hand size was measured in this study

The way of measuring was inspired by Anthropometry of infants, children and youths to age 18 for product safety design [2] and The Digital Human Research Center [3].

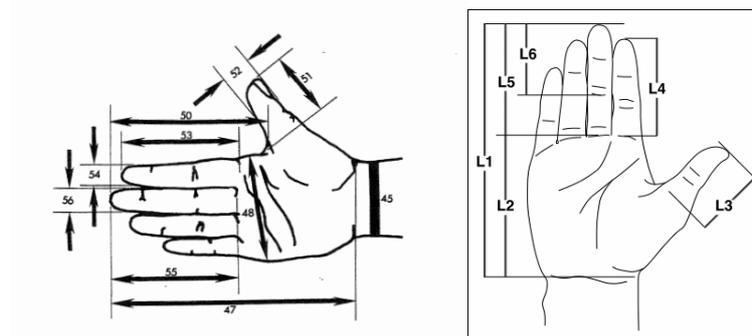


Fig. 1. This figure shows how the hand size was measured by The Highway safety research institute, The University of Michigan and by The Digital Human Research Center.

2.2 Grip force

Maximum and average value of their grip force was measured for both hands by using a dynamometer called Gripit [4]. The arm was positioned with 90 degrees angle in the elbow and the lower arm resting in a horizontal support with the wrist in a straight position. During ten seconds the test person use all their hand force to grip the handle (black vertical part of fig 3) as hard as they can.

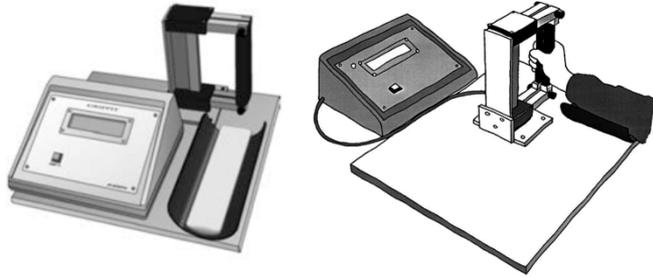


Fig. 3. Gripit is a measuring instrument used for characterising the grip force [5].

2.3 Hand function

GAT, Grip Ability Test [6], is a method to measure a person's ability to perform predefined actions while clocking the time needed. The test consists of three actions, pouring a glass of water from a one litre jug, putting a metallic clip on an envelope without dragging any of the items to the edge of the table and pulling a gauze tube over the hand until the whole thumb is visible. The method is extracted from the more covering and complicated Sollerman test [7]. In the development of the GAT test they were comparing the results of the different parts of the Sollerman test between people with rheumatism and people without any problems in their hands. The result was analysed to find the variables that are most sensitive to change due to exercise of the hands. Those variables were divided into groups from what kind of grip it involved. A statistical calculation procedure found that the time requirement of the three tasks in GAT were representative for the Sollerman test. The test is sensitive to changes in the hand function and thereby appropriate to use for evaluation of progression from treatment and exercise. The test takes less than five minutes to perform. It is validated and has a high level of reliability [8].

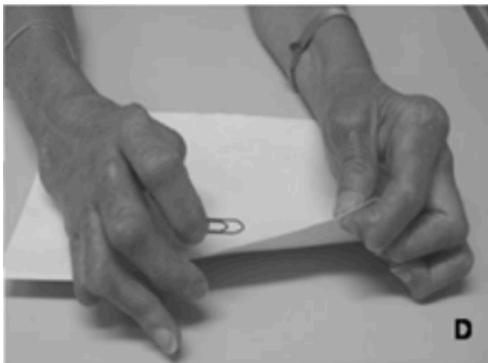


Fig. 3. GAT, Grip Ability Test is way to evaluate the hand function of a person by measuring the time needed to perform three different tasks [9].

2.4 Judging packages

Unicum – Nordic Design for All Centre [10] and the Swedish Rheumatism Association [11] has developed a method to measure the experience of handling packages and products. As measuring instruments we use test groups with reduced hand function. The method is a part of the Design for All Test [12]



Fig. 3. The test person perform every handling step of the package and judge them on a scale from 0= impossible, 1= very hard, 2 rather hard, 3 neither hard nor easy, 4= rather easy and 5= very easy.

The average value of the test group is calibrated with results from a reference group of over 100 people with reduced hand function. If a package or product reaches a judgement of 3 or higher from a calibrated test group The Swedish Rheumatism Association approves it as easy to use.

In this study the test persons from both groups were then asked to open three different packages (A, B and C) and judge their experience. All packages came from Tetra Pak, had a screw cap and a weight of approximately 300 gram. A and B was recently designed to be easy to use while C was an older package. The order that they evaluated the packages was changed for every test person so that every package will be equally judged without influence of tired hands or comparing's with the previous. All test people was observed and captured on movie while performing the opening of the packages.



Fig. 4. Test of package A, Tetra Prisma ® Aseptic 330 DreamCap™ 26



Fig. 4. Test of package B, Tetra Brik® Aseptic 200 Edge with Helicap™ 23

3 Result

The results from the test were analysed and some interesting finding occurred.

3.1 Grip force

The grip forces between the individuals were more similar in the group of children compared to the adults group. The average values of the groups show that the adults are stronger in their hands than the children. It is still impossible to draw any general conclusions from that fact since the differences are too small and the variety in the adult group too big. We can also see that both the maximum and average grip force of the right hand is overlapping between the two groups.

If we compare these groups to the average hand strength of an adult person, that is 370 for the right hand and 326 for the left [13], we can see that both these groups have an average value that is less than half. These numbers come from a study with another instrument called Jamar but the concurrent validity between Jamar and Grippit is very high. [14]. These results agree with the study of rheumatic women made by [4]. In their result they found that women with rheumatic diseases on average had about 30% of the hand force of a healthy woman and that a healthy woman on average has 54% of a healthy man's grip force. They also found that the average value of the grip force in ten seconds was about 70% of the maximum value for the group of rheumatic women. In this study the average value was 80 % of the maximum.

Fig. 3. This figure shows results from the GAT tests. Each vertical line represents a 95 % confidence interval for the average time needed to perform the tests in the different groups.

3.3 Hand size

The palm width measurement shows some overlapping but all measured fingers of the participants in the adult group were longer than the children's. The biggest difference between the groups was the length of the hand.

The length of the hand seems to be the strongest difference concerning the hands of adult people with reduced hand function compared to six years old children.

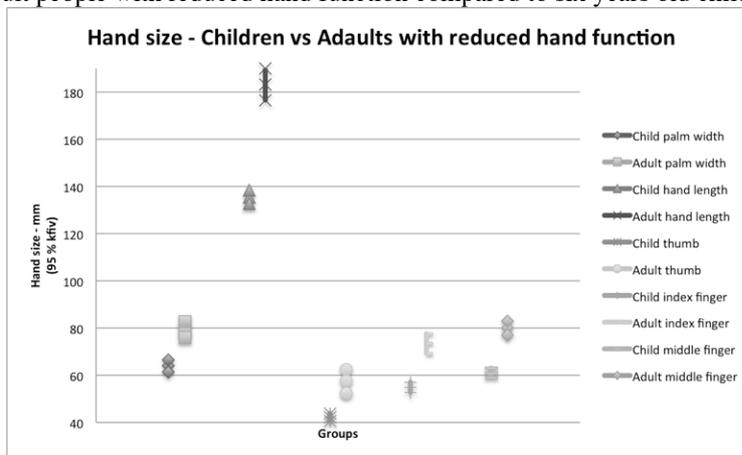


Fig. 3. This figure shows results from the hand size measurements. Each vertical line represents a 95 % confidence interval for the average size of different parts of the hand in the different groups.

2.4 Judging packages

The over all experience from the observation study was that the children judged the packages higher than the adult group in relationship to their success in the opening procedure. Although this differences between the groups we can still see correlating results. The difference in the average values of the judging of the packages was A:0,56, B:0,45 and C:0,33 with an average value of 0,45. A and B was judged higher by the children. C required a lot of force and six children and three adults could not open it at all. Therefor was the average value of opening C lower in the child group.

The two groups were agreeing whether the packages should be approved as easy to open or not. Package A scored 4,36 from the children and 3,8 from the adults. Package B scored 4 from the children and 3,55 from the adults. Both packages scored definitely above 3, the limit to be approved by The Swedish Rheumatism Association [11].

Package C was judged 1,57 in average by the children and 1,9 by the adults which means that they also agreed that this package was to hard to open to be approved.

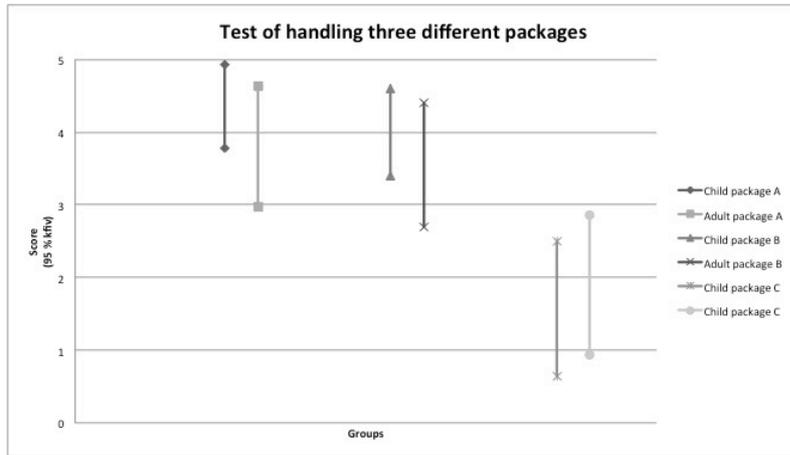


Fig. 3. This figure shows results from opening the three packages. Each vertical line represents a 95 % confidence interval for the average assessed score in the different groups.

If we look at the spread of the judgements in the two groups we can see that the intervals overlap, meaning that adults and children were judging the ease of opening these packages similar.

4 Discussion

These findings could have an impact on how to design products and packages depending if we want to include or exclude the children.

In situations where we aim for Design for All solutions, that includes both people with reduced hand function and children we need to consider that their grip force is less than half of an average adult, that both groups are defined by GAT to have reduced hand function and that the hand size of a six year old child is about 75% of an adult. The design should require less than half of an average adults grip force, don't require complicated coordination skills and be able to handle with different hand sizes.

If you want to exclude the children the safest way, according to this study, is that the product or package requires the larger hand size of an adult person.

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