

Grasps in daily tasks

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Abstract

Activities are done using the hands. With the hand's grasps are performed on objects, grabbing, manipulating, and using them. There are 33 grasps, according to the recent European Grasp Taxonomy. Grasps are the way objects are grabbed, in a secure mode, independent of the position of the wrist, forearm or arm. To better understand the use of the hands and the grasps in the daily activities and relate it with the difficulties identified by the patients, when they have a hand pathology, we need to know in which tasks are they performed. Using a Delphi Panel, composed by 20 Occupational Therapists also Hand Therapist, considerer experts in this area, we collect data, in two rounds. For each one of the 33 grasps was created a question, with some characteristics of the grasp, such as the number of used fingers and the diameter of the grasped object. Experts were asked to identify the tasks where the grasps are used. An image of the grasp was also presented to exemplify. After the language uniformization, the elimination of tasks that doesn't complied with the grasp's characteristics and unification of very similar tasks, there were identify tasks used in work, leisure, and self-care activities. For each one of the grasps there were identified at least 13 tasks. It will be easier for therapists to relate the difficulties in the use of the grasps with the performance of activities in daily living.

Keywords— "Occupational Therapy", "Activities of Daily Living", "Grasps"

I. INTRODUCTION

The hand is the way thought witch man can act on objects, on others or communicate. Trough the hands, we can do things that let us be and become. During the day, we perform different activities, and the hands do exquisite and complex movements [1]. To perform these activities, the grip is combined with the application of muscle strength, allowing the manipulation of objects and the performance of daily tasks [2]. During these activities, several grasps are performed, with different configurations, strengths, and sensitivities, on several types of objects. The fingers are used as vectors of strength, and they can act as an all or combine with each other, in different numbers, to make a specific hand grasp configuration. The understanding of those configurations, and their use in daily tasks, can be relevant for occupational therapists, to relate the difficulties identify by the patients in the performing of these tasks, when they have a hand pathology.

The position in which an object can be grabbed, safely with one hand, without concern the hand position, is known as a grasp [3]. Most of the tasks, in the activities of daily living, require the grasp of an object, with the hand, in a stable way [4]. There are two basic types of grasps: the strength grasp, in which some of the fingers bend over the palm of the hand. In this grasp the thumb is always involved, and it can be done with three to five fingers; and the precision grasp, where the approach is to use the thumb and the forefinger to grab the object between them [3]. The estimated total daily time in which people used their hands, in activities of daily living, is more than five hours, without counting the work and sports activities [5]. If we consider that eight hours per day are spend sleeping, we have only 16 hours to perform activities. We spend approximately eight hour per day at work, so it remains eight hours to make other activities, such as feeding, cleaning, weight hygiene, clothing, house storage or leisure. Regarding that we spend more than five hour per day, using our hands in these activities, we can assume that we do not use the hands in 11 hours per day (eight at sleep and three not using them). In fact, during the sleep we use our hands but most of the time we do it without a meaningful purpose. So, we spend 55% of the day, around 13 hours, performing activities in which grasps are made with one or two hands, and used in professional, leisure or selfcare activities. Regarding the feeding and leisure activities, hands are used for more than an hour per day, being booth hands needed during most of the time [5].

In 2016, Thomas Feix, lead a team that made a systematic review of the existent grasp's taxonomies. This study was ordered by the European Economic Community, that identified the need to have a common taxonomy that can be used in different domains, within Europe [5]. There were identified 22 taxonomies with a total of 211 grasps configurations. After the analyse and exclusion of the similar and repeated ones, the authors identified 33 different grasps [5]. They were organized into groups, according to the position of the thumb in the moment of the grasp (adduction/abduction), the hand contact surface with the object (palmar, lateral and pad) the number of fingers involved (from two to five), the strength applied on the object (power, intermediate, precision) as well as the diameter of the objects that are being grabbed [5]. So, a new taxonomy, the Grasp Taxonomy, was organized to be used in Europe, in the field of health sciences, mould industry, cloth and many others.

There are several studies regarding the analysis of grasps, their strength, or the manipulative capacity of the hands [2], but few relates the grasp configuration with the different tasks of the daily living activities. The need

to relate the configuration of the grasps, with the tasks in which they are performed is priority for Occupational Therapists and Hand Therapists. The more we understand the grasps and their use in the tasks, more the treatment can be focused in the real performance, and the outcomes can be improved.

This study aims to identify the tasks where with one of the 33 hand grasps configurations, of the Grasp Taxonomy, are performed during the activities of daily living.

II. METHODOLOGY

Occupational Therapists are experts in the identification of the different types of grasps used in the daily tasks. A Delphi Panel composed by 20 Occupational Therapists, with the specialization on Hand Therapy, with an academic and 19 practitioners, was implemented. The Delphi Panel methodology, allows to implement a scientific method for achieved expert consensus, thought a structured process used to collect knowledge thought a qualitative and quantitative analysis, and follow-up using a series of surveys until an accord is established and summarized [6, 7]. The advantages of the Delphi method include anonymity [8, 9] and the capability of achieving consensus when uncertainty may exist due to the inevitable lack of complete and definitive evidence [10, 11]. A questionnaire with 33 questions, one for which type of grasp, was developed. Each question refers the diameter of the grabbed object, has an image of the grasp configuration and an example of a task performed with it. The questions used were similar in all the questionnaire: "In what daily tasks do you identify that this grasp can be used grabbing an object is 6 to 7 cm of diameter?"

The questionnaire was sent to the experts, thought a link, and data, regarding their answers, was collected. The analyse of the answers, was made, using the webQDA[®] software. First, the similar and repeated answers were maintained. All the single answers (answers referred by one or two of the experts), were disregarded. The similar answers were selected and rewrite in the same way. The uniformization of the words was made. Some of the participants used "grab", "catch" or "hold" and the chosen term was "Grab". In the end there were lists with different tasks for which one of the grasps configurations. After gathering all the answers and apply these "filters", the second Delphi Panel was implemented. As in the first one, but with all the tasks listed, the experts were asked if they agree or not with it. They also can identify the tasks they do not agree and add some more they recall.

III. DISCUSSION

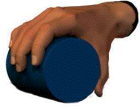

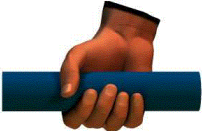

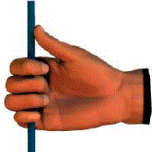


In the first Delphi Panel, the experts identified most of the tasks but some of them did not match the diameter of the objects in 12 (36,3%) of the grasps. Eight of the experts (40%), also indicated the activities instead of the tasks, such as coke a meal, bake a cake, drive a car, brush the teeth. These were disregard, because in these activities several types of grasps are performed. Also, the tasks that did not match the diameter described in the question, were disregarded. The designations were other issue since different types of words were used for the same objects such as box of cereals and package of cereals. In these cases, the use of the words was uniformized, and only one of them was selected to be used. All the tasks were collect in a text, for each grasp. In the second phase of the Delphi Panel, on 12 (36,3%) of the grasps, the expert identified tasks they do not agree with. On 19 (57,5%) of the grasps they identified new tasks. The Parallel Extension and the Lateral Tripod configurations receive the higher numbers of "Do not Agree" and consequent higher number of new suggestions of tasks. The configurations Small Diameter, Light Tool, Precision Sphere and the Tripod Variation received some suggestions to remove some of the tasks and had others. In the end all the grasps have the minimum of 13 tasks for each one. These tasks can be performed in the daily living activities related with work, leisure, or self-care. Some can be used in more than one type of activity. For instance: the grasp of the comb can be used in a self-care activity or in a professional activity such as hairdresser; to grab the oars from a canoe, can be performed as a leisure activity, or in a professional canoeing sport activity; to grab a microphone, can be performed in a group of friends, in the Karaoke leisure session, or by a professional singer.

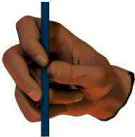








Different grasps can be used in the same task depending on the diameter of the grabbed object. For example, to grab a bottle of water it can be used the Large Diameter grasp configuration, for the 1,5l bottle, the Medium Grasp, for the 0,33l or the 0,25l, and the Ring configuration for all of them.











Regarding the dominance, the use of the right or left hand during the task, wasn't analyzed. Also, the use of one or both hands in the performance of the tasks, even with different grasps, was also not analyzed.








As a result of this Delphi Panel, for which one of the 33 grasps configurations were identified several tasks where the specific grasp is used (Table 1).

TABLE I
TASKS IDENTIFIED IN THE PERFORMANCE OF THE DIFFERENT GRASPS

Grasp Configuration and Name	Object Diameter	Number of strength vectors	Tasks where the grasp is used
 Larger Diameter	6-7	2-5	Grab a glass, your phone, a pack of napkins, a large piece of fruit, a hair dryer, a ball, a 1.5l bottle, a 1l bottle, a 0.75l bottle of wine, a pack, a soda can, a jar, a packet of cereal, a can, cylindrical large vegetables, the stair rail, a bottle, a shampoo pack, a pack of shower gel, a roll of toilet paper, the car side mirror, a packet of rice, a stick, the alarm clock, a bowl.
 Small Diameter	1-3	2-5	Grab a broom, a mop, the shower, the hair brush, the handle of the shopping cart, the handle of the stroller, the handle of the door, the handle of the toothbrush, a fan, a stapler, a rope, the oars from a canoe, the handlebar of the bike, the handlebar of the scooter, the cable of the beach sun hat, a hose, the wooden spoon, the dough roll, the handle of a window, a leaf saw, the handle of the hammer, the handle of the suitcase, the handle of the shopping basket, the steering wheel of the car, the handle of the knife, the dog's leash, a tool, a make-up brush, a candle, a walker, a microphone.
 Medium Wrap	4-6	2-5	Grab a carrot, the cable of the vacuum cleaner, the diesel fuel pistol, a tennis racket, the steering wheel of the car, the iron, the handle of a suitcase, the dog's leash, a banana, the handle of the knife, the handle of the hoe, the handle of the frying pan, the handle of the broom, a drill, the hammer handle, a peeler, the handle of a door, the handle of a window, the handle of the bucket, the rod from the public transports, a screwdriver, the handle of the shovel or pick, the shower, the remote control of the television, an electrical screwdriver, the handle of the refrigerator door, a cane, the car speed handle, a gym alter, a piece of clothing to twist, a liquid yogurt, a walker, a microphone, a wheelbarrow.
 Adducted Thumb	2-5	2-5	Grab the phone, the rod of public transport, the command of the television, a tray, the handle of a knife, the tennis racket, the baby's egg, the gas gun, the dog's leash, a snooker cue or billiards, the handle of a suitcase, the paint roller, the handle of the frying pan, a landline, the steering wheel of the car, a banana, a handle of a briefcase, the handle of the vacuum cleaner, a book, a tablet, the handle of a shopping basket, the handle of the rain hat, the handle of the bike, the handle of a door, the handle of a window, the controls of a console, the hammer handle, a stapler, a fan, a microphone.
 Light Tool	2-3	2-5	Grab a coffee spoon, a screwdriver, the eye mascara, a tip to break a brick, the handle of the toothbrush, the glasses by the rod, a dent, a book, a cutlery, the wing of a cup, the phone, the phone, a tweezer, the wings of a bag, a pen, the pencil from the eyes, a comb, a pack, the wing of a mug, the handle of a drawer, a pencil, a snooker cue or billiards, a screwdriver, a drill, a pointer to teach.
 Prismatic 4 Fingers	2-4	2-5	Grab a rubber, a comb, a straw, a fork, a tube, a small book, a small sugar pack (7gr), a nail, a teaspoon or coffee, tweezers, a rubber, a nail polisher brush, a screw, the glasses by the rod, a nail cutter, a bundle of sheets of paper, a pen, a pencil, a screwdriver, the wing of a cup, a brush, a pen, the bow of the violin, a magazine, the eye mascara.
 Prismatic 3 Fingers	1-3	2-4	Grab a straw, a tube, glasses, a plate, a lipstick, a notebook, a coin holder, a screw, a book, an eye mascara, the handle from a drawer, a piece of clothing, a screwdriver, a bundle of sheets of paper, a notepad, the chopsticks of sushi, a coffee spoon, the phone, a pen, a pencil, a small pack, a CD, a spring of clothes, a platter, a mobile pen, a matchbox, the wing of

			a tea, the handle of a knife, a wooden spoon, the nail polish, a packet of small sugar (7gr.), a nail cutter.
 Prismatic 2 Fingers	1-2	2-3	Grab a pencil, a pen, a book, a screw, a screwdriver, a hair band, a spring of clothing, a nail clipper, a plate, the eye mascara, a wallet mirror, a coin holder, the trouser belt, a cotton swab, a notepad, a straw, a small sugar pack (7gr), a piece of clothing, a ring, a tablespoon, a cup of coffee, a notebook, a watch, a nail, a tint of hair, the cutlery, the car key, a pen, a cup of a tray, a mobile pen, a lipstick, a cotton makeup remover, a coffee spoon, a small package, a key chain, a mug, the cell phone, a large chalk, the handle of a drawer, a CD.
 Palmar Pinch	1-2	2	Grab a chalk tip for fabric, a screw, a nail, a coffee spoon, a packet of sugar (7gr), a ring, the earrings, the SIM card from the phone, a card, a bundle of sheets of paper, a button, a needle, a coin, a piece of clothing, the phone, a saucer, a shoelace, the deck of cards, a tweezer, a sawblade, a wad of notes, a headset, glasses, clips, a droplet sitter, a notebook, a sauce of sheets of paper, the clasp of the pants, a key.
 Power Disk	6-10	2-5	Grab the lid of a bottle, an ashtray, a can, a pliers, a box, a scissor, the phone, an alarm clock, a pruning scissors, a ball, a pack, a tablet, the paint gun, a paint can, a refractory brick, a candle, a saucer, a packet of cereal, a round pack, a small plate, the lid of a tupperware, a wallet, a stapler, a sponge.
 Power Sphere	3-6	2-5	Grab the car speed handle, a gaming joystick, an anti-stress ball, a round box, a piece of fruit, a lamp, a ball, the bath sponge, a horn, a cup, the round handle of a door, a tap, a round vegetable, a tennis ball, an egg, a case, the round cap of a bottle, a small water bottle, the soap, the deodorant, the lid of a pan, the lid of a jar.
 Precision Disk	3-7	2-5	Grab a saucer, the mouse from the laptop, a vegetable, a CD, a bowl, the bath sponge, a pot, a baby under his arms, a cup over the top, a round object, a roll of toilet paper, a soap, a big piece of fruit, a round vegetable, a dog brush, a loaf of bread.
 Precision Sphere	4-5	2-5	Grab the lid of a jar, a ball, a glass, a piece of fruit, a tap, a skein of wool, the gearbox, a bowl, a round perfume bottle, a cake, a biscuit, the round handle of the door, a loaf of bread, a vegetable, a pack, a box, a makeup remover, the button of an appliance, the button of the car's soface.
 Tripod	3	2-3	Grab the lid of a small jar, the oven or the stove button, a faucet, a small jar, a small can, the lid of a jar, a piece of fruit, an egg, a case, a key chain, the gear handle, the handle of the blinkers, the glasses, a vegetable, a ping-pong ball, the handle of a drawer, a skein of wool, a small box, a ball, a cup, the remote control of the television, the handle of the door, a candy, the watch, a rubber, the buttons of the appliances, a cup of coffee, a candle.
 Fixed Hook	1-2	2-5	Grab a mason's cutlery, a lady fanny pack, the wing of the watering can, the tape from the blind, the window handle, the handled of the door, the wooden spoon, the magic wand, the shower, a book by the spine, the handle of a briefcase, a shopping bag, the rod of public transport, a coffee maker, a vaporizer, the iron, the handle of a knife, a wallet, a lady's purse, the handle of a suitcase, the wing of a claw.
 Lateral	1-2	2	Grab an ATM card, a saucer, a rug, the lugs at the supermarket, a sheet of paper, a button, documents, a needle, a CD, a mobile pen, a coin, a hexagonal nut, a book, a notepad, a screw, a card, a rubber, a key, notes, a tube of toothpaste, a hook, a nail file, a clip, a torx type key.

 <p>Index Finger Extension</p>	3-5	3-5	Grab a comb, a hair brush, a knife, a cigar, a spray, a microphone, a hose, a frame eraser, a screwdriver, a saw, the remote control of the television, the dough-cutting utensil (e.g., patties), a perfume bottle, a saw, a peeler, the handle of a suitcase, the handle of a briefcase, the backpack handle, an opens cans.
 <p>Extension Type</p>	2-5	2-4	Grab a plate, the handle of a folder of documents, the restaurant menu, a tray, a platter, a book, a phone, a beach disc, a board, a cushion, a napkin, individual for the meal, a tablet, the pyrex cover, a table to carry, a pack of notes, a pack of candy, a CD, a laptop, a magazine, a narrow package, a narrow board.
 <p>Distal Type</p>	-	2-5	Grab a stapler, a punch, a tenacious salad, scissors, a pair of pliers, a pruning scissors, a first aid umbu, a rectangular wrapper, a tube, a cell phone, a television command, the viola's arm, a bowl.
 <p>Writing Tripod</p>	0,5 -1	3	Grab the japanese chopsticks, a makeup brush, a wooden spoon, a napkin, a brush, a shell, a book, a tweezers, a cutlery, the nail polish brush, the pen broker, the frame sharpener, a spoon, a slice of pizza, a rubber, a lipstick, the wing of a mug, a wire stick, a mop, the handles of a pan.
 <p>Tripod Variation</p>	1	3-4	Grab a tablet, portable, a book, the handle of a briefcase, a fanny pack, a sauce of sheets of paper, a box, a briefcase, file pastes, the honeycomb plate, a straw, a wallet, a notepad, a tray, a pack, a bundle of sheets of paper.
 <p>Parallel Extension</p>	2-3	2-5	Grab a book, a pack of tissues, a fan, a matchbox, a wallet, a notepad, a laptop charger, a tablet, a television remote control, a computer, a small package, an eye mascara, a comb, the nail polish, the back of a chair, a tray, the viola's arm, a bundle of sheets of paper.
 <p>Adduction Grip</p>	1	2	Grab a needle, a straw, a toothpick, the individual tea package, a dart, a screw, a lady pin, a nail, a sheet of paper, a hairpin, a button, glasses by the stem, a sugar pack (7gr).
 <p>Tip Pinch</p>	0,5-1	2	Grab a tweezer, a button, an eraser, a hook, a spring of clothes, a nail cut, a pencil, a mobile pen, a straw, the eye pencil, a hair spring, a pen, a screw, a coin, a needle, the stem of the glasses, an earring, the clasp of the pants.
 <p>Lateral Tripod</p>	1-2	3	Grab a lid from a container, a rubber, the nail polish cover, a coin, a clip, a comb, a hook, a makeup brush, an eye pencil, a straw, a lipstick, a wipe, salt or other seasonings, a button, the pencil to paint the eyes, an earring, a plug from an appliance .
 <p>Sphere 4 Fingers</p>	3-6	2-4	Grab an egg, a small piece of fruit, a ball, a faucet, a spice jar, the handle of a drawer, the handle of a cabinet, a lid from a jar, a pack, a vegetable, the lid of a billet, the lid of a crystal bottle, a golf ball, the lid of a container, the lid of a pot, a round jar, a button, the lid of a jar, a ball cap.

 Quadpad	2-3	2-4	Grab a piece of fruit, a ball, the gear handle, the water bottle stopper, the microwave button, the door handle, the lid of a jar, a round faucet, the container lid, the stove button, a baby milk bottle, the computer mouse, a round key holder, a can, a lamp, a glass, a jar of spices, an egg, a make-up sponge, the glasses by the hoops, a joystick, a cake or biscuit, a plug from an appliance.
 Sphere 3 Fingers	1-6	2-3	Grab a piece of fruit, a ball, the gear handle, a pack, the water bottle stopper, the microwave button, the door handle, the lid of a bottle, a round faucet, the container lid, the stove button, the microwave button, a baby milk bottle, the computer mouse, a round key holder, a can, a lamp, a cup.
 Stick	3-4	2	Grab a pointer to teach, the handle of a drawer, a drum stick, a screwdriver, a hair brush, a bundle of sheets of paper, a pencil, a brush, a lighter, a stick, a reco reco, the xylophone sticks, a notebook, the cape of the umbrella, the trouser belt, the zip, a magazine, the phone/tablet charger wire, pompoms, a rock, a maraca, a wooden spoon, a pen, the duster to clear the dust, the eye mascara, the toothbrush cord, percussion instrument sticks, the bow of the violin, the laces of the sneakers, a makeup brush, a key.
 Palmar	1-4	2-5	Grab the handlebar of the bike, the handlebar of the scooter, a pen, a bundle of sheets of paper, a chair, the tamp of the tupperware, the handle of a brush, a plate, a tray, a thin cover, the handle of a paste, a brush, a wallet, a platter, a beach disc, a tablet, a fan, the toothbrush handle, a shopping bag, the handle of a drawer, the handle of a door, a book, a piece of clothing by the goal, a toothpaste.
 Ring	3-8	2	Grab a rolled-up face towel, a deck of cards, a pack, a case of the glasses, a mug, a cup, a piece of fruit, a shoebox, a hole punch, a bulb, a jar, a cake, a carcass, the school case, a ball, a lady's purse, a can, a bivalve to eat, a carcass, a box, a jar, a stapler, a cup of coffee, the dough roll, a baby, a round pack, a berlin ball, a pine cone, a wooden roll.
 Ventral	1-2	2	Grab the hair brush, a wooden spoon, a pointer to teach, a bundle of sheets of paper, a tablet, a jump rope, a spring of cloth, a book, the handle of a suitcase, the cutlery, a magazine, a pen, a toothpaste, the handle of the brush teeth, a stick, a sheet of paper, a cover, a napkin, a pan by the wings, a brush, the tape from the blind, a toothpaste tube, a notebook, a handle of a folder.
 Inferior Pincer	1-5	2	Grab the cord of the vacuum cleaner, an egg, a can, a piece of fruit, a matchbox, a tobacco pack, a cup of coffee, a bottle, a perfume bottle, a pack of hair lacquer, a hair foam pack, the earrings, a candy, a cake, a ball, a school case, a book, the broom handle, a button, the handles of a suitcase, a glasses box, a tube, a mobile pen, a small pack, a can of spray paint, the nail case, a lady's purse, a wallet, the contact lens box, a wafer, a microscope lamella, a plug from an appliance.

IV. CONCLUSIONS

The identification of several tasks, for which one of the 33 grasps of the Grasp Taxonomy, was possible and will give therapists some specific knowledge in the use of the hand, the number of strength vectors and the diameter of the opening of the hand, during the performance of the tasks on the daily activities. Even for the experts, Occupational Therapists and Hand Therapist, was not easy to identify the tasks associated to each grasp configuration. The relation with the activity, was always present, but an activity can use different grasps, performed on several objects. The diversity and the multiple combinations that can be used to grab an object is very rich and depends on different aspects such as the diameter of the object, its weight, and the person. This leads us to believe that the grasps are not always analyzed by professionals in the context of their use, in their

actual performance context. Thus, training in real context or using tasks with purpose, is essential to improve the provision of care to people with hand pathologies and to ensure a customer-centered approach. More studies should be developed in a larger scale and implementing the organization of the tasks through the major activities such as leisure, self-care, and productivity. The analyses of these tasks with other characteristics of the grasps, such as the thumb positioning, the contact with the hand or the strength, will bring knowledge to health professionals. Regarding the children's it would be interesting to have the analyses of the use of these grasps in their activities, especially in playing. It would also be interesting to have an instrument to assess grasps in actual tasks, giving the professionals real information's.

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