

Children's Climbing Skills

R &T project to identify what products children can climb on and how they use support points while climbing these products - Part 1
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Summary

Children can and will climb on almost anything that attracts them. Falling is therefore one of the major causes of injuries to children. In many standards for products associated with children, for example fairground equipment, the ability to climb is a safety issue that needs to be addressed. Research is required into children's ability to climb a range of products to identify what they can climb and how they use footholds and grip/ grasp when climbing these products in order to keep the standards practical and up-to-date.

This project is the first of two parts and addresses three main areas:

- research on children's ability to climb
- identification of the main criteria that children require for climbing
- a list of recommended climbing situations for the practical tests

Part two will be the practical tests.

Although a lot of research has been done on child development in general, very little is written about their specific climbing skills. Some research has been done on this subject but most with young children 2-4 years old.

Children aged 5-9 years old are being in the risk group of having a falling accident with playground equipment while younger children have more falling accidents with furniture and stairs in the house. Older children do not climb that much anymore and if they climb they are being more careful and calculating. They know what they are doing and because of this they are less interesting for the test.

Young children until the age of 6 still have to learn how to climb and they inevitably will have accidents as a result of unsuccessful attempts. Their motor skills are still developing and of course they lack strength and length to climb on high objects. On the long term they will learn to judge their capacities and accidents will happen less often. For this reason real dangerous and high objects have to be made inaccessible to children who are not yet able to climb them by themselves.

Children aged 6-9 are spending a lot of time at playgrounds playing by their selves without supervision of an adult. They invent their own fantasy games and climbing on all available playground objects is a natural part of it. The playing house will be as easily a castle, a boat or a watchtower. In the heat of the game they have to concentrate on a lot of things at the same time. Not all children will be capable to do this faultlessly. Every playground having at least one climbing frame, it is not surprising that children have a lot of falling accidents at this age.

Children aged 10-14 mostly prefer real sports games like soccer and basketball. They are able to learn techniques and start to understand tactics. Simple climbing exercises are not interesting enough anymore. They need more challenge to keep them from getting bored. Climbing activities for this age group are: sports climbing on a professional climbing wall, rock climbing, climbing on self built rope bridges and networks, climbing on a roof to get a ball or something else that flew up.

Good climbers can be recognised when they are still young. They move very easy and relaxed, can look around and concentrate on a lot of things at the same time while climbing, take alternating steps, do not necessarily stay close to the object, they like to climb, choose automatically the best climbing technique for each object. Six year old children have already developed the basic motor skills

needed for climbing. Only 1/3 being talent and 2/3 exercise it is very worth full to allow young children to experiment with climbing on different objects instead of. This is also a plea for good gymnastics lessons and more space outside for children to play physical games. By doing this bad climbers can upgrade their climbing level and become at least mediocre climbers.

It has been observed that good climbers tend to be lightly built and strong. A lot of weight seems to hamper their climbing abilities especially if the child is not strong enough to carry his own weight, which is a basic need for climbing. Another stimulating factor for more exercise during their early childhood.

The aspect of fear of heights is a very strong restricting factor which keeps children from being a good climber even if they have the physical qualities to become one. Real fear of heights turns up at the age of 9 or 10. Younger children can sometimes be a bit reluctant and of course there are differences in character which make a child a dare devil or not but this can not be called fear of heights because until this age they do not know exactly what height means.

The criteria important for climbing can be divided in two groups: qualities of the climbing child and qualities of the object to be climbed.

Qualities of children and aspects that can influence their climbing skills (ordered from a lot of influence to less influence):

- dare-devil or not, afraid of heights
- exercise (Is the child playing outside a lot or is it sitting behind the computer most of the time? Is the child going in for a sport, does the child have active parents?)
- motor development (age)
- strength in arms
- weight in combination with strength
- length
- physique (light or heavy built)
- strength in hands
- physical flexibility
- living environment (city child or small village child)
- family members (does the child have older brothers and sisters)
- with or without shoes

Qualities of objects that decide if an object is easy to climb or not are:

- Height until first support point
- Distances between the support points (horizontal and vertical)
- Angle between support points
- The angle of the plane with the support points
- Form of the support points
- Measures of the support points
- Mesh size of a rope net
- Roughness of the material
- Cold or warm material
- Splintering wood
- Height of top of the object (if there are no other support points available)
- Other objects near the climbed object that can be used as support point
- Pattern in support points or chaotic positioning
- Organic formed object or not

Different types of objects ask for different climbing methods. The following types are being observed:

Platforms 	Fences 	Climbing wall 	Vertical positioned clamber frame 	Through a climbing frame 	Real climbing objects without support points 
Wall without support points higher than the climber 	Angled plane with rope 	Angled plane with little support points 	Rope network 	Angled clamber frame 	Irregular shaped objects 

The different types of climbing and the matching products for different age groups:

1-3 years	products
successive platforms	stairs in the house, stairs of a slide.
platform	highchair, normal chair, cupboard, table
wire fence, fence with rails	baby crib
irregular shaped objects	baby module blocks, mattress, pillows, boulders
angled plane with little support points	sliding side of small slide

4-6 years	products
through a climbing frame	Clamber frame with irregular placed steps, hoops and sticks, playground climbing frame
wire fence	fence around school
angled plane with little support	sliding side of small slide
rope network angled or horizontal	rope pyramid
climbing wall (angled)	playground climbing wall
platform	table, climbing frame

7-9 years	products
angled climbing frame bottom side	clamber frame at school
through a climbing frame	large playground climbing frame with irregular placed steps, hoops and sticks.
irregular shaped object	tree
wall without support points higher than the climber	wall/ fence
climbing wall	sports climbing wall
angled plane with little support points	sliding side of big slide thick mattress against clamber frame
rope network	rope network rope bridge
rope	swinging rope, tree

10-14 years	products
irregular shaped object	tree
rope	drainpipe, tree, rope
wall without support points higher than the climber	high fence or wall
climbing wall	professional climbing wall
platform	bike shed
rope network	big rope pyramid, Van Schelde moving climbing net

It is recommended to that the climbing object types mentioned in the tables above are part of the practical tests in the second part of this project.

2 Introduction

2.1 *Background*

Children can and will climb on almost anything that attracts them. Falling is therefore one of the major causes of injuries to children. In many standards for products associated with children, for example fairground equipment, the ability to climb is a safety issue that needs to be addressed. Few studies on children's ability to climb fences and barriers have been conducted. However it is known that children of 30 months can climb a fence 1 metre high. Research is required into children's ability to climb a range of products to identify what they can climb and how they use footholds and grip/grasp when climbing these products. With this information it will be easier for consumer representatives to argue for appropriate requirements in standards.

2.2 *Purpose of the project*

This research project is the first of two parts. Objective of part 1 is: Examining the climbing skills of children in the age group 0-14 years. How do they develop their climbing skills and which qualities and aspects are influencing the development. What supports do children need in climbing on and over objects and what climbing situations do occur very often, are dangerous or are simply challenging and attractive to children and therefore a good choice as climbing situation in the practical test.

The possibility to change an object in order to create different levels of difficulty is an important aspect in choosing the right test objects as well.

The result is a list of criteria that children require for climbing, a priority list of climbing situations and further recommendations for the planning of the practical tests in part 2.

A climbing situation will contain information about the age of the child, a description of the object to be climbed on, including the aspects to be measured and the specific supports a child will use when climbing this object.

2.3 *Scope*

The project focuses on the climbing skills of children aged 0 to 14 years. The products addressed are all products children of these age come into contact with. These are usually both so called children products (highchairs, playground equipment) and other products like chairs and tables.

2.4 *Definitions*

Climbing

With climbing you have to make your own support points in order to move in a certain direction (not necessarily upwards). Climbing in ropes, trees or lamp-posts are therefore examples of real climbing.

Clambering

You use the support points on an object to move in a certain direction (not necessarily upwards). Clambering can be done on steps, climbing walls, rocks and most playground objects. The climbing method will be adapted to the possibilities an object is offering.

Despite these definitions, in this report the word climbing will be used for both clambering and climbing. Most people do not know the difference (even

gymnastic teachers could not exactly describe their meaning) between these words and climbing is mostly used in everyday life. People think climbing has to do with getting higher and clambering can be done on the same level. This is not true but to avoid misunderstandings climbing will be used for both situations.

3 **Methods**

This study on children's climbing skills is focusing on the following questions:

children's ability to climb

- How do children develop their climbing skills?
- What qualities make a child a good climber?
- What age groups are suitable for testing the climbing abilities of children?

objects attractive for climbing

- What objects are attractive for children of different ages to climb on and over.
- What makes these objects so attractive for climbing?

supports and methods used for climbing

- What supports do children use for climbing?
- What methods do children use when climbing different objects?

designing, developing and buying children's products

- What information and criteria are important for designing, developing and choosing new playground/ school products?

In order to answer these questions three different research methods have been used:

3.1 *Literature research*

To gather information about the research which has already been done on the subject of climbing skills of children several different sources have been studied: the internet, Medline database (10 interesting articles found), books from the university library, video data from a research project on 9 year old children climbing a specific climbing frame, the NEN standards, accident figures from the Consumer Safety Institute, a recent research project of Consumer Safety Institute on how to measure if an object is suitable for climbing.

The literature study resulted in a temporary list of criteria which might be of importance for the climbing skills of children and the climbability of children's products.

3.2 *Expert interviews*

Different experts on children's climbing abilities have been interviewed. See appendix G: questionnaires for some example lists with questions and appendix H for the experts being interviewed.

3.3 *Field research*

Several observations of children in their playing environment have been carried out to get an idea of their climbing habits and preferences. On an observation list some qualities of several children have been written down together with their motor skills and their preferences for certain objects. Climbing methods have been observed and recorded in pictures.

With the gathered information the criteria that children require for climbing have been listed and recommendations for the practical tests in part two are given.

4 Literature research

4.1 *Method*

Bearing the eight questions, mentioned in chapter 3, in mind there has been searched for interesting literature on different subjects concerning climbing children; which research projects on climbing skills of children have been carried out already and are they containing interesting information for this new project? A lot has been written about child development and the development of their motor skills. The library of the Technical University in Delft stores a lot of child data which might come in handy in part 2 of this project. Some articles in the magazine "Richting SportGericht" about climbing lessons for children aged 4-6 can probably serve as an example for the test-situation in part 2 of this project. See Appendix A for a complete list of the literature being used.

4.2 *Accident figures*

In the Netherlands a large amount of First Aid treatments of children occur after an accident with a climbing frame (4000 per year) or a slide (2.700). Boys have as many accidents as girls. Children in the age group of 5–9 are running the most risk of having accidents with playground equipment (50 % of all First Aid Treatments). Children under 5 years are having 25 % of the accidents. Most accidents are falling accidents (66%). Children fall from a height, or fall while jumping of a playground object. (2)

Every year about 4400 children in the age of 0-14 years are being treated at a First Aid ward at the hospital after having had a climbing accident. Most of these children are between 5 and 10 years old (62%, 2800). Most climbing accidents occur at playgrounds (40%, 1800), at the school playground (16%, 720) and in the house (6%, 250). Almost 80% of these children (78%, 3500) fell of a climbing frame. Other objects where children fell from or out were: trees (3%, 110), sitting furniture (2%, 80) or fences (1%, 50).

The percentage of the children who had a fracture (most of the time arm, wrist or shoulder fractures) as a result of the climbing accident is 40%. 11% of the children had to be admitted at the hospital. Climbing accidents seem to be relatively severe accidents. (see appendix C)

Drowning is among the leading causes of accidental death for children under five years of age. Fences and walls are not effective enough in preventing the children from these accidents.

4.3 *Reasons for climbing*

Most research on climbing skills has been done with children of 2-4 years old. This reason for this is the higher risk on accidents like drowning, falling and being strangled.

Little children do not yet see the consequences of climbing on or over an object. They climb on an object just because they have an intrinsic need to explore their surroundings and develop their motor skills in every possible way.

Other reasons why children want to climb on everything they come into contact with are; wanting to show off, practising their motor skills, wanting to be on the other side of an object, copying behaviour of older children, and of course the excitement of being on top of a high object attracts them. Climbing fits into all kind of fantasy games.

4.4 *Development of climbing skills*

A baby starts crawling after about 6 months. On hands and knees it will be able to climb a small grass hill in the playground yard. A toddler of 1 year old starts to pull himself up on table edges, knees and trousers of parents, and the edge of the crib. From these age children start practising their climbing skills. (18)

On the average children start walking after 13 months. A four year old child can walk like an adult. At six year most children can perform the basic motor skill tasks on the level of an adult. Before this age large differences in motor skills can be observed. (17)

Until the age of 4 boys and girls do not show significant differences in climbing skills. (3) After this age the boys are developing more strength in their body parts than girls.

Anthropometric measures of children can strongly extend the age groups. A 4 year old child can be longer than a 6 year old child. Therefore it can be interesting to divide children in groups, using physical qualities like length. (17)

4.5 *Age groups*

How to divide children into age groups

Different strategies can be found in the examined literature and in practise.

- Het speelgoedboek (20) - infant 0-6 months, baby: 6 –12 months, old baby: 1 year, toddler: 2 years, toddler: 3 years, toddler: 4 years, toddler: 5-6 years, primary school (middle group): 7-8 years, primary school (oldest group) : 9-12 years.
- Consumer Safety Institute - Decree Safety of attraction- and playground equipment 5 years into operation (26) - 0-4 years, 5-9 years, 10-12 years, 13-14 years.
- Child development (17) - range 2-13 years, each group 1 year.
- Young children's ability to climb fences (5) - 24-36 months, 36-42 months, 42-48 months.
- Age side height and spindle shape of the crib in climbing over the side (3) - range 13-36 months, each group 2 months.
- School system the Netherlands - Child Day Care: 0-4 years, Preschool: 4-6, primary school (young): 6-9 years, primary school (older):9-12, highschool:12-14 years.

The age groups in the "Speelgoedboek" (20) are based on the social and motor skills development of children and should therefore be a good choice for a research project on climbing skills. Children at the age of 5-6 and 7-8 do play different games then the older children in age group 9-12. At the age of 6 or 7 children are playing more fantasy games, while children of 9-12 years old prefer action games. Children aged 12-14 years form a special group. One could question their liking of climbing. They are becoming adolescents and they have better things to do. They start using the climbing frame as a place where they can hang about while talking to each other.

Because the children on day care often have mixed groups with children in the age of 0-4 years it could also be an option to put the children aged 1-4 into one age group because they often come into contact with the same toys, furniture and playground objects.

The playground equipment standard (NEN-EN 1176-1 (29)) is stating that it should be prevented that children under three years old can climb a playground

object on their own. Designers of playground equipment should know what children under 3 years can climb and what not. Taking this into account dividing the younger children (1-4) into 2 groups; 1-2 and 3-4 years old, might be the best option.

4.6 *Children's qualities and measures (good and bad climbers)*

Steenbekkers' book on child development, design implications and accident prevention (17) contains a lot of measures of children. Some of these measures might be important for the climbing skills of children.

Research has been done on climbing skills of young children (age 1-3 years) in climbing out of cribs. In this case age and length of the child were not found to be the main qualities of children for being successful climbers. (2,3)

Physical qualities of children do play an important role in their ability to climb. A longer child will of course be able to climb higher objects than a smaller child. Also weight, leg length, arm length until grip point of the hand, vertical length until grip point hand, height difference while jumping and step height. (11) (see appendix D – Child Data, for the values of the factors mentioned above.) Strength in the arms of children is important as well. This will decide if a child is able to pull or push himself up. And of course the measures of hand and foot have to fit the supports.

Clothes and shoes in general do not influence the climbing skills of children. Cords on clothes, loose scarves, long hair and large inflexible shoes however can cause serious accidents when they get stuck in small openings. Falling children can hang themselves or get injured when this happens on high objects.(11)

The character of the child is also important for becoming a good or a bad climber. Very active, adventure loving children are found to be better climbers than are the more quiet children. This factor seems to be even more influencing than age. The playground equipment standard is stating that it should be prevented that children of under three years old can climb a playground object. However in practice children of these age are often found to be able to climb a lot more than designers of playground equipment and playground managers think. (11)

Physical flexibility is thought to play a role as well but this is not examined yet in combination with climbing tasks.

4.7 *Products attractive for climbing*

Children can and will climb on almost everything that attracts them and lies within their ability to climb.

Designers of children's products should be aware of the habit of children always wanting to climb on an object even or especially if this action contains a certain danger which is the case if the object is not meant for climbing. Therefore it should be more appropriate to change the definition of falling height in standardisation into the highest point of the object, disregarding the fact that this is not the highest point meant to be climbed. (11)

Objects mentioned to be climbed by children in a different way than they were built for are: roofs of playing houses, swings with a horizontal bar, combination

climbing frames, safety fences on high platforms, (tunnel)slides, playground objects with other objects standing close. (11)

Other objects which children use for climbing and which have been the subject of a research project are: cribs, fences, shopping carts, swimming pool walls, high chairs, stair guarding. (2,3,4, 8,9)

4.8 *Climbing methods and criteria*

In the NEN standards grasp and grip measures are mentioned as important construction requirements for climbing frames and other playground equipment. Requirements for ladders and stairs are given as well. (28,29) (see appendix D and E for children's measures important for climbing)

Many children in the age group 12,5 to 36,5 months can climb out of cribs with sides of 26 inch (66 cm) high which was at the time of the project the standard in the USA.

All of the children could stand and keep themselves standing holding on to the top bars of the crib. 98 % of the children used the same method for climbing out of the crib; they moved to the corner and pushed themselves up. They put one leg over one of the sides, the other leg following. Not knowing how to climb further down they let themselves fall on the other side. Few children used only one side of the crib to climb over. A possible reason might be that children have more supports within reach in a corner than they have on a straight part of the fence. (2,3)

Young children do not yet see the dangers of climbing onto high objects. When children can distinguish the dangers of heights and their behaviour they will be prepared and accidents will occur less.(11)

A practical test has been done with children within the age of 24 months to 48 months to see what types of fences they could climb. The types of fences put in order from easy to climb to not able to climb(5)

	4 ft (122 cm)	4,5 ft (137 cm)	5 ft (152 cm)
large chain links (2,5 inch)	a lot of children in all age groups can climb this fence	a lot of children in all age groups can climb this fence	a lot of children in all age groups can climb this fence
small chain link (1,25 inch)	a lot of children in all age groups can climb this fence	some children in all age groups can climb this fence	some children in all age groups can climb this fence
picket	a few children (42-48 months) can climb this fence	a few children (42-48 months) can climb this fence	a few children (42-48 months) can climb this fence
stockade	some children (42-48 months) can climb this fence	some children (42-48 months) can climb this fence	not one child can climb this fence
iron	a few children (42-48 months) can climb this fence	not one child can climb this fence	not one child can climb this fence

Conclusion of this test: horizontal supports are making it a lot easier to climb an object taken into account that the horizontal supports are within reach of the child. Children use horizontal top bars to pull themselves up and horizontal supports in between as handgrips and footholds.

Another practical test with children of 42 to 54 months shows the climbing method of these children while climbing a wall, a wall with a ladder frame without horizontal steps, a wall with a pool filter close to the wall (4). (See appendix F for an overview of the all climbing methods that has been observed in the different projects.)

Children will use everything that is standing close to the object they want to climb to reach their goal; the top of the object. (4,11)

Three climbing methods of children on three different types of playground objects are described into detail; a tunnel slide, the roof of a combination climbing object and a climbing frame. An overview of the used support points on the objects is also given. (11) (see for the results appendix F)

A test has been done with children aged 4-6 years to observe their ability to climb stair guarding. Results indicate that the majority of children aged between four and six years can climb onto or over stair guarding unassisted.

Three distinct climbing strategies are observed: the body hoisted in a semi-prone position onto the top of the guarding; the body lifted by arms above the height of the guarding enabling a kneeling position on the top of the guarding; and, the knee bent against the side of the guarding to gain the added height required to make the climb. It was noted that older or taller children tend to rely on height, leg length or both whilst climbing whereas younger children appear to depend more on strength. (8)

The following qualities of a playground object provide the climbability of the object (11):

- The size of a support. A measuring device exists to decide if a support is big enough for a child to stand on with or without other supports.
- The distance between the supports. The bigger the distance between the different support points, the bigger a child must be to be able to climb the object.
- The smoothness of a support. The smoother a support point is, the more difficult for a child to use it as a foot or handhold.

4.9

Source validation

Most anthropometric data are at least 8 years old. This means that they are not very trustworthy anymore. Children have become bigger and longer all over Europe. One can use them but a correction has to be made.

4.10

Conclusions

Most research on climbing skills of children has been done with children under five years old because of the higher risk on deathly accidents like drowning, falling from heights and being strangled after falling.

Not one research project on climbing skills has been carried out with children aged 6-14 years. Only one investigation has been done on a playground where children of all ages were playing.

The following division into age groups will be used for the expert interviews and for the field research:

0-1 years, 1-2 years, 3-4 years, 5-6 years, 7-8 years, 9-12 years, 12-14 years

While observing these groups it will become clear if this choice is best for the practical tests in phase two of the project. It might be better to use large age groups based on the big development changes of children and use their physical qualities to put them into smaller test groups.

The following qualities of a child seem to play a role in their climbing skills: age, length, weight, strength, character, leg length, arm length, grip, grasp, step height, physical flexibility.

Clothes and shoes do not significantly influence their climbing skills. However they can be the cause of severe accidents with climbing children.

The following criteria for climbing have been observed:

- footholds
- handholds
- the smoothness of support points
- horizontal bars, rail, guarding or platforms, are used for pulling up.
- the horizontal and vertical distance between support points]
- the vertical distance from the standing point of the child to a horizontal bar, rail, guarding or platform.

Climbing methods of children can be characterized as follows: The children look for a horizontal bar, rail or something else they can grab. They pull themselves up on the arms while looking for footholds and support points for their hands. While climbing a wall or a fence they sometimes use their knees as well. To come on top of an object they throw one leg over the edge of the horizontal support or they push themselves up until they are able to put one foot next to their hands.

5 Expert interviews

5.1 Method

Some experts on the subject of climbing children have been asked to answer questions about motor development in general and particularly the climbing skills of children. Most interviews have been taken at the working place of the expert. Some experts took the questionnaire home, answered the questions on paper and sent them back.

The questionnaires had different questions adjusted to the expertise of the person being interviewed. See appendix G and H for some example questionnaires and a list of the experts being interviewed.

5.2 Climbing accidents

Most experts agree that children know their bounds. Once they are climbing on a playground object they do not go higher as they dare and as their body allows them. However a critical remark must be made. Children learn by trying and failing attempts are part of this learning process. On the long term they will learn to judge their capacities better and accidents will happen less often. Therefore real dangerous and high objects have to be made inaccessible to children who are not yet able to climb them by themselves.

Accordingly the experts working with young children stress the importance of an older person staying close to the playing children all the time. Children under 3 years do not know the danger of falling of high objects. They simply start climbing and can not predict that the effect of this climbing will be that they have to climb down as well. They have a strong urge to explore and to try new things but they still have to learn by experiencing what is possible and what is not.

Accidents occur on moments that the children are being put onto an object they were not yet able to climb by themselves. When the observers loose their guard for a moment an accident can happen very easily.

The experts agree that children have to learn things by trying as long as the situation is not becoming too unsafe. But there is nothing wrong with learning children they are not allowed to climb on all objects in the room and outside. This is part of the development process as well.



Of a group of baby's climbing on a angled plane about 90 percent has been observed tot turn around with their face to the object, while descending the plane.

Reasons for falling accidents mentioned in the interviews are:

- slipping
- taking other toys or objects while climbing an object
- playing wild games, climbing becomes a less important task and the children will pay less attention to the climbing movements. Balance is lost easily (especially by the children with a weak motor system).
- inciting each other
- pushing and pulling of other children
- failing materials
- construction faults in object

Accidents that have been mentioned are: fall from climbing frame on school playground (broken arm), head got (almost) stuck in climbing frame, small bruises after pushing and pulling each other while climbing the slide. But most of the experts are telling that the amount of accidents happening when they are at guard is really small.



5.3 *Reasons for climbing*

Children climb because they want and almost have to. They have a strong urge to explore everything they come into contact with. They want to push back the lines. This is the natural way children are exercising their motor skills. Kids also like it to be on top of objects because from there they have a good view of their environment and everything that is happening in there. In the interviews a girl is telling that she likes to act like a monkey.

Other reasons for climbing are:

- wanting to get away from other children (while playing games)
- wanting to be on the other side of the object (a fence)
- imitating other children and adults
- looking for a quiet place where no one else can come
- showing-off

This behaviour is the same for some grown-ups. They still can show a strong urge to climb the highest mountain or to be on top of a viewpoint, the Eiffel tower in Paris.

Not all children do have this urge as much as others. Some are being more conservative or they simply are not such good climbers. When you are not so good at something it often gets less attractive. This can easily start a vicious circle: not being a good climber->less fun->less practise->climbing is not getting better->being laughed at->not even trying to climb...



5.4 *Development of climbing skills*

The expert on physical development of young children (quoting Peter Hirtz) distinguishes seven different aspects of coordination development:

- coupling motor skills, the ability to couple movements to one another in order to make a smooth movement pattern.

- movement differentiation or complexity. Young children can not yet make complex or differentiated movements. For instance they can not clap their hands while they are singing a song.
- motor adaptation skills. Children learn to move as adults do at the moment they are able to adapt their movements to an ever changing environment.
- motor reaction skills, the fastness and force of the movement. Young children do not have much strength and they are not yet able to make fast movements.
- Rhythmic of movements
- Movements orientation. Young children are not that good at orientating themselves while they are making movements. Not on their selves or the materials they are handling nor on their environment. Moving with little extra materials, straight up and forward is the most easy way to start with.
- motor balancing skills, balancing (A real important aspect of climbing, there are not so many sports which train this aspect)

These seven aspects are off course closely connected to each other. Once a child is not performing as good as the others on one of the points it probably will fail on the other points as well. But knowing these definitions can help us to recognize the children with an arrears in their motor development. And once we know what the problem is, it will be much easier to give the child the right exercises to improve their motor skills.

Climbing is the ultimate sport for exercising motor skills because all seven aspects are being trained at the same time.

Some general rules for growth and development

- Growth of physical functions and limbs is not happening simultaneous.
- There is a difference between maturation and learning. Maturation is the process of a certain biological system getting ready. Afterwards the child has to learn how to use this system. It is a bit silly to practice ball throwing and catching with a two year old child because his neuron system is not yet ready to do this.
- There are large differences between the growth and development processes of children called inter-individual differences.
- It is possible that a child is a quick walker but a bit late with learning to cycle. These differences are called intra individual differences.
- Growth and development are processes with sudden starts and stops.
- Growth and development start from simple and are growing more and more complex.

Motor skills develop:

- from inside to outside, first the trunk, then the shoulders, arms and at last the hands.
- from top to bottom, arms are getting stronger before the legs do. Small children are using their arms to push themselves up to standing all the time and when young children have to climb up in a rope they tend to use their arms more than their legs whereas using the legs would make it much easier.
- gross to fine. Children start making large movements before they learn to use the fine muscles of for instance their hands. Therefore climbing on a climbing wall is not interesting for kids until they are 6 years old.

The development of the motor skills needed for climbing takes place between 3 and 6 years. After the age of 6 children will grow stronger and longer which can

help them to climb higher on different objects. They also can understand why a certain technique is working better. Now they are ready for sport climbing. The basic skills needed for climbing however will not get much better.

Short summary of the development of climbing skills:

1-1,5 years

Pulling themselves up on rails and edges of furniture, starting to walk, small steps of about 20 cm (stairs and mattress), crawling over small bumps and low obstacles. They do not see any danger and do not yet know what height means.

1,5 – 2,0 years

walking gets better, climbing on a slide and sliding of, more high steps behind each other (foot after foot), step over something, trying to keep their balance, do not yet know their own bounds.

2,0 – 3,0 years

Climbing higher, more balancing, starting to know what is possible and what not and most of all what is allowed. They have little or no fear for heights.

3,0 – 4,0 years

good balance, jumping of objects, hanging on stick, sitting on small object, become a bit frightened sometimes: difference between good and bad climbers becomes bigger. They start to play real games together.

4,0-6,0 years

Children are developing all the seven aspects of their motor skills further. They can walk the stairs alone. Once they are 6 years old most children can move as adults and they are starting to learn more difficult movements like riding on a bicycle with two wheels. Some of these children are able to climb a rope but most can not do this yet.

Parents will often still come with them when they play outside to keep an eye on them.

Until this age there is little difference between boys and girls.

7,0-9,0 years

Children in this age group like to play fantasy games. They play a lot outside the house without someone watching them. They like to climb on playground equipment and are experts at finding new ways to do this. A lot of them can still not climb a rope. Some of them because they are frightened, some of them because they do not understand the technique of using their legs and some of them because they are too heavy and they are not strong enough to carry their own bodyweight. Their body mass is becoming more important for the ability to climb.

At the age of about 9,10 years children start to understand what height means. From this time on some kids can become more scared of heights than they were before. Especially girls can show some regression in climbing skills at this age.

10-14 years

Children of this age are starting to play more sport games like soccer and hockey. Puberty will start around the age of 12 and this will change a lot in the lives of the children. Some of them will have to get used to their new body forms and will become averse to physical movement. Differences between boys and girls are becoming bigger. Boys are getting stronger.

As adolescents the children will climb a climbing frame or other objects but they do not play on it, they use it as a place where they can sit and look over the area

while talking to each other. The change that they will fall from the object is therefore very small.

5.5 *Children's qualities and measures (good and bad climbers)*

The following qualities are mentioned by all the experts as playing a role in the development of climbing skills:

- exercise (Is the child playing outside a lot or is it sitting behind the computer most of the time? Is the child going in for a sport, does the child have active parents?)
- dare devil or not
- strength in arms and legs (arm muscles are more important than legs)
- Body structure (light or heavy built)
- weight
- age
- living environment (city child or small village child)
- family members (does the child have older brothers and sisters)
- If a child is becoming a good or a bad climber is caused by talent (1/3) and by the environment they live in (2/3).

Less important are: length, measures of hands, feet, legs and arms, clothes.

5.6 *Attractive climbing objects*

0-1 year

At home: stairs, baby crib, mattress, pillow, soft baby module blocks

Outside: small slopes in the grass, crawling tunnel, benches

1-3 years

At home: stairs, stair-guarding, chair, table, cupboard, bench, bed (every object in the house)

Outside: playing house, low climbing module blocks, lower part of a climbing net, low fences of wood, baby slide, swing, fences up to 1 meter

4-6 years

At home: stairs, playing house (the roof), climbing net, roof of the bike shed,

Outside: trees, boulders, fences, swing, slide (both sides), climbing frame,

At school: clamber frame in all positions, thick safety mattress standing upright against the clamber frame with rope,

7-8 years

Outside: trees, all kind of playground equipment, the roof of a playing house, roof of the bike shed, walls and fences

At school or inside: thick safety mattress standing upright against the clamber frame without rope, professional climbing walls

9-10 years

Outside: trees, all kind of playground equipment, scouting bridges and survival climbing situations, roof of houses along the rain pipe (to get a ball), bus stop, high walls and fences

Inside: thick safety mattress standing upright against the clamber frame without rope, professional climbing walls,

11-12 years

Outside: climbing in the mountains, high climbing objects on a playground (highest parts of a large rope pyramid), long slide with a strong slope, scouting

bridges and survival climbing situations, bus stop, roof of houses along the rain pipe (to get a ball).

Inside: professional climbing walls

13-14 years

Outside: climbing in the mountains

Inside: professional climbing walls

5.7 *Climbing methods*

Children use their arms more than their legs. This is not very surprising when you know that the arm muscles are developing before the leg muscles do. Young children of 1,5 years old use their arms to pull themselves up and from these age on they use their arms as the most important tool for climbing. Young children still use their whole body and especially their knees.

Older children climb with only their hands and feet touching the object. Most of the time they use three points to keep their balance while the remaining hand or foot is moving to another support point.

Climbing on a hanging rope asks for another technique. Most children do not know how to use their feet and legs properly. They want to pull themselves up mostly with their arms. Obviously small, strong or thin children are often better at climbing in ropes than the large, weak and thick ones.



5.8 *Inspecting playground equipment*

Playground equipment inspection institutions like the Keurmerkinstituut in the Netherlands will be very content with figures and percentages of children who can climb a certain object and the percentage of children who are not yet able to do this. They prefer data in the following form: 90% of the children of 3 years old can climb a platform of 40 cm high. They also state that the measures mentioned in the standard requirements NEN 1176-1 have become a little bit old fashioned. Children are growing bigger and bigger these days and they are much better climbers than the standard makers thought they would be. An update would be advisable. They are also interested in the distances between the different grip and grab points on an object and the angle between these points. There are a lot of gaps in the standards. For instance the advised height for balustrades is 700 mm. There is no measure for a safe height of the walls of a playing house so most inspectors take the height of a balustrade as minimum height. Unfortunately a wall this high can be easily climbed by most children. A balustrade serves as safety guarding and is not meant to prevent children from climbing over it and therefore it does not have to be that high. Lack of good requirements for walls of playing houses are causing these faults.

The expert on safety of playground equipment wonders why all measures are in mm. Most of these measures are based on old research projects and the preciseness of the measures is a bit overdone. In his opinion measures in cm can be just as effective as long as they are up to date and based on real experience with climbing children.

5.9

Critical remarks

If you want to test what children can climb you will have to give them at least three attempts to do this because some children need a bit more time before they dare to climb on an object. This does not mean the child is not able to climb the object.

Before starting a practical test it is advisable to decide what you exactly want to test.

- Do you want to know what children dare to climb and how in what way nerves influence the climbing skills of children?
- Do you want to examine how children develop their climbing skills?
- Do you want to examine how exercise and environmental aspects influence the development of climbing skills and how much they stipulate if the child becomes a good climber or not?
- Do you want to know how high children will climb when they get the opportunity to climb as high as they can?
- Do you want to know what objects children at a particular age can climb and what object they are not yet able to climb?
- Do you want to know how many children at a certain age can climb a specific object?
- Do you want to know what methods children use while climbing a specific object?

These questions are all very interesting but because it is impossible to test all aspects at the same time choices have to be made. Each question requires a different test situation and plan.

6 Field research

6.1 *Method*

An observation list has been made and four different locations have been visited; two schools, one with a professional climbing wall, a guarded playground and a child day care.

At the schools the purpose was to find out what qualities of children and other aspects play an important role for becoming a good or a bad climber. How do children develop their climbing skills, how can we measure the climbing skills of children, which methods do they use when climbing and which objects are more difficult to climb than others.

The gymnastics teachers of both schools were asked to make a trail with all the climbing objects they could think of, which would challenge the children to climb on and over them.

On the playground climbing and playing children have been observed. A lot of pictures have been made to get an idea of the different climbing situations children come into contact with and which situations are attractive and challenging for which age groups.

The day care offered information about the climbing skills of the youngest children (0-4 years). The children were observed while playing outside with a small slide, a climbing combination which could be changed because it was made of module blocks and a climbing frame with two platforms and a slide attached to it. The observations mainly focused on the way the children were trying to climb on all objects (the methods they were using), the inter-individual differences in motor development and the age at which they were able to climb a specific object.

6.2 *Climbing accidents*

Small children do not yet understand the laws of nature, they try to climb on things of which we can say in the blink of an eye that it is not possible to climb on it. The children will learn by experiencing that it is not working the way they hoped and in some cases this will lead to a kid having a small accident because of his experimental climbing behaviour.

During the observations not one serious accident occurred.

6.3 *Development of climbing skills*

Once they are able to walk children of 1-4 years try to climb on everything they come across.

From the age of 4 to 6 years the motor skills develop very quickly. 6 year old children have reached a stable climbing skills level. They can climb on and over almost everything (except the swinging rope, which requires a special technique and a lot of strength in the legs and arms)

A child of 1,2 years old has been observed to climb on a platform of 30 cm high. After climbing on this object it climbed further to the next platform which was situated 70 cm above ground level. The child followed its way and came to the slide which was very attractive. Next moment it was going down with its head first. A crash into the ground followed but the child was indefatigable, it went for another round!



All children have an inner urge to explore and a conservative inner urge to safety. Most of the time these two are in a state of equilibrium but one of these always dominates a bit. That explains why some children are a bit slower than others in trying new climbing situations. During the observations some of the children are indeed watching the others first before they try to climb on things themselves while most children run to the first object they see and can hardly wait to try the other structures. In the end most of the children have tried all the climbing objects and especially the slower ones can show a lot of progress in the development of their climbing skills.

6.4

Children's qualities and measures (good and bad climbers)

good climbers

Look around often. Can pay attention to other things that happen at the same moment.

Can do things next to climbing, talking, looking, eating, playing a game

Use often two support points only (one hand and one foot) instead of three.

Move with great ease. They rather walk straight over the object without holding their hands if that is possible.

Movements are smooth. They do not stop during climbing. Fast climbers.

bad climbers

Look at their own hands and feet during climbing to control their movements.

Are being absorbed in the act of climbing. Need all their attention to do it.

Use three support points most of the time (two feet and one hand or two hands and one foot).

Stay close to the object they are climbing on.

Stop every time to look for support points or to look downstairs to see how far they have come. Slow climbers.

Choose often without learning the best technique of climbing

Are strong enough to carry their own weight with their arms.

Dare-devils. Are not afraid.

Move in a rhythm

Take alternating steps while climbing

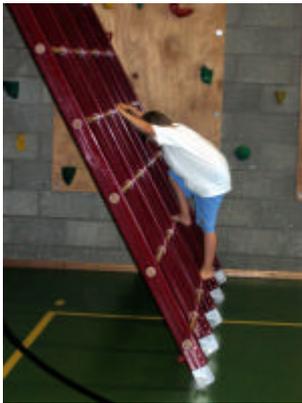
Do not know how to climb the object

Are a bit too fat or too weak to carry their own weight.

Are a bit frightened for heights

Do not move harmoniously.

Put their foot always next to their other foot before climbing to another step.



Bad climber stays close to the object while good climbers climb alternating and move fast and easy

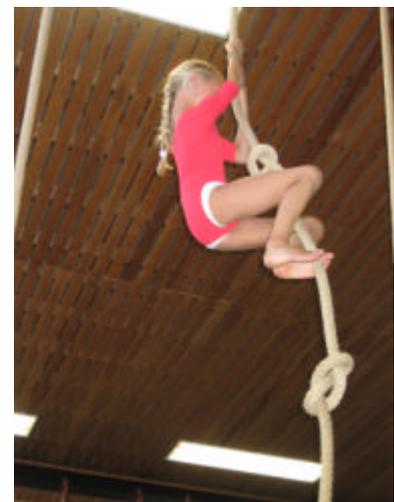
Children good at climbing in ropes are also good climbers on other objects.

6.5 *Attractive climbing objects*

Objects have to challenge the climbing skills of children. Once climbing becomes easy they are getting bored very quickly and they start to look for other options (which might lead to dangerous situations). They start to play games on the objects or they start using them in a way the designer and manufacturer did not think of (They of course tried to think of all those possible situations but children are very inventive in making up new games.).

The thick safety mattress standing before the angled clamber frame, used at one of the visited gymnastic lessons, is very attractive for all age groups. The mattress looks huge as it is standing straight up. Even the oldest children like trying to climb up without using a rope. It is challenging, you end up in a high position and you can slide down again. Soft mattresses are nice to sit on and play with. They give the children the impression that it is less dangerous to climb on it.

Difficult but attractive to children who are not afraid of heights is rope climbing. Rope climbing is one of the few climbing situations for which the children



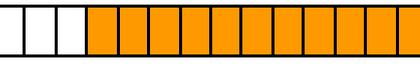
have to create their own support points by using their legs and feet. This technique is very difficult and asks for strong leg and hip muscles. There are some 6 year old children, thin, strong ones, who can do this. Most however find it hard (and scary) to stand on the knot in the first place. In the group of the oldest children (11-12 years old) there are still some children who can not manage to climb in the rope. This is mainly caused by fear of heights. At this age their motor system and muscles in legs and arms should be developed enough to complete this task. Another reason can be thickness. Heavy built children will have to carry more weight and they are less flexible. A last reason for not being able to climb a rope can be because children find it difficult to learn the technique of how to cling the rope between their feet. They are hanging on their arms while they are wrestling with the rope between their feet. Most of the time they have to let go the rope before they can manage to bring the rope into the right position between their feet.

6.6 Climbing methods

Different objects ask for different climbing strategies and for children some objects are easier to climb on than others. Of course the methods used to climb an object can differ slightly for each child but the basic climbing method is implicated by the particular type of object they have to climb. The table below shows a summary of the observed types of climbing objects, the matching age group, the qualities and aspects that are needed to climb this type of object and the aspects that can be measured and differentiated in the practical test. See appendix J for a detailed description of the used climbing methods and some examples of objects of each type.

type of climbing object	age														important aspects for child	important aspects for object
	1	2	3	4	5	6	7	8	9	10	11	12	13	14		
platforms 															<ul style="list-style-type: none"> - Strength in arms - Length 	<ul style="list-style-type: none"> - vertical distance between two successive platforms - size of the platform - Hands have to reach the platform which has to be lower than the child self.
fences 															<ul style="list-style-type: none"> - Strength in arms, legs and hands. - Physical flexibility - Length 	<ul style="list-style-type: none"> - height of the fence - mesh size of the wire frame - distance between rods and pipes (large enough for feet and hands)

<p>Climbing wall</p> 	 <p>5- 14 years</p>	<ul style="list-style-type: none"> - Strength in arms, legs and hands. - Nerves. - Without shoes more feeling with the support points 	<ul style="list-style-type: none"> - horizontal and vertical distances between support points - angle of the wall form and dimensions of the support points
<p>Vertical positioned clamber frame</p> 	 <p>4-9 years</p>	<ul style="list-style-type: none"> - Strength in arms, legs and hands. - Nerves. 	<ul style="list-style-type: none"> - vertical distances between rods - diameter of the rods (grip or grab)
<p>through a climbing frame</p> 	 <p>3-9 years</p>	<ul style="list-style-type: none"> - Strength in arms, legs and hands. - Physical flexibility - Small corps - not being afraid to climb with down in a strange position (head down to the ground for instance) 	<ul style="list-style-type: none"> - horizontal and vertical distances between support points in frame - Chance of head or foot getting stuck. Gaps should be large enough to let these body-parts through.
<p>Wall without support points, higher than the climber</p> 	 <p>8-14 years</p>	<ul style="list-style-type: none"> - Strength in arms - jumping height (strength in legs) - Perseverance - Length - Shoes with tread 	<ul style="list-style-type: none"> - roughness of the surface - height of the top of the object. - thickness of the top (is it possible to sit on it?)
<p>Angled plane with rope</p> 	 <p>4-12 years</p>	<ul style="list-style-type: none"> - Strength in arms, hands - light built - Shoes with tread, or bare feet 	<ul style="list-style-type: none"> - material of the plane - Chance of head or foot getting stuck. Gaps should be large enough to let these body-parts through.

<p>Angled plane with little support points</p> 	 <p>3-14 years</p>	<ul style="list-style-type: none"> - Strength in arms - Perseverance, nerves - Shoes with tread, or bare feet 	<ul style="list-style-type: none"> - angle of plane - form and dimensions of grab points - roughness (material) of plane
<p>Rope network</p> 	 <p>4-14 years</p>	<ul style="list-style-type: none"> - Strength in hands. - Physical flexibility - Not afraid of heights (you can see the ground through the network and this can be scary) 	<ul style="list-style-type: none"> - mesh size - thickness of rope
<p>Angled clamber frame</p> 	 <p>4-9 years</p>	<ul style="list-style-type: none"> - Strength in arms, legs, hands and feet. - Nerves - not being afraid to climb with your head down. 	<ul style="list-style-type: none"> - distances between support points in frame - Chance of head or foot getting stuck. Gaps should be large enough to let these body-parts through.
<p>Real climbing objects without support points</p> 	 <p>6-14 years</p>	<ul style="list-style-type: none"> - Strength in arms, legs and hands. - not afraid of heights - Not too heavy built 	<ul style="list-style-type: none"> - grip of the object - roughness of the material
<p>irregular shaped objects</p> 	 <p>2-14 years</p>	<ul style="list-style-type: none"> - Strength in arms, legs and hands. - Physical flexibility - nerves - not being afraid to climb with down in a strange position (head down to the ground for instance) - inventiveness 	<p>what support points are being used?</p>

7

Discussion

There seems to be a contradiction between the wish to make all objects for children as safe as possible and the wish to make them challenging and good for exercising their strength and motor skills and fun at the same time.

One of the experts gives his solution to this problem: I would advise designers and teachers not to search for challenge in height but to try to make an object on which children can climb, exercise and play without getting high of the ground. I know this is possible from my experience as a gymnastics teacher and especially for young children (4-6 years old) this is a really satisfying solution. Take a clamber frame and make it more attractive and difficult to climb by binding hoops and sticks with rope to the frame. A ribbon can be woven through the frame to indicate a trail which the children have to follow (See appendix K).



Another problem seems to be the unexpected use of objects. Children will climb on the roof of a playing house. They will climb on the sliding side of a slide. So why not change the objects to make this behaviour as safe as possible thought Nijha (manufacturer of playground equipment). They simply started with observing the habits of children while playing on a playground. Afterwards they tried to adjust their equipment to this behaviour. Take for instance the seesaw. A third child was always trying to climb and stand in the middle of it. Nijha made an extra handle in the middle so they could grab it once they were losing balance. On the other side children have to learn that they can not climb on everything they want. Chairs, beds and cupboards and fences are not meant for climbing or playing. We do not have to adjust everything in the house to make it possible for children to climb safely. Specific children's furniture like highchairs might be an exception because it would be a nice exercise for a child to climb his own chair just like the older people do.

8 Conclusions

8.1 *Development of climbing skills*

Once they start walking children start developing their motor skills which are essential for climbing. They learn how to use their arms and legs to move in a coordinated way. Young children have an inner urge to climb and improve their motor skills. They will start doing this without anyone helping or stimulating them with assignments. At the age of 6 most children have the skills to climb as an adult. Children who are good climbers at this age will stay good climbers for the rest of their life. Until the age of 6 children. Children of 6 years old have the same proportions as an adult. But because they are still small and lightly built they are often better climbers than older people. The proportion between weight and strength is an important aspect for climbing.

Exercise and exploring their bounds until this age is very important to improve their climbing skills. Only 1/3 of the climbing skills is provided by talent and 2/3 can be influenced by the environment of the young child. Parents and teachers can for instance stimulate the child to exercise its climbing skills by offering a lot of different objects it is allowed to climb.

Children of 6 years old will grow and get stronger until the age of 18. This will not turn them into better climbers but they can reach higher and will therefore be able to climb higher and more difficult climbing objects than younger children. At this age they need challenging orders to improve their climbing skills. At the age of 10, 11 children are ready to learn more difficult climbing techniques for instance on a sports climbing wall.

When they get older (from about 10 years) fear of heights can become a limiting factor to their climbing ability. Children start to understand the meaning of heights and some will stop climbing at the same high objects they did climb when they were younger.

Puberty can reduce the climbing activities of children aged 12 – 14. At this age they start worrying about the things other people might think about them and a lot of children (especially girls) stop climbing and playing at playgrounds for a while. Instead they start hanging about, talking at each other and looking at the other sexes. They have to get used to their new body forms. This can make them insecure and a bit clumsy.

8.2 *Dividing children into age groups*

The division into age groups being used in the experts interviews and the field research turns out to be too refined for the practical test. Larger age groups will be as effective and they will make the test plan less complicated.

Children under 1 year old are not able to walk and climb. They can of course crawl but only after starting to pull themselves up by grabbing for instance the edge of a couch, they can really try to climb on things. Therefore it will be advised not to include children of under 1 year in the practical test.

It is recommended to divide the children into the following age groups: 1-3 years, 4-6 years, 7-9 years and 10 – 14 years. Age has been found out (interviews and field research) not to be the main distinctive factor for being a good or a bad climber, but because of the large physical and motor differences between very young children and the older ones groups are necessary to prevent the older children of getting bored in an early stage of the test. Very young children are growing faster than the older ones. Differences in physical qualities and motor skills are larger. To get a good picture of the development of their climbing skills small age groups are advisable. Until 3 years the children are not able to climb on

most large playground equipment. Children of 4 years old are starting to see cause and effect and they are able to keep their balance. 4-6 year old children are developing their motor skills until they are on adult level, and children aged 7-14 are gaining more length, weight and strength and become the climbers they will be for the rest of their life.

Children in the age groups 1-4 and 5-9 are having most falling accidents. The following aspects are probably influencing these figures:

- Children of under 3 year do not see danger of heights.
- Children aged 1-6 are still practicing their climbing skills. They can fall from an object very easily when they are playing games at the same time.
- Children in the age 6-9 are playing outside a lot without adults keeping an eye on them.

If the practical test is becoming to large to handle, it might be an option to concentrate on the age group 1-9 years and leave 10-14 out of it.

Causes of accidents of climbing children: from interviews and the accident figures of Injury Information System of the Consumer Safety Institute.

- Pushing and pulling at each other
- Taking toys with them while climbing on an object
- Lifting children to a position on an object which they can not climb by themselves
- Not recognizing danger of height
- Showing-off
- Inferior materials
- Fault in design of the object
- Playing wild games and climbing at the same time
- Tripping or sliding from object
- Climbing on (parts of) objects which are not meant for climbing

8.3 *List of criteria important for climbing*

qualities of objects that decide if an object is easy to climb or not:

- Height until first support point
- Distances between the support points (horizontal and vertical)
- Angle between support points
- The angle of the plane with the support points
- Form of the support points
- Measures of the support points
- Mesh size of a rope net
- Roughness of the material
- Cold or warm material
- Splintering wood
- Height of top of the object (if there are no other support points available)
- Other objects near the climbed object that can be used as support point
- Pattern in support points or chaotic positioning
- Organic formed object or not

Qualities of children and aspects that can influence their climbing skills (a lot of influence to less influence):

- dare-devil or not, afraid of heights
- exercise (Is the child playing outside a lot or is it sitting behind the computer most of the time? Is the child going in for a sport, does the child have active parents?)
- motor development (age)

- strength in arms
- weight in combination with strength
- length
- physique (light or heavy built)
- strength in hands
- physical flexibility
- living environment (city child or small village child)
- family members (does the child have older brothers and sisters)
- with or without shoes

Different kinds of grip:

- round horizontal wooden bar (clamber frame, top bar of a fence)
- round horizontal metal bar (tumble frame)
- rope
- vertical rod
- thin branch of tree

Different kinds of grab:

- climbing wall support points (in many different sizes and forms available)
- platform/ plane edge
- irregularities in a wall
- thick branch of tree

8.4 List of climbing situations

Climbing situations	interesting for age														situation is occurring a lot - not so often (1-3)	many accidents yes/no		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14				
<i>at home</i>																		
baby crib	■	■	■	■												1	yes	
highchair	■	■	■	■												1	yes	
table		■	■	■	■											2	no	
stairs		■	■	■	■											1	yes	
chair		■	■	■	■											1	yes	
cupboard		■	■	■	■											2	no	
bed	■	■	■													1	no	
high bed				■	■	■										3	yes	
<i>gymnastic lessons</i>																		
rope						■	■	■	■	■	■	■	■	■	■	■	2	no
angled clamber frame front						■	■	■	■							2	no	
angled clamber frame back						■	■	■	■	■	■	■				2	no	
up right standing clamber frame				■	■	■	■									1	no	
ladder						■	■	■	■							2	no	

9 Recommendations for the practical tests

9.1 Recommended test situations and climbing criteria per age group

1-3 years	different levels	important aspects (child)	results, aspects to measure	example products
successive platforms	<ul style="list-style-type: none"> - changing height between steps - changing total height - with or without banisters 	<ul style="list-style-type: none"> - Strength in arms - Length 	<ul style="list-style-type: none"> - motor skills level - step height - method used to climb the object 	stairs in the house, stairs of a slide.
platform	<ul style="list-style-type: none"> - changing height - different objects (highchair, table, normal chair) 	<ul style="list-style-type: none"> - Strength in arms - Length 	<ul style="list-style-type: none"> - motor skills level - time to climb an object - highest platform (object) that can be climbed - method used to climb the object 	highchair, normal chair, cupboard, table
wire fence fence with rails	<ul style="list-style-type: none"> - changing mesh size - changing height - added objects to make it easier 	<ul style="list-style-type: none"> - Strength in arms, legs and hands. - Physical flexibility - Length 	<ul style="list-style-type: none"> - motor skills level - time needed to climb over it - highest fence that can be climbed - smallest mesh size that can be climbed - method used to climb the object 	baby crib
irregular shaped objects	<ul style="list-style-type: none"> - changing route with height differences 	<ul style="list-style-type: none"> - Strength in arms, legs and hands. - Physical flexibility - nerves - not being afraid to climb down in a strange position (head down to the ground for instance) - inventiveness 	<ul style="list-style-type: none"> - motor skills level - time needed to complete the route - method and supports used to climb the object 	baby module blocks, mattress, pillows, boulders
angled plane with little support points	<ul style="list-style-type: none"> - changing angle - changing height 	<ul style="list-style-type: none"> - Strength in arms - Perseverance, nerves - Shoes with tread, or bare feet 	<ul style="list-style-type: none"> - motor skills level - method and supports used to climb the object 	sliding side of small slide

4-6 years	different levels	important aspects	results, aspects to measure	example products
through a climbing frame	<ul style="list-style-type: none"> - routes and added objects see appendix J 	<ul style="list-style-type: none"> - Strength in arms, legs and hands. - Physical flexibility - Small corps - not being afraid to climb down in a strange position (head down to the ground for instance) - adaptive climbing 	<ul style="list-style-type: none"> - motor skills level - nerves - highest point on climbing frame - biggest distance between steps that can be climbed - time needed to climb a route - method used to climb the object 	Clamber frame with irregular placed steps, hoops and sticks, playground climbing frame
wire fence	<ul style="list-style-type: none"> - changing height - changing mesh size 	<ul style="list-style-type: none"> - Strength in arms, legs and hands. - Physical flexibility - Length 	<ul style="list-style-type: none"> - method used to climb the object 	fence
angled plane with little support	<ul style="list-style-type: none"> - changing angle - changing height 	<ul style="list-style-type: none"> - Strength in arms - Perseverance, nerves - Shoes with tread, or bare feet 	<ul style="list-style-type: none"> - motor skills level - method used to climb the object 	sliding side of small slide
rope network angled or horizontal	<ul style="list-style-type: none"> - changing mesh size - changing angle 	<ul style="list-style-type: none"> - Strength in hands. - Physical flexibility - Not afraid of heights (you can see the ground through the network and this can be scary) 	<ul style="list-style-type: none"> - motor skills level - highest point above ground level that can be reached - biggest mesh size that can be climbed - differences in angles of rope net - method used to climb the object 	The clamber tower of Van Schelde
climbing wall (angled)	<ul style="list-style-type: none"> - different routes with different distances between support points - different support points - changing angle 	<ul style="list-style-type: none"> - Strength in arms, legs and hands. - Nerves. Without shoes more feeling with the support points 	<ul style="list-style-type: none"> - motor skills level - nerves/ fear of heights - highest point that children can climb - time needed to climb a climbing route - method used to climb the object 	The clamber tower of Van Schelde
platform	<ul style="list-style-type: none"> - changing height 	<ul style="list-style-type: none"> - Strength in arms - Length 	<ul style="list-style-type: none"> - Highest platform that can be climbed - method used to climb the object 	table, The clamber tower of Van Schelde

7-9 years	different levels	important aspects	results, aspects to measure	example products
angled climbing frame bottom side	<ul style="list-style-type: none"> - changing angles - changing distances between steps - with or without rope see appendix K 	<ul style="list-style-type: none"> - Strength in arms, legs, hands and feet. - Nerves - not being afraid to climb with your head down. 	<ul style="list-style-type: none"> - nerves - angle that can not be climbed anymore - method used to climb the object 	clamber frame at school
through a climbing frame	<ul style="list-style-type: none"> - routes and added objects 	<ul style="list-style-type: none"> - Strength in arms, legs and hands. - Physical flexibility - Small corps - not being afraid to climb down in a strange position - adaptive climbing 	<ul style="list-style-type: none"> - motor skills level - nerves - highest point on climbing frame - biggest distance between steps that can be climbed - time needed to climb a route - method used to climb the object 	large playground climbing frame with irregular placed steps, hoops and sticks.
irregular shaped object	<ul style="list-style-type: none"> - different objects 	<ul style="list-style-type: none"> - Strength in arms, legs and hands. - Physical flexibility - nerves - not being afraid to climb down in a strange position - inventiveness - adaptive climbing 	<ul style="list-style-type: none"> - time needed to climb the object - support points being used - method used to climb the object 	tree
wall without support points higher than the climber	<ul style="list-style-type: none"> - changing height - changing roughness of the surface 	<ul style="list-style-type: none"> - Strength in arms - jumping height (strength in legs) - Perseverance - Length - Shoes with tread 	<ul style="list-style-type: none"> - material of surface that can be climbed - method used to climb the object 	wall/ fence
Climbing wall	<ul style="list-style-type: none"> - different routes with different distances between support points - different support points - changing angle 	<ul style="list-style-type: none"> - Strength in arms, legs and hands. - Nerves. - Without shoes more feeling with the support points 	<ul style="list-style-type: none"> - nerves/ fear of heights - highest point that children can climb - time needed to climb a climbing route - the use of different forms of support points - method used to climb the object 	sports climbing wall
angled plane with little support points	<ul style="list-style-type: none"> - changing height - changing angle - see appendix J 	<ul style="list-style-type: none"> - Strength in arms - Perseverance, nerves - Shoes with tread, or bare feet 	<ul style="list-style-type: none"> - method used to climb the object 	sliding side of big slide thick mattress against clamber frame

rope network	<ul style="list-style-type: none"> - changing mesh size - changing angle 	<ul style="list-style-type: none"> - Strength in hands. - Physical flexibility - Not afraid of heights (you can see the ground through the network and this can be scary) 	<ul style="list-style-type: none"> - highest point above ground level - biggest mesh size that can be climbed - differences angled – horizontal - method used to climb the object 	rope network rope bridge
rope	<ul style="list-style-type: none"> - vertical, horizontal, angled 	<ul style="list-style-type: none"> - Strength in arms, legs and hands. - not afraid of heights - Not to heavy built 	<ul style="list-style-type: none"> - height that can be climbed - method used to climb the object 	swinging rope, tree

10-14 years	different levels	important aspects	results, aspects to measure	example products
irregular shaped object	<ul style="list-style-type: none"> - different objects 	<ul style="list-style-type: none"> - Strength in arms, legs and hands. - Physical flexibility - nerves - not being afraid to climb down in a strange position (head down to the ground for instance) - inventiveness 	<ul style="list-style-type: none"> - time needed to climb the object - support points being used - percentage of children that can complete the task - method used to climb the object 	tree
rope	<ul style="list-style-type: none"> - vertical, horizontal, angled 	<ul style="list-style-type: none"> - Strength in arms, legs and hands. - not afraid of heights - Not to heavy built 	<ul style="list-style-type: none"> - height that can be climbed - time needed to climb the object - method used to climb the object 	drainpipe, tree, rope
wall without support points higher than the climber	<ul style="list-style-type: none"> - changing height - changing roughness of the surface 	<ul style="list-style-type: none"> - Strength in arms - jumping height (strength in legs) - Perseverance - Length - Shoes with tread 	<ul style="list-style-type: none"> - material of surface that can be climbed - method used to climb the object 	high fence or wall
climbing wall	<ul style="list-style-type: none"> - different routes with different distances between support points - different support points - changing angle 	<ul style="list-style-type: none"> - Strength in arms, legs and hands. - Nerves. - Without shoes more feeling with the support points 	<ul style="list-style-type: none"> - nerves/ fear of heights - highest point that children can climb - time needed to climb a climbing route - highest starting point that can be reached - method used to climb the object 	professional climbing wall

platform	<ul style="list-style-type: none"> - different buildings - with or without drainpipe or other helping objects 	<ul style="list-style-type: none"> - Strength in arms - Length 	<ul style="list-style-type: none"> - time needed to climb the object - support points being used - highest object that can be climbed - percentage of children that can complete the task - method used to climb the object 	bike shed
rope network	changing mesh size changing angle	<ul style="list-style-type: none"> - Strength in hands. - Physical flexibility - Not afraid of heights (you can see the ground through the network and this can be scary) 	<ul style="list-style-type: none"> - highest point above ground level - biggest mesh size that can be climbed - differences angled – horizontal - method used to climb the object 	rope network big, Van Schelde moving climbing net

9.2 *Measuring the climbing skills of children*

For the practical tests it is necessary to measure the climbing skills of children in a way that makes it possible to tell if a child is a good or a bad climber for his age group. It is recommended to use the seven aspects of motor skills described in paragraph 5.4 as an observation guide for children aged 1-6 years.

It tells us if the child has reached a certain level in the development of his motor skills. The scores of all children attending the test will be compared and a good picture of the climbing skills level of children aged 1-6 will be the result.

For children older than 6 it is interesting to decide if they are good or bad climbers without looking at the motor skills development. An observation table can be made using the table in paragraph 6.4.

A simple test to decide which child is able to judge his own capacity and which one is not.

Use as many climbing ropes as there are children. Draw a line 3 meter away from the ropes. Tell the children to take a rope and stand behind the line. They get the order to let swing the rope back and forth one time and to complete a simple task in between before they catch the rope again. The in between task might be something like sitting in a hoop and getting up again. Ask the children to put the hoop on a certain distance from the ropes on the ground. They have to be back in time to catch the rope so now they have to predict the time they need to run to the hoop, sit down, get up and run back again. Children that can not judge their own capacity will place the hoop to far away (mostly boys who want to show off). On the other side some children might be to modest or frightened to fail the test. This is telling us something about the character of the child. Is it a dare-devil or a bit to careful?

9.3 *Proposal for the practical test*

Purpose of the test: Getting to know which objects children can climb at a certain age. The climbing skills should be measured and described in figures in order to make them ready for use in new standards and safety inspections of typical children's products

An interesting question is if there is a correlation between one of the qualities of children, which have been found out to influence their climb-ability, and their climbing skills.

Another purpose is to gain insight in the way children climb different types of objects by making video recordings. How do they use the different types of support points to climb over the object.

Age groups

The children will be divided into the following age groups: 1-3 years, 4-6 years, 7-9 years and 10 – 14 years. The group of 10-14 might be left out if the test is becoming to complex.

The test

About four to six different types of climbing objects will be placed on a trail (see tables in paragraph 9.1). Each type will be testing another climbing skill. The children are being asked to follow the trail and climb on and over all the objects they come across. If they do not feel safe doing it they can pass the object without climbing it. They get 3 chances for every object. After each round the objects are being upgraded; higher, bigger step heights, bigger slopes, depending on the kind of object (see paragraph 9.1).

Of a large group of children of all ages ranging 1-14 years the following aspects are being measured:

- length
- weight
- step height
- arm strength
- leg strength
- physical flexibility
- capability of judging his own capacities.

The following questions are being asked:

Questions for the child before the test:

- How old are you?
- Do you practise a sport?
- How many times a week do you play outside the house?
- Do you have any brothers or sisters?
- Where do you live? (city or village kid)

Question for the mother, father or school teacher:

- Is it a dare-devil or not?
- Is the kid afraid of heights?

Questions afterward:

- What object did you like most and why?
- What object was the most easy to climb on?
- What object was the most difficult to climb on?
- Did you get scared?

The test will start with a basic trail which every child in the group can easily overcome. The level will be raised until no child in the group is able to climb over one of the objects in the trail.

Correlation of children's qualities and their ability to climb

The tested child tries to climb all the objects on the trail. The successful attempts are being scored. For some objects it might be easier to measure how high a child is climbing, for instance the rope network, instead of increasing the difficulty of the object.

object	clamber frame vertical	rope	clamber frame angled	climbing wall	platform
level 1: ...					
level 2: ...					
level 3: ...					
level 4: ...					
level 5: ...					

Afterwards the children can be ranged on their ability to climb. This scores will tell us what aspects correlate with the climbing ability of the children.

The aspects that have to be changed in order to make an object more difficult to climb are shown in the tables in paragraph 9.1. Of course it is advisable to change only one aspect at the time to get the best picture of the results on the climbability of an object.

After the test it will be possible to tell what percentage of a certain age group is able to climb a certain object.

Handling of specific support points

This research project already brought a lot of information on the basic methods children use for climbing on and over different types of objects but it might be interesting to look if there are differences between individuals and to look more closely at the way children handle the different types of support points. It is recommended to videotape the test. The tapes can be examined after the test.

Looking for other ways to climb on an object

Another interesting question is how many different kind of climbing methods children can think of when they are being asked to climb over an object in a different way than the children before them did. This resembles the case when they are getting bored with climbing an object in the usual way.

9.4 Further recommendations

Mentally handicapped children are forming a separate group. They can act like young children but their body is larger and therefore they can climb on objects a 3 year old child is not able to climb on. This situation might get a bit dangerous. For this group different standards should be advisable.

Physically handicapped children sitting in a wheel chair are not able to climb on playground objects. There are however children with a physical handicap who are able to walk and climb. For this group different measures and qualities will be important for climbing. A separate study on this subject could be interesting for manufacturers designing playground and climbing equipment for this target group.

To test the climbing skills of children without the aspect of fear of heights one should create climbing situations with different levels in difficulty without making the object higher. This is especially interesting for the younger children because

they are still developing their motor skills and it is more easy to examine their progress without the fear aspect.

The older children have already developed their motor skills and they should be able to climb most objects. Fear of heights will become the most important distinguishing aspect in combination with length, strength and built.