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## Appendix A: References

### *Scientific articles*

1. A common perceptual parameter for stair climbing for children, young and old adults  
Cesari P, Formenti F, Olivato P, Human Movement Science. 2003 Feb;22(1):111-24
2. How do children climb out of cribs?  
Ridenour MV., Perceptual and Motor Skills. 2002 Oct;95(2):363-6.  
Biokinetics Research Laboratory, Temple University, Philadelphia, PA 19122, USA.
3. Age, side height, and spindle shape of the crib in climbing over the side.  
Ridenour MV., Perceptual and Motor Skills. 1997 Oct;85(2):667-74.  
Biokinetics Research Laboratory, Temple University, Philadelphia, PA 19122, USA.
4. Climbing performance of children: is the above-ground pool wall a climbing barrier?  
Ridenour MV., Perceptual and Motor Skills. 2001 Jun;92(3 Pt 2):1255-62.  
Department of Kinesiology, Temple University, Philadelphia, PA 19122, USA.
5. Young children's ability to climb fences.  
Rabinovich BA, Lerner ND, Huey RW., Human Factors. 1994 Dec;36(4):733-44.  
COMSIS Corporation, Silver Spring, Maryland 20910.
6. Ladder angle and ankle flexion while climbing.  
Gabbard C, Miller G, Thiebaud R., Perceptual and Motor Skills. 1984 Dec;59(3):893-94.
7. Exerted effort and performance in climbing among boys: the influence of achievement goals, perceived ability, and task difficulty.  
Sarrazin P, Roberts G, Cury F, Biddle S, Famose JP., Research Quarterly for Exercise and Sport. 2002 Dec;73(4):425-36.  
Faculty of Sport Sciences, University of Grenoble, France.
8. Initial assessment of children's ability to climb stair guarding. (abstract only)  
Riley JE, Roys MS, Cayless SM., Journal of the Royal Society of Health. 1998 Dec;118(6):331-7.  
Healthy Building Centre, Garston, Watford.
9. Safety of children in grocery carts: adults' personal health and safety habits. (abstract only),  
Harrell WA., Psychological Reports 2003 Jun;92(3 Pt 1):908-14. University of Alberta, Centre for Experimental Sociology, Edmonton, Canada.
10. Dangerous activities by children in grocery carts: is adult supervision important? (abstract only),  
Harrell WA., University of Alberta, Centre for Experimental Sociology, Edmonton, Canada.

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15. Gymbasics 14 basisgymnastiek voor school en club, Translaties Klauteren/klimmen, Dick Sol, Richting SportGericht 2 – 1997, page 40-44
16. De 'face lift' van uw klauterraam, Heleen Wartena, Richting SportGericht 2 – 1997, page 9-11

*Literature: child development*

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L.P.A. Steenbekkers, Faculty of Industrial Design Engineering, Delft University of Technology, 1993, Delft University Press
18. Growth, health and fitness of teenagers -Longitudinal Research in International Perspective  
H.C.G. Kemper, Medicine and Sport Science, Amsterdam, 1985, ISBN 3-8055-4042-6
19. Growth, maturation and physical activity  
Robert M. Malina (University of Texas) and Claude Bouchard(Laval University), Human Kinetics Books, Champaign, Illinois, 1991
20. Het Speelgoedboek  
Marianne de Valck, Uitgeverij Vroegindewei, Leusden, 1996
21. Schulung koordinativer Fahigkeiten  
Kristina Kroll, Ann Katrin Erichsen, Julia Wasmundt, Institut fur Bewegungswissenschaften und Sport, Hauptseminar: Spezielle Aspekte der trainingslehre, Wintersemester 2003/2004

*Literature: anthropometric data*

22. Kinderen en hun maatjes -Bepaling van lichaamsmaten van Nederlandse kinderen ten behoeve van onderzoek naar speeltoestellen  
M.M. de Rijke, Stichting Consument en Veiligheid, ir. J.H.A. Bruggers, Technische Hogeschool Delft, ir. J.F.M. Molenbroek, 1985
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P.Koopman, Delft Technical University, 1987

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Government Consumer Safety Research, Department of Trade and Industry

Literature: Accident figures

25. Injury Information System, Consumer Safety Institute
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University of Newcastle upon Tyne, prepared for the Department of Trade and Industry, may 1999

*Literature: standardisation of playground equipment*

27. Besluit veiligheid attractie- en speeltoestellen 5 jaar in werking -analyse van de ongevalsgegevens en inhoudelijke uitvoeringsaspecten  
M. Hoofwijk, H. Goossens, C. Stam, Consument en Veiligheid, 2002
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## Appendix B: Abstracts of articles

1. A common perceptual parameter for stair climbing for children, young and old adults.

Cesari P, Formenti F, Olivato P., Human Movement Science. 2003 Feb;22(1):111-24, Scienze delle Attività Motorie e Sportive

In this paper we examine whether a common perceptual parameter is available for guiding old adults, young adults and children in climbing the highest stair mountable in a bipedal fashion. Previous works have shown that the ratio between the height of the stair and the hip height was the body-scaled invariance adopted as information for selecting the highest stair by young adults [Journal of Experimental Psychology: Human Perception and Performance 10 (1984) 683-703] but not by older adults [Journal of Experimental Psychology: Human Perception and Performance 3 (1992) 691-697]. Indeed, for older adults additional bio-mechanical parameters needed to be added to the model due to their decrease in leg strength and flexibility. Up to now, no perceptual invariant has been identified yet for determining the relevant information used for guiding the stair climbing action for normal healthy people. We propose a new parameter as the angle defined by the ratio between the height of the stair and the distance taken from the feet to the top edge of the stair before the initiation of the movement. We show that this angle is the same for children, young adults and older adults despite the different kinematics of the motion, the anthropometrics and the skill ability exhibit by the participants. In summary we show that even when the climbability judgments, based on the simple ratio leg length-stair height, are influenced by differences in age, participants use a common perceptual variable when they are coordinating their stair climbing action.

2. How do children climb out of cribs?

Ridenour MV., Perceptual and Motor Skills. 2002 Oct;95(2):363-6. Biokinetics Research Laboratory, Temple University, Philadelphia

48 children between the ages of 16 and 32 mo. were observed climbing out of a crib. Each child was observed four times climbing out of the crib. All the children were able to walk independently and were less than 35 in. tall. Two different climbing patterns were identified and associated with a location of the climbing event within the crib environment. Most children (90%) climb from a crib by first moving to a corner of the crib and then start climbing from the crib. The remaining 10% of the children used a side-climbing pattern in at least one of the four observations. Crib safety standards have eliminated the most common catch-point, the cornerpost extension from cribs. Since at least 10% of the children climbed over the side of the crib rather than at the corner, any potential catch-points should be eliminated from the complete perimeter of the crib.

3. Age, side height, and spindle shape of the crib in climbing over the side.

Ridenour MV., Perceptual and Motor Skills. 1997 Oct;85(2):667-74. Biokinetics Research Laboratory, Temple University, Philadelphia

The crib is the only infant product in which a consumer, such as a parent or caretaker, is encouraged to leave the infant unattended, usually alone in the bedroom, while the infant is sleeping or going to sleep or waking. Given frequent falls from the crib, federal crib regulations have set the minimum distance between the top of the mattress support and top of the crib side rail as 26 in. and this height must include a 6-in. thick mattress. When a mattress is used with the

crib, the actual height of the crib side as a barrier is 20 in. These crib regulations also require instructions for the caretaker to discontinue using the crib when the child's height is 35 inches. These federal crib regulations attempt to create an escape-resistant sleeping environment for all children who are less than 35 in. tall. Of 144 children between the ages of 12.5 and 36.5 mo. observed while attempting to climb out of a crib, who also had standing heights of less than 35 in., many were able to climb from cribs with side rail heights of 26 in. When the crib side-rail height was raised beyond the minimum of 26 in., the frequency of children climbing over the crib rails decreased.

#### 4. Climbing performance of children: is the above-ground pool wall a climbing barrier?

Ridenour MV., *Perceptual and Motor Skills*. 2001 Jun;92(3 Pt 2):1255-62.  
Department of Kinesiology, Temple University, Philadelphia

15 children between the ages of 42 and 54 months attempted to climb a 48-in. wall representing the wall of an above-ground swimming pool. Three different climbing tasks were presented to all the children: (1) climbing over the swimming pool wall without any tools which could assist their climb, (2) climbing over the wall with a child-resistant ladder frame placed over the wall, (3) climbing over the wall when a pool filter was placed 12 in. from the wall. Each child's success or failure climbing over the pool wall was recorded. A repeated-measures analysis of variance indicated there were no significant performance differences in performance across the three climbing tasks. None of these climbing tasks resulted in more successful climbing performances for all the children. The results of these observations indicated the removal of the swimming pool filter or support frame of the ladder did not always stop the children from climbing over the wall. Since the 48 in. wall of the home swimming pool does not consistently function as a barrier, additional fencing is needed to prevent children from entering above-ground home swimming pools. However, no barrier replaces constant supervision of young children.

#### 5. Young children's ability to climb fences

Rabinovich BA, Lerner ND, Huey RW., *Human Factors*. 1994 Dec;36(4):733-44.  
COMSIS Corporation, Silver Spring, Maryland 20910.

Three studies were performed to evaluate the fence-climbing abilities of children who are in the high-risk age group for drowning in residential pools. Study 1 examined the ability of children in the age range of 24 to 54 months to climb commonly used fences (common chain link, small chain link, picket, iron, and stockade) at a 4-ft (1.22-m) height. Study 2 examined children's abilities to climb fences retrofitted with features that would potentially make them more difficult to climb. Study 3 examined children's abilities to climb 5-ft (1.52-m) fences. Results of the three studies show that the common chain-link fence is easy to climb even by two-year-old toddlers. Other fence types offered more effective barriers, especially for younger children.

#### 6. Ladder angle and ankle flexion while climbing.

Gabbard C, Miller G, Thiebaud R.  
*Perceptual and Motor Skills*. 1984 Dec;59(3):893-94.

39 children 4 to 8 yr. of age were filmed while ascending and descending ladders positioned at 90, 67, 40, 24, 14, and 0 degree from horizontal. Analysis indicated

that the greatest range of motion, i.e., variability, took place at angles of 90, 67, and 40 degrees, and at each angle the deviation was from dorsito plantar flexion. While results showed that at each angle more dorsiflexion was exhibited ascending than descending, minimal plantar flexion was noted so most movement occurred in the dorsiflexion range. The greatest deviation (and near maximal movement) was in dorsiflexion at the horizontal (0 degree) position. Implications for design of play apparatus were presented.

7. Exerted effort and performance in climbing among boys: the influence of achievement goals, perceived ability, and task difficulty. (abstract only)  
Sarrazin P, Roberts G, Cury F, Biddle S, Famose JP.  
Research Quarterly for Exercise and Sport. 2002 Dec;73(4):425-36.  
Faculty of Sport Sciences, University of Grenoble, France.

In achievement contexts such as sport, achievement goal theory assumes that an individual's major concern is to demonstrate competence. However, competence may be expressed in two ways: as task and ego involvement (Nicholls, 1989). Seventy-eight boys (M age = 13.6 years) performed five climbing courses, and the influence of achievement goals, perceived ability, and task difficulty on effort and performance was studied. According to the achievement goal theory: (a) task-involved boys exerted more effort and performed better than ego-involved boys; and (b) exerted effort was determined by an interaction of one's achievement goal, perceived ability (PA), and task difficulty. Ego-high PA boys and task-low PA boys exerted the most effort on the moderate course; ego-low PA boys exerted least effort on the moderate and very difficult courses. Finally, task-high PA boys exerted more effort on the most difficult courses. The motivational processes underlying these findings are discussed.

8. Initial assessment of children's ability to climb stair guarding.  
Riley JE, Roys MS, Cayless SM., Journal of the Royal Society of Health, 1998 Dec;118(6):331-7, Healthy Building Centre, Garston, Watford.

This study examined the ability of children aged between four and six years to climb stair guarding set at the minimum height for domestic handrails recommended in the guidance given in Approved Document K that supports the Building Regulations in England and Wales. The purpose was to assess the adequacy of such safety guidance. Simulated guarding was set up at an indoor play centre and behaviours examined in two groups of children. Observations were made during free play and during solicited climbing. Results indicate that the majority of children aged between four and six years can climb onto or over stair guarding unassisted. Younger children are influenced and frequently abetted by their elders in climbing, behaviour which may be replicated in the home environment. 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 each whilst climbing whereas younger children appear to depend more on strength. A re-examination of safety guidance in relation to barrier climb-ability by children is recommended, and has started at BRE.



9. Safety of children in grocery carts: adults' personal health and safety habits. (abstract only)

Harrell WA., Psychological Reports 2003 Jun;92(3 Pt 1):908-14.

University of Alberta, Centre for Experimental Sociology, Edmonton, Canada.

Observations of 246 children and the adults accompanying them were carried out in supermarkets. Of those arriving and leaving by automobile (n = 194), 36% of adults used safety belts, and 51.1% of children used safety belts or restraining seats. While shopping, 79% of adults lost sight of the children in their care at least once, and 73.2% were 10 feet or more from their children at least once. 48% of children climbed or attempted to climb from carts; 27% stood in carts, and 23.6% handled hazardous products. 24% of adults purchased tobacco products.

Poor adult supervision of children was related to adult's nonuse of safety belts and the child's and adult's ages. Climbing from the cart was related in a logistic regression to both poor adult supervision and child's age. Tobacco purchases were related to handling of hazards by children and standing in carts. Child's age and adult's safety belt use related to the restraint of children in vehicles.

10. Dangerous activities by children in grocery carts: is adult supervision important? (abstract only)

Harrell WA., University of Alberta, Centre for Experimental Sociology, Edmonton, Canada.

Systematic observations of 231 children (infancy to 5 years) and the 231 adults accompanying them were made in 29 supermarkets in Edmonton, Alberta, Canada. The objective of the study was to describe the influence of two indices of adult supervision in supermarkets on children's activities in shopping carts. Adult supervision was measured by whether the adult ever lost sight of the child and whether the adult was 10 feet or more from the child at any time during a shopping trip. 23% of the children stood on the ends or sides of carts; 49% climbed or tried to climb out of carts. Adults lost sight of a child, whether in or outside the cart, a mean of 3.3 times and were 10 feet away 2.7 times during an average shopping trip. Logistic regression showed that a child rather than an adult pushing a shopping cart through the store was the strongest factor related to standing on ends or sides of carts. Pushing by a child was more likely to occur when adult monitoring was low and when children were older. Climbing out was predicted by the number of times an adult was > or = 10 feet away, older children, and a child being in the cart basket as opposed to outside the cart or in the child safety seat.

## Appendix C: Accident figures

Table 1: First Aid treatments after climbing accidents with children aged 0-14 years, at age, amount and percentage.

Age group	Amount	%
0-4 years	1.000	23
5-9 years	2.800	62
10-14 years	660	15
<b>Total</b>	<b>4.400</b>	<b>100</b>

Source: Injury Information System 1998-2002, Consumer Safety Research institute

Table 2:  
First Aid treatments after climbing accidents with children aged 0-14 years, at location and percentage.

Location	Amount	%
At home	250	6
Livingroom	70	2
Bedroom	50	1
Stairs	20	<1
Kitchen	20	<1
around the house	180	4
Garden	130	3
Schools and Day Care	1.000	23
Playground	720	16
School or university	190	4
Child Day Care	30	<1
Sport location	30	<1
Sport accommodation, gymnastic	20	<1
Street	30	<1
Trade and service	20	<1
Playgrounds, attractie- en bungalowparken	2.000	44
Playground	1.800	40
Camping ground	50	1
Nature reserve	30	<1
Rest	20	<1
Unknown	900	20
<b>Total</b>	<b>4.400</b>	<b>100</b>

Source: Injury Information System 1998-2002, Consumer Safety Research institute

Table 3:  
 First Aid-treatments after climbing accidents of children aged 0 – 14 years,  
 ranged after accident scenario: amount and percentage

Accident scenario	Amount	%
Fall by jumping	120	3
of playground equipment	100	2
Fall from stairs or ladder	50	1
from built in stairs	40	<1
Fall from height, from or out	4.300	96
from playground equipment	3.600	82
from climbing frame	3.500	79
from tree	110	3
from sitting furniture	80	2
from fence	50	1
from baby, children's furniture	40	<1
from table	30	<1
from wall	20	<1
from gymnastic equipment	20	<1
Fall from height, other	<10	<1
Total	4.400	100

Source: Injury Information System 1998-2002, Consumer Safety Research institute

## Appendix D: child data

	description	data source
Length		TNO/LUMC, research growing children 1997
Weight		Steenbekkers, 1993, research with Dutch children
Leg length	length from hip until heel	Pheasant, 1988, Great Britain
Arm length until grip	the length of the arm until the midpoint of a tube which the child is holding in his hand	Pheasant 1988 at Great Britain
Vertical length until grip	The length from the floor until the midpoint of a tube which the child is holding in his hand	Pheasant, 1988, Great Britain and Steenbekkers, 1993, the Netherlands.
Length difference while jumping		Branta 1984 USA.
Grip circumference	The maximum circumference of the circle, made by thumb and forefinger when enclosing a cone	Steenbekkers, 1993, the Netherlands
Hand breadth (without thumb)	The distance from the radial to ulnar side of the hand, measured at the distal extremities of the metacarpals	Steenbekkers, 1993, the Netherlands.
Hand thickness	The maximum distance between the pal and the back of the hand at the middle finger joint	Steenbekkers, 1993, the Netherlands.
Foot breadth	the maximum width across the ball of the right foot	Steenbekkers, 1993, the Netherlands.
Instep height	The height of the biggest step a child can make.	Steenbekkers, 1993, the Netherlands
Arm strength		
Gripping force	Maximum gripping force of the hand, exerted for 3 seconds	Steenbekkers, 1993, the Netherlands

## Girls

age	length (cm)			weight (cm)			leg length (cm)			arm length until grip (cm)			jumping height (cm)		
	P2	P50	P98	P3	P50	P97	P5	P50	P95	P5	P50	P95			
1	70	75	80	7,1	9,6	11,5									
2	81	88	94	11,7	14,1	17,6	36,5	41,5	46,5	27,0	31,5	36,0			
3	89	96	104	12,9	16,0	19,6	40,5	46,0	51,5	29,0	34,5	39,5			
4	96	104	112	15,0	18,4	22,7	44,5	50,5	56,5	31,5	37,0	43,0			
5	102	112	121	16,6	21,0	28,0	49,0	54,0	59,0	33,5	39,0	45,0		15,3	
6	109	118	128	19,4	23,6	29,6	52,25	58,0	78,25	35,0	41,5	47,5		17,9	
7	114	125	136	19,0	26,9	36,2	55,5	61,5	97,5	38,0	43,5	49,5		21,4	
8	120	131	143	21,2	29,2	39,2	58,5	65,0	71,5	40,5	46,5	52,0		23,6	
9	125	137	150	23,1	32,1	43,6	61,0	69,0	77,0	40,5	48,0	55,5		26,4	
10	130	143	156	30,2	38,6	56,4	65,0	73,0	81,0	42,0	49,5	56,5		29,2	
11	136	149	162	29,6	40,6	55,0	67,0	75,0	83,0	45,5	53,0	60,5		28,6	
12	142	155	169	33,0	44,4	62,0	70,5	78,0	85,5	46,5	55,5	64,0		31,3	
13	147	161	174				72,5	80,5	88,5	49,0	57,0	64,5		33,9	
14	151	165	178				73,5	81,0	88,5	53,0	59,0	65,0			

age	length until grip vertical (cm) NL			length until grip vertical (cm) UK			Step height (cm)			Grip circumference (cm)			hand breadth (cm)		
	P3	P50	P97	P5	P50	P95	P3	P50	P97	P3	P50	P97	P3	P50	P97
1															
2	94,4	105,3	116,7	96,5	104,5	112,5	24,8	34,3	45,1	5,9	6,8	8,2	4,4	5,1	5,6
3	103,6	116,0	126,3	102,5	112,5	122,5	25,2	38,6	48,5	6,3	7,4	8,6	4,9	5,3	5,8
4	115,7	124,8	135,5	108,5	120,5	132,5	23,8	41,5	54,0	6,5	7,6	9,1	5,1	5,5	6,2
5	123,7	135,4	148,0	117,0	129,0	141,0	28,4	45,1	61,6	6,9	8,1	9,5	5,3	5,8	6,4
6	133,7	144,4	158,1	125,5	138,0	150,5	36,9	52,1	69,0	7,3	8,7	10,3	5,6	6,1	6,8
7	137,9	153,1	166,6	132,5	145,5	158,5	41,1	54,1	71,0	8,0	9,2	10,6	5,6	6,4	7,1
8	146,0	159,5	172,2	140,5	153,5	166,5	40,9	57,3	75,4	8,0	9,6	11,4	5,8	6,5	7,1
9	151,9	167,0	179,0	146,0	161,5	177,0	40,4	59,4	75,9	8,0	10,1	11,8	5,8	6,6	7,5
10	161,7	176,7	194,0	154,0	170,5	187,0	48,2	61,9	74,3	9,1	10,6	12,1	6,3	6,9	7,6
11	165,9	181,9	199,3	157,5	176,0	194,5	49,8	63,6	76,8	9,5	11,0	12,9	6,5	7,1	7,9
12	168,1	188,5	205,0	165,0	183,5	202,0	52,0	66,8	79,3	9,5	11,5	14,0	6,2	7,2	8,1
13				170,0	189,0	208,0									
14				176,5	193,0	209,5									

## Girls

age	hand thickness (cm)			foot breadth (cm)			Instep height (cm)			gripping force (N)		
	P3	P50	P95	P5	P50	P95	P3	P50	P95	P3	P50	P97
1												
2	1,2	1,6	1,9	5,1	5,9	6,6	4,7	5,5	6,7			
3	1,2	1,6	2,1	5,3	6,1	6,9	4,9	5,8	6,9			
4	1,4	1,7	2,0	6,1	6,6	7,4	5,1	6,1	7,3	14,7	45,8	88,2
5	1,4	1,8	2,1	6,2	6,9	7,7	5,4	6,5	7,6	24,5	66,1	107,8
6	1,4	1,8	2,1	6,5	7,2	8,2	5,3	6,8	8,7	44,1	88,0	142,1
7	1,7	2,0	2,3	6,6	7,5	8,5	5,8	7,2	8,7	58,8	108,4	161,7
8	1,6	2,0	2,3	6,9	7,7	8,6	6,2	7,4	8,9	68,6	114,0	166,6
9	1,7	2,1	2,3	7,1	7,9	8,8	6,3	7,6	8,9	83,3	142,8	220,5
10	1,8	2,1	2,4	7,2	8,3	9,4	6,5	8,0	9,6	88,2	168,9	254,8
11	1,9	2,2	2,5	7,5	8,5	9,5	6,5	8,0	9,3	117,6	186,4	294,0
12	1,8	2,2	2,6	7,7	8,6	9,5	6,7	8,2	9,8	112,7	209,6	352,8
13												
14												

## Boys

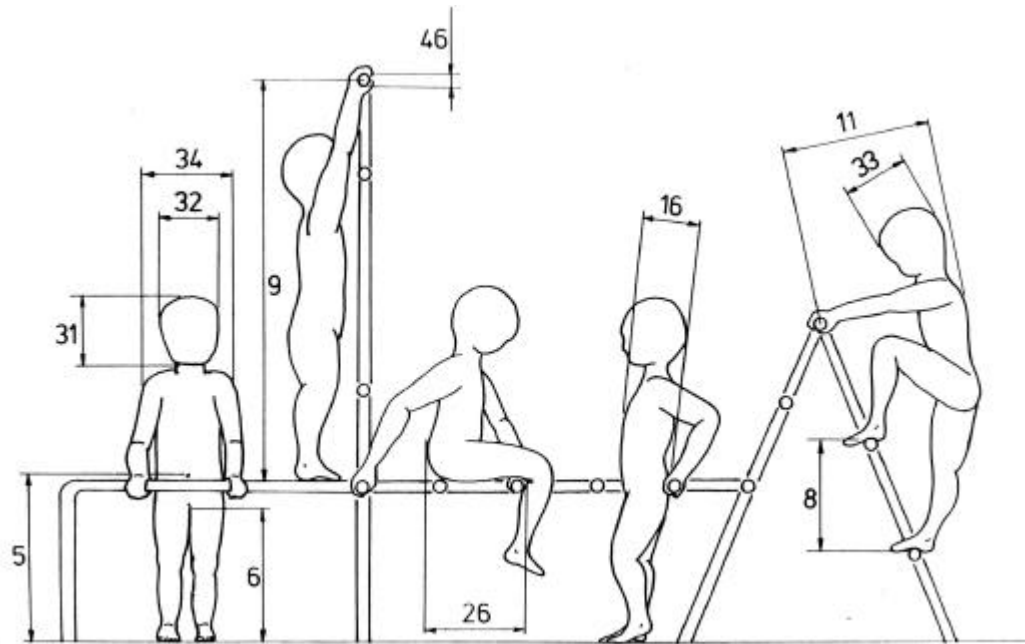
age	length (cm)			weight (cm)			leg length (cm)			arm length until grip (cm)			jumping height (cm)		
	P2	P50	P98	P3	P50	P97	P5	P50	P95	P5	P50	P95			
1	71	77	82	9,2	10,7	12,5									
2	82	88	95	11,3	14,5	19,0	36,0	42,0	48,0	29,5	34,0	39,0			
3	91	98	105	13,8	17,0	21,0	40,0	46,0	52,0	32,0	36,5	41,0			
4	98	106	112	15,5	18,6	21,8	44,5	50,0	55,5	34,0	38,5	43,0			
5	102	113	122	17,3	21,6	28,0	49,0	55,0	61,0	35,5	40,5	45,0		14,8	
6	110	120	130	19,4	23,5	29,3	52,0	59,5	67,0	37,0	42,5	48,0		18,7	
7	116	127	138	20,9	26,4	33,7	57,0	63,5	70,0	40,0	45,0	50,5		21,6	
8	121	133	144	22,3	28,9	38,0	60,5	66,5	72,5	42,5	47,5	52,5		24,8	
9	126	138	151	26,3	32,9	44,6	63,5	70,0	76,5	43,5	49,0	54,5		26,5	
10	130	144	156	27,3	36,4	51,7	66,0	73,5	81,0	44,5	51,5	58,0		29,4	
11	132	148	162	29,7	40,0	56,5	68,5	76,5	84,5	46,0	53,0	60,0		29,7	
12	139	154	169	31,0	42,5	57,1	72,0	80,5	89,0	49,0	56,0	62,5		32,1	
13	145	161	177				74,0	83,5	93,0	50,5	58,5	66,0		35,2	
14	152	168	184				79,5	87,0	94,5	54,0	62,0	69,5			

## Boys

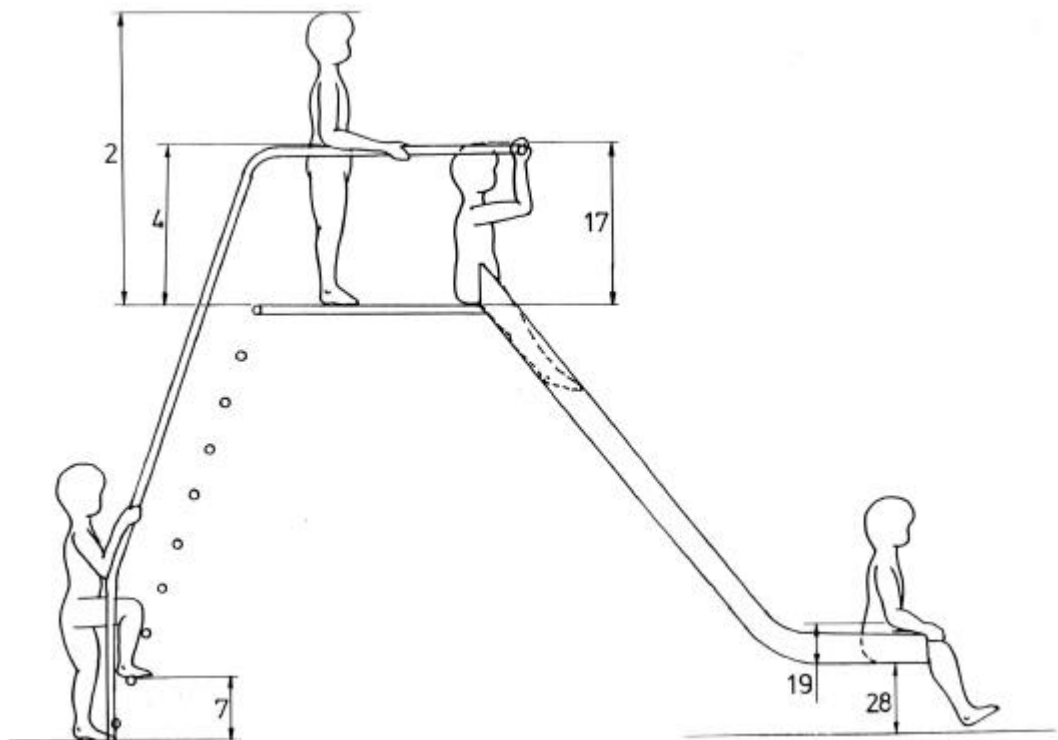
age	length until grip vertical (cm) NL			length until grip vertical (cm) UK			Step height (cm)			Grip circumference (cm)			hand breadth (cm)		
	P3	P50	P97	P5	P50	P95	P3	P50	P97	P3	P50	P97	P3	P50	P97
1															
2	95,3	106,5	118,3	92,0	104,5	117,0	24,3	33,7	43,5	5,9	6,8	8,2	4,6	5,2	5,9
3	107,1	118,0	133,6	100,5	113,0	125,5	27,7	39,7	54,3	6,3	7,5	9,0	4,9	5,4	6,3
4	114,5	126,2	136,4	109,5	121,5	133,5	30,5	41,7	55,4	6,5	7,6	8,6	5,1	5,6	6,1
5	125,4	137,0	149,6	118,0	130,5	143,0	31,0	47,0	61,6	6,9	8,2	9,5	5,4	6,0	6,6
6	129,7	144,4	156,5	123,5	139,0	154,5	34,2	50,4	66,5	7,3	8,6	10,3	5,6	6,2	6,7
7	138,2	152,0	163,4	135,0	147,5	160,0	36,4	52,6	68,8	7,6	9,1	10,6	5,8	6,4	7,0
8	146,1	159,7	172,1	142,5	155,0	167,5	42,0	54,8	67,2	8,0	9,6	11,0	6,0	6,6	7,3
9	157,3	169,6	184,6	147,5	161,0	174,5	46,7	59,7	73,5	8,8	10,1	11,8	6,3	6,9	7,8
10	158,0	175,6	193,1	154,0	168,0	182,0	39,7	61,0	77,9	8,4	10,5	12,5	6,4	7,1	8,0
11	167,6	182,1	199,1	157,5	174,0	190,5	51,1	62,8	75,9	9,1	10,9	12,9	6,6	7,3	8,1
12	169,4	188,5	203,7	165,5	183,5	201,5	51,0	65,2	79,5	9,5	11,1	13,3	6,6	7,4	8,3
13				172,0	190,5	209,0									
14															

age	hand thickness (cm)			foot breadth (cm)			Instep height (cm)			gripping force (N)		
	P3	P50	P97	P3	P50	P97	P3	P50	P97	P3	P50	P97
1												
2	1,3	1,6	2,0	5,0	6,0	7,1	4,7	5,5	6,7			
3	1,2	1,7	2,0	5,5	6,4	7,2	4,9	6,0	7,2			
4	1,4	1,7	2,1	6,1	6,8	7,7	4,9	6,3	7,6	19,6	53,7	98,0
5	1,6	1,9	2,1	6,4	7,2	8,0	5,4	6,5	7,6	34,3	79,2	112,7
6	1,6	1,9	2,3	6,6	7,3	8,3	5,4	6,9	8,0	44,1	93,1	151,9
7	1,7	2,0	2,3	7,0	7,7	8,6	5,8	7,3	8,9	78,4	120,2	176,4
8	1,6	2,1	2,4	7,1	8,0	9,0	6,5	7,6	8,9	78,4	140,3	200,9
9	1,7	2,1	2,4	7,3	8,2	9,3	6,7	7,9	8,9	117,6	167,6	235,2
10	1,8	2,2	2,5	7,5	8,5	9,5	6,5	8,2	9,8	102,9	194,6	284,2
11	1,9	2,2	2,6	7,7	8,8	9,8	6,9	8,4	9,8	156,8	217,7	313,6
12	1,9	2,3	2,7	8,3	9,1	10,0	7,1	8,6	9,8	161,7	246,5	328,3
13												
14												

**Appendix E: Child measures in combination with playground objects**



Climbing frame



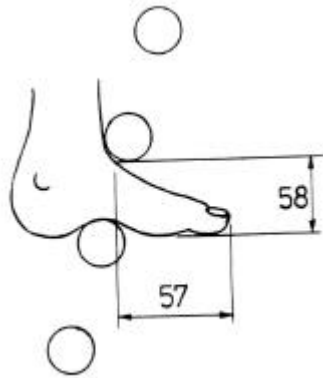
Normal slide



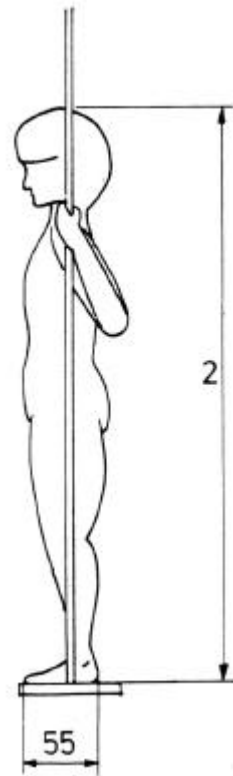
46 Diameter tube length



58 distance between ladder supports



55 foot support



## Appendix F: Survey of observed climbing methods of children

Source:

How do children climb out of cribs?

Ridenour MV., *Perceptual and Motor Skills*. 2002 Oct;95(2):363-6.

Object to be climbed: Sides of the crib 26 inch high.

Age of the children: between the ages of 16 and 32 months

Method used for climbing:

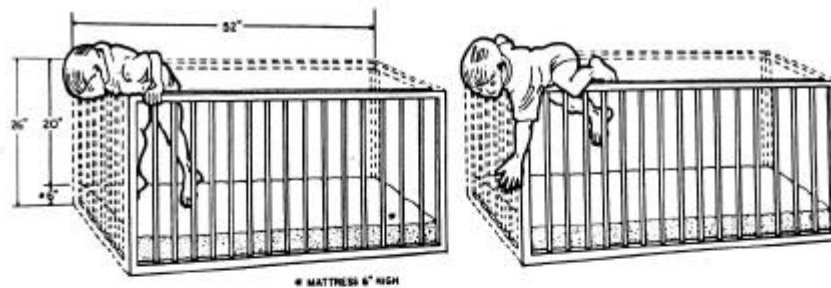


FIG. 1. Typical corner-climbing pattern of a child climbing from a crib. (Drawn using video frame images from the Biokinetics Research Laboratory, Temple University, Philadelphia, Pennsylvania)

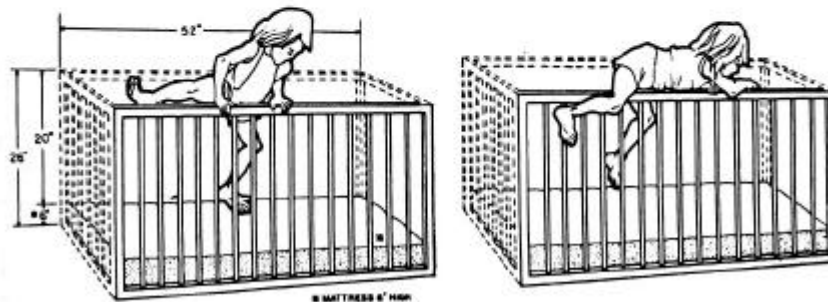


FIG. 2. Typical side-climbing pattern of a child climbing from a crib. (Drawn using video frame images from the Biokinetics Research Laboratory, Temple University, Philadelphia, Pennsylvania)

Source:  
 Climbing performance of children: is the above-ground pool wall a climbing barrier?  
 Ridenour MV., *Perceptual and Motor Skills*. 2001 Jun;92(3 Pt 2):1255-62.

Object to be climbed: above-ground pool wall

Age of the children: 15 children between the ages of 42 and 54 months attempted to climb a 48-in. wall representing the wall of an above-ground swimming pool.

Method used for climbing:

1258

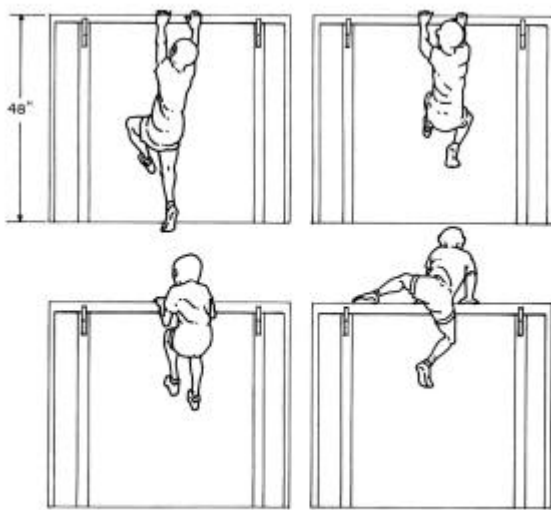


FIG. 1. Typical movement pattern of a child climbing over the pool wall. (Drawn from video frame images from the Biokinetics Research Laboratory, Temple University, Philadelphia, PA)

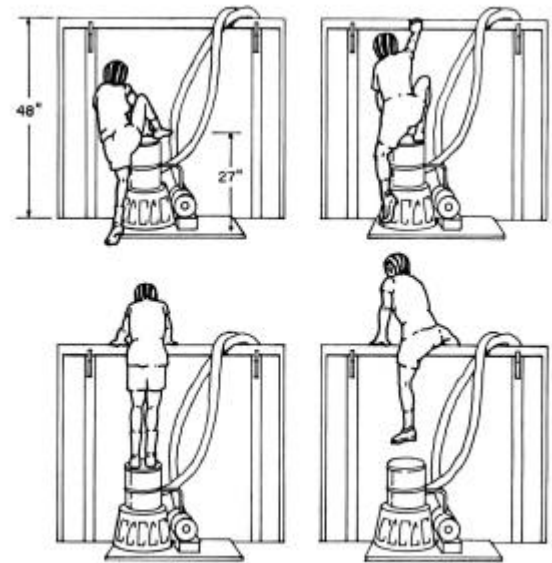


FIG. 2. Typical movement pattern of a child climbing over the pool wall with a filter. (Drawn from video frame images from the Biokinetics Research Laboratory, Temple University, Philadelphia, PA)

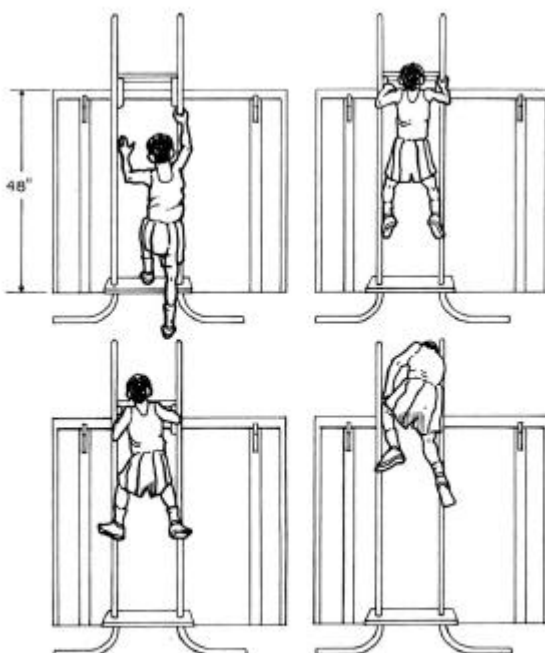


FIG. 3. Typical movement pattern of a child climbing over the pool wall with a safety ladder frame. (Drawn from video frame images from the Biokinetics Research Laboratory, Temple University, Philadelphia, PA)

Source:

Young children's ability to climb fences.

Rabinovich BA, Lerner ND, Huey RW., Human Factors. 1994 Dec;36(4):733-44.

Object to be climbed: commonly used fences (common chain link, small chain link, picket, iron, and stockade) at a 4-ft (1.22-m) and 5-ft (1.52-m) height.

Age of the children: **24 to 54 months**

Source:

Speelplekken en speeltoestellen de veiligheid en beklimbaarheid

Alie van der Weide, Stichting Consument en Veiligheid, juni 2003

Observed object to being climbed on: tunnel slide, climbing frame, roof on combination playground object, crawling tunnel

## Appendix G: Experts and field research addresses

### Experts

- Bakkum, Floor: day care teacher De Capriool, Amsterdam
- Bos, Jeroen: Keurmerkinstituut, Zoetermeer
- Climbing children: Stijn (11 years), Ruben (7 years), Helen (8 years)
- Drolenga, Frits: gymnastics teacher St. Catharinaschool, Amsterdam
- Everaerst, Frans: director of Spereco Holland BV, manufacturer of playground equipment, Weert
- Hebben, Ron: manager of playground De leemkuil, Nijmegen
- Kortekaas, Gijsbert: teacher HALO, school for gymnastic teachers, The Hague
- Melskens, Frans: sports climbing teacher and tester of professional climbing walls, author of a set of books about sports climbing at schools.
- Sol, Dick: expert on gymnastics lessons for children and motor skills development
- Verhoef, Marijn: gymnastics teacher De Kruidenhoek, Rotterdam
- Warmerdam, Ellen van: gymnastics teacher Ignatius Gymnasium, Amsterdam

### Field research addresses

- Playground De Leemkuil, Nijmegen
- Child Day Care De Capriool, Amsterdam
- St. Catharina Basisschool, Amsterdam
- De Kruidenhoek, Rotterdam
- St. Ignatius Gymnasium, Amsterdam

## Appendix I: Questionnaires

### Questionnaire Child Day Care teacher

- What is the age of the children at this day care?
- How are they divided into groups?

#### Development of climbing skills

- Can you describe the motor skills and climbing skills of children in every age group?
  - o age 0 – 1,5 years
  - o age 1,5 – 2 years
  - o age 2 - 3 years
  - o age 3 – 4 years
- What aspects demand more attention in every age group?
- How do you stimulate the development of climbing skills?
- Do children show differences in climbing skills development or is every child developing them in the same way? If there are any differences, can you describe them?
- What is causing these differences? (guts, motor development, upbringing, curiosity, influence of other children, environment, ...)
- Which of the following aspects is influencing the climbing skills of children and how much?

aspects	how much	short explanation
age		
character of a child (think about wild/quiet, enterprising and curious/ reserved, introvert/ extrovert)		
gender		
physical flexibility		
built		
step height		
size of hands		
size of feet		
arm length		
leg length		
strength in hands		
strength in legs		
strength in arms		
clothes		
physical exercise		

Climbing objects

- Which objects are attractive to climb on for the different age groups?

	0-1 years (baby)	1- 2 years (old baby)	2- 3 years (young toddler)	3-4 years (old toddler)
crib				
bed				
highchair				
table				
swing				
slide (1 meter high)				
slide (higher than 1 meter)				
climbing frame				
playing house				
crawling tunnel				
bench				
tree				
fence with diagonal planks				
wire fence				
fence with vertical metal bars				
stone wall				
commode				
bike				
large boulder				
type of cart				
stair guarding fence				
stairs				
.....				

- Do children climb on objects not meant for climbing? Can you mention some of these objects?
- Do children climb on playground equipment in a different way than you would expect?
- Why are the objects mentioned above attractive to a certain age group?
  - most attractive for baby:  
because, ....
  - most attractive for old baby:  
because, ....
  - most attractive for young toddler:  
because, ....
  - most attractive for old toddler:  
because, ....

Climbing methods

- Can you distinguish different climbing methods?

- Can you describe these methods?
- What supports do children use while climbing (think about: points to hold on to, points to stand on, support points that help them pushing themselves up, other objects standing close)
- Do climbing methods differ per object, per child or both?

#### Character and climbing skills

- Do you agree that adventurous children are better climbers than other children?
- And how about wild children?
- Can you mention other qualities that are influencing the climbing skills of children?

#### Dangerous situations

- Is climbing of children causing dangerous situations and can you describe them?
  - group 1: age ... until ... :
  - group 2: age ... until ... :
- What is the cause of this dangerous situation do you think?
- In what way do you try to prevent this to happen?
- On what objects the children are not allowed to climb?

#### Safety and climbing equipment

- What do you know about the safety requirements being drawn up for playground equipment?
- Do you consider the climbing objects at your Day Care safe enough?

Thanks a lot for answering the questions.



**Questionnaire: climbing skills of children (gymnastics teacher)**

- What is the difference between climbing and clambering?
- In what way should you test the climbing skills of children?
- Do you give children grades for their climbing skills?
- Imagine, you would actually give them grades what aspects should you take into account?
- Does climbing on a climbing wall resembles climbing on other objects or are there differences between these types of climbing?
- What objects are according to you interesting for a practical test on climbing skills of children?
- How do gymnastics teachers stimulate the climbing skills of children?

**Development of climbing skills**

- Do children show differences in climbing skills development or is every child developing them in the same way? If there are any differences, can you describe them?
- What is causing these differences? (guts, motor development, upbringing, curiosity, influence of other children, environment, ...)
- Which of the following aspects is influencing the climbing skills of children and how much?

aspects	how much	short explanation
age		
character of a child (think about wild/quiet, enterprising and curious/ reserved, introvert/ extrovert)		
gender		
physical flexibility		
built		
step height		
size of hands		
size of feet		
arm length		
leg length		
strength in hands		
strength in legs		
strength in arms		
clothes		
physical exercise		

- Which of these aspects make it possible to predict if the child is a good or a bad climber without having seen the child climbing?

**climbing objects**

- Which objects are attractive to climb on for the different age groups?

	1-2 years	3-4 years	5-6 years	7-8 years	9-12 years	12-14 years
picknicktable						
table in the house						
highchair						
crib						
baby bed						

cupboard						
baby slide						
slide medium						
slide high						
tunnel slide						
swing						
rope net						
climbing frame						
playing house						
combination playground equipment						
crawling tunnel						
bench						
tree						
large boulder						
fence with diagonal ...						
wire fence						
fence with vertical ...						
stone wall						
bikes						
cars						
stairs						
soccer goal						
bottle bank						
drainpipe						
lantarenpaal						
bus stop house						
bike shed						
clamber frame						
rope						
turnkast						
horizontal ladder						
professional climbing wall						
long mattress over rekstok						

- Is it possible to measure if an object is easy or difficult to climb and how would you do that?

### **Climbing methods**

- Do climbing methods used by children differ for each object, for every child or both?

### **Dangerous situations**

- What is the cause of a dangerous situation do you think?
- One says that children know exactly what they can climb and what not. It is not likely they will do things they are not yet able to. How do you feel about this and do you think it is still useful to pay so much attention on the safety of playground equipment?

- Do children climb on objects in an other way than the object is meant for? If so, can you mention some examples?
- What are according to you the most important causes of climbing accidents?

	yes/ no, because	age
children pushing each other		
clothes/ hair		
showing off		
unable to recognize danger		
playing wild games		
playing fantasy games		
not knowing how to leave a position in a safe way		
unmeant use of an object		
taking toys or other objects with them while climbing an object		
slipping		

#### **Safety requirements on climbing equipment**

- Do safety requirements take the aspects mentioned above into account?
- Is it possible to take all these aspects into account and is it necessary?
- A great deal is responsibility of the user and the caretakers.
- What do you think of the following statement: Every child deserves his own broken arm?
- There seems to be a contradiction in the wish to make a completely safe playground object and the wish to offer the children the possibility to explore and develop their motor skills. How do you feel about this?

That was the last question. Thanks a lot for answering.

## Children

What do you know about climbing?

Hello, we are doing some research on the subject of climbing children. Because we think you know a lot more about this subject than we do we want to ask you some questions.

- How old are you?
- What is your length?
- Are you a boy or a girl?
  
- Do you like climbing and why do you like or not like it?
- Over or on which of the following objects did you ever climb?

	yes/ no	what was the height of the object?
tree		
tree-house		
bus stop house		
roof of bike shed		
roof of a normal house		
bottle bank		
normal slide		
on top of a tunnel slide		
climbing frame		
fence		
rope net		
wall		
swing		
playing house		
castle or other large playground object		
wip		

- What kind of fence is easy to climb?
- What kind of fence you are not able to climb?
- What is the highest object you did ever climb and how high was it do you think?
- Are you a good rope climber?
- What is according to you the best way to climb a rope?
- Did you ever climb on a professional sports climbing wall?
- If yes, how did it go?
- What is the best way to climb a fence?
- What is the best way to climb in a tree?
- What is the best way to climb a climbing frame?
- Are you able to climb the roof of a playground house?
- How do you manage to do this?
- What advise would you give other children to learn them how to become a better climber?
- What is your favourite climbing object and why?

Did you answer all the questions properly? Thanks a lot and who knows there will come even nicer climbing objects in the playground thanks to your help!

**Appendix J - Different types of climbing objects and methods for climbing these objects**



Climbing wall	
Age	5 years and older
Description	Irregular placed support points against a straight or angled wall.
Example products	<ul style="list-style-type: none"> <li>- drainpipe on wall</li> <li>- irregular stone wall</li> <li>- professional climbing wall</li> </ul>
Basic climbing method	<ul style="list-style-type: none"> <li>- staying as close to the object as possible</li> <li>- always 3 point contact, one hand or foot moving to other support point</li> <li>- thinking which is the best route to take</li> </ul>
Needed qualities and aspects concerning the children	<ul style="list-style-type: none"> <li>- Strength in arms, legs and hands.</li> <li>- Nerves.</li> <li>- Without shoes more feeling with the support points</li> </ul>
Dimensions and other important aspects for the object	<ul style="list-style-type: none"> <li>- horizontal and vertical distances between support points</li> <li>- angle of the wall</li> <li>- form and dimensions of the support points</li> </ul>



Vertical positioned clamber frame	
Age	4 years and older
Description	horizontal rods in a row straight above each other with regular or irregular spaces between them.
Example products	<ul style="list-style-type: none"> <li>- ladder</li> <li>- school clamber frame</li> </ul>
Basic climbing method	<ul style="list-style-type: none"> <li>- Grabbing the highest rod possible with both hands</li> <li>- put one foot on first rod</li> <li>- pull the other foot next to the first foot or put it directly one rod further (for good climbers)</li> <li>- replace one hand and so on...</li> <li>- good climbers can climb over the top or they turn around and jump down from the highest stairs.</li> <li>- children that are afraid of heights are more afraid when their face is turned into the direction of the open space.</li> </ul>
Needed qualities and aspects concerning the children	<ul style="list-style-type: none"> <li>- Strength in arms, legs and hands.</li> <li>- Nerves.</li> </ul>
Dimensions and other important aspects for the object	<ul style="list-style-type: none"> <li>- vertical distances between rods</li> <li>- diameter of the rods (grip or grab)</li> </ul>



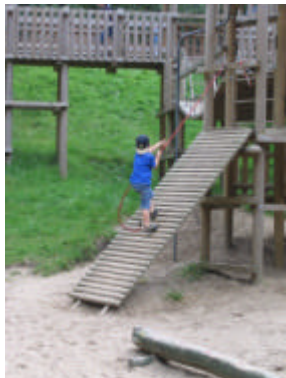
through a climbing frame	
Age	4-9 years (depends on the measures of the gaps in the frame).
Description	A difficult frame made of wood or iron pipes. Does not have to be very high to make it attractive
Example products	- climbing frames on playgrounds
Basic climbing method	<ul style="list-style-type: none"> <li>- adaptive climbing</li> <li>- always 3 point contact, one hand or foot moving to other support point</li> <li>- thinking which is the best route to take</li> <li>- looking for gaps big enough to let the body through.</li> </ul>
Needed qualities and aspects concerning the children	<ul style="list-style-type: none"> <li>- Strength in arms, legs and hands.</li> <li>- Physical flexibility</li> <li>- Small corps</li> <li>- not being afraid to climb with down in a strange position (head down to the ground for instance)</li> </ul>
Dimensions and other important aspects for the object	<ul style="list-style-type: none"> <li>- horizontal and vertical distances between support points in frame</li> <li>- Chance of head or foot getting stuck. Gaps should be large enough to let these body-parts through.</li> </ul>



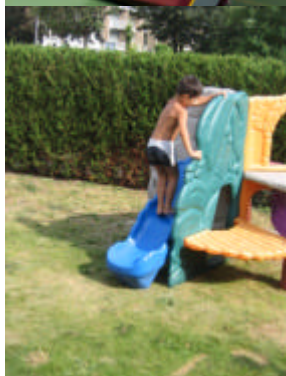
Wall without support points, higher than the climber	
Age	8 years and older
Description	A wall, wooden fence or object with smooth sides
Example products	<ul style="list-style-type: none"> <li>- playing house</li> <li>- bike shed</li> </ul>
Basic climbing method	<ul style="list-style-type: none"> <li>- The whole body will be used to climb on these objects.</li> <li>- jump to reach for top with hands.</li> <li>- Both hands on top of the object.</li> <li>- Push oneself up. (use feet and knees against wall to push)</li> <li>- one knee or foot over or on top.</li> <li>- sit on top</li> <li>- turn around, face to other side</li> <li>- other leg over the top</li> <li>- let down the body</li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>- sit on top</li> <li>- other leg over top</li> <li>- jump down</li> </ul>



Needed qualities and aspects concerning the children	<ul style="list-style-type: none"> <li>- Strength in arms</li> <li>- jumping height (strength in legs)</li> <li>- Perseverance</li> <li>- Length</li> <li>- Shoes with tread</li> </ul>
Dimensions and other important aspects for the object	<ul style="list-style-type: none"> <li>- roughness of the surface</li> <li>- height of the top of the object.</li> <li>- thickness of the top (is it possible to sit on it?)</li> </ul>



Angled plane with rope	
Age	4 – 12 years (depending on the height and steepness of the angled plane)
Description	Typical playground equipment. A rope serves as the third support point while two feet touch the angled plane.
Example products	<ul style="list-style-type: none"> <li>- entrance to climbing objects on playgrounds</li> <li>- thick mattress against angled clamber frame</li> </ul>
Basic climbing method	<ul style="list-style-type: none"> <li>- take the rope with both hands</li> <li>- walk to the top with one foot on each side of the rope,</li> </ul> <p>or</p> <ul style="list-style-type: none"> <li>- walk to the top with two feet to one side of the rope</li> </ul>
Needed qualities and aspects concerning the children	<ul style="list-style-type: none"> <li>- Strength in arms, hands</li> <li>- light built</li> <li>- Shoes with tread, or bare feet</li> </ul>
Dimensions and other important aspects for the object	<ul style="list-style-type: none"> <li>- material of the plane</li> <li>- Chance of head or foot getting stuck. Gaps should be large enough to let these body-parts through.</li> </ul>



Angled plane with little support points	
Age	3-14 years (3 year old children starting with a baby slide)
Description	There are support points but they are not meant as real supports (sides of slide, side of thick mattress).
Example products	<ul style="list-style-type: none"> <li>- entrance to climbing objects on playgrounds</li> <li>- sliding side of a slide.</li> </ul>
Basic climbing method	<ul style="list-style-type: none"> <li>- put one foot on the plane.</li> <li>- grab anything that you can grab with your hands (most of the time this will be the sides of the plane)</li> <li>- pull with your arms, while putting one foot forward.</li> <li>- replace hands and put other foot forward, ...</li> </ul>



Needed qualities and aspects concerning the children	<ul style="list-style-type: none"> <li>- Strength in arms</li> <li>- Perseverance, nerves</li> <li>- Shoes with tread, or bare feet</li> </ul>
Dimensions and other important aspects for the object	<ul style="list-style-type: none"> <li>- angle of plane</li> <li>- form and dimensions of grab points</li> <li>- roughness (material) of plane</li> </ul>



<b>Irregular shaped object</b>	
Age	2 years and older (depending on the size of the object)
Description	Support points are not always there when you need them. Moving parts.
Example products	<ul style="list-style-type: none"> <li>- entrance to climbing objects on playgrounds</li> <li>- sliding side of a slide.</li> </ul>
Basic climbing method	<ul style="list-style-type: none"> <li>- adaptive climbing</li> <li>- whole body will be used</li> <li>- thinking about the best route to take</li> <li>- looking for things that can use as support points</li> </ul>
Needed qualities and aspects concerning the children	<ul style="list-style-type: none"> <li>- Strength in arms, legs and hands.</li> <li>- Physical flexibility</li> <li>- nerves</li> <li>- not being afraid to climb with down in a strange position (head down to the ground for instance)</li> <li>- inventiveness</li> </ul>
Dimensions and other important aspects for the object	<ul style="list-style-type: none"> <li>- What support points are being used?</li> </ul>



<b>Rope network</b>	
Age	4-14 years (depends on the dimensions of the gaps in the network.)
Description	network made of ropes. Can be a big pyramid but also a bridge or a horizontal or vertical plane.
Example products	<ul style="list-style-type: none"> <li>- entrance to climbing objects on playgrounds</li> <li>- bridge</li> <li>- scouting built structures</li> <li>- rope pyramid</li> </ul>
Basic climbing method	<ul style="list-style-type: none"> <li>- adaptive climbing</li> <li>- always 3 point contact, one hand or foot moving to other support point</li> <li>- thinking which is the best route to take</li> <li>- looking for gaps big enough to let the body through.</li> </ul>



Needed qualities and aspects concerning the children	<ul style="list-style-type: none"> <li>- Strength in hands.</li> <li>- Physical flexibility</li> <li>- Not afraid of heights (you can see the ground through the network and this can be scary)</li> </ul>
Dimensions and other important aspects for the object	<ul style="list-style-type: none"> <li>- mesh size</li> <li>- thickness of rope</li> </ul>



Angled clamber frame	
Age	4-9 years
Description	Clamber frames can become more difficult when they are placed in an angled position. Especially climbing on the bottom of the frame is very heavy and can be scary. Climbing on top of an angled frame can be more frightening than climbing on a upright positioned clamber frame because you can look through the frame and see the empty space and distance to the ground below.
Example products	<ul style="list-style-type: none"> <li>- entrance to climbing objects on playgrounds</li> <li>- ladders</li> <li>- school clamber frame</li> </ul>
Basic climbing method	<ul style="list-style-type: none"> <li>- same as for the upright standing clamber frame</li> </ul>
Needed qualities and aspects concerning the children	<ul style="list-style-type: none"> <li>- Strength in arms, legs, hands and feet.</li> <li>- Nerves</li> <li>- not being afraid to climb with your head down.</li> </ul>
Dimensions and other important aspects for the object	<ul style="list-style-type: none"> <li>- distances between support points in frame</li> <li>- Chance of head or foot getting stuck. Gaps should be large enough to let these body-parts through.</li> </ul>



Real climbing objects without support points	
Age	6 years and older
Description	support points have to be made by the climber. Rope or pipe can be vertical but also horizontal or angled.
Example products	<ul style="list-style-type: none"> <li>- rope</li> <li>- vertical metal bar</li> <li>- tree</li> </ul>
Basic climbing method	<ul style="list-style-type: none"> <li>- special technique required</li> <li>- make support points by clasping the feet and/ or knees around the object.</li> <li>- pushing oneself up with the legs and hips</li> <li>- or pulling oneself up with the arms</li> </ul>



	(not the best technique because this is much more tiring)
Needed qualities and aspects concerning the children	<ul style="list-style-type: none"> <li>- Strength in arms, legs and hands.</li> <li>- not afraid of heights</li> <li>- Not too heavy built</li> </ul>
Dimensions and other important aspects for the object	<ul style="list-style-type: none"> <li>- grip of the object</li> <li>- roughness of the material</li> </ul>



Platforms	
Age	2 – 9 years (depending on the height of the platform)
Description	platform placed on a distance above the ground.
Example products	<ul style="list-style-type: none"> <li>- stairs</li> <li>- platforms in climbing objects</li> <li>- chairs, tables and other furniture</li> </ul>
Basic climbing method	<ul style="list-style-type: none"> <li>- both hands on the platform</li> <li>- pulling oneself up</li> <li>- one knee or foot on the platform</li> <li>- other foot next to first foot.</li> <li>- next step...</li> <li>- Some children pull their body up and lie down on the top.</li> <li>- older children can climb on higher platforms by jumping onto it. Placing their hands on top of it, pushing themselves up</li> <li>- The older the children get the easier it becomes to climb stairs with small distances between the steps. Once they are able to keep their balance they will try to walk the stairs without using their hands. They also start jumping of platforms and stairs.</li> </ul>
Needed qualities and aspects concerning the children	<ul style="list-style-type: none"> <li>- Strength in arms</li> <li>- Length</li> </ul>
Dimensions and other important aspects for the object	<ul style="list-style-type: none"> <li>- vertical distance between two successive platforms</li> <li>- size of the platform</li> <li>- Hands have to reach the platform which has to be lower than the child self.</li> </ul>



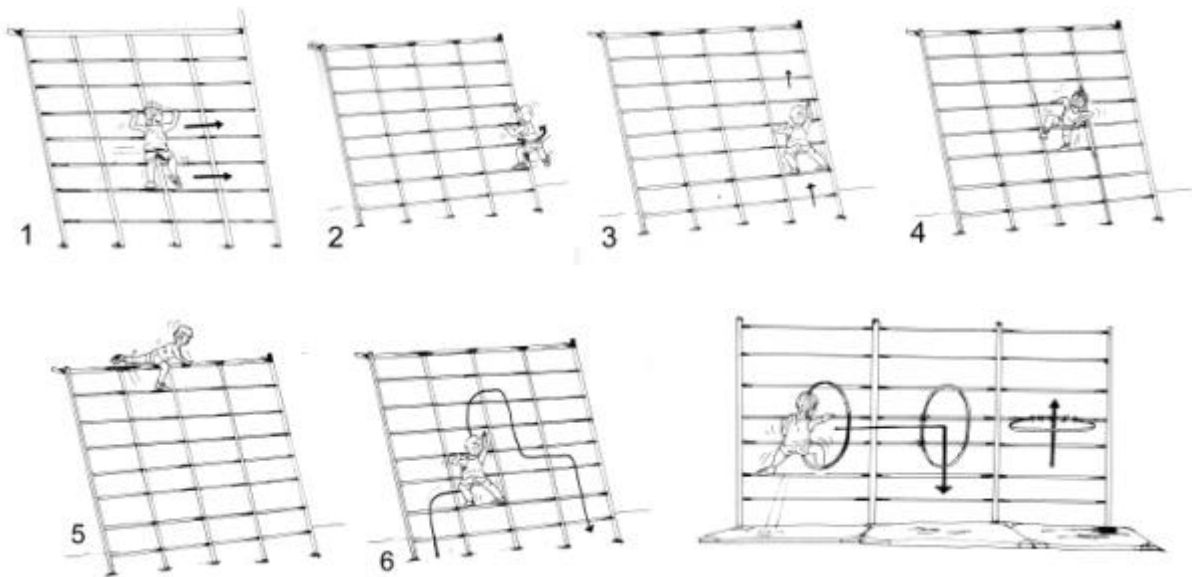
Fences	
Age	3 years and older (depending on the kind of fence, fences with vertical rod are difficult to climb when they are higher than the child self)
Description	Barriers meant to prevent children or adults from passing a border. Made of metal, wood or wire frames
Example products	<ul style="list-style-type: none"> <li>- sides of bed</li> <li>- crib</li> <li>- wire fence</li> <li>- wooden fence</li> <li>- fence with vertical bars</li> </ul>
Basic climbing method	<ul style="list-style-type: none"> <li>- Depends on the kind of fence you are dealing with. See appendix B and F</li> </ul>
Needed qualities and aspects concerning the children	<ul style="list-style-type: none"> <li>- Strength in arms, legs and hands.</li> <li>- Physical flexibility</li> <li>- Length</li> </ul>
Dimensions and other important aspects for the object	<ul style="list-style-type: none"> <li>- height of the fence</li> <li>- mesh size of the wire frame</li> <li>- distance between rods and pipes (large enough for feet and hands)</li> </ul>

## Appendix J – Creating different climbing situations with a simple clamber frame

Source: two articles by Dick Sol in the magazine 'Richting SportGericht' 1997

First steps in clamber lessons:

1. Climbing along a clamber frame
2. Climbing from the front side to the back side
3. Climbing up and down
4. Climbing through the frame
5. Climbing over the top of the frame
6. Combining these climbing skills will result in a difficult climbing path, indicated by a rope weaved through the frame which the children have to follow.



Hoops and sticks can make the path through the frame more challenging.



Change grip: Wooden rungs, a rope net, support points for a climbing wall, they feel very different and ask for a different climbing technique.

Irregular placed support points are more difficult to climb than regular support points.

The climber has

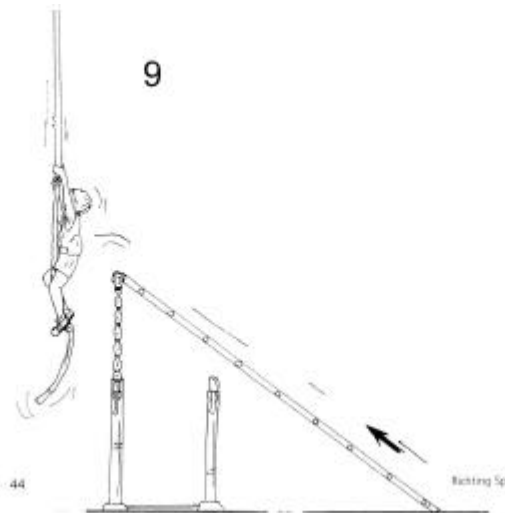
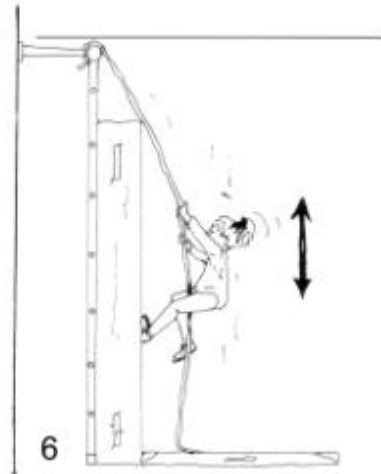
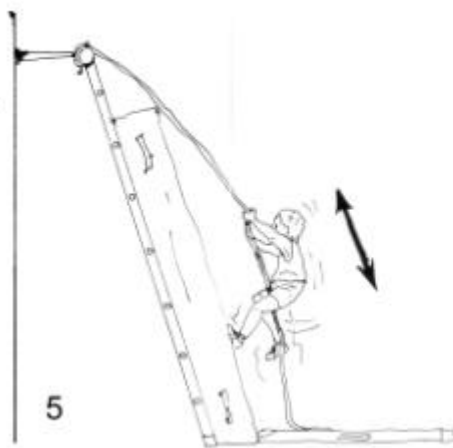
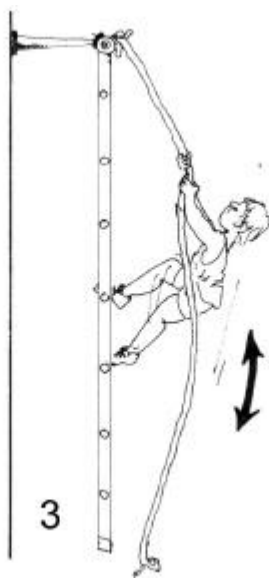
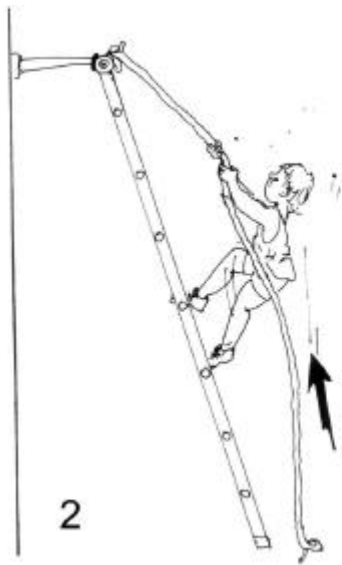
to think and look during climbing and it will adapt his route constantly (adaptive climbing). Practical solution: Take a saw and remove some of the rungs in the clamber frame.

Change the angle of the clamber frame. A smaller angle between frame and ground will result in a more difficult climbing situation, especially on the backside of the frame.

Climbing through the frame is technically more difficult than climbing over the top of the frame but a lot of children will find the last option more frightening because of the height and the open space they will have to face while turning around on the top of the frame.

Children at the age of 5/ 6 years can start with the following climbing exercises.





## Appendix K – Climbing equipment by Van Schelde International

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