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Do children create standardized playgrounds? A study on the gap-crossing affordances of jumping stones

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ABSTRACT

One point of critique on playgrounds is their omnipresent standardization—the distances between, for example, jumping stones or the ropes in a climbing net tend to be equal. Although current psychological literature suggests that nonstandardized playgrounds are beneficial for the children's motor development, standardized playgrounds may have a greater appeal to children because of their symmetry. The present study examined whether children opt for standardization if they construct their own playground. A group of children, who varied in their stepping and jumping capabilities, were provided with six identical jumping stones. Each child was asked to create her own jumping stone playground and play in it. The vast majority of the children created a configuration with varying gap widths. Moreover, the maximum and mean gap widths in the playgrounds were scaled to the (perceived) action capabilities of the children. This suggests that standardized playgrounds are indeed undesirable.

> "Modern architecture includes many examples of how the rational geometric framework upon which plans are laid—by creating an illusion of functionality—dominates the design process in a way contrary to the apparent needs of children." (Olwig, 1990, p. 49)

1. Introduction

Playgrounds are considered to be important for the development of children (see e.g., Czalczynska-Podolska, 2014; Hart, 1979; Moore, 1986; Solomon, 2014; Ward Thompson, 2013). Yet over the last decades, contemporary playgrounds have received serious critique (e.g., Jansson, 2010; Woolley, 2008). Hart (2002), for instance, stated that playgrounds fail to "satisfy the complexity of children's developmental needs" (Hart, 2002, p. 135). And in her book on American playgrounds the art historian Solomon started with stating that these playgrounds "are a disaster" (2005, p. 1).

Among the aspects that have been criticized is the omnipresent standardization of playgrounds. As the landscape architect Nebelong (2004) put it,

> I am convinced that 'risk-free', standardized playgrounds are dangerous – just in another way from those with obvious risks. When the distance between all the rungs in a climbing net or a ladder is exactly the same, the child has no need to concentrate on where he puts his feet. Standardization is dangerous because play becomes simplified and the child does not have to worry about his movements. This does not prepare him for all the knobby and asymmetrical forms he is likely to be confronted with outside the playground and throughout life. (p. 30)

The standardization that Nebelong refers to can be found in the vast majority of playgrounds and has a long history. Consider, for example, Aldo van Eyck's renowned playgrounds in Amsterdam. Van Eyck was a Dutch architect who developed more than 700 playgrounds in the second half of the previous century, the design of which has been widely copied (e.g., Lefaivre & Tzonis, 1999; Solomon, 2005). After the Second World War, van Eyck aimed to give the city back to the children. As he wrote in his book *The Child, the City and the Artist*, "If childhood is a voyage, let us see to it that the child does not travel by night" (van Eyck, 1962/2008, p. 21). Van Eyck's playgrounds consisted of many abstract forms intended to stimulate the creativity of the children. Yet, standardization abounds in his work. For example, his jumping stones, which figured as a central element in many of his playgrounds, were often placed in a typical symmetrical form, resembling a figure 8. In such a standardized configuration there are only two different gap

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widths that the child can cross (see Fig. 1).

1.1. Arguments against standardization

On the basis of the current psychological literature one can make several arguments against this standardization of playgrounds. As argued earlier (Prieske, Withagen, Smith, & Zaal, 2015), authors working from different theoretical perspectives have suggested that motor skills primarily develop when they are performed in different ways (e.g., Chow, Davids, Hristovski, Araújo, & Passos, 2011; Schmidt, 1975; Schmidt & Lee, 2003; Schöllhorn, Beckmann, & Davids, 2010). That is, the child should not repeatedly perform the same movement pattern; rather, to enhance the developmental process, the movement needs to be performed in a variety of ways. Standardized playgrounds, in which distances between blocks or rungs tend to be equal, do not facilitate this "variability of practice". Instead, they invite the child to continuously replicate a movement pattern.

Another argument why standardized playgrounds are undesirable is that children vary in their action capabilities. The implications of this truism become clear if one adopts an ecological approach to playgrounds (e.g., Broberg, Kyttä, & Fagerholm, 2013; Kyttä, 2002, 2004; Prieske et al., 2015; Sandseter, 2009; Storli & Hagen, 2010). Gibson (1979/1986), one of the founders of the ecological movement, stated that the environment of animals consists of action possibilities, which he coined *affordances*. With the introduction of this concept Gibson shifted the focus to the functional significance of the environment, to what an animal can do in it. Indeed, applying his ecological perspective to playgrounds would mean that they do not so much consist of play equipment (i.e., swings, climbing frames) located in a geometric space, but of things to sit on, climb in, glide from, and jump across (cf. Heft, 1988). Crucially, affordances exist by virtue of a relationship between the physical properties of the world and the action capabilities of the animal—whether a gap affords jumping across depends on the width of the gap relative to the jumping capabilities of the child. This means that the same playground can afford different behavior to children with different action capabilities. Hence, if a designer intends to develop a jumping stone playground for children who vary in their gap crossing abilities, she had better discard the standardization and opt for a wide variety of gap widths between the stones.

1.2. Do children create standardized playgrounds?

In the present study we examined what kind of playgrounds children create themselves. Do children opt for standardization as many adult designers do? Although the above arguments against standardization can be made on the basis of the current psychological literature, they by no means imply that nonstandardized playgrounds are to be desired. Among other things, standardized playgrounds entail symmetrical forms that might contribute to the attractiveness of the playground. Indeed, from infancy onwards, human beings are attracted to symmetry (see e.g., Bornstein, Ferdinandsen, & Gross, 1981). Hence, if nonstandardized, asymmetrical playgrounds have a limited appeal to children, they will not be frequently visited, implying that implementing them is not very effective.

In our study, children had a number of jumping stones at their disposal. Each child was asked to arrange these stones in such a way that she could jump or step from one stone to the other without touching the ground. This experimental design allowed us not only to test whether children opt for standardization, but also whether the created gaps were scaled to their (perceived) jumping and/or stepping capabilities.

2. Methodology

2.1. Participants

Forty children between 6 and 12 years of age participated in this study. There were twenty-four boys and sixteen girls, all from the same elementary school in the Netherlands. The study was approved by the local institution's ethics committee. By giving their informed consent, parents gave permission for the participation of their children.

2.2. Design and procedure

The study took place in a room (9.28 m × 7.53 m) of an elementary school in the Netherlands. We placed two camera's in the room: one for taking a photograph of the created playground, one to videotape the behavior of the children. The study consisted of three phases. In the first phase, each child was asked to create her own playground. To this end, the child was provided with 6 identical jumping stones made from honeycomb cardboard. The top and

Fig. 1. Zaanhof playground in Amsterdam designed by Aldo van Eyck. The left picture is a photograph of this playground (Courtesy of the Amsterdam City Archive), and the right figure is a top view of the arrangement of the jumping stones.

the sides of the stones were covered with carpet, to the bottom a thin rubber mat was affixed that prevented slipping. The stones were cylindrical with a diameter of 50 cm, a height of 20 cm, and a weight of 3.789 kg. One of the jumping stones was fixed in the middle of the room, the others were stacked in one of the corners of the room. Each child was instructed to build her own playground in which she could jump or step from one stone to the other without touching the ground. The child could place the stones wherever she wanted in the room with the exception that she was not allowed to pile the stones or to move the jumping stone that was fixed in the middle of the room. To experience whether the constructed playground was in line with her desires, the child was allowed to jump or step from one stone to the other during this phase. After the child completed all the phases of the study, the distances between the stones were measured with a ruler.

In the second phase, the child was asked to play for 2 min in the playscape that she had created. She started on top of the jumping stone that was fixed in the middle of the room and was free to cross over any of the created gaps without touching the ground. When a child accidentally touched the ground or fell from a stone, she was encouraged to step on the nearest stone and to continue playing. Based on the video recording of the child's playing behavior we determined which of the created gaps were crossed, how often these gaps were crossed, and how they were crossed (e.g., by stepping or jumping).

In the third phase of the study, we measured the perceived and actual stepping and jumping capabilities of the child. To this end, we used two jumping stones that were identical to the stones that the children used to create their playground. One of the stones was fixed, the other could be moved. The experimenter first demonstrated what was meant with stepping—starting with both feet at the edge of the fixed jumping stone, she stepped to the other stone. During the execution of the movement the experimenter always kept one foot on either one of the stones. Then the moveable stone was placed at a distance of 75 cm. The child, standing at the edge of the fixed platform, was asked whether she could cross this gap by stepping. If the child estimated she could, the gap width was increased with 5 cm; if the child judged the gap too wide, the distance was decreased with 5 cm. This procedure was reiterated until the perceived maximum stepping distance was reached. For the jumping task, the same procedure was used. The experimenter first performed a jump—she stood with both feet at the fixed stone and jumped to the other stone, with both feet having no contact with either one of the stones during a period of the movement. Then the moveable stone was placed at a distance of 1 m and the child, again standing at the edge of the fixed platform, was to judge whether she could cross this gap by jumping. As in the stepping condition, the distances between the stones was increased or decreased in steps of 5 cm, depending on the estimation of the child (see also Prieske et al., 2015).

After the estimations were made, we determined the maximum actual stepping and jumping distances. Again, the experimenter demonstrated what was meant with stepping. Then the child was to stand on the fixed stone and to step to the moveable stone that was placed at her perceived maximum stepping distance. If the step was performed successfully, we increased the gap width with 5 cm; if the child did not succeed in stepping to the other stone within three attempts, the gap width was decreased with 5 cm. As in the judgment tasks, this procedure was repeated until the actual maximum stepping distance was reached. The same procedure was followed to determine the maximum jumping distance. After the experimenter demonstrated a successful jump, the child was to jump from the fixed stone to the moveable stone (placed at her estimated maximum jumping distance), and the gap width was adjusted following the procedure of the stepping task.

Finally, we measured the child's standing height and leg length using Warren's (1984) methodology (see also Konczak, Meeuwsen, & Cress, 1992). The child had to stand against the wall and then to sit on the floor with her back against the wall and her legs straight. Leg length was computed by subtracting the child's sitting height from the child's standing height.

2.3. Analyzing the playing behavior

We used The Observer XT Version 11.5 (Noldus Information Technology, Wageningen, the Netherlands) to analyze the children's playing behavior. The following gap-crossing behaviors were coded: stepping across a gap, jumping across a gap, and other. Stepping and jumping were defined as mentioned earlier. Stepping means crossing the gap while having always one of the feet on a stone. For jumping, on the other hand, there should have been a period in which the performer's feet had no contact with the stones during the execution of the movement. Other was defined as all gap-crossing behavior that could not be classified as either stepping or jumping (e.g., using hands and knees to cross the gap). These behavioral criteria appeared to be sufficiently reliable. Two independent observers coded the playing behavior of nine children (22.5% of the whole sample). The inter-rater reliability was good (Cohen's kappa = 0.917).

3. Results

3.1. Child and playground characteristics

We first tested whether children were capable of perceiving their action boundaries. Table 1 gives an overview of the children's perceived and actual stepping and jumping capabilities. We found that children underestimated their maximum stepping and jumping distance—the perceived maximum distances were smaller than the actual maximum distances for both stepping ($t = 9.83$, df $= 39$, $p < .001$), and jumping ($t = 9.76$, df $= 39$, $p < .001$). Such underestimations are common when there are potential risks involved (Heft, 1993). After all, overestimations could lead to unsuccessful gap-crossing behavior, giving rise to injuries.

Subsequently, we examined the characteristics of the playgrounds that the children had created. By placing six jumping stones in a space, one necessarily creates 15 gaps.[1] However, not all of these gaps are meaningful to the child. For example, in Aldo van Eyck's jumping stones playground, the gap between the stones depicted at the bottom and the top of Fig. 1 is not of interest to the gap-crossing child. Hence, to determine the characteristics of the playground that each child had made, we used the playing behavior of the child in her playground. On the basis of the gaps that the child crossed in the playing phase, we determined for each playground the minimum gap distance, the maximum gap distance, the mean gap distance, and the number of different gaps crossed. In addition, to examine how many different gap widths each child had created, we conducted for each playground a hierarchical cluster analysis using the furthest neighbor method. This analysis was performed on the Euclidian distances of the crossed gaps, and we used as a cut-off point 10% of the mean gap width of that child's playground. This means that within each of the created clusters the differences between the gap widths did not exceed 10% of the average gap width of that child. Consequently, the number of clusters informs about how many different gap widths the child had created.

[1] Placing n stones creates $((n - 1)/2)*n$ gaps.

Table 1
The leg length, and the perceived and actual action boundaries for stepping and jumping across gaps of each participant.

Participant	Perceived max. stepping distance (cm)	Actual max. stepping distance (cm)	Perceived max. jumping distance (cm)	Actual max. jumping distance (cm)	Leg length (cm)
1	80	90	95	105	72
2	95	130	120	165	82
3	95	105	115	155	79
4	100	105	130	130	71
5	105	110	125	145	78
6	90	110	105	130	78
7	80	85	105	115	76
8	100	125	140	150	77
9	100	115	115	140	82
10	80	100	115	135	65
11	90	115	95	140	72
12	80	90	95	100	60
13	80	85	105	115	58
14	90	105	100	130	74
15	85	110	115	125	72
16	95	105	115	115	69
17	85	90	100	120	72
18	70	90	90	105	68
19	85	95	95	100	70
20	80	110	95	120	78
21	80	90	95	115	75
22	75	95	105	110	73
23	85	95	105	125	61
24	70	90	95	120	59
25	90	90	115	120	62
26	75	85	95	105	59
27	80	95	100	120	60
28	105	100	105	120	64
29	90	105	100	125	74
30	80	95	95	120	68
31	80	105	115	120	69
32	80	100	120	150	64
33	85	100	105	120	73
34	90	110	120	130	82
35	85	95	100	125	67
36	100	100	110	125	73
37	95	105	100	125	63
38	75	95	105	120	62
39	75	85	95	110	55
40	80	80	100	100	58
Average (SD)	86.00 (9.28)	99.63 (11.11)	106.25 (11.31)	123.63 (15.11)	69.35 (7.52)

As one can see in Table 2,[2] there was substantial variation within and between the created playgrounds. Among other things, the children varied in the number of different gaps that they crossed in their playground. Child 30, for example, crossed only 5 different gaps in her playground. Child 5, on the other hand, crossed the highest number of different gaps during the play phase (see Fig. 2). The relatively short distances between the stones in his apparently symmetrical playground allowed this child not just to cross over gaps but also to jump over stones (see Fig. 2). Hence, of all the 15 gaps available in a playground consisting of 6 stones (see Footnote 1), 13 were crossed. Apparently, symmetrical playgrounds do not necessarily limit the possibilities for action.

More interestingly, however, is the number of different gap widths in each of the playgrounds and their minimum and maximum width. Indeed, the main purpose of the present study is to examine whether children create standardized playgrounds. Do children opt for playgrounds in which the distances between rungs or stones are equal? As shown in Table 2, there was a considerable difference between the minimum and maximum gap width for the majority of children. None of the children created a playground in which the crossed gaps had the same width. Indeed, the minimum number of gap widths in the playgrounds was 2, and only two out of forty children created such a playground (see Fig. 3, Child 19, for an example). Seventy-eight percent of the children created playgrounds in which 4 or more different gap widths were crossed. This number is especially meaningful in light of the average number of different gaps that were crossed: 7.83. Hence, if children are the architects of their own playground, the vast majority of them created a variety of gap widths. The playground of Child 20 consisted of even 7 different gap widths (Fig. 3; see also Child 21). They varied from a relatively small gap width (36 cm) to gap widths that are almost equal to her perceived maximum jumping distance (96 cm; see Table 1). This brings us to the variation in gap widths between the playgrounds.

The children who participated in this study varied in their (perceived) maximum stepping and jumping distances (see Table 1). To examine whether the minimum, maximum, and mean gap widths in the playgrounds were scaled to the children's perceived and/or actual action capabilities, we conducted a series of

[2] For several children (e.g., Child 4, 8, & 15), the maximum gap width that they crossed in the play phase exceeded the actual maximum jumping distance that was determined after they had played. The reason for this might be two-fold. First, any measurement of a variable implies measurement errors. Second, and more importantly, the actual maximum jumping distance was measured while the child was to jump from a *standing* position. In the play phase on the other hand, the children could cross gaps while already moving. This allowed them to use their momentum in their jumps, implying that they could cross wider gaps.

Table 2
The minimum gap width, maximum gap width, mean gap width, number of different gaps that are crossed, and number of different gap widths of each playground.

Participant	Minimum gap width (cm)	Maximum gap width (cm)	Mean gap width (cm)	Number of gaps crossed	Number of different widths
1	55	83	70.60	5	3
2	67	144	107.13	8	4
3	76	92	86.33	6	2
4	102	144	119.75	8	3
5	34	128	68.77	13	6
6	48	109	70.78	9	6
7	70	106	79.75	8	4
8	78	176	124.33	10	5
9	71	127	91.44	9	6
10	48	82	67.79	7	4
11	47	96	69.50	10	6
12	42	85	59.75	8	3
13	57	82	68.67	6	4
14	55	84	66.20	5	4
15	62	171	124.33	9	5
16	56	120	90.50	8	5
17	43	67	55.44	9	4
18	36	91	53.25	8	5
19	60	79	69.00	6	2
20	36	96	59.40	10	7
21	18	77	36.33	9	7
22	1	107	60.67	9	6
23	50	122	74.25	8	4
24	59	136	96.60	10	5
25	37	62	52.88	8	4
26	42	94	62.00	8	6
27	96	136	119.17	6	3
28	41	101	75.00	6	4
29	52	81	67.83	6	4
30	53	80	63.60	5	4
31	66	149	98.86	7	5
32	90	170	126.25	8	4
33	64	134	96.29	7	5
34	94	130	111.67	6	3
35	52	104	79.80	10	5
36	73	103	93.50	8	3
37	63	151	102.13	8	5
38	21	33	24.60	5	3
39	18	81	35.45	11	5
40	33	79	49.83	6	4
Average (SD)	54.15 (21.81)	107.30 (32.37)	78.24 (25.62)	7.83 (1.82)	4.43 (1.24)

multiple regression analyses using the forced entry method. As independent variables we used the perceived maximum stepping distance, perceived maximum jumping distance, actual maximum stepping distance, and actual maximum jumping distance. Because in a previous study the affordance of stepping across a gap was quantified as a percentage of leg length (Chemero, Klein, & Cordeiro, 2003), we also included this anthropometric measure as an independent variable in the multiple regression analyses. Table 3 provides an overview of the created models. As one can see, the model for the minimum gap width did not reach significance—none of the included independent variables significantly predicted the size of the narrowest gap. The maximum gap width, on the other hand, had two significant predictors: perceived maximum jumping distance and the actual maximum stepping distance. And mean gap width was significantly predicted by the perceived maximum jumping distance—the greater the child's estimated jumping distance, the wider the mean gap width was. Hence, the differences in gap widths between the playgrounds of the children can be partly explained by the variation in their (perceived) action capabilities.

3.2. Playing behavior

As mentioned in the method section, we also analyzed the behavior during the play phase. On the basis of the video recordings we counted how often each child crossed the gaps by means of stepping, jumping, or in another way (e.g., using hands and knees). Table 4 provides an overview of the gap crossing behavior of each child. Although an earlier study revealed that children prefer to jump in crossing gaps (Prieske et al., 2015; see also Sheets-Johnstone, 2003), we did not find a significant difference in the frequency by which the children jumped and stepped ($t = 0.13$, df = 39, $p > .05$). However, the children varied considerably in their gap crossing behaviors. Four children (Child 13, 24, 27, & 32) crossed the gaps by only jumping; two children (Child 14 & 21) did do so by only stepping; and the rest of the children used varying mixtures of gap crossing behaviors during the play phase.

Presumably, this variation in gap crossing behavior can be partly explained by the variation in the gap widths of the created playgrounds. After all, it is likely that if the created gaps are wider, the child is more inclined to jump across them than to step across them. We indeed found significant correlations ($ps < 0.001$) between the percentage of jumps and the minimum gap width

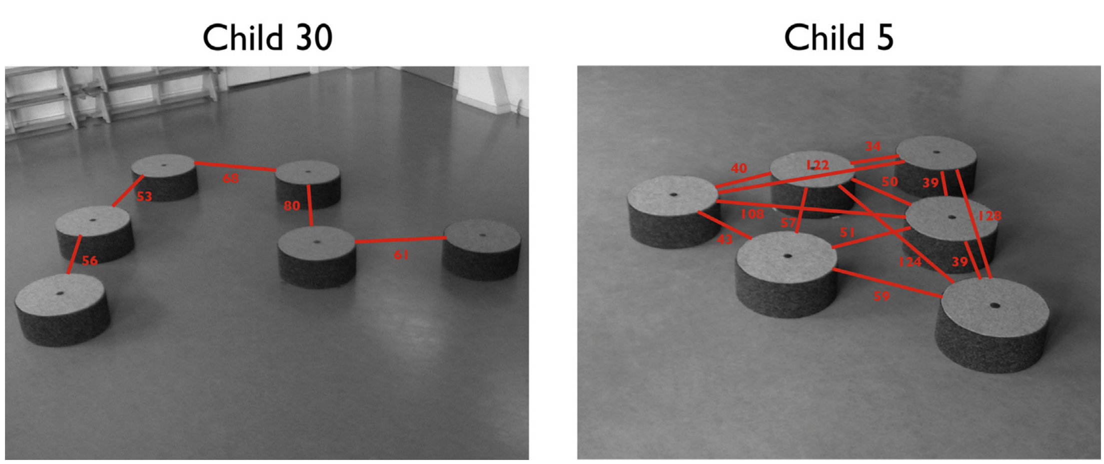

Fig. 2. Variation in the number of gaps that are crossed. The red lines indicate the gaps that are crossed during the play phase (distances in cm). The left figure depicts the playground of Child 30, and the right figure depicts the playground of Child 5. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

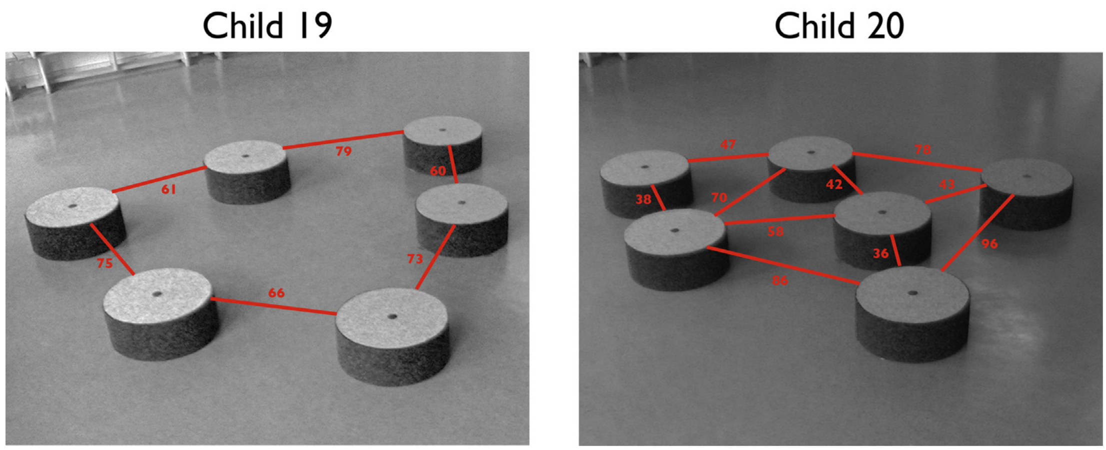

Fig. 3. Variation in the number of different gap widths that are created. The red lines indicate the gaps that are crossed during the play phase (distances in cm). The left figure depicts the playground of Child 19, and the right figure depicts the playground of Child 20.(For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

Table 3
Multiple regression models for the minimum, maximum, and mean gap width. As independent variables we used the perceived maximum stepping distance (PMstep), perceived maximum jumping distance (PMjump), actual maximum stepping distance (AMstep), actual maximum jumping distance (AMjump), and leg length. For each independent variable in each model the coefficient (*b*), the standard error of the coefficient (*SE* of *b*), its 95% Confidence Interval (95% CI), and the *p*-value (*p*) are reported. The r^2 and the adjusted r^2 of the models are mentioned below the table.

Model	Predictor	*b*	*SE* of *b*	95% CI		*p*
				Lower	Upper	
Minimum[a]	Constant	−57.55	36.83	−132.39	17.30	0.13
	PMstep	0.16	0.49	−0.83	1.15	0.75
	PMjump	0.64	0.41	−0.20	1.48	0.13
	AMstep	0.02	0.57	−1.14	1.18	0.97
	AMjump	0.27	0.37	−0.49	1.02	0.48
	Leg length	−0.06	0.59	−1.27	1.14	0.92
Maximum[b]	Constant	−64.13	46.84	−159.32	31.06	0.18
	PMstep	−0.76	0.62	−2.02	0.51	0.23
	PMjump	1.38	0.53	0.32	2.45	0.01
	AMstep	1.92	0.73	0.44	3.40	0.01
	AMjump	−0.26	0.47	−1.22	0.71	0.59
	Leg length	−1.01	0.75	−2.54	0.52	0.19
Mean[c]	Constant	−72.79	37.81	−149.62	4.05	0.06
	PMstep	−0.23	0.50	−1.25	0.78	0.64
	PMjump	1.06	0.42	0.20	1.92	0.02
	AMstep	1.05	0.59	−0.15	2.24	0.08
	AMjump	−0.04	0.38	−0.82	0.74	0.92
	Leg length	−0.60	0.61	−1.83	0.64	0.34

[a] $r^2 = 0.267$, Adjusted $r^2 = 0.159$.
[b] $r^2 = 0.462$, Adjusted $r^2 = 0.382$.
[c] $r^2 = 0.440$, Adjusted $r^2 = 0.357$.

($r = 0.569$), maximum gap width ($r = 0.449$), and mean gap width ($r = 0.630$). Hence, if the gaps are wider, children are more likely to cross them by means of jumping.

4. Discussion

The present experiment examined whether children create standardized playground facilities, that are, facilities in which distances between, for example, jumping stones or the ropes in a climbing net are equal. This standardization is one of the aspects that has been criticized in contemporary playgrounds (e.g., Nebelong, 2004). In our study, we provided a group of children, who varied in their stepping and jumping capabilities, with 6 identical jumping stones and asked each of them to create their own jumping stone playground. We found that the vast majority of children created a variety of gap widths. Moreover, we observed that the maximum and mean gap widths in the playgrounds were scaled to the (perceived) action capabilities of the child. In the

Table 4
The number of steps, jumps, and other gap-crossing behaviors (other) during the play phase.

Participant	Steps	Jumps	Other
1	46	28	0
2	17	39	0
3	37	53	0
4	13	43	0
5	85	17	0
6	92	5	0
7	59	7	0
8	7	68	0
9	20	43	0
10	20	83	0
11	35	22	0
12	29	22	9
13	0	80	0
14	23	0	0
15	7	31	0
16	11	60	0
17	47	37	1
18	68	30	0
19	66	17	0
20	75	18	0
21	77	0	0
22	55	14	0
23	45	26	0
24	0	43	0
25	6	83	0
26	9	46	0
27	0	40	0
28	12	58	0
29	67	30	0
30	17	4	0
31	29	61	1
32	0	53	0
33	39	26	0
34	5	58	0
35	42	16	0
36	2	56	0
37	18	21	0
38	43	23	15
39	78	5	0
40	70	43	0
Average (SD)	34.28 (27.68)	35.23 (22.80)	0.65 (2.73)

remainder of the discussion we discuss the implications of these findings for the question of whether playgrounds should be standardized. We end with some comments on a difference between children and adults as architects.

4.1. Should standardized playgrounds be discarded?

In the introduction of this paper, we stated that although nonstandardized playgrounds are likely to be beneficial for the motor development of the child, the asymmetry that often characterizes them might make them less attractive. However, the present study questions this latter concern and provides two arguments for discarding the omnipresent standardized playgrounds. First, we found that if children are the architects of their own jumping stone playground, the vast majority of them created a playground with a variety of gaps widths. Apparently, children do not opt for standardization within their own playground. Hence, although earlier studies on picture viewing have revealed that children prefer symmetrical patterns (see e.g., Bornstein et al., 1981), this preference seems not of overriding importance in the children's design of the jumping stones playground. Second, based on the multiple regression analyses, we observed that the mean and maximum gap widths in the playground were predicted by the (perceived) action capabilities of the children. The mean gap widths in the playgrounds, for example, were scaled to the children's estimated maximum jumping distance. That is, children with different (perceived) jumping capabilities created different gap widths, suggesting that standardized playgrounds are indeed unsuitable for a wide range of children.

This latter finding is in line with the affordance perspective that we laid out in the introduction. To reiterate, according to this perspective, the environment consists of possibilities for action and is perceived as such. Thus, visiting a jumping stone playground, a child would not perceive the distance between two stones in terms of centimeters but in terms of whether the gap is crossable for her (e.g., Gibson, 1979/1986; Heft, 1988). The present study suggests that affordances are not only primary in the children's perception of the environment but also in their design of it—if children can modify their environment they do so in accordance with the (perceived) action capabilities of their body (cf. Withagen & van Wermeskerken, 2010). This brings us to the child as architect.

4.2. The child versus the adult as architect

By letting children to be the architect of their own playground, the present study revealed a discrepancy between the designs of children and those of adults. The vast majority of the created jumping stones playgrounds in this study did not mimic the omnipresent standardized ones. Over the last decades, several authors have commented upon the discrepancy between the adults' design of playgrounds and the needs of children (e.g., Cooper Marcus & Moore, 1976; Francis, 1988; Olwig, 1990). Interestingly, Olwig (1990) traced the origin of this discrepancy to the nature of the design process.

> Architects begin their training at the drawing board, and it is the drawing board to which they return when they must solve a problem. […] Understandably, given this background, the first step the planner or environmental designer often makes when approaching a problem is to draw a plan, blueprint, or map. The problem thereby becomes framed by the invisible geometric coordinates upon which the plan is drawn. The design, then, is predicated upon a notational system that defines the world in terms of Euclidian geometric space. (Olwig, 1990, p. 47)

The result of these "invisible geometric coordinates" in the design process may appear not only in the grid structure of many cities (e.g., Koolhaas, 1978/1994), but also in the (public) places for children's play (Olwig, 1990). Indeed, the omnipresent standardization in playgrounds is arguably the result of this too. Hence, whereas the child creates a playground that is based on her (perceived) action capabilities, the adults' design of playscapes is guided by a geometric framework that is indifferent to those.

There are, of course, different ways to circumvent this problem. One way is by letting children to be the architects of their own playscapes, as we did in the present study. In the 1940s and 1950s, the landscape architect Sørenson and the writer and horticulturist Lady Allen of Hurtwood already experimented with this idea in their so-called Adventure Playgrounds (see Cooper Marcus & Moore, 1976; Solomon, 2005). These playgrounds often consisted of an enclosed area with chunks of wood and metal in which children were given full vent to their "strong desire to manipulate the physical environment" (Hart, 1979, p. 343). This arguably results in spaces that are in line with the children's preferences and match their action capabilities. However, although modifiable (nature) playgrounds are increasingly popular nowadays, they cannot be realized in many (urban) settings because of various reasons (e.g., safety, vandalism).

Another option is to develop fixed playgrounds that are inspired by the designs of children, are created in dialog with them (e.g., Francis, 1988), or at least take the wide variability in the children's (perceived) action capabilities as its starting point. The present study indicates that such approaches would result in the construction of nonstandardized playgrounds instead of standardized ones. An example of such a playscape is depicted in Fig. 4. The wide variety of gap widths and heights in this play facility has several advantages. First, it affords children with different action capabilities to climb and cross over gaps. Second, it would facilitate the "variability of practice" that we mentioned in the introduction—navigating through the construction, children have to cross over gaps of different widths and climb different heights. And such variability of practice, current thinking in human movement sciences indicates, is beneficial for the motor development of the child.

Fig. 4. A play facility in Lichtenwald, Germany, designed by Kukuk. Reprinted with permission.

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