



# The influence of environment potentiality (affordances) on motor development in 6–9 years old children with intellectual disability

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## Abstract

**Background** Affordance is the tendency to encouraged of growth changes. It involves providing critical assistances and encouraging or training learners.

**Objective** The purpose of this study was to determine the effects of environmental affordances on motor development in children with intellectual disability.

**Methods** This was a quasi-experimental study. Target population included 175 children (6–9 years old) with intellectual disability living in Babol in 2017. Among them, 50 children were conveniently recruited and randomly divided into two groups: experimental and control group (25 per each group). The experimental group went under a specific program including the environmental affordances, such as facilities, training, and exercises focusing on motor skills development of children. The intervention lasted for 36 weeks, three sessions per week, and 30–45 min per session. Bruininks–Oseretsky Test of Motor Proficiency was used to assess the motor skills development of participants. Analysis of covariance was used to analyze the collected data.

**Results** The obtained results revealed that affordances had impact on upper parts of the body coordination ( $p=0.02$ ), agility ( $p=0.04$ ), balance ( $p=0.04$ ), response rate ( $p=0.6$ ) and power ( $p=0.03$ ). Also, results of the study showed that affordance had no impact on the variables of motor–visual, speed and dexterity of the upper parts in the study ( $p=0.13$ ).

**Conclusion** In conclusion, there should be special attention to the environmental affordances for enhancing motor skills development in children with intellectual disability. Considering the benefits of the assigned protocol in the present study, it could be used as a complementary and alternative medicine for motor skills development in children with intellectual disability without the side effects owing to medication.

**Keywords** Environment · Affordances · Motor skills development · Children · Intellectual disability

## Introduction

Research on the relationship between behavior and environment factors has been investigated for a century. For example, Gulliver in 1908 [1] and Trowbridge in 1913 [2] considered this issue. Environment potentiality as a key and useful concept has been referred by many behavior

and environment theories, while its various applications followed diverse interpretations and themes. These theories have shown the general concept, i.e., life quality in the man-made environment and this reveals the necessity of considering man-made environment potentialities [3]. In the real life, our behaviors take place in the environment; although the environment is consistently changing, there is a lot of information; i.e., it embeds much more meaning than it appears [4].

Gibson's theory had been the turning point in the development of environmental psychology, and is a context in the increasing development by considering it as an interactional relation between the actor and other factors and physical systems [5].

Nevertheless, few researches considered the relationship between motor development and environment capacity in

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children with mental disorders [6]. A study about the influence of affordances in environment on children's motor development stated that a wide range of the presented stimulus in the physical environment such as sport tasks and equipments and toys leads to an improvement of children's motor development; yet, the quality of children education is very important. In this study, the application of developmental content and tools caused promotion of rough and delicate motor skills in children [7]. Geuze in a research investigating affordances and constraint, in motor development and learning of children with developmental coordination disorder proved that the role of constraints as a key in motor development and learning leads to a proper understanding of growth concept [8]. Bjørgen in a study about the physical activity in outdoor space using affordances claimed that the opportunities and affordances existing in an outdoor space for inculcating potential qualities and physical activities are an appropriate catalyst for enhancing children's motor development. This study showed that the main feature of an outdoor space is an opportunity and an inspiring source for children. The authors further showed that via practice, children were able to maintain their height from the intended blocks while standing and sitting and keep their posture control [9].

In Gibson's belief, there is a close relationship between perceptual and movement system. From this perspective, individuals, with the consistent movement of the eyes, head and body, have a direct perception toward their environment and do not require complicated calculations and information processing pertaining to their body and entities for performing movement. Affordance is the tendency to the development or encouragement of developmental changes. It involves critical helps, catching hands, encouraging and education learners [10].

The development of all existential dimensions of the child originates from the "movement", and "motor development" is considered as the major dimension and the basic of growth and evolution. Therefore, considering the significance of early ages of life stages on the development, and existence of open opportunities, it seems that the influence of environmental affordances as a stimulating factor in optimal use of opportunities for the optimal development of children with mental disorder should receive more attention [11]. Compared to other children, these groups of children obtain lower scores in the fundamental movement skills and acquire these skills slower than normal ones. Considering that few researches have carried out studies on the influence of environmental affordances on the development of children with mental disorder, the purpose of this study was to address the impact of environmental affordances in 6–9 years old children with intellectual disability. Most studies already conducted in an area are causative–comparative and there had been no intervention in the area. Therefore, providing some intervention in the environment affordance is due

to the needs so that we could investigate the intervention effects on motor development of children with intellectual disability.

## Methods

### Study design

The present study is an empirical research with pretest and post-test with the control group.

### Participants

The statistical population of this study included 175 students of 6–9 years old with mental disorder in 2017 academic year. A total number of 50, 25 for each group of control and experimental were selected. Given the available facilities and cooperation of the principal and teachers of exceptional schools of Babol, this number (one control and one experimental group) was randomly selected.

Cohen stated that at least 15 samples should be selected for sample selection in purposeful and experimental studies [12]. Accordingly, and based on the facilities and cooperation of teachers and principals of the exceptional schools of Babol, among the above-mentioned students, 50 were selected for sampling. Sampling was carried out in a simple random manner. Drawing was used for this purpose; therefore, children were provided with equal chances to be in the experimental or control group.

### Inclusion and exclusion criteria

In this study, the criteria for participating in the study included IQ between 53 and 73, the age range of 6–9 years old, and no genetic, cardiac, neurological, organoleptic, orthopedic (skeletal, muscular), postural and multi-disability abnormalities, and also the criteria for leaving the study were lack of regular and continuous participation in exercises. To ensure the physical health of the participants and to meet the criteria for participating and leaving the study, all subjects were medically examined at the first session.

## Measures

### Stanford Binet

This intelligent test involves verbal and non-verbal intelligence.

In its 5th version (2003), five factors including immobile argument, quantity reasoning, spatial–visual processing, and non-verbal intelligence are calculated. The individuals

age range includes 2–85 and intelligence calculation using totally proprietary score transformation tables for different ages is among the advantages of this test which represents evolutionary development of scale and mental scales. Moreover, mean of 100, SD 15 is total and mean 10 and SD 3 for each subtest are achieved [13].

The reliability of this test was obtained through Cronbach's alpha and its validity was proved through correlation of subscales scores with the total score of the test as 0.79 and 0.83, respectively. The results of internal consistency analysis in this study showed that the alpha coefficient for the total scale is 0.84 and for the sub-scales is between 0.73 and 0.81 [14].

### **Bruininks–Oseretsky Test of Motor Proficiency (bot BOTMP)**

This test is designed for evaluating motor proficiency of children of ages between 5 and 14. This scale is performed individually and has 36 articles, and measures variant motor competence like fingers, eyes–hands coordination and the activities of big muscles, hands, feet and body. As it is clear from the title, this is a motor index. The existing information shows that there is a rather constant slope, yet gradual between the ages of 5–14 Oseretsky scale is a motor scale which is created by Russian researcher. Oseretsky, in fact, comprises the main pillar of these motor tests. In 1950, after conducting some the main pillar of these motor tests. In 1950, after conducting some deliberation and deletion of 49 articles from the original scale, this present scale, which consists of 36 articles, is in use. Moreover, there was an attempt to arrange these 36 articles in order of difficulty [15].

Experiences show that children of 10 years old and above have little challenges in the first 5 articles. In this case, the total score could be allocated to the above-mentioned group and start from article no. 6. The items of this test could be scored from zero to 1 and 2, and the final total score would be 159. The obtained score would be brought on the curve, and given the age, the status of the participants be represented with respect to normality will or abnormally.

The reliability of this test was obtained through Cronbach's alpha and its validity was determined by correlation of subscales scores with the total score of the test as 0.73 and 0.82, respectively. The results of internal consistency analysis showed that the alpha coefficient for the total scale is 0.75 and for the sub-scales is between 0.71 and 0.78 [16].

### **Procedure**

For conducting research, first by taking license from the intended centers specific for exceptional students, an adequate number of student with mental disorders were

selected; hence, also samples were selected. Then by showing university introduction letter research objectives were explained with the help of school principal and volunteer. Parents were invited to assist in this project. Also the phone number of all eligible participants was received from the school administrators. They were contacted and research objectives were explained to them, and volunteer parents were selected, by an appointment with the them. Volunteer parents received a consent letter. Then, based on the anticipated variables of this study, affordances were provided based on facilities or training and practicing in the school environment for the students. Before doing the study, first all intended tests and scales were implemented on children with mental disorders so that the reliability and validity of these tests could be examined on the intended population and sample.

First, Stanford Binet intelligence first employed for all the participants with examiner's assistance and the score of each participant was calculated. In pretest phase, for measuring motor development of groups, BOTMP was employed 2 weeks before starting the plan. These tests were taken by planning with the participants.

After 36 session's period of affording using the intended scales in post-test, children development was measured and pretest and post-test scores were composed.

### **Intervention**

For investigating the impact of affordances in the school environment, the equipments training and practicing were applied for creating an environment with high potentialities, aligned with intended variables.

Then, the experimental group spent 3b sessions (3 months, 3 sessions per week), each session 30–45 min in an equipped and veracious atmosphere and with the supervision of medical expert for injury prevention, and worked in on affordance-equipped environment.

In this study, the educational environment has some hardware, equipment such as treadmill, twist, swing, carousel, slide and bale pool. Also, it should be noted that the training relevant to sport activities must be carried out by competent coaches and experienced therapists for mentally retarded children.

Due to ethical consideration, the processes and objectives of the research were explained to school administrators, coaches and students' parents. They were justified that this is just a research project and they are required to participate if they want to; otherwise, they could give up. For statistical analysis of raw data, descriptive and explorative data were used. The obtained data were analyzed by spss21 and multivariate covariance analysis was employed.

## Results

Table 1 represents the mean and standard deviation of the individual characteristics of control and experimental groups.

Table 2 shows mean and SD of motor development variables in the control and experimental groups.

As it is shown in Table 3, there was a significant difference between two groups in motor development area ( $p < 0.01$ ). In other words, the difference between two group’s scores indicates that affordances were influential in improving motor developments skills in retarded children. Given eta square, it could be said that 68% of this improvement change is due to the influence of intervention program.

Results of Table 4 indicate that affordances have led to significant difference between experimental and control group in two coordinations of motor skill of upper parts of the body and mutual coordination with high statistical power is indicative of high precision of the test and adequacy of sample volume. Also, eta square related to upper body coordination is 0.48. In fact, influence rate is 48%. Statistical power of 0.62 is indicative of high precision of this test and adequacy of sample volume. Moreover, affordances had no impact on motor–visual control speed and agility variable ( $p < 0.01$ ). Table results represent that affordance had impact on improvement of other skills of motor development such as balance, response rate and power, their statistical significance was 0.39, 0.51, 0.74, 0.49, and 0.19.

## Discussion

This study aims at investigating the influence of environment potentialities (affordances) on motor development of mentally retarded children of 6–9 years old. Results show that affordances affected improvement of motor development skills in mentally retarded children. By considering eta square, it could be said that 68% of these changes of improvement is due to intervention influents. Given

**Table 1** Mean and SD of the sociodemographic variables of participant and individual features

Variable	Experimental group		Control group	
	Mean	SD	Mean	SD
Age	7.4	0.6	7.9	0.8
Height	108.2	7.2	108.7	7.6
Weight	24.1	1.6	25.7	1.8

**Table 2** Mean and SD of control and experimental groups in motor development area

Motor developmental skills	Control group		Experimental group	
	Mean	SD	Mean	SD
Agility	0.878	0.7	0.864	0.6
Two-way coordination	0.825	0.4	0.837	0.3
Power	0.934	0.3	0.972	0.5
Response rate	1.243	0.9	1.643	0.5
Speed and agility of the upper extremity	1.482	2.374	1.457	1.237
Upper limb coordination	1.394	1.547	1.657	1.271
Movement-controlled vision control	0.872	0.9	0.849	0.8
Balance	0.792	0.9	0.736	0.8

**Table 3** Results of multivariate covariance analysis to show the difference among motor development subscales in control and experimental groups in

Statistical index reference	Lambda Wilkes	F	p	$\eta^2$	Statistical power
Group	0.483	18.382	0.001	0.684	0.79

eta square, it can be said that 68% of these changes of improvement are due to intervention influences. These research results are in concordance with Refs. [7, 8] and not in concordance with Refs. [9, 17].

This research showed that understanding affordances and developmental changes in children with developmental coordination disorder are useful. During motor development process in normal children, perception-motor information connect naturally. Some motor development practitioners like [18] believe that many learning problems are due to some disorders that emerge as a result of genetic factors, pregnancy infections or environmental deprivations of development period in neural system [19]. Therefore, it could be concluded that most probably, in abnormal children such as children with mental disorder the appropriate coupling between perception and movement has not been formed during development process, especially sensitive period. Also, Bjørngen in study also suggests that the main feature of outdoor space is that it is an opportunity and an inspiring factor for children [9]. Moreover, social opportunities and human interactions are the most positive effects that emerge as a result of children’s game in the long run. There should be adequate sport and social opportunities in the outdoor spaces like enough time and education for children so that they could achieve proper cognitive and motor development. Affording could be defined as opportunities which provide the individuals potentialities for performing actions which

**Table 4** Results of multivariate covariance analysis (MANCOVA) difference between experimental and control groups in motor development subscales

Agility	Indicator	Number	Sum of squares	<i>F</i>	<i>p</i>	$\eta^2$	Statistical power
Agility	Experimental	25	35.361	13.2	0.04	0.39	0.39
	Control	25	59.472				
Two-way coordination	Experimental	25	44.482	8.29	0.02	0.61	0.73
	Control	25	76.381				
Power	Experimental	25	42.294	7.83	0.03	0.43	0.49
	Control	25	72.648				
Response rate	Experimental	25	26.482	14.87	0.6	0.27	0.19
	Control	25	58.294				
The speed and agility of the upper extremity	Experimental	25	31.359	9.46	0.13	0.19	0.46
	Control	25	72.382				
Upper limb coordination	Experimental	25	38.284	8.37	0.04	0.48	0.62
	Control	25	73.294				
Movement-controlled vision control	Experimental	25	33.294	7.94	0.11	0.31	0.13
	Control	25	64.286				
Balance	Experimental	25	36.682	8.82	0.04	0.36	0.51
	Control	25	58.467				

Degree of freedom is 1

lead to learning and development of a skill, or development of different parts of his /her biological system [20]. Prieske et al., in their research entitled providing small spaces and its role in challenging children, stated that Gibson's environment psychology employed children game concept [17]. This concept included environment as a factor for children's motor and cognitive development. In general, children did not like the non-challenging affordances. Moreover, especially while descending and crossing blocked gaps in a certain path children preferred to jump, even if there were stairs to use. The lack of alignment of the aforementioned study with this present one is likely due to the space type which is selected by the researchers as small spaces and restricts the freedom for performing and selecting game and task methods for children.

Results showed that children through practice could maintain their height from the intended blocks while standing and sitting and keep their posture control. Result of the study also revealed that affordances have led to a significant difference between control and experimental groups in two skills of coordination movements of upper body with high statistical power. The table results show that affordances impact on improving other skills of motor development such as agility, balance, response rate and power. Failure in development and modification of professional and fundamental motor skills in the sensitive pre-school and early years of school age would lead to failure in their performance in an adolescence and adulthood. Failure in development of mutual patterns like throwing catching and hitting would further hinder children's success in games and exercises. If

children do not learn the necessary motor skills in a certain activity, they would not achieve any success in accomplishing that activity [10, 21]; these results were in line with Audrei et al. research results. They reported that child will grow more cognitively by enriching its environment with more cognitive and developmental tools [22]. Tools help the child to grow more in terms of movement and cognition. Affordance help that children interact with their surrounding world more comfortably contextual information more easily.

The strengths of this research can be explained by development of the new idea, along with the field and research libraries, necessary for conducting this research and the full accompaniment of parents and school officials with this work. As one of the weak points of this research, the physical condition of the research participants could be pointed out, which sometimes complicated the implementation of the research.

This study was encountering some limitations such as lack of precise follow-up test of 'participants' status exposed to interventions and also participants age limitations. Moreover, inclusion of only male participant was among its limitations, too.

Regarding the findings of the accomplished research, it is suggested that one of the appropriate and necessary solutions for modifying and amendment of motor development problems in children with mental disorders is the design of programs based on sport standards and eventually the implementation of this plan in all educational centers. At the beginning of the academic years, there should be the measurement of motor development ability and recognition of

retarded children so that these children would be identified and treated in the early stages. Also appropriate methods of affordance teaching to retarded children should be provided for teachers and administrators through in-service courses. According to the results of this study, application of an affordance program as a non-medical method leads to improve motor development skills in children with mental disorders.

The findings of this study suggest that it is necessary to pay special attention to the environment and environmental abilities, and the use of appropriate methods of affordances for enhancing the motor abilities of children with mental disorder. Using affordance methods and taking advantages of environmental capabilities, many of these children's problems in implementing motor skills could be reduced.

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### Compliance with ethical standards

**Conflict of interest** The authors declare they have no conflict of interest.

**Ethical approval** The study procedure, consent form, and measures were confirmed by the Ethic Committee of the University of Tehran (code number = IR.UT.SPORT.REC.1396020). The authors declare that this manuscript and research has been developed based on the Helsinki statement of ethical principles.

**Informed consent** Written informed consent was obtained from all individual participants included in the study.

### References

- Guliver FP (1908) Orientation of maps. *J Geogr* 7:55–58
- Trowbridge CC (1913) On fundamental methods of orientation and imaginary maps. *Science* 38:888–897
- Pellicano A, Borghi AM, Binkofski F (2017) Bridging the theories of affordances and limb apraxia. *Front Hum Neurosci* 11:148
- Bell PA et al (1996) *Environmental psychology*. Harcourt, York
- Kuh LP, Ponte I, Chau C (2013) The impact of a natural playscape installation on young children's play behaviors. *Child Youth Environ* 23(2):49–77
- Danks SG (2010) *Asphalt to ecosystems: design ideas for school-yard transformation*. New Village Press, New York
- Müller AB, Valentini NC, Bandeira PFR (2017) Affordances in the home environment for motor development: validity and reliability for the use in daycare setting. *Infant Behav Dev* 47:138–145
- Geuze RH (2018) On constraints and affordances in motor development and learning—the case of DCD. A commentary on Wade and Kazeck. *Hum Mov Sci* 57:505–509
- Björger K (2016) Physical activity in light of affordances in outdoor environments: qualitative observation studies of 3–5 years olds in kindergarten. *Springerplus* 5(1):950
- Gallahue DL, Ozmun JC, Goodway J (2006) *Understanding motor development: infants, children, adolescents, adults*. McGraw-Hill, Boston
- Janssen AJ, Van Dolder DE, Kollée R, Oostendorp LA, Nijhuis-van der Sanden RA (2012) Development of a movement quality measurement tool for children. *Phys Ther* 92(4):574–594
- Cohen P, West SG, Aiken LS (2014) *Applied multiple regression/correlation analysis for the behavioral sciences*. Psychology Press, New York
- Silverman W et al (2010) Stanford-Binet and WAIS IQ differences and their implications for adults with intellectual disability (aka mental retardation). *Intelligence* 38(2):242–248
- Farid F et al (2015) The comparison of diagnostic validity of new version of tehran- stanford binet intelligence scales (TSB-5) and wechsler intelligence scales for children—fourth edition (WISC-4) in children with learning disability. *J Learn Disabil* 4(2):70–83
- Wilson BN et al (1995) Use of the Bruininks–Oseretsky test of motor proficiency in occupational therapy. *Am J Occup Ther* 49(1):8–17
- Homayounnia M et al (2018) The effects of environmental affordances on perception of vision and balance in children with intellectual disability. *Mot Behav* 9(30):165–182
- Prieske B et al (2015) Affordances in a simple playscape: are children attracted to challenging affordances? *J Environ Psychol* 41:101–111
- Delacato CH (1974) *The ultimate stranger: the autistic child*. Doubleday, Oxford
- Storli R, Hagen TL (2010) Affordances in outdoor environments and children's physically active play in pre-school. *Eur Early Child Educ Res J* 18(4):445–456
- Johnson DC, Wade MG (2009) Children at risk for developmental coordination disorder: judgement of changes in action capabilities. *Dev Med Child Neurol* 51(5):397–403
- Sheikh M et al (2014) The effects of selected physical activities on perceptual motor ability in pre-school children with neuropsychological learning disabilities. *Arch Rehabil* 15(3):36–43
- Miquelote AF, Santos DC, Caçola PM, Montebelo MI, Gabbard C (2012) Effect of the home environment on motor and cognitive behavior of infants. *Infant Behav Dev* 35(23):329–334

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