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博 士 論 文

幼児におけるボタンのかけはずし能力の発達
に関する定量的研究

(An investigation of age-related
developmental differences of button
ability)

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An investigation of age-related developmental differences of button ability

Abstract

Background: There is little standardized information about simple-and easy-to-use evaluation of fine motor skills in disabled children. This study is focused on unbuttoning and buttoning activities. The purpose of this study was to determine the relationship between unbuttoning and buttoning activity ability and age and sex difference.

Methods: One hundred and forty-four children (63 boys and 81 girls; age range from 36 to 83 months) and 14 young adults took part in this study. The children were categorized into four groups according to age. Every subject went to nursery school and/or kindergarten. On the basis of Montessori education system, unbuttoning and buttoning were performed. The time from beginning to end was measured individually. All the participants were instructed to do the task in the same way.

Results: The mean time required for unbuttoning activity was reduced promptly until 4 years old, while that for buttoning was also reduced until 5 years old, respectively. There were no significant differences between boys and girls except the unbuttoning activity at the age of 3 years.

Conclusion: More attention should be paid to unbuttoning and buttoning activities in children. It might be a simple-and easy-to-use evaluation method at clinical setting.

Key Words:

Buttoning activity, Development, Fine motor skill, Occupational Therapy, Development

Introduction

The development of finger function reflects the maturity process of the central nervous system, and the normal developmental process is of importance for children, which could give their activities of daily living, play and learning. Learning to facilitate fine motor skills will take much time and effort even for nondisabled children. Fine motor skills require a high level of fine motor coordination and high-precision force regulation as well as perceptual and cognitive function.¹ Poor in-hand manipulation skills could be linked to clumsiness or poorer performance of functional activities.^{2,3}

During the last several decades the number of disabled children with clumsiness has increased in the clinical setting of occupational therapy. Most previous studies of evaluation for fine motor skills were focused on opposite position of thumb finger⁴⁻⁶, handwriting^{1,2}, and grasp pattern of objects.^{3,7} However, there is little standardized information about simple and easy-to-use evaluation

of fine motor skills of this age. It is necessary to set up a guideline which measures quantitative developmental change of fine motor skills in childhood. This study is focused on unbuttoning and buttoning activities requiring a high level of fine motor coordination and high-precision force regulation, and perceptual and cognitive function. These activities are familiar with the children and essential to acquire activities of daily living in childhood.

Using these activities as evaluation of fine motor skill is valuable, which could result in quantification of the outcome for therapists as well as parents. The purpose of this study was to determine age- and sex-difference in unbuttoning and buttoning activity ability.

Materials and Methods

One hundred and forty-four children (63 boys: mean age \pm SD = 62.2 ± 10.9 months and 81 girls: 62.2 ± 12.2 months; age range from 36 to 83 months) and 14 young adults (7 male: 20.5 ± 0.3 years and 7 female: 20.2 ± 0.3 years) took part in this study. These children went to nursery school and/or kindergarten. Any children had received neither occupational therapy nor physical therapy for motor problems prior to the study. They were categorized into 4 groups; 24 (7 boys and 17 girls) from 36 to 47 months (the first group), 34 (17 boys and 17 girls) from 48 to 59 months (the second), 53 (25 boys and 28 girls) from 60 to 71 months (the third), and 33 (14 boys and 19 girls) from 72 to 83 months (the fourth).

A task instrument based on the Montessori education system was used. Five buttons (15mm in diameter and 65mm between the two buttons) on a part of a shirt (300mm \times 300mm) were held in place on a 300mm \times 300mm board (Fig.1).

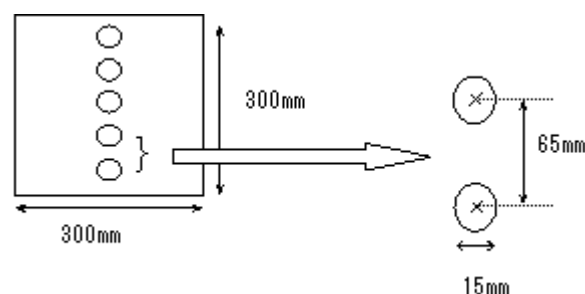


Fig.1 Outline of a task instrument

After informed consent was obtained from directors of the nursery school and/or the kindergarten, as well as from the children and their parents, this experiment was video-recorded in a comfortable environment. An instruction about the activity was given to each child verbally to carry out as quickly as possible in its own way (Fig.2).

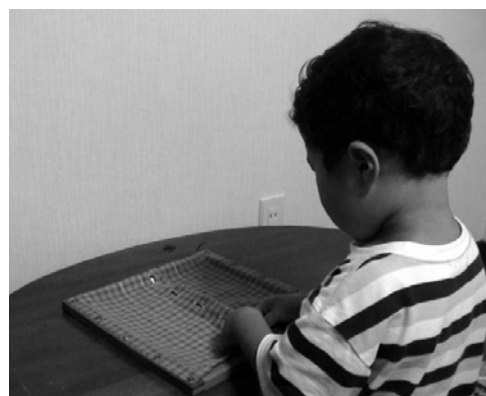


Fig.2 Activity Scene

The time from beginning to end was measured. All the participants finished the task in the same way. When the children

couldn't finish the task, their data were removed from the analysis.

Data were analyzed using one factor analysis of variance (ANOVA) among the categories. Scheffe's Test was used as post hoc test. The sex difference in the same age group was analyzed by Welch's t-test. Statistical difference was considered to be significant at the 5% level. Each statistical analysis was utilized by StatViewJ-5.0 (SAS Institute, USA).

Results

The mean unbuttoning time from the first through the fourth groups showed 38.4 ± 27.1 , 28.6 ± 19.5 , 20.8 ± 10.8 , and 17.6 ± 9.3 seconds, respectively. A significant difference was found between the first and the third ($p < 0.01$), and the first and the fourth ($p < 0.001$). Young adults showed 8.7 ± 2.2 seconds. As the age increased, the time required for the task decreased promptly until 4 years old (Table 1). The buttoning mean time from the first through the fourth groups indicated 57.8 ± 28.3 , 51.6 ± 31.8 , 33.5 ± 17.3 , and 28.8 ± 9.7 seconds, respectively. Buttoning activity ability between the first and the third ($p < 0.01$), the first and the fourth ($p < 0.001$), and the second and the third ($p < 0.01$), and the second and the fourth ($p < 0.01$) differed significantly. Young adults showed 13.3 ± 2.6 seconds (Table 2).

As the age increased, the time required for the task decreased promptly until 5 years old. Although even the six-year-old children didn't reach the adult level, the time required for unbuttoning activity relatively became stable after 4 years, while

that for buttoning relatively became stable after 5 years.

One boy (first group) could not perform both activities, and four children (two boys; one is in the first and another is in the second, two girls; one is in the first and another is in the second) could not perform buttoning activity.

There were no significant differences between boys and girls except the unbuttoning activity in the youngest group (Table 1, 2).

Table 1 Comparison in mean time (mean \pm SD) among the four age categories and sex difference in unbuttoning activity, and mean time of young adult

Group (range of months)	Sex	n	unbuttoning		p value
			Mean	SD	
First		23	38.4	27.1	#
(36 to 47 months)	Male	6	60.3	40.6	
	Female	17	30.7	16.0	
Second		34	28.6	19.5	
(48 to 59 months)	Male	17	26.6	19.4	
	Female	17	30.9	20.1	
Third		53	20.8	10.8	**
(60 to 71 months)	Male	25	21.3	11.7	
	Female	28	20.4	10.2	
Fourth		33	17.6	9.3	***
(72 to 83 months)	Male	14	17.2	7.2	
	Female	19	17.9	10.8	
Young adults		14	8.7	2.2	

**: p<0.01 First vs Third
 ***: p<0.001 First vs Fourth
 #: p<0.05 First (Male) vs First (Female)

Table 2 Comparison in mean time (mean \pm SD) among the four age categories and sex difference in buttoning activity, and mean time of young adult

Group (range of months)	Sex	n	buttoning		p value
			Mean	SD	
First		21	57.8	28.3	
(36 to 47 months)	Male	5	69.2	23.0	
	Female	16	54.2	29.5	
Second		32	51.6	31.8	
(48 to 59 months)	Male	16	49.0	24.1	
	Female	16	54.3	39.1	
Third		53	33.5	17.3	**, \$\$
(60 to 71 months)	Male	25	39.1	23.3	
	Female	28	29.4	9.7	
Fourth		33	28.8	9.7	***, \$\$
(72 to 83 months)	Male	14	33.8	9.3	
	Female	19	25.2	8.5	
Young adults		14	13.3	2.6	

**: p<0.01 First vs Third
 ***: p<0.001 First vs Fourth
 \$\$: p<0.01 Second vs Third, Second vs Fourth

Discussion

This investigation focused on the evaluation of fine motor skills during buttoning activities, which is one of the activities of daily living. From the aspect of mean values of the unbuttoning and buttoning activities, this study clarified that buttoning activity was more difficult than unbuttoning. This suggests that buttoning activity could require more fine motor skill, cognitive function and concentration than unbuttoning. The mean time required for unbuttoning activity was reduced promptly until 4 years old, while that for buttoning was also reduced until 5 years old, respectively.

Folio et al. reported that passage rate of two buttoning within twenty seconds showed 11% in 36 to 41 months, 38% in 42 to 47 months, 65% in 48 to 59 months, and 76% in 60 to 71 months, respectively. They also reported that passage rate of opposite position of thumb finger within eight seconds showed 4% in 36 to 41 months, 22% in 42 to 47 months, 72% in 48 to 59 months, and 82% in 60 to 71 months, respectively.⁴ These findings suggested that

isolated finger function became mature enough to perform buttoning at the age of 4 to 5 years, indicating that unbuttoning and buttoning activities related to opposite position of thumb finger. Danckla reported that the time of opposite movements between thumb finger and the other fingers in nondisabled children decreased at the age of 5 to 7 years.⁵ Our result was consistent with previous studies.^{4,5} From the viewpoint of simple and easy-to-use evaluation at a clinical setting, unbuttoning and buttoning activities may be estimated at the age of 4 and 5 years, respectively.

Young adults performed both tasks more quickly than the forth group, indicating that six-year-old children didn't still reach the adult level. Denckla reported that opposite position of thumb finger became complete after 9 years.⁶ Grip force for lifting objects reached the adults level after 8 years.⁸ Our study focused on 3 to 6 years, because the children with clumsiness were found in the group activity such as nursery school and/or kindergarten. Further investigation might be required to know the

characteristics performance skill after 7 years.

On the other hand, one boy (first group) couldn't perform both activities, and four children (two boys; one is in the first and one in the second, two girls; one is in the first and another is in the second) couldn't perform buttoning activity. It was speculated that three-year-old participants would have just started to unbutton and button. This result may be due to the fact that standard deviation of the first and the second groups were greater than those of other two groups. Fine motor skills (speed and precision) at 3 years old were reported to be more various than those of other age groups.^{1-3,7} Moreover, two children at the age of 4 years couldn't perform buttoning activity. As to buttoning activity, it became stable at 5 years old. Humphry reported that this activity might be a little difficult to perform for some children at 4 years old.³

As to sex-related differences, girls in the first group could perform the unbuttoning task more quickly than boys in unbuttoning activity (Table 1). In both unbuttoning and buttoning activities, however,

there were no significant differences between boys and girls in other groups. Previous studies also demonstrated that there were no significant sex difference in fine motor skills, even though girls seemed to be more skillfully than boys.^{3,7} The girls develop earlier than boys in language speech, however, there seems to be no clear difference between girls and boys in the development of skill in fine motor skills.

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