

# Development of Scales for Measuring the In-person Growth of Young Children in Japan, China and Korea

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## ABSTRACT

There are a lot of developmental scales around the world and they are used in different situations. However, these tests are not perfect for two reasons. The first reason is that most developmental scales, including intelligence tests, normally tend to rank the children in the groups of the same age as those in-growth groups. However, an examination to capture in-person growth is necessary. The second reason is that most conventional development tests are created independently by each country, translated and used in another country, so there is the problem of global standards not being satisfied. To cope with these problems, we tried to develop scales for 3 to 6-year-old children in a group of less than 4,000 in Japan, China and Korea. These countries have some common child rearing cultural aspects and declining birthrate problems. In our research, we examined the validity and reliability of the composition concept, created specific items, investigated, and selected practical items for child rearing. The relevance of the composition concept included content aspect, substantive aspect, structural aspect and external aspect.

*Keywords: Development of Scales, In-person Growth, Validity, Reliability, Cross Culture Research*

## 1. Introduction

Various developmental tests for infants have been made on the basis of the average value by age in order to grasp the position in the same age group. These tests are widely used to check how well children could adapt at school (Aoyagi et al., 2013). In addition, these scales tend to capture the characteristics of young children in the dimension of "able - not able". However, there is a need to clarify how children grow. Parents and guardians, who are the human environment surrounding the infant, and their caregivers could give appropriate support to the young child more effectively if they know the developmental character of each child. Furthermore, it can be used even when experts provide parenting support. Therefore, an examination to capture the developmental change within a child who is placed in a social and cultural environment such as the home, or nursery is necessary.

Since conventional developmental tests were created in one country and translated and used in other countries, there is the problem that global standards, including regionality and cultural characteristics, are not satisfied. For example, if a developmental

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test made in Europe and the United States is translated directly into each language and used throughout Asia, items that do not fit in each area will be generated. Therefore, our research group selected three countries in East Asia —Japan, China and South Korea—as the subjects to be surveyed. The reason is that these three countries are geographically close and are in a cultural area where parenting is carried out under the strong influence of Confucian thought.

## 2. Research Goal

Using the global standards in the three East Asian countries, we aim to create a developmental scale to measure the individual growth of young children and use it for child rearing support. For this purpose, this presentation mainly focuses on the validity of the composition concept and the reliability of the scale.

## 3. Methods

### 3.1 Preliminary Survey and Preparation of Questionnaires for Japanese Version, Chinese Version and Korean Version

The questions of this scale are based on "TK type infant development test" (Taken Co., 1979). "TK type infant development test" focuses on 5 realms (Health, Relationship, Environment, Language, Expression) to cherish in their childhood and is widely used for young children in Japan in order to capture their developmental aspect and character. This developmental scale has 2 viewpoints; (1) "Viability", such as social skills and competences, that are indispensable in our daily life and (2) "Lifestyle Habits" such as basic habits and acquisition of discipline." Viability" includes questions about "Physical Activity", "Verbal skill", "Group Activity", "Self-control" and "Spontaneity". And "Lifestyle Habits" includes questions about "Cleanliness", "Potty training", "Grooming", "Sleep" and "Eating".

Ishikawa et al. (2005), Kominato et al. (2005) and Sone et al. (2005) selected the questions about "Viability" and upon re-examination pointed out that some items may be unsuitable in today's society. So, in our research, question items with inadequate content validity were deleted. Because "TK type infant development test" was written by Japanese researches, when we made the Chinese version and the Korean version, a psychology major from China and Korea living in Japan translated the questions into the Chinese version and Korean version. Subsequently, we asked psychology majors from China and Korea who live in Japan different from the translators for back translation. When the meaning differed between the Japanese version and the back-translation version, we asked the two translators from each country to work on their translation again and come up with the same meaning. Representatives of the research team visited each country and discussed with each psychologist several times to examine whether the created Chinese version and Korean version are appropriate for each country.

### 3.2 Investigation and Standardization Process of Globalization

The participants in this study consisted of 1179 Japanese mothers, 1304 Chinese mothers and 1349 Korean mothers with children aged 3-6. The investigation period was

from January 2006 to April 2007. Mothers evaluated children's development by using the following words: "not able", "sometimes able", "often able" and "completely able". Sampling in Japan used the stratified random two-stage extraction method. To examine the validity of the scale, we referred to the effect size ( $\eta^2_p$ ). Regarding the developmental difference, it was evaluated that the substantial difference in development was small if  $\eta^2_p < .02$ , evaluated that  $\eta^2_p > .07$  was large, and those items were deleted, and 102 items remained (Table1).

Factor analysis by weightless least squares method was performed on 102 items, and 11 factors were extracted by Promax rotation. However, items with high loads gathered up to the second factor, the number of items constituting the sixth factor to the ninth factor was small, and the factor correlation also exceeded a value of more than .5. In other words, a clear multifactorial structure could not be confirmed by factor analysis. Therefore, we carefully discussed again and decided to adhere to the above 11 factors. Therefore, the structural validity was examined for each subscale by using a reliability coefficient, I - T correlation, and  $\alpha$  coefficient according to a convolution method.

Table1. Scale in the Survey on Children

Subscales and Items	
<b>1. Fine motor skills</b>	<b>7. Morality</b>
(1) makes simple buildings with blocks	(1) tries to help friends who are in trouble.
(2) cuts a meal properly by using chopsticks	(2) tries to comfort the child who feels sad.
(3) draws a triangle using pencils, or crayons	(3) tries to help the child for whom work is late.
(4) writes properly by using a pencil	(4) If a friend is quarreling, he/she can stop that.
(5) draws a diamond shape using pencils or crayons	(5) doesn't hit younger children.
(6) cuts out simple shapes such as circles, or triangles using scissors	(6) can keep the promise.
(7) pastes things	(7) can permit selfishness of a child younger than oneself.
(8) fastens or undoes a button	(8) does not get angry even if his younger child mischieves his/her own toys
(9) folds Origami into the shape of a plane, or a crane	(9) knows that telling a lie is bad
(10) wrings a towel or a dishcloth	(10) After doing a bad thing, he/she think shamefully
(11) does paper handicrafts	(11) takes the one-pickup up to a parent or a teacher
<b>2. Gross motor skills</b>	<b>8. Self-control</b>
(1) carries a glass of water without spilling the water	(1) does not take up his/her friend's toy even if he/she wants it
(2) skips to a rhythm	(2) can be patient to eat what he/she wants to eat when he/she has a stomachache
(3) climbs to the top of a jungle gym	(3) does not play with what he/she has been warned about its danger
(4) stands on one leg for 10 seconds or more	(4) can endure what he/she dislikes and do it when you reason with him/her
(5) catches a ball (e.g. play dough ball) with both hands	(5) can put up with something without appealing to you when you say no
(6) walks 1000 meters without being carried in the arms, or on the back	(6) does not cry at a slight injury
(7) rides a bike without using training wheels	(7) can come back home at the finish time even when playing outside
(8) does jump rope 10 times or more	(8) does not make a noise in public place such as restaurants or trains
(9) protects oneself using hands, when about to fall over	(9) does not cry when visiting a hospital
<b>3. Language comprehension</b>	<b>9. Self-motivation</b>
(1) says his/her date of birthday correctly when he/she was asked	(1) if he/she has some questions, he/she can study with his/her encyclopedia by himself/herself or ask his/her parents
(2) correctly names his/her teacher or friend/nurse by name of his/her teacher or friend	(2) wants to try new play
(3) if his/her friends teach him/her a new game, he/she plays that game	(3) practices to be perfect (e.g. jump rope, bicycle)
(4) counts ten objects accurately (counters 10 or more things)	(4) can read the picture book by himself/herself and understand the story. (not ask for explanation some)
(5) can read most of HIRAGANA	(5) do his/her work by himself/herself for his/her responsibility (without his/her parents urge to do it)
(6) reads the books smoothly	(6) can fix the toy if he/she can fix it by himself/herself
<b>4. Language expression</b>	(7) can talk to his/her parents what he/she heard from the preschool or kindergarten
(1) not speaks in baby talk (e.g. gummy, doggy)	(8) in the city, he/she can ask to his/her parents the word that he/she doesn't know
(2) talks in a telephone	(9) tries to draw a picture
(3) tells about events of the day begins to talk about great events	(10) can say what his/her dream is
(4) can make an easy story with looking the picture	<b>10. Attention</b>
(5) can tell the message correctly to your friends	(1) can across the road after checking the cars around him/her
(6) can talk with friends about what are we going to play	(2) does not follow after strangers
(7) can talk about the TV with friends	(3) does not go to the dangerous place alone (e.g. deep river)
(8) can talk about the picture book	(4) does not touch the kettle on fire
(9) uses future tense ; for example "Grandma will be here"	(5) does not touch the iron heated
(10) can tell the rules to friends	(6) does not get something from the stranger
(11) writes almost all letters	(7) does not cut in until someone talking
<b>5. Group activity</b>	(8) if he/she looks child chatted on TV, he/she can judge people who are nice or bad
(1) Shares his/her toys and plays with his/her friends.	(9) does not feel afraid if we have to be silent
(2) Enjoys playing games with simple rules (e.g. hide and seek)	<b>11. Help</b>
(3) Plays make-believe with friends.	(1) helps you set the table.
(4) Rest and borrow his/her toys.	(2) helps you clear the table.
(5) Refers to one or more "best friends".	(3) helps you clean up the room.
(6) To cooperate with his/her friends and make up a work with blocks.	(4) helps you water the plants.
(7) To cheer his/her team in the sports day.	(5) taps you or your husband on the shoulders.
(8) May change the rules of a game as the activity progresses.	(6) carries a small bagpack for you.
(9) Play well with new friends.	(7) helps you fold the laundry.
(10) Makes up a quarrel with friends.	(8) helps you serve fruits or sweets when having guests.
<b>6. Play and Social development</b>	(9) unlocks and opens the door for you when your hands are full.
(1) Understands the rules of a swing or a ball play	
(2) Understands the win and lose in "rock-paper-scissors"	
(3) Understands the concept of colors of signal	
(4) Keeps the rules in the classroom	
(5) Understands the meaning to buy a thing with money	
(6) Understands a rule across the road to go along the pedestrian crossing	
(7) Be careful with a public thing and the thing of another person	

## 4. Results and Discussion

### 4.1 Consideration of Content Validity and Substantive Validity by Creating Development Regions and Items

We divided the composition of this scale into [Motor development] and [Social development] broadly. [Motor development] summarized in handling movement" and "locomotive movement", then the former was named "fine motor development" and latter was called " gross motor development ". Regarding ' Social development ', adaptation to 'Group activity', acquirement of " Rules in playing and rules of society ", "Morality", "Self-motivation" and "Self-control" are essential for young children, so we added them to the sub-scales.

In addition to the social adjustment, the coping skills for nature and their physical environment are necessary in early childhood, so we added "Attention " to the sub-scales too. Finally, "Chores " which is considered to be important for child development, especially in East Asian society, was added. Altogether, the questionnaires of this study consisting of 11 sub-scales shown in Table 1, which contain 12 to 17 questions each totaled 149 items.

The age-specific total score, standard deviation and  $\alpha$  coefficient obtained in the preliminary survey are also shown in Table 2. According to the results of this preliminary survey, the score of each region was high, due to the aging. Therefore, it is considered that our scale accurately capture a child's developmental changes. Moreover, as the coefficient was high on all scales, it can be said that our developmental scale provides high reliability (Aoyagi et al.,2007, Yamagiwa et al.,2007).

Table 2. The Score of each Subscale( Mean, SD) and  $\alpha$

Subscales	Number of items	3yr	4yr	5yr	$\alpha$
1. Fine motor skills	13	34.5,(6.3)	40.3(5.7)	44.7(4.9)	0.890
2. Gross motor skills	14	34.7(4.8)	39.1(5.6)	44.7(5.9)	0.851
3. Language comprehension	17	42.7(7.2)	49.9(7.4)	55.9(7.2)	0.899
4. Language expression	15	36.6(7.0)	43.9(7.1)	49.9(6.9)	0.919
5.Group activity	12	34.1(5.7)	38.2(4.8)	40.8(5.4)	0.901
6. Play and Social development	13	36.3(5.4)	42.5(5.0)	44.8(4.8)	0.876
7. Morality	13	32.6(6.4)	36.5(5.4)	39.9(5.9)	0.899
8. Self-control	14	35.2(5.4)	38.1(5.7)	41.7(5.8)	0.836
9. Self-motivation	13	32.5(6.0)	37.5(5.8)	40.7(5.5)	0.852
10. Attention	13	38.2(5.7)	41.3(5.2)	43.3(4.9)	0.854
11. Help	12	32.2(6.9)	36.3(6.3)	39.3(5.8)	0.885

Translation from Yamagiwa et al. (2007)

### 4.2 Results of Examination of Validity

#### 4.2.1 About Contents Aspect

We considered some questions about sociability and morality, not just about intelligence. In addition, its content validity considered sufficiency, because in selecting the question items, we regarded the cultural perspective and discussed with great care and depth the usefulness and the attentional points on use. Also, in all

question items, the average value increases as the age. It can be said that “relevance” as a measure of development is sufficient. From the view point of the gender difference, girls tended to score higher with many question items. It has been pointed out that girls develop more quickly than boys, so it may guarantee the validity of this scale.

#### 4.2.2 About Substantive Aspect

It is worth noting that the answers to the question items were given by the infant himself but by a parent who lives with an infant or nursing teacher. It is considered that it is possible for a child's condition to be evaluated more accurately if the observer becomes a respondent. In other words, the answer format by observation is practical and highly relevant.

#### 4.2.3 About the Structural Aspect

The examination of the structural aspect is a verification on whether each subscale is consistently measuring psychological characteristics structurally and consistently, and it also confirms the reliability. We used a semi-seminary method to estimate reliability coefficients in order to verify the consistency of each scale as a whole. As shown in Table 3, the minimum value is 0.733, which is considered to be sufficiently consistent. Table 2 also shows the I-T correlation as to whether the score of each question item and the total score of the subscales are consistent. Only one item of "Self-control" showed an insufficient value, and it was only one out of 102 items. The consistency of the subscale showed that the variance of each question item was small, and the consistency was sufficient because of the high Cronbach's alpha coefficient.

Table3. Subscale Reliability Indicator

Subscales	Number of items	Reliability coefficient of Spearman-Brown	Item-Total Correlation			$\alpha$
			Min	Max	Mean	
1. Fine motor skills	11	0.846	0.402	0.711	0.594	0.880
2. Gross motor skills	9	0.740	0.359	0.616	0.483	0.788
3. Language comprehension	6	0.797	0.405	0.756	0.623	0.837
4. Language expression	11	0.880	0.486	0.767	0.669	0.904
5. Group activity	10	0.856	0.555	0.729	0.659	0.899
6. Play and Social development	7	0.792	0.536	0.633	0.567	0.876
7. Morality	11	0.827	0.463	0.683	0.573	0.880
8. Self-control	9	0.733	0.273	0.589	0.431	0.790
9. Self-motivation	10	0.806	0.381	0.593	0.487	0.828
10. Attention	9	0.797	0.387	0.668	0.528	0.847
11. Help	9	0.827	0.459	0.699	0.579	0.869

Translation from Aoyagi et al. (2013)

#### 4.2.4 About External Aspects

Because nursery teachers are experts of childcare, they are considered to evaluate the child's development objectively as a general child's developmental condition. External validity of this scale was verified by examining the relation with the numerical value evaluated by the childcare provider on each subscale. As shown in Table 4, the average score of evaluation scores by nurseries is higher according to age. However, the number of parents' data was more than 10 times that of the childcare center. Therefore,

we randomly extracted the data of parents and adjusted it to the same degree of data as the nursery teacher and created comparable samples. Therefore, we examined the average value of each subscale of parents and childcare givers. As a result, only for "Morality", the grades by the nursery teacher were significantly higher than that of the guardians ( $t(135) = 3.38, p < .01$ ), but there was no significant difference in the other subscales. Therefore, since the guardians' rating is the same level as the objective teachers' assessments and there is little distortion in evaluation due to the close relationship with their child, it is suggested that our measure fulfills an external validity.

Table 4. The Score by Teachers( Mean and SD)

Subscales	3yr		4yr		5yr	
	M	SD	M	SD	M	SD
1. Fine motor skills	19.5	4.2	25.5	2.2	27.7	2.7
2. Gross motor skills	16.3	3.7	20.3	2.2	23.4	1.8
3. Language comprehension	10.5	2.3	14.2	2.1	16	1.4
4. Language expression	20.3	5.5	26.5	3.6	30.1	2.3
5. Group activity	21.8	4.5	26.5	2.2	28.8	1.8
6. Play and Social development	15.8	3.9	19.2	1.6	20.3	1.2
7. Morality	20.4	5.0	28.6	2.8	30.4	2.7
8. Self-control	18.1	4.2	21.7	3.7	24.1	3.7
9. Self-motivation	19.6	4.6	24.5	3.5	26.6	2.4
10. Attention	17.9	4.0	21.9	2.8	23.5	3.7
11. Help	20.1	4.0	23.9	2.2	24.5	2.5

Translation from Aoyagi et al. (2013)

## Conclusion

Through the examinations we carried out, our developmental scale shows sufficient validity. In other words, this scale indicates there is little need to regard the cultural effect, at least in East Asian countries, and may be useful when capturing not only the developmental position of children in their group but their characteristics. To conclude, it is our hope that this scale will be helpful for parents and caregivers who support children's development. However, it needs to be acknowledged that our research is based on crossing data, and therefore to collect essential validity by collecting longitudinal data will be necessary in the future.

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