

## Development of the subjective experience evaluation scale for children's physical activity

SHINTARO ENDO<sup>1</sup>, NAOFUMI UETA<sup>2</sup>, TETSUYA MATSUO<sup>3</sup>, KAZUO OISHI<sup>4</sup>

<sup>1</sup>Research Center for Youth Education, National Institution for Youth Education JAPAN

<sup>2</sup>National Recreation Association of Japan, JAPAN

<sup>3,4</sup>College of Community and Human Services, Rikkyo University JAPAN

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### Abstract:

To improve the psychological and physical problems among children, physical activity is the main focus. However, few studies have clarified what elements of physical activity are functional and effective against psychological aspects. The importance of the subjective experience of physical activity has been identified as one of the factors that impact psychological aspects such as cognition and sociality. However, there are two major problems. First, there is no comprehensive scale of the subjective experience of physical activity. Second, there is no simple evaluation scale for children. The purpose of this study was to develop a simple scale to comprehensively evaluate subjective experiences of physical activity in children and to examine the reliability and validity of the scale. The participants were 852 children (417 boys and 435 girls; mean age = 10.9 years, SD = 0.9). The result of exploratory factor analysis showed three factors. First, factor 1 was named the "challenge/achievement". Factor 2 was named the "communication". Finally, factor 3 was named the "originality and ingenuity". The reliability of the three factors was acceptable ( $\alpha = .71-.88$ ). Confirmatory factor analysis was performed to test its goodness-of-fit. The fit indices for the structural model met the condition ( $\chi^2(24) = 49.567$ , CFI = .992, RMSEA = .034). As a result of Pearson's product-moment correlation coefficient between the scale and the subjective happiness scale showed significant positive correlations. As the results of analyses, an acceptable reliability and validity scale was developed, consisting of three factors. The scale is a simple nine item scale that is easy for children to answer. In addition, the scale can be administered multiple evaluations or can be used in combination with other scales. In the future, it is necessary to reveal the details of physical activities that enhance psychological effects used the scale.

**Key Words:** Factor analysis, Challenge/achievement, Communication, Originality and ingenuity

### Introduction

#### I. Psychological and physical problems in children

Ministry of Education, Culture, Sports, Science, and Technology, Japan, compared suicide rates worldwide and reported that the rate of Japan was the worst among developed countries (Ministry of Education, Culture, Sports, Science and Technology-Japan, 2019). In particular, the number of children who committed suicide was around 250 in 2018, and the number has remained at a high level (National Police Agency, Japan, 2019). Depression is one of the causes of suicide in children. Globally, the prevalence of depression is 1-2% in childhood and 1-7% in adolescence (Erskine et al., 2016). Depression may cause a functional decline in daily life such as poor academic performance and deterioration of interpersonal relations worldwide. In recent years, a depressive tendency that does not meet the diagnostic criteria for depression has also become a problem. This depressive tendency is reported to lead to problematic behaviors such as social maladjustment and drug use (National Health and Medical Research Council, 1997).

Various problems have emerged not only in the psychological aspects but also the physical aspects of children worldwide. For example, obesity among children is increased (Wang, Dong, Wang, Zou, & Ma, 2017), and studies report that this number has increased about 2-4 times from 30 years ago in Japan (Ozeki, 2009). Obesity is a serious risk factor in children as well as in adults, including hypertension, hyperlipidemia, and atherosclerosis (Singh et al., 2008). Therefore, it is desirable to solve the psychological and physical problems of children.

#### II. Effect of physical activity on psychological and physical problems in children

To improve the above problems, physical activity is the main focus. In terms of psychological aspects, studies have reported overseas that regular physical activity is effective in reducing depressive tendencies (Korczak, Madigan, & Colasanto, 2017). Similar results are also reported in Japan. Yasuda et al. (2012) reported that physical activity reduced the risk of increasing depressive tendencies in a longitudinal study. It is generally known that physical activity plays an important role in mental health. Regarding the effects of physical activity on physical aspects, it is well known that it reduces the incidence rate of lifestyle-related diseases such as

obesity. There was a negative correlation between physical activity and obesity, and lack of physical activity was associated with poor physical health, such as dyslipidemia and hypertension worldwide (Hong, Coker-Bolt, Anderson, Lee, & Velozo, 2016). Therefore, there is a common perspective that physical activity has a positive impact on these physical problems.

In addition to the known effects of physical activity, the effects of psychological aspects such as cognition and sociality have attracted attention in recent years (Burdette & Whitaker, 2005). This is because the stress from which children tend to suffer has changed significantly in recent years. There has been an increase in the pressure of taking lessons and studying, as well as problems with friends (Bluth & Eisenlohr-Moul, 2017; Toyama & Li, 2020). Though these stresses are likely to directly or indirectly cause problems such as bullying, truancy, violence, and suicide, there are inadequate effective physical activity strategies to improve these problems (Burdette & Whitaker, 2005). In addition, few studies have clarified what elements of physical activity are functional and effective against different psychological aspects.

### III. Focus on the subjective experience of physical activity

The importance of the subjective experience of physical activity has been identified as one of the factors that impact psychological aspects such as cognition and sociality (Shima et al., 2021; Shimamoto & Ishii, 2007). McAuley and Courneya (1994) focused on the experience of affective change caused by physical activity and extracted three factors: positive well-being, psychological distress, and fatigue. Previous studies reported that physical activity improved several psychological problems via enjoyment (Nishida, Hashimoto, Kiuchi, Tsutsumi, & Tanimoto, 2016). Shimamoto and Ishii (2007) extracted four factors as subjective experiences of physical education classes in university students: self-disclosure (to convey one's thoughts and thoughts to others), cooperation (to cooperate and encourage others), challenge (to challenge and achieve inexperienced plays and techniques), and enjoyment (to enjoy sports itself with friends).

In recent years, more studies focusing on the concept of playfulness have been conducted. Playfulness is described as the internal elements or characteristics of play (activity) and consists of five factors: immersion, self-determination, competence, group rules, and human connection. Takai, Shimazaki, Lee, and Takenaka (2013) reported that physical activity mediated playfulness and improved psychological problems in children. Nishida et al. (2016) reported that subjective experiences of communication and cooperation through physical activity improved their sense of adjustment related to mental health in first-year university students. These results suggest that the subjective experience of physical activity plays an important role in the improvement of psychological problems in children.

### IV. Problem of previous studies

Understanding the subjective experiences of physical activities provide important knowledge for effective improvement of psychological problems. However, there are two major problems with related previous studies. First, there is no comprehensive scale of the subjective experience of physical activity. To clarify which components of physical activity function act effectively for which psychological aspects, a scale that comprehensively evaluates the contents of the subjective experience is necessary. However, previous studies did not consider negative aspects such as cheating or playing practical jokes without following the rules (Anan, 1989; Kinoshita, Onishi, & Mori, 2017), or focused only on one aspect such as enjoyment. Moreover, there are no comprehensive scales including the experience of self-disclosure and cooperation as described above. Second, there is no simple evaluation scale for children. In general, a simple and easy self-reported evaluation scale is required for children (Nishimura, Murakami, & Sakurai, 2015). However, both scales for evaluating playfulness and play experience in physical activity have a large number of items (15 or more items), making it difficult for children to respond accurately. In addition, considering the need for multiple evaluations or combined use with other scales, a simple scale that maintains reliability and validity is necessary (Nishimura, Murakami, & Sakurai, 2015), but yet to be developed.

### IV. Purpose of this study

The purpose of this study was to develop a simple scale to comprehensively evaluate subjective experiences of physical activity in children and to examine the reliability and validity of the scale.

## Material & methods

### I. Participants

The participants were 1,065 children (4th to 6th grade) from four elementary schools in the metropolitan area. After excluding those who did not complete the questionnaires, a total of 852 children (417 boys and 435 girls; mean age = 10.9 years, SD = 0.9) were analyzed. This survey was conducted in the cooperative schools in which authors were collaborating. Before the survey, we asked the principal of each school for their consent on the purpose and content of the questionnaire. We also sent documents from the school to parents asking for their consent. In addition, when the survey was conducted, children were given an explanation that their responses were voluntary and there were no disadvantages in non-participation, and their consent was obtained by responding to the questionnaire.

### II. Measurements

Subjective experiences of physical activity in children

To develop a subjective experience evaluation scale (experience evaluation scale) of physical activity in children, scale items were created through the following process. 1) 7 experts (4 university teachers and 3 elementary school teachers) discussed the contents of the items. They referred to previous studies such as scales for evaluating affection, experiences in physical education classes, flow, playfulness, and play experience including physical activity (e. g., Kinoshita, Mori, & Onishi, 2017; McAuley & Courneya, 1994; Shimamoto & Ishii, 2007; Takai et al., 2014). 2) After selecting the items, sentences in the items that even elementary school students could easily understand were created. As a result, a draft of a 31-item experience scale was developed, including positive and negative aspects. Each item was assessed on a 4-point Likert-type scale from 1 = “none or less” to 4 = “always or more than.”

#### Subjective Happiness Scale

To examine the convergent validity of the experience evaluation scale developed in this study, we referred to the Japanese version of the Subjective Happiness Scale (Shimai, Otake, Utsuki, Ikemi, & Lyubomirsky, 2004). As in one previous study (Imura, Aoki, Takahashi, Nonaka, & Yamada, 2013), we used 1 item (In general, I consider myself; from 1 = “not a very happy person” to 10 = “a very happy person”) that children might understand. Since physical activity has been reported to enhance positive aspects such as well-being (Smedegard, Christiansen, Lund-Cramer, Bredahl, & Skovgaard, 2016), it was expected to show a positive correlation with the experience evaluation scale.

In this survey, we used other scale to evaluate the character strength of children, but the detail has been omitted because it is different from the purpose of this study.

#### III. Statistical analyses

First, to examine the factor structure of the experience evaluation scale, the slope of each item was calculated by item response theory after excluding the items of ceiling effect or floor effect. We used the criteria of Roznowski (1989) to exclude items with lower slope values ( $\gamma < .30$ ) from further analysis. The factor structure was determined using the minimum average partial correlation (MAP) and parallel analysis. Second, exploratory factor analysis (EFA) (maximum likelihood and promax rotation) was performed. The selection criteria for each factor item were that one factor had a factor load greater than .50 and multiple factors had no factor load greater than .40. Third, the internal consistency of the each analyzed factor was examined by calculating Cronbach’s alpha coefficient. Factorial validity was also examined by confirmatory factor analysis (CFA). Chi-square/degrees of freedom ( $\chi^2/df$ ), comparative fit index (CFI), and root mean square error of approximation (RMSEA) were used to evaluate the model’s goodness-of-fit. Garson (2012) proposed the following conditions for good model fit: CFI  $> .90$ , and RMSEA  $< .08$ . Finally, Pearson’s product-moment correlation coefficients between the experience evaluation scale and the subjective happiness scale were calculated to examine the convergent validity.

Statistical analyses were conducted using the Japanese versions of SPSS and Amos (Version 25; IBM, Armonk, NY) and the statistical free software HAD 12.304 (Shimizu, 2016).

## Results

### I. Examination of items and item reduction

First, the mean and standard deviation of each item was calculated, and 21 items with ceiling or floor effects were excluded. Second, the slope value of the remaining 10 items was calculated by item response theory. Based on the condition ( $\gamma < .30$ ) of previous studies, 1 item (Q18) in which the value of slope did not meet the condition was excluded (Table1).

**Table 1. Descriptive statistics of experience scale in physical activity for children**

Item	Mean	SD	Slope
7	3.14	0.84	1.35
8	3.14	0.84	0.86
11	3.10	0.87	1.08
12	3.07	0.89	1.05
13	2.88	0.98	0.99
15	3.04	0.87	1.48
18	2.06	1.06	0.14
23	3.23	0.82	0.92
29	2.61	1.01	0.86
30	3.11	0.91	1.40

### II. The result of exploratory factor analysis

As a result of performing MAP and parallel analysis on the remaining items, the three-factor structure was finally judged to be valid. EFA showed nine items listed in Table 2 (Cumulative contribution ratio = 69.41%). First, factor 1 consisted of 4 items, and was named the “challenge/achievement” factor because it was considered for children to try various things and try to achieve in physical activity, such as “I didn’t give up and challenged

until did it” and “I could do it that I thought it difficult”. Factor 2 consisted of 3 items, and was named the “communication” factor because it was considered that children interacted with others in physical activity, such as “I could express my feelings to my friends” and “I made my friends understand me”. Finally, factor 3 consisted of 2 items, and was named the “originality and ingenuity” factor because it was considered that children changed the content of the physical activity to enjoy on their own, such as “In order to have fun together, I changed activities” and “We made new rules to enjoy together”.

**Table 2. Factor loadings for subjective experience scale in physical activity for children**

Item	F1	F2	F3	Commonality
<b>F1. Challenge / Achievement</b>				
15. I didn't give up and challenged until did it	<b>.806</b>	.028	-.035	.649
7. I could do it that I thought it difficult	<b>.790</b>	.038	-.056	.617
30. I felt I could do something difficult	<b>.697</b>	.026	.089	.601
8. There was something I could do better than my friends	<b>.507</b>	.047	.100	.373
<b>F2. Communication</b>				
12. I could express my feelings to my friends	.034	<b>.748</b>	-.046	.557
23. I made my friends understand me	.009	<b>.652</b>	.014	.447
11. I supported my friend	.111	<b>.619</b>	.025	.523
<b>F3. Originality and ingenuity</b>				
29. In order to have fun together, I changed activities	.011	-.086	<b>.886</b>	.709
13. We made new rules to enjoy together	.022	.252	<b>.503</b>	.497

### III. Examination of internal consistency

To examine the reliability of the three factors, Cronbach's alpha coefficient was calculated. The results showed that “challenge/achievement” was = .83, “communication” was = .75, “originality and ingenuity” was = .71, and the overall scale was = .88.

### IV. Examination of factorial validity and convergent validity

CFA was performed on the 9 items extracted by EFA to test its goodness-of-fit (each item as an observation variable and each factor as a latent variable). The fit indices for the structural model was  $\chi^2(24) = 49.567$ , CFI = .992, RMSEA = .034. These values met the condition of Garson (2012). As a result of Pearson's product-moment correlation coefficient between the experience evaluation scale and the subjective happiness scale was calculated, there were significant positive correlations between each factor of the scale and subjective happiness scale [ $r(851) = .36, p < .001$  for challenge/achievement,  $r(851) = .37, p < .001$  for communication,  $r(851) = .23, p < .001$  for originality and ingenuity, and  $r(851) = .38, p < .001$  for the overall scale].

## Discussion

### I. Composition of the scale

Subjective experiences of physical activity in children were expected to play an important role in various psychological and physical aspects. The contexts of subjective experiences in previous studies can be summarized as follows: 1) experiences of trying various things by oneself (e.g., challenge), 2) experiences of interacting with others (e.g., cooperation), and 3) experiences of affection (e.g., enjoyment) (e.g., Kinoshita, Mori, & Onishi, 2017; McAuley & Courneya, 1994; Shimamoto & Ishii, 2007; Takai et al., 2014). Kinoshita, Mori, and Onishi (2017) also reported 4) creative experiences in play including physical activity. In this study, three factors were extracted: challenge/achievement, communication, and originality and ingenuity. First, challenge/achievement consisted of the items (e.g., “I didn't give up and challenged until did it”, “I could do it that I thought it difficult”) that children tried to achieve by challenging various things in physical activity. This result may correspond to 1) the experience of trying various things by oneself in previous studies. Next, communication consisted of the items (e.g., “I could express my feelings to my friends”, “I made my friends understand me”) that children interacted with others in physical activity. This result may correspond to 2) experience of interacting with others. Originality and ingenuity consisted of two items (“I could express my feelings to my friends” and “I made my friends understand me”) that children could flexibly change the content of their physical activities. This result may correspond to 4) creative experiences.

In the previous study, 3) experience of affection such as enjoyment (Shimamoto & Ishii, 2007) and negative experiences such as cheating without obeying rules (Anan, 1989) or playing practical jokes (Kinoshita, Onishi, & Mori, 2017) were extracted. In this study, items related to affection or negative experiences were also considered but excluded by the ceiling effect or floor effect. This result is likely because most children

experience affectionate experiences and do not experience negative experiences. Therefore, when evaluating affectionate or negative experiences in children, it may be necessary to use a measure that is specific to each aspect. Based on the above, the scale in this study may evaluate the three experiences extracted in previous studies.

## II. Reliability and validity of the scale

In this study, the measurement accuracy of each item comprising the experience evaluation scale was examined by confirming the ceiling effect and floor effect and calculating the slope. The results showed that the extracted items did not have significant biases in the responses and adequately identified the respondents' abilities. In addition, Cronbach's alpha coefficient for the entire scale and each factor were acceptable (.71-.88). It indicated that the internal consistency of the experience evaluation scale was sufficient. These results may indicate that the experience evaluation scale has a high degree of reliability at the item level and the scale score level. In terms of factorial validity, the results of CFA demonstrated that all of the indicators met the conditions of Garson (2012). Convergent validity was examined with the expectation (Smedegard et al, 2016) that positive correlations would be obtained between the experience evaluation scale and the subjective happiness scale, and significant positive correlations were obtained between these scales, including the sub-factor. Therefore, the experience evaluation scale is considered to have acceptable factorial validity and convergent validity.

## III. The simplicity of the scale

In previous studies with children, the playfulness scale (Takai et al., 2013) and play experiences scale including physical activity (Kinoshita, Mori, & Onishi, 2017) had a large number of items (15 or more items), making it difficult for children to respond. In general, to reduce the difficulty, it should be as few items as possible (Nishimura, Murakami, & Sakurai, 2015). In this study, the scale consisting of nine items was developed, so the burden on the children is more acceptable.

## Conclusions

In this study, we developed a simple scale to comprehensively evaluate subjective experiences of physical activity in children and examined the scale's reliability and validity. As the results of analyses, an acceptable reliability and validity scale was developed, consisting of three factors: challenge/achievement, communication, and originality and ingenuity. The scale is a simple nine item scale that is easy for children to answer. In addition, the scale can be administered multiple evaluations or can be used in combination with other scales. In the future, it is necessary to examine how the experience evaluation scale relates to various psychological variables such as mental health and quality of life. It is also necessary to reveal the details of physical activities that enhance psychological effects used the scale.

## Conflicts of interest

The authors declare no conflicts of interest associated with this manuscript.

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