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VALIDATION OF THE PERCEPTUO-MOTOR SKILL ASSESSMENT IN YOUNG TABLE TENNIS PLAYERS

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Abstract:

The purpose of the study was validation of the Perceptuo Motor Skill Assessment in young table tennis players. For the compilation of the study a total 100 male and 100 female table tennis players aged ranged between 12-18 years were selected as a subject for the study. Perceptuao-motor skill test developed by Irene R Faber et.al (2014) was used for data collection process. This perceptual skill includes eight test items i.e. speed, agility, eye-hand coordination, aiming at target, throwing a ball, ball skills, vertical jump, and speed while dribbling was selected as perceptuo-motor skills. The validity of the test battery was determined by factor analysis in which CFA were used confirm the test items from their respective test battery, Cronbach Alpha Coefficient was used to assess the reliability of the perceptual-motor skill test. Results showed that all the Perceptuo-Motor Skill Test with their batteries loading for the proposed skill test and values ranged from 0.467 to 0.709 which are more than 0.4. Whereas, two of the test batteries' loadings were very low i.e., aiming at target and its loadings were 0.205, ball skill and its loading were .092 while computing the first order of Goodness of Fit model and accordingly, two of them removed from the model. Cronbach's alpha coefficient of reliability value obtained was 0.820 for the Perceptuo-Motor Skill Test of 6 items. The value indicates a good internal consistency for the 6 test battery items with the present sample of 200 subjects playing at the national level. So, The findings of the present study validate the Perceptuo-Motor Skill Test of table tennis players on young Indian origin athletes with only six test items i.e. sprint, agility, vertical jump, speed while dribble, throwing the ball and eye-hand coordination . As this study is validate in Indian origin it can be used in a talent identification programme.

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1. INTRODUCTION:

The early detection of gifted athletes is crucial consideration for coaches, researchers, federations, parents, sponsors, etc. Once talented individuals have been detected, it allows the involved persons to optimally arrange the resources required.

Research on athletic talent identification is incredibly limited, and the literature on talent development is scarce **(Pearson, 2002)**. However, it is important to remember that every sport has different requirements and features, therefore each should have its own model for Talent Identification **(Vaeyens et al., 2008).**

When developing a talent identification model for any given sport, careful thought must be given to the multidimensional and dynamic aspects of sports and talent, as both are concepts that are multidimensional and dynamic and cannot be solved separately **(Russell, 1989; Williams & Reilly, 2000; Vaeyens et al. 2008)**.

The concept of talent Sports identification is a key component of sports research as it helps determine an athlete's potential early on since talent indicators and predictors point to the foundations of exceptional achievement **(Kamlesh, 2012; Verma, 2009, 2011).** The significance of identifying talent was further highlighted by **Singh (1991)**, who said that talent development and identification have grown to be important research areas within sports and games.

A number of researches have indicated a strong correlation between an individual's performance and anthropometrical characteristics **(Chaouachi, 2009; Sertić et al., 2007; Bond et al., 2015).** Higher level of competitiveness can be divided into groups based on the distinctive physical characteristics and anthropometric profiles of each individual **(Claessens and associates ,1999)**.

Validation is a concept that has been evolving continuously since its first formal appearance in the United States in 1978. The concept of validation has expanded through the years to encompass a wide range of activities that should take place after product development and at the beginning of commercial production.

Perceptuo Motor Skills From the eighth to the eleventh year of life improves a lot as the child is extremely active during this period of time. There is a strong desire to be physically active during this phase. The development of sense organs, the accumulation of experiences, and accurate interpretation of felt sensations all contribute to improved perception. At this age, the child can discriminate between different shapes, sizes, and times, as well as unique features like distance, right, left, and down.

The rationale of the Study

Forecasting future performance in youth table tennis players based on current performance is complex due to, among other things, differences between youth players in growth, development, maturity, context and table tennis experience. Talent development programmes might benefit from an assessment of underlying perceptuo-motor skill for table tennis, which is hypothesized to determine the players' potential concerning the perceptuo-motor domain. The Dutch perceptuo motor skills assessment intends to measure the perceptuo-motor potential of table tennis in youth players by assessing the underlying skills crucial for developing technical and tactical qualities.

The purpose of the study is validation of the perceptuo motor skill assessment in young table tennis players.

2. METHODOLOGY:

The data was obtained from N=200, (Male-100), and (Female-100) national table tennis players who were chosen at random from different sports academies in delhi region. All the samples are national level athletes (12Years – 26, UNDER 13 - 56, UNDER 15 - 70, UNDER 17 - 47 i.e. Male - 104, Female- 96). All the subjects selected were playing in different age categories at the national level. The subject's age is 12 to 18 years old. The subjects chosen were those who had at least taken part at the national level. The sample had been taken from various Academies and clubs in the field of table tennis and without making a distinction based on the individual's socioeconomic standing or upbringing. The data was gathered from all such subjects.

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For this study selected perceptuo-motor skill test was Speed, Agility, vertical jump, Eye-Hand Coordination, Aiming at Target, throwing a ball, ball skills, speed while dribbling. For data collection Perceptuao-motor skill test developed by Irene R Faber et.al (2014) was used. The test was selected to authenticate an Indian version of Perceptual Motor skill for the sportspersons of Indian origin.

Perceptuo-motor skills assessment:

The perceptuo-motor skill assessment consists of three tests assessing gross motor function (i.e., sprint, agility, vertical jump) and five tests assessing ball control (i.e., speed while dribbling, aiming at target, ball skills, throwing a ball and eye-hand coordination). 'Sprint' included a pyramid-shape circuit in which players need to gather and return five table tennis balls one by one as fast as possible from five different baskets starting at the basis of the pyramid-shaped circuit (measured in s). For 'agility', players needed to get through a circuit, including climbing over a gymnastics' cabinet and under and over a low hurdle as fast as possible (measured in s). At 'vertical jump' players were instructed to jump as high as possible and touch the wall at the highest point possible. The difference between the jumping height and standing height with one arm up along the wall was measured in centimeters. 'Speed while dribbling' used a zigzag circuit in which the players needed to move sideways as fast as possible while dribbling with a basketball using one hand (measured in s). At 'aiming at target' players needed to hit a round target (Ø 60 cm) on the floor at 2.5-meter distance with a table tennis ball using a standard bat with their preferred hand (measured as points made). 'Balls skills' also required hitting a round target on the floor (Ø 75 cm), Can perceptuo-motor skills outcomes predict future competition participation/drop-out and competition performance in youth table players needed to throw a table tennis ball with their preferred hand via a vertical table tennis table from two different positions, 1 and 2 meter distance away from the target (measured as points made). At 'throwing a ball', the players threw a table tennis ball as far away as possible with their preferred hand (measure in m). In the 'eye-hand coordination' test players were instructed to throw a ball at a vertical table tennis table at 1 meter distance with one hand and to catch the ball correctly with the other hand as frequently as possible in 30 seconds (measured as points made). The complete test protocol of the assessment is available online.

Statistical Analysis:

After the completion of data collection, a detailed statistical analysis was carried out. The following are the statistical techniques used for the calculation of the study.

Descriptive statistics i.e. Mean, Standard Deviation, Minimum and Maximum scores on each test item of the battery. To assess the normality of the data Skewness and Kurtosis were also applied.

The Alpha Coefficient of reliability was calculated with the purpose of determining the test reliability and internal consistency of the test item.

The validity of the test battery was determined by factor analysis in which CFA were used to confirm the test items from their respective test battery, Cronbach Alpha Coefficient was used to assess the reliability of the perceptual-motor skill test purpose. All players were assessed under similar conditions at a different local training center from delhi region. Before starting the assessments, all participants did a warming-up as a part of the event.

A test item to measure an underlying variable was created using factor analysis, and it was also used to reduce a large data collection to a manageable size while preserving as much of the original data as possible. The Statistical Package for Social Sciences (SPSS), AMOS was used to calculate CFA to confirm the Factors and validate the test.

3. RESULTS AND DISCUSSION:

Table 1: Parameter Summary (Group number 1)

	Weights	Covariances	Variances	Means	Intercepts	Total
Fixed	9	0	0	7	0	9
Labeled	0	0	0	0	0	0
Unlabeled	7	0	9	0	6	16
Total	16	0	9	7	6	25

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Table 1 shows the parameter summary of the model, fixed total weights 9, Unlabeled weights score 7, covariances 0 and variances 9 adding all the parameter together 16 parameters need to be estimated in the model. Whereas, overall total score is 25.

Table 2: Calculation of Degree of Freedom

Computation of Degree of Freedom (Default model)	
Number of distinct sample moments	36
Number of distinct parameters to be estimated	16
Degree of freedom (36-16)	20

As above shown in table 2 — the total numbers of 36 distinct sample moments are selected and 16 distinct parameters are used to the estimate in the proposed model. Total 16 unique factors are subtracted from the 36 distinct moments. There are 20 degrees of freedom in all. Because the degree of freedom is positive, the model has therefore become over identified.

According to Kline R. B. (2010) model specification is one of the five logical processes of SEM. Model identification is figuring out if a model is over-identified, just-identified, or under-identified. Computation of the coefficients is only possible if the model is under- or over identified.

Estimation of Measurement Model:

The correlations between the model and the construct were estimated using the AMOS programme. Various techniques exist for estimating parameters, contingent on the type of data and model (Mavondo 2007). These techniques include maximum likelihood, standardized regression weight, intercept, covariances, correlation, and variances.

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The most often used and well-liked model estimate technique is the maximum likelihood estimate (MLE) approach (Mavondo, 2007). MLE produces reliable findings even with limited sample sizes (J. F. Hair, 2006). The combined measurement model's CFA was used to thoroughly validate the latent component measurements. How well the defined indicators describe the predicted structures determines the overall model fit in CFA. All the components showed relationship with each other, and all the indicators of latent constructs were included into the relevant constructs. According to J. F. Hair's findings from 2006, the average extracted variance is (0.5), factor loads exceed 0.4, and the composite reliability of each whole scale is (0.7).

Table 3: Standardized Regression Weight of Factors Perceptuo Motor Skill Test

TEST BATTERY	Indicators	Standardized Structural Coefficient
PERCEPTUO-MOTOR SKILLS TEST FOR TABLE TENNIS	SPRINT	**.658**
	AGILTY	**.534**
	VERTICAL JUMP	**.505**
	SPEED WHILE DRIBBLE	**.648**
	THROWING THE BALL	**.709**
	EYE-HAND CO-ORDINATION	**.467**

As shown in the above table 3, all the PERCEPTUO-MOTOR SKILL TEST with their batteries loading for the proposed skill test and values ranged from 0.467 to 0.709 which are more than 0.4 and significant at (t = 1.96, p=0.05). Whereas, two of the test batteries' loadings were very low i.e., aiming at target and its loadings were 0.205, ball skill and its loading were .092 while computing the first order of Goodness of Fit model and accordingly, two of them removed from

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the model.

In conclusion, the results can't be considered as sufficient representations of the specified components given the various criteria of overall model for goodness of fit and standardized regression weights.

Overall Model Fit (Goodness of Fit):

CFA has established an enormous number of fit indicators. As per J. F. Hair (2006), the investigator must evaluate the quality of fit data in order to determine whether to accept or reject the structural model.

The result for each of the four goodness of fit metrics utilized in the current Flow State Scale model is analyzed by AMOS. According to (J. F. Hair, 2006) and (Mavondo, 2007), distinct indices from each form of goodness of fit measure should be presented to assess the structural model; however, not all types of goodness of fit metrics need to explain.

The first order runs in CFA outputs are seen in selected fit statistics shown in Table 4. The entire model $\chi 2$ is 41.385 with 20 degrees of freedom. The p-value associated with the results is .003 and the value is significant. The covariance matrix calculated is not match the observed covariance matrix within sampling variance, as per the $\chi 2$ (chi-square) goodness of fit statistic. It can also analyze other fit statistics because of the issues with applying this test alone and the 200 participants are effective sample size.

We then look at a few other fit indices. As a rule, we should rely on at least in addition to the $\chi 2$ (chi-square) findings, one absolute fit index and one incremental fit index. The amount for Absolute fit index RMSEA is 0.073. This result seems quite low and the value is lower than the threshold value given for it i.e., .08 for a model with a sample size of 200 and 8 measurable variables. Using the 90% confidence interval, we conclude that the real RMSEA value for this RMSEA lies between 0.041 and 0.105. So, even in this instance, the RMSEA upper and lower end is less than threshold, the RMSEA values provide the model fit more evidence.

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The next to be examined is the root mean square residual (RMR), which has a value of .513. It is higher than the cautious threshold of.05. With a value of 41.385, the normed χ2 (chi-square) is the third absolute fit statistic. This measurement is obtained by dividing the chi-square value by the degrees of freedom (41.385/20 = 2.069). A score between 2.0 to 5.0 is deemed adequate, and less than 2.0 is considered extremely excellent. The values of the measurable variables are marginal, and several of them go below the threshold, as can be seen in the first order run.

As a result, there was room for modification, as indicated by table 4.

TABLE 4: Goodness-of-Fit Statistics (First Order)

Chi – square (χ2)

Chi-square = 41.385 (p - .003)

Degree of Freedom = 20

Absolute fit Measures

Goodness-of-fit index (GFI) = 0.952

Root mean square error of approximation (RMSEA) = 0.073

90 percent of confidence interval for RMSEA = (0.041; 0.105)

Root mean square residual (RMR) = 0.513

Normed Chi-square = 2.434

Incremental Fit Indices

Normed Fit index (NFI) = 0.844

Comparative Fit index (CFI) = 0.910

Relative Fit index (RFI) = 0.783

Tucker-Lewis index (TLI) = 0.875

Incremental Fit index (IFI) = 0.913

Parsimony Fit Indices

Adjusted goodness-of-fit index (AGFI) = 0.914

Parsimony normed fit index (PNFI) = 0.603

Modification of the Model:

Numerous methods can be employed to diagnose the goodness-of-fit statistics of the model. They might offer a way to enhance the model even more or a fix for an issue that hasn't been identified yet. It is necessary to confirm the route estimations, standardized residuals, and modification indices obtained via CFA. Based on the modification indices, a few of the model's variables have low standard loading values. Removing the variables with low standardized loadings may enhance the goodness-of-fit model.

Second order run the model was completed after the elimination of two test battery i.e., Aiming at target having the value of 0.205 and the second test battery i.e. Ball skill with the value of 0.092 Table 5 below displays that the value of all the goodness-of-fit of the model increased from the marginal value to accepted level and many of the indices value increased from the threshold value towards the excellent level. The entire model $\chi 2$ is 13.243 with 9 degrees of freedom. The p-value associated with the results is .152 and the value is significant. The $\chi 2$ (chi-square) goodness of fit value indicates that the predicted covariance matrix does not match the observed covariance matrix within sampling variance.

The value of the other two fit index is also required for the model fit, one absolute fit index and one incremental fit index. The amount for Absolute fit index RMSEA is 0.049. This result seems quite low and is under the 0.05 threshold for a model with a sample size of 200 and 6 measurable test battery. Using 90% confidence interval, we conclude that the real RMSEA value for this RMSEA lies between 0.00 and 0.0101. Additional evidence for the model fit is provided by the RMSEA value.

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TABLE 5: Goodness-of-Fit Statistics (Second order)

Chi – square (χ2)

Chi-square = 13.243 (p - 0.152)

Degree of Freedom = 9

Absolute fit Measures

Goodness-of-fit index (GFI) = 0.977

Root mean square error of approximation (RMSEA) = 0.049

90 percent of confidence interval for RMSEA = (0.00; 0.101)

Root mean square residual (RMR) = 0.324

Normed Chi-square = 1.471

Incremental Fit Indices

Normed Fit index (NFI) = 0.953

Comparative Fit index (CFI) = 0.985

Relative Fit index (RFI) = 0.905

Tucker-Lewis index (TLI) = 0.967

Incremental Fit index (IFI) = 0.981

Parsimony Fit Indices

Adjusted goodness-of-fit index (AGFI) = 0.947

Parsimony normed fit index (PNFI) = 0.566

It was concluded that the final fit statistics listed below were sufficient: With df = 9, N = 200, χ^2 (13.243), $p < 0.152$, χ^2 /df = 1.471, CFI = 0.985, RMSEA = 0.049, and a 90 percent confidence interval ranging from 0.000–0.101, the results are apparent. Although it shouldn't be used as a

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general cut-off criteria, the RMSEA is one of the most significant fit indices in SEM (F. Chun, 2008). Tiny RMSEA confidence intervals indicate tight fit in the population (Browne & Cudeck, 1993; Hu & Bentler, 1998), and a value of 0.060 would suggest a high match (Bentler, 1999). (Exploratory and Confirmatory Factor Analysis, R. B. Kline, 2005). Over the 0.90 criterion, the CFI = 0.985 is greater.

First, we began with PERCEPTUO-MOTOR SKILL TEST having eight test battery, in which six test battery having good factor loading i.e. > .4 but the other two test battery having low factor loading i.e. < .4. So, we did not intend to achieve acceptable Goodness of Fit indices by moving on to the questionable procedure of removing multiple items at the expense of construct validity. We agree with (H. W. Marsh, 2004) that component loadings, factor correlations, variance accounting, and other pertinent facts do not support the use of Goodness of Fit (GOF) indices as constructive selection criteria. Rather, they are impractical and should not be used to make sound decisions.

All six test batteries met the requirements for low to high factor loadings (0.40 to 0.60), with high loadings ranging from 0.467 to 0.711 (J. F. Hair R. E., 1998). The resultant squared multiple correlations (SMC) can account for 15% to 60% of the variance in the components. Factor loadings, on the other hand, showed that some items (such 0.092 and 0.205) had far lower factor loadings and were thus less effective than other items (like 0.711). We next used Cronbach's alpha (Cronbach, 1951) to analyze the internal consistency of each scale, which varied from 0.734 to 0.822 and met the conventional cut-off value of 0.70. Internal consistency and content validity are also demonstrated by the outcomes.

Establishing Reliability

Reliability is the measure of internal consistency of the Perceptuo-Motor Skill Test in the study. A test is reliable if the Cronbach's Alpha value is greater than .70 (Hair et al., 2013).

Table 6: Cronbach's Alpha Reliability Statistics of Perceptuo-Motor Skill Test

Cases	No. of Subjects	N (100%)	Cronbach's Alpha	No. of Items
Valid	200	100%		
Excluded	0	0	.820	06
Total	200	100%		

Reliability is the measure of internal. A test is reliable if the Cronbach's Alpha value is greater than .70 (Hair et al., 2013).

We can see from Table 6 that Cronbach's alpha coefficient of reliability value obtained was 0.820 for the Perceptuo-Motor Skill Test of 6 items. The value indicates a good internal consistency for the 6 test battery items with the present sample of 200 subjects playing at the national level.

4. CONCLUSION:

The findings of the present study validate the perceptuo-motor skill of table tennis players on young indian origin athletes with only six test items i.e. sprint, agility, vertical jump, speed while dribble, throwing the ball and eye-hand coordination . As this study is validate in Indian origin it can be used in a talent identification programme.

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