Modification of Reactive Agility Test Measuring Instrument for Table Tennis Performance: Aiken's Validity and Retest Reliability Test

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Abstract: Reactive agility ability is essential for table tennis performance. However, there is lack of reactive agility test measuring instrument for table tennis performance. This research aims to test the validity and test re-test reliability of reactive agility for table tennis performance. The method used in this research was mix method; qualitative and quantitative approaches. The participants were some documents, nine experts and some junior table tennis athletes. The researcher used literature systematic technique reviews with the Delphi technique to gather the data. Questionnaire with rating scale between 1 and 4 was used as research instruments. Then, in analyzing the data, researcher used Aiken's formula to test content validity. Furthermore, the researcher used product moment formula to reliability test re-test. The result found that the Aiken's coefficient value for each item was above 0,76. It meant that all aspects were valid in terms of the content of reactive agility test. The reliability of the reactive agility test was 0,955; it meant that this test had high stability. The conclusions were: reactive agility test for table tennis performance had high Aiken's validity and its reliability was high.

Keywords: Validity, reliability, reactive agility, table tennis performance

1. Introduction

Table tennis is one of group net games, which has characteristics of intermittent movements and rapid movements in changing direction in response to a stimulus (Zagatto et al., 2008; Zagatto et al., 2014). Every table tennis player has to master some dominant bio-motor components (Zagatto et al., 2010) that are endurance, reaction time, agility, speed, power, high level balance (Zhang et al., 2013; Sumaryanti et al., 2019). Agility is important bio-motor component in table tennis performance. It is because table tennis has the characteristic of moving left and right quickly changes in direction (Carrasco et al., 2011). Besides, reaction time is also important because table tennis has characteristic of returning the ball from the opponent after getting a stimulus (Carlos et al., 2019). Therefore, reaction time and agility were important to be improved by practicing and scoring.

Generally, all branches of net and invasion games need agility because it helps the body to move backward, sideward and onward quickly during sports (Haj-Sassi et al., 2011; Warren., 2015). Agility has been considered as the ability to quickly and dynamically change movement without losing balance for years (Issam et al., 2018; K Azmi & Kusnanik., 2018). For many years the limitation of the agility only focuses on general motor performance, not yet paying attention to the components of perception in which athletes get stimulation and decision-making during changes in motion (Frederick et al., 2014). As the consequence, most of the research about agility has been specified to test the speed of direction change that previously planned.

The result of reactive agility research has been defined as a quick whole-body movement with direction or speed change toward a stimulus (Sheppard et al., 2006). Reactive agility test is the unification of change in direction velocity, stimulus components, and information processing. The new reactive agility test consists of stimulus perception components and decision-making in responding to tester movements. Therefore, this test instrument is important to improve table tennis performance.

There are three information processing steps that indicate reactive agility. Those are stimulus perception, response selection, and movement execution. Those three steps are important parts of table tennis performance. In consequence, reactive agility test measuring instrument should be considered as an integral part of functional testing of table tennis performance. Based on that explanation, it is necessary to modify reactive agility instrument specifically to test table tennis performance. It should be valid and reliable.

Validity and reliability are two important issues on modifying measuring instruments (Tshidi., 2018; Mohajan., 2017). It is important because validity and reliability are the key of the measuring instruments' quality (Bajpai S. R & Bajpai R., 2014). Validity describes how accurate measuring instrument can produce research

data and accurate information (Bolarinwa., 2015) to measure correctly the concept that being studied (Drost., 2011) and be used as one of the requirements scientific research method (Babaee & Le., 2013).

Furthermore, validity is identified into two; internal and external. Internal validity refers to research design ability to get rid of alternative explanation of the result (Marczyk et al., 2005). High internal level is associated with experimental design in which independent variable effect on dependent variable is studied under strict conditions control. Medical research and clinical test are the experimental examples that mostly used on draft. Linda signifies that external validity is associated with generalization of research findings (Linda., 2004). In other words, if the research is repeated in different ways, in different place, and by other people, it has to have same result. Sample should represent the population studied to ensure the external validity.

There are four type of validity; those are content validity, face validity, construct validity, and validity that are associated with criteria (Embretson., 2007). Content validity is the most frequently used in the early stages of developing test and measurement. Besides, this validity helps to ensure construct validity and give the readers and the researchers confidence about the instruments used. Content validity is measuring how far the questions about instruments and scores can represent all possible questions asked about content or ability. In other words, content validity is the relevance of the instrument to the measured construct (F Yaghmale., 2008). It also depends on expert judgment. If the measure, design, and the field test skills are not suitable, the table tennis performance should be repaired. Construction of reactive agility test made should be able to measure table tennis performance.

Reliability in qualitative research can be defined as the extent to which the assessment tool produces stable and consistent result (Cook & Beckman., 2006). Observed score reflects the real score of the measurement. Reliability is defined as the extent to which the assessment tool shows the consistency and constancy of the test used and it also show the consistency of the test result (Heale & Twycross., 2015).

There are two types of reliability, namely stability and internal consistency reliability. Stability is the ability of measuring instrument which when used will produce the same result over time, although the test conditions were not the same (Widhiharso., 2010). Stable measurement will produce the same or almost the same score although done repeatedly. This test has high trust level. There are two ways to test stability, namely test re-test reliability and parallel reliability test (Oladimeji., 2016). The researcher used test re-test reliability in this research. Retest reliability test was done twice, first and second measurement. Then, the first and second results are correlated and the result will show the reliability of this test.

The aim of this research is to modify reactive agility test instrument of table tennis performance with approaches of Aiken's validity and test re-test reliability.

2. Research Method

This research used mix method; qualitative method and quantitative method (Borrego et al., 2009). The participants of this research are some documents and nine experts. These seven experts consist of four expert judgment lecturers that evaluate sports and five expert judgments that have national training certificate (at least bachelor's degree certificate).

The first procedure of this research was qualitative approach with systematic literature reviews method (Randolph., 2009; Rossella., 2015). The documents were international journals that discuss about the existing reactive agility measurement test. This is done to compose conceptual definition of reactive agility and reactive agility measurement test construction of table tennis sport. The steps of systematic review research process (Perry & Hammond., 2002) are as follows: (1) Identifying research questions. In this step the researcher transformed problem of reactive agility test into research questions. (2) Developing protocol of systematic review research. It aims to give guidance in doing systematic literature reviews. (3) Establishing location of research result database as journal search area with MEDLINE. It aims to give a search area limitation to the relevant research result. (4) Selecting relevant research results. In this step the researcher gathered research results that are relevant to research questions. (5) Choosing quality research results. In this step, the researcher did inclusion and exclusion toward the researches that will be chose to be incorporated in systematic literature reviews based on their qualities. (6) Extracting data from individual study. It aims to find the important findings. (8) Synthesizing the results using narrative technique. In this step, the researcher synthesized the results using narrative technique (meta-synthesis). (9) Presenting the result. The researcher wrote the result of the research in the document reports on the results of systematic literature reviews.

The second procedure was doing content validity test. It tested the result of systematic literature reviews analysis on the construction of reactive agility rest for table tennis. Then, it continued with expert construction test on agility test of table tennis sport with Delphi technique (Chia-Chien & Brian., 2007; Cox et al., 2016; Mgreen., 2014), in which every judgment expert did not meet each other while scoring (Landeta., 2006; Yudhistira & Tomoliyus., 2020) construct design of reactive agility test on table tennis. Furthermore, it continued with qualitative analysis of expert judgment inputs. The result was analyzed and returned to the experts to be revised (Fraenkel et al., 2011). The instruments used in this research was questionnaire with rating scale between 1 to 4. The expert judgment's data were analyzed using Aiken's formula (Aiken., 1980; Aiken., 1985) in which every aspect was calculated using content validity index as follows:

$V = \sum s / [n(C-1)]$

$S = r - lo$

Lo = lowest score

C = highest score

R = the number/score given by the appraiser (expert)

The third was test re-test reliability. It was validity test that was done after doing trials to the respondents as subject. They were junior table tennis athletes. Every respondent did the trial twice at interval of 15 minutes. Reliability estimation was done by correlating first and second trial. The researcher used Pearson product moment correlation statistical analysis.

3. Findings and Discussions

Qualitative Analysis Result

This was the collaboration between qualitative analysis result with systematic literature review technique and some inputs from expert judgments about instrument construction reactive agility test for table tennis sport. The picture is as follows:
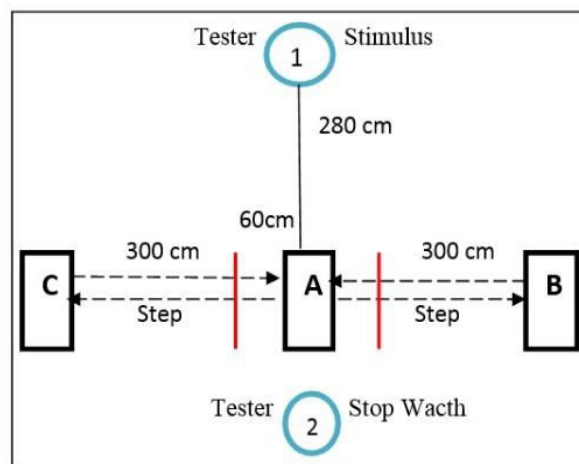
Figure.1. Reactive Agility Test Construction for Table TennisTesting Procedure

• Participant does some warming up.

• Tester give some directions to do the test.

• Participant try it once.

• Participant gets ready to stand in the A box and concentrates on looking ahead to both tester's hands that hold a flag.

• If tester lift up the flag with his left hand, the participant should step to the right side (the tester turning on the stop watch simultaneously). The participant should do it quickly until one of his feet is into the box with one of his hand touching cone B.

• After touching cone B, the participant step back to cone A as quickly as possible while still looking at the tester's hands.

• If one of participant's feet is above the red line while stepping, the tester will give another stimulus by lifting up the flag.

• If the participant seeing the tester lifting up the flag with his left hand, after one of participant's feet entering the box, he should step back to the right side to the cone B quickly and go back to cone A as soon as possible while still looking at the tester's hands.

• Otherwise, if the participant seeing the tester lifting up the flag again with his right hand, after one of the participant's feet entering the box, he should step to the left side toward cone C and go back to cone A as soon as possible while still looking at the tester's hands.

• This is done up to 6 times the tester lifts up the flag. He has to lift the flag up three times with his right hand and three times with his left hand. He should do it randomly. For instance, the tester can lift the flag up with his right hand after lifting it up with his right hand and he can lift the flag with his left hand after lifting it up with his right hand.

• If the participant do the last step from cone B to cone A or from cone C to cone A, his both of his feet should enter the box of cone A and the tester will stop the stop watch.

• The score will be noted every second.

The Result of Aiken's Validity

There were six instrument aspects of reactive agility test for table tennis performance that were assessed by the expert judgments. These aspects were: (1) the aspect of conceptual definition suitability, (2) the aspect of suitability of the stimulus amount for respondents, (3) the aspect of distance suitability, (4) the aspect of step movements suitability, (5) the aspect of the test procedure clarity, and (6) the aspect of the clarity construction drawing and test size clarity. The final scoring used scale range between 1 and 4. The scores that get closer to 1 were not relevant. In the other words, the scores that get closer to 4 were relevant. The expert judgments' data were qualitatively analyzed using Aiken's formula. The result of the test was as follows.

Table.1. The Result of Aiken's Validity

Evaluator	Aspect 1		Aspect 2		Aspect 3		Aspect 4		Aspect 5		Aspect 6	
	score	s	score	s	score	s	score	s	score	s	score	s
A	4	3	4	3	4	3	4	3	4	3	4	3
B	3	2	3	2	3	2	3	2	3	2	3	2
C	4	3	3	3	4	3	4	3	4	3	4	3
D	3	2	4	3	4	3	4	2	3	2	4	3
E	4	3	3	2	4	3	4	3	3	2	4	3
F	3	2	4	3	4	3	4	2	3	2	4	3
G	4	3	4	3	4	3	4	3	3	2	4	3
H	4	3	4	3	3	2	3	2	4	3	4	3
I	3	2	3	2	4	3	4	3	4	3	4	3
∑ S	23		24		25		25		22		26	
V	0,851		0,889		0,926		0,926		0,815		0,962	

Based on the Table 1 on aspect 1, the Aiken's V coefficient value for the conceptual definition suitability of the reactive agility was 0,851; on aspect 2, the Aiken's V coefficient value for the aspect of suitability of the stimulus amount for respondents was 0,889; on aspect 3, the Aiken's V coefficient value for the aspect of distance suitability was 0,926; on aspect 4, the Aiken's V coefficient value for the step movements suitability was 0,926; on aspect 5, the Aiken's V coefficient value for the test procedure clarity was 0,815; on the last aspect, the Aiken's V coefficient value for construction drawing clarity and test size clarity was 0,962. Aiken's V coefficient value was between 0 – 1. In conclusion, all aspects were having high validity because the minimal

standard of Aiken's V coefficient value was 0,76. In other words, all of the expert judgments were having high level of agreement toward the rated aspects.

The Result of Reliability Test Re-Test

The Table 2 below was the result of the reliability test using Pearson product moment correlation statistical analysis.

Table.2. Result of The Reliability Test

		Test 1	Test 2
Test 1	Pearson Correlation	1	0.955
	Sig. (2-tailed)		0.000
	N	20	20
Test 2	Pearson Correlation	0.955	1

Based on the data on the table, the result showed that there was a correlation between first and second measurement (r = 0.955; p<0.001). It showed that there was a stability measurement result over time to time (reliable). In other words, the construction of the reactive agility test to measure table tennis performance was reliable.

4. Discussions

Based on exercise and sport science literature, it is important to find the characteristic of the measurement, which is expert agreement, in modifying reactive agility test for table tennis performance (Pilot & Hunger., 1999). It is important because it is used to prove whether the content of the test is developed accordingly and relevantly to the reactive agility concept. In this research, the researcher modified the reactive agility test to find the expert agreement (content validity). There were two steps to find the expert agreement. The first step was composing reactive agility concept and construction design of reactive agility test for table tennis performance using systematic literature reviews technique. The second step was giving the construction of the reactive agility test for table tennis performance to nine experts to be rated/assessed by using Delphi technique (DeVon et al., 2007). The Delphi technique was used in three rounds and the experts would give the score then. The data got from the experts were quantitatively analyzed using Aiken's V. All aspects were having high level of agreement from the experts (high content validity). These aspects were the aspect of reactive agility's conceptual definition suitability, the aspect of suitability of the stimulus amount for respondents, the aspect of distance suitability, the aspect of step movements suitability, and the aspect of the clarity construction drawing and test size clarity. These aspects were having high level of agreement because its Aiken's V coefficient value were above 0,76 (Fleiss., 1975).

Besides, it is important to find measurement characteristic, which is reliability, in modifying reactive agility test for table tennis performance (Hopkins., 2000; Currell & Jeukendrup., 2008). This research used test re-test reliability by giving same reactive agility test to the respondents/participants twice in different times (Trochim., 2001). The result revealed that both of the result test had high correlation (r = 0,955). In the other words, reactive agility test for table tennis performance had high stability. It was high because the implementation of the first test and second test had a short time interval. Therefore, it minimalized the effect of changing conditions on the respondents/participants and the environments (Linn & Gronlund., 2000).

5. Conclusions

According to the results and discussions, it could be concluded that reactive agility test for table tennis performance were having high level of agreement (high content validity) and the reliability was stable. Therefore, this instrument can be used or tested to measure reactive agility of junior table tennis athletes. The researcher recommends to the future researchers to have further research on the external validity and practicality of the test.

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