



## Nonlinear Movement Anticipation Test with Specific Skills in Badminton Sport Studying Based on Ecological Psychology Approach

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### Keywords

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### Abstract

**Objective:** The aim of the present study was to investigate nonlinear movement anticipation test with two specific skills in badminton sport based on ecological psychology approach.

**Methods** 20 young men, 10 members of Tehran Youth Badminton Team and 10 physical education students, who had just passed the badminton-I course, participated in two coincidence anticipation timing (CAT) tests. The tests included performing one coincidence anticipation-timing task with the same conditions in service and drop skills. For data analysis, independent t-test and dependent t-test were used with adjusted significance level ( $P \leq 0.025$ ).

**Results:** Statistical analysis results indicated that there was a significant difference just in the service test ( $P=0.008$ ) between the novice and professional groups.

**Conclusion:** Also, the result showed that the precision of CAT of the novice has significant difference ( $P=0.02$ ) between two drop and service tests.

### Introduction

One of the characteristics of expertise in many sport skills is the perceptual abilities (Nuri, Shadmehr, Ghotbi, & Attarbashi Moghadam, 2013). Anticipation is one of the most important ones in reactive skills. A person would be able to explain interceptive action by using perceptual anticipation ability. Poulton (1975) changed the name of interceptive actions to CAT. According to his idea, CAT consists of two different kinds of anticipation. Coincidence-anticipation timing refers to the ability to time a movement so that its

arrival at a target coincides in time with a moving object's arrival at the same target. CAT is used as hand-coordination test and the visual acuity function in general (quoted by (Ripoll & Latiri, 1997). For this purpose, it is frequently used for evaluation of athletes and talented individuals in sports (Hagemann, Strauss, & Cañal-Bruland, 2006).

In most of the studies, it has been shown that this ability has more accuracy in experts, compared with the novices (Mori, Ohtani, & Imanaka, 2002) (Houmourzoglou, Kourtessis, Michalopoulou, &

Derri, 1998). Houmourtzoglou, et al (1998) compared three groups of elite athletes with two novice groups and claimed that elites had better coincidence anticipation (Houmourtzoglou et al., 1998). Results of the research of Besides, Mori, Ohtani and Imanaka (2002) showed that expert karate athletes were superior to novice in CAT (Mori et al., 2002). However, there are some researches in which no significant difference has been found among experts and novices in coincident anticipation timing (see, Molstad et al., 1994 cited in (Williams & Starkes, 2002); (Vänttinen, Blomqvist, Luhtanen, & Häkkinen, 2010)).

Athletes of rapid ball sports ,such as badminton, table tennis and tennis, require good abilities in CAT for positioning, finding the right status and getting ready to respond to a hit. In these sports, contact position and timing to hit the ball with the racket are the two main factors determining the direction of a ball which is sent to the opponent court. Little change in the timing may be cause ball deflection from the court or table (Akpınar, Devrilmez, & Kirazci, 2012). Williams and Starkes (2002) investigated the CAT in different skill level of Tennis players and got to this conclusion that high skilled players had better CAT ability (Williams & Starkes, 2002). Moreover, some researches have compared this ability in different ball sports. For example, Ak and Koçak (2010) compared CAT ability among tennis and table tennis players and found more accurate CAT in tennis players (Ak & Koçak, 2010). Even further studies investigated differences between variable

sports in different conditions of stimulus presentation. As an example, Akpınar, et al (2012) compared the CAT accuracy of athletes of badminton, tennis and table tennis with various stimulus velocities and demonstrated that tennis players ,under the low stimulus velocity, table tennis players .under the high stimulus velocity, and badminton players ,under moderate stimulus velocity, had better accuracy in CAT (Akpınar et al., 2012).

According to what was said CAT ability is a crucial element in the successful performance of sports, especially rapid ball sports. Therefore, studying about this subject has been developed increasingly and considered in the sport field. However, how is studying it as a special skill in a particular sport?

One of the characteristics of expertise in many reaction skills is using advanced visual information from the different movement patterns to anticipate behavioral events. Since one of the methods of time constraints analysis is investigation CAT ability, it may be assumed that this ability is unique for any skill and it's level differs for each skill. Thus the first purpose of this study was investigation of this ability in two specific skills in a rapid ball sport (Jackson & Mogan, 2007).

So, badminton is one of the fast ball sports which requires high perceptual abilities including punctuate CAT (Akpınar et al., 2012) and there has been no study exclusively focusing on this ability up to now. From these skills, which require high coincidence timing ability, we can call service and drop. The service is a hit which starts the game and

the drop is a hit which strikes from over head to the component court (Downey & Ross, 1982). Experiment has shown that service performance is harder than drop performance for novices in comparison to professionals because it requires more punctuate coincidence timing, so the rate of coincidence timing in each of these skills might be different between novices and professionals. Therefore, the second goal of present study is the examination of CAT difference in two specific drops and service skills between novice and professional badminton players.

The main restriction and weak point for the so-called researches, which had examined the coincidence anticipation ability for the athletes in different fields, is testing this skill through the survey of a linear movement and mostly unlikely with real motor patterns implemented by the athletes in that field. This has considerably decreased the external validity of these studies. And as we know, players' performance in real situations is definitely different and is usually in a non-linear path, in a curved shape (Robyn, Genevieve, & Kuba, 2013). To this end, the other aim of this research is the use of coincidence timing task based on specific inhibitory tasks stimulation in service and drop hits in badminton.

Recently ecological psychology approach has undermined these three phases implementation and has proposed the act-perception phenomena (Williams & Starkes, 2002). Especially Gibson are not separate sensory and motor phases and none of them has priority: therefore, they should not be studied separately. The ecological approach knows

the better use of informational constraints in relation with environment and task as a better factor of anticipation for professionals. The constraints limit and enable a number of paths that the system can adjust. The informational constraints are different kinds of energy flows throughout the system such as light reflection from a train toy or sound waves that a child receives when hits the ball to the ground. The informational constraints help shape the necessary motor responses and support action coordination by considering dynamic environments (Keith, Chris, & J, 2008). So, the ultimate aim of this research is to examine all of the previous goals in the framework of ecological psychology approach.

According to what was said, innovation of present research is the extension and development of the CAT research literature through the nonlinear anticipation test by stimulating two specific inhibitory tasks in elite and novice badminton players on the basis of ecological psychology approach, so that by finding more and accurate results in addition to choosing the talented in badminton, the use of training programs for the increase of CAT ability for each skill can be suggested to the coaches.

## **Method**

### ***Participants***

The method of this research was descriptive. The participants were 20 young men ( $Mean_{age}=20\pm 4$ ) including 10 members of Youth badminton team in Tehran and 10 students of physical education who passed badminton-1 course at

university. The number of participants was chosen according to previous researches (Nuri et al., 2013); (Duncan, Smith, & Lyons, 2013). The participants were placed deliberately according to their skill levels in 2 corresponding groups: professional (10) and novices (10). The criteria was the health vision of participants by Snellen test (Hasan Barani, Abdoli, & Farsi, 2014). None of the participants knew the research aim and all of them filled the consent form before implementing task. Totally, the number of subjects were 26 but after investigating the initial criteria, they were declined to 20 members.

### *Measures*

The tools used in this research were Snellen chart and the coincidence anticipation device. Snellen test considered for vision accuracy. The most popular evaluation scale for vision accuracy in the USA is Snellen table. This table consists of E Latin letters with different standard sizes and directions. The participants should be able to see the last row of table from 20 Ft. (6 m) distance as a person with natural sight vision easily with two eyes simultaneously (binocular) as well as with right and left eyes (monocular) separately (Hasan Barani et al., 2014). The CAT device evaluates the precision of CAT. This device has two hardware and software parts. The software part has been designed in such a way that the lightening stimulus, with specific characteristics, starts its movement on a specific direction toward a defined target. Then, the participant is asked, by pressing the corresponding key or passing hand in a clear space

(hardware part), to answer in such a way that the brightening stimulus stops on the target point. The software records and saves the time and space error. Abdoli, Farsi and Ramezanzadeh (2012) have reported the validity and reliability of this tool to be 0.87 and 0.83 (Abdoli, Farsi, & Rmezanzadeh, 2012).

### *Procedures*

At the beginning, every participant was examined by Snellen test and if he had no problem or adjusted with glasses and lens during the test, he could participate in the research. After entrance, the participants performed two special inhibitory tasks - two CAT tests which looked like drop and service hits. Every test included 10 trials and one-minute break between each of them. In these tests, the participants adjusted their movement with the stimulus movement by having racket in their hands and being in the corresponding hitting situation. In the drop test, the stimulus movement was in a circle path from down to up with the same speed, which lasted for three seconds (Figure. 1A). In the service test, stimulus was moving in a circle path with the same speed but from up to down. The stimulus movement took four seconds (Figure. 1B). The present order of these two tests was offered in a counterbalance shape among participants of each group. In drop test, the participants were asked to stand in drop-hit situation along with the start of stimulus movement and finish the hit by anticipating the stimulus reach to the target point. In the service test, the participants were standing in long service situation from the beginning and with

the start of stimulus movement, they coordinated their movement in such a way that the moment of ball touch to the racket corresponded to the moment of stimulus reach to the target point. After data collection, the mean absolute error of each person was calculated in each test and was considered as the person score in the group for the next calculations.

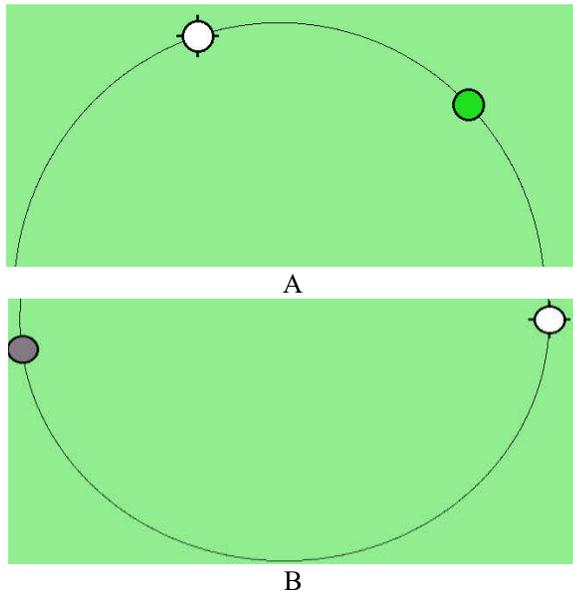


Figure 1. Test A: Drop, Test B: Service.

### Analysis

Descriptive statistics, Shapiro-Wilk test and Leven statistics were used for categorizing the data, examining the natural data distribution and investigating group homogeneity of variances respectively. After understanding that data distribution was normal, independent t-tests in the adjusted significant level of ( $P \leq 0.025$ ) were used to compare between groups. To compare the intra groups, dependent t-test with the adjusted significant level of ( $P \leq 0.025$ ) was also used

(Meyers, Gamst, & Guarino, 2006). Statistical Analysis was performed in SPSS software version 18 for statistics analysis and. Excel software version 2010 was used for drawing charts.

### Results

As seen in figure 2, the mean absolute error of the CAT for two groups in the service test was more than that in the drop test. This error amount is more in the novice group.

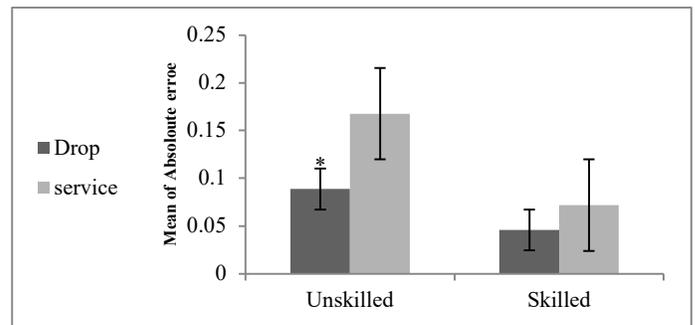


Figure 2. Groups mean absolute error in Service and Drop test.

The independent t-test results showed that, between the novice and professional group, there is a significant difference just in the service test ( $P=0.008$ ) (Table 1).

Table1. Summary of independent t-test results of absolute error coincidence anticipation in group variable.

Test	t	df	Sig
Service	3.01	18	0.008*
Drop	1.65	13.91	0.12

\*Significant in 0.025 level

In order to examine the inter group difference, the dependent t test in the significant level

( $P \leq 0.025$ ) was used in tests which can be seen in Table 2.

Table 2. Summary of dependent t-test results of absolute error coincidence anticipation intergroup variable

Group	t	df	Sig
Professional	1.69	9	0.12
Novice	2.62	9	0.02*

\*Significant in 0.025 level.

The results showed that the precision of CAT of the novice has significant difference ( $P=0.02$ ) in two drop and service tests and the comparison of this group means in two tests present more error in service test. However, the results show no significant difference between the performances of the professional group in two tests ( $p \geq 0.025$ ). However, the comparison of means shows more anticipation timing accuracy of the professional group in drop test than service one.

### Discussion and Conclusions

The present research's aim was to examine the nonlinear movement anticipation test by two specific incisory tasks in badminton players based on ecological psychology approach. The accuracy of CAT is one of the most important perceptual abilities in sport professional performance which considering the research developments the real situations has not been examined in specific inhibitory tasks in fast ball sports such as badminton and alike. Also, the examination and the base of this ability was on cognitive approaches including information process which knows the perception prior to movement in perceptual-motor

skills and presents the high experiment and training a factor of superiority of the professionals in the anticipation. However, the ecological psychology approach does not separate the movement and perception and acknowledges the better use of informational constraints as the superiority of the professionals. For this purpose, the present research aims have been shaped to remove these restrictions.

About the first aim, the results showed that there is a significant difference between CAT accuracy in two specific inhibitory tasks (two service and drop tests) in the novice group. It was also shown that the anticipation error is more in service test, Of course, the professional group also experiences more error in service test, but compared to drop test, this error was not significant. These results state that the CAT accuracy is different in each skill and appears differently in each of them. According to the ecological psychology approach, the task need rate will affect the determination of this ability rate. This result is ,along with Jackson and Mogan (2007) idea, based on the specialization of the perceptual-motor skills (Jackson & Mogan, 2007). In addition, one of the other reasons, based on ecological psychology approach, is the higher number of components involved in service hit performance which requires more in-member coordination and more coincidence timing. Although previous studies in the field of CAT ability have not directly compared specific skills in special sport, the studies in the field of specialization of CAT ability have been

implemented in sport so that they are somehow in line with the present research. For example, Ak and Koçak research (2010) has examined the CAT and the reaction time of 10-14-year-old Tennis and table tennis players. 107 Tennis players and 101 table tennis players participated in this study. The tennis players showed more CAT accuracy compared to table tennis players while table tennis players had less reaction time (Ak & Koçak, 2010). Akpınar et al (2012) compared the CAT ability among badminton, tennis and table tennis players to different speeds of stimulus present in their study. 90 players (15 girls and 15 boys) for each sport participated in this study. At the end, the result showed that the tennis players, the table tennis players and the badminton players had the highest CAT accuracy in low speeds, high speeds moderate speeds of stimulus present respectively (Akpınar et al., 2012).

About the second aim, the result showed that there is significant difference between the professional and novice groups only in the service test. However, the professional group conducted less error in both tests but the difference between the novice and professional was big and significant only in the service test. Regarding the superiority of the professional group over the novice in the service test, this study is in line with the researches of Houmourtzoglou and colleagues (1998), Mori, et al (2002) and Williams and Starkes (2002). The research aims in Houmourtzoglou and et al (1998) study was to examine the differences between the professional and novice in number of perceptual skills. Three groups of professional athletes,

including 44 members of national Greece Basketball, Volleyball and Water polo teams, were chosen. Two groups of physical education students were considered as novices too. At the end, the results showed that the professionals were better than the novices and each sport field nature affects the perceptual abilities difference (Houmourtzoglou et al., 1998). Also, Mori and colleagues (2002) compared two groups of novices and professionals in Karate. Six university students who were Karate champions, as professionals, and 7 students without Karate exercise but familiar with this field ,as novices, were chosen. In the end, the results indicated the superiority of the CAT accuracy in the professionals. The researchers of the article attributed this phenomenon to the more experience of the professionals (Mori et al., 2002). Williams and Starkes (2002) studied the skill level difference of Tennis players in performing the CAT task, and concluded that the professional players have higher coincidence anticipation skill. They acknowledged that the experience in open skills facilitates the coincidence timing ability development. They also concluded that skill level in ball games is positively related to the coincidence timing ability (Williams & Starkes, 2002). Some studies, in this regard, introduced the visual perception of the professionals as the main reason of their better anticipation skill. As it was stated, the professional athletes have had the perception ability of visual information about the competitor's motor pattern, and they use these information to anticipate the subsequent events (Shim, Carlton, Chow, & Chae, 2005). Also,

Savelsbergh, Williams, Vanderkamp and Ward (2002) stated that the professionals, compared to the novices, are better in using developed visual signs to guide the anticipation responses (Savelsbergh, Williams, Kamp, & Ward, 2002). Moreover, the previous studies have shown that the superiority of visual process and the compatibility with perceptual mechanism in the professionals cause their better ball path anticipation as well as better response. It is worth mentioning that compatibility is made by high exercise (Ripoll & Latiri, 1997). On the other hand, the present research results were contrary to that of Vääntinen and colleagues' (2002). In their study, 142 professional and non-professional players were considered but no significant difference was found in their anticipation ability; however, they magnified professional's higher scores in their results, and stated the better output of the professionals' visual system as the reason (Vääntinen et al., 2010). Considering the past studies results, the superiority of the professionals over the novices in the CAT accuracy can be explained because of the visual perception preference by high experience and exercise. Although, it should be said that the professionals, in this research, had significant superiority only in the service test, but this was not significant in drop test. It seems that the discussion of this ability in each skill indicates no significant difference in drop test or maybe the novice players have had many exercises on the drop hit skill in this research. It's better to repeat this discussion in the last aim of the present research.

The third aim of this study was the investigation of the first and the second aim's results according to ecological psychology approach. In the ecological psychology approach, contrary to the cognitive approaches and in particular the information process, it is believed that the performance of an act is not accomplished after the perception. According to the cognitive approaches, the information is firstly perceived through senses and then the order is issued to perform the act after the occurrence process in mind and therefore the movement is done. But the ecological approach believes the perception and act process are not two separate phase and that they are as a cycle. In this regard, Gibson says: 'we perceive for movement and we move for perception.' (Davids, Button, & Bennett, 2008; Keith et al., 2008). According to the information process approach, Alder, Ford, Causer and Williams (2014) stated that the professional's superiority in the anticipation ability is because of their more experience in the answer choice step (Alder, Ford, Causer, & Williams, 2014), whereas Williams and colleagues (2002) believe that the information process viewpoint knows just the subjects of process capacity and response programming as the main reason but the ecological viewpoint uses invariable space or time patterns to provide information and to perform the act among which the visual information such as the moment of ball hit with the racket plays an important role in organizing the professionals' response (Williams, & Starkes, 2002). Shim (2005) states that the visual information should be correctly perceived at first

the next events can be anticipated (Ak & Koçak, 2010), but Ripoll and Latiri (1997) know the perceptual-motor coordination essential to the coincidence of stimulus entrance time to the target and pressing the key, or in other words, the better coincidence anticipation performance. They also stated that the difference between the professionals and novices can be interpreted as the result of an adjustment in the joined perceptual-motor level and not only on the basis of a supposed visual level (Ripoll & Latiri, 1997). Moreover, Mori and colleagues (2002) propound that the high level competitive sports are determined by difficult space and time constraints which are imposed on the performer. Under such constraints, the player's ability is facilitated to perceive visual information for making a fast and accurate decision, and more time feasibility is provided for preparing and organizing the motor behavior as well as that the professional players are better than the novices in recognizing the informational and invariable constraints in the surrounding (Mori et al., 2002). Considering the results of this research and previous studies, it seems that both the professional constraints in the environment regard to task needs, but the professionals have better recognition to the task needs due to more experience and showed better compatibility in perception-action under applied environmental constraints. So they could have better CAT in performing the tests. Also, there is more error in both groups in the service hit than in drop one, which requires more time for the coordination and compatibility of perception-action. Generally, the important finding of this

research is the non-difference between the professionals and novices in the service test. This non-difference contravenes this point that the professionals are always better in the CAT, and according to the ecological psychology approach, the task needs and variable environmental conditions determine this difference.

As the general rule, the CAT ability in each sport skill is specific, and it is suggested to the Badminton coaches to examine this ability specifically and present the practical programs specific to each skill in order to support the CAT. In addition, it is suggested that the researchers, in the further researches, study the CAT specifically in each sport and skill in order to examine the ability. In the end, we need to talk about the research limitations. Finding the skilled subjects was really hard so we just had 13 of them, however three of them were rejected after the stage of initial investigating.

## References

1. Abdoli, Farsi, & Rmezanzadeh. (2012). The effect of increasing and decreasing contextual interference with the change motor program and parameter on the task anticipation timing coincidence learning and error detection capability. *Journal of Motor Behavior (in persian)*(13), 29-44.
2. Ak, E., & Koçak, S. (2010). Coincidence-anticipation timing and reaction time in youth tennis and table tennis players. *Perceptual and motor skills*, 110(3), 879-887.
3. Akpınar, S., Devrilmez, E., & Kirazci, S. (2012). Coincidence-anticipation timing requirements are different in racket sports. *Perceptual and motor skills*, 115(2), 581-593.
4. Alder, D., Ford, P. R., Causer, J., & Williams, A. M. (2014). The coupling between gaze behavior and opponent kinematics during anticipation of badminton shots. *Human movement science*, 37, 167-179.

5. Davids, K. W., Button, C., & Bennett, S. J. (2008). *Dynamics of skill acquisition: A constraints-led approach*: Human Kinetics.
6. Downey, J., & Ross, L. (1982). *Winning badminton singles*: EP Publishing.
7. Duncan, M., Smith, M., & Lyons, M. (2013). The effect of exercise intensity on coincidence anticipation performance at different stimulus speeds. *European journal of sport science*, 13(5), 559-566.
8. Hagemann, N., Strauss, B., & Cañal-Bruland, R. (2006). Training perceptual skill by orienting visual attention. *Journal of Sport and Exercise Psychology*, 28(2), 143.
9. Hasan Barani, F., Abdoli, B., & Farsi, A. (2014). Effect of errorless and errorful learning on performance kinematic parameters in a throwing task: A pilot study. *Journal of Research in Rehabilitation Sciences*, 9(6).
10. Houmourtzoglou, E., Kourtessis, T., Michalopoulou, M., & Derri, V. (1998). Differences in several perceptual abilities between experts and novices in basketball, volleyball and water-polo. *Perceptual and motor skills*, 86(3), 899-912.
11. Jackson, R. C., & Mogan, P. (2007). Advance visual information, awareness, and anticipation skill. *Journal of motor behavior*, 39(5), 341-351.
12. Keith, D., Chris, B., & J, B. S. (2008). *Dynamics of skill acquisition: A constraints-led approach*: Human Kinetics.
13. Meyers, L. S., Gamst, G., & Guarino, A. J. (2006). *Applied multivariate research: Design and interpretation*: Sage.
14. Mori, S., Ohtani, Y., & Imanaka, K. (2002). Reaction times and anticipatory skills of karate athletes. *Human movement science*, 21(2), 213-230.
15. Nuri, L., Shadmehr, A., Ghotbi, N., & Attarbashi Moghadam, B. (2013). Reaction time and anticipatory skill of athletes in open and closed skill-dominated sport. *European journal of sport science*, 13(5), 431-436.
16. Ripoll, H., & Latiri, I. (1997). Effect of expertise on coincident-timing accuracy in a fast ball game. *Journal of sports sciences*, 15(6), 573-580.
17. Robyn, K., Genevieve, N., & Kuba, G. (2013). Development of coincidence-anticipation timing in a catching task. *Perceptual & Motor Skills*, 117(1), 319-338.
18. Savelsbergh, G. J., Williams, A. M., Kamp, J. V. D., & Ward, P. (2002). Visual search, anticipation and expertise in soccer goalkeepers. *Journal of sports sciences*, 20(3), 279-287.
19. Shim, J., Carlton, L. G., Chow, J. W., & Chae, W.-S. (2005). The use of anticipatory visual cues by highly skilled tennis players. *Journal of motor behavior*, 37(2), 164-175.
20. Vanttinen, T., Blomqvist, M., Luhtanen, P., & Häkkinen, K. (2010). Effects of age and soccer expertise on general tests of perceptual and motor performance among adolescent soccer players. *Perceptual and motor skills*, 110(3), 675-692.
21. Williams, A. M., & Starkes, J. (2002). Cognitive expertise and performance in interceptive actions. *Interceptive actions in sport: Information and movement*, 40.