# PSYCHO-PHYSIOLOGICAL PREDICTORS OF TEN-PIN BOWLING PERFORMANCE AMONG EAST COAST STATE BOWLERS

By

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# CERTIFICATE

This is to certify that the dissertation entitled

**PSYCHO-PHYSIOLOGICAL PREDICTORS OF**

**TEN-PIN BOWLING PERFORMANCE AMONG**

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is the bona fide record of research work done by

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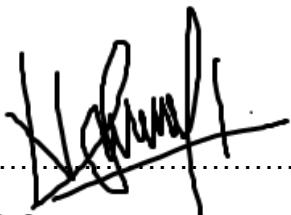
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# DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated and duly acknowledged. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at Universiti Sains Malaysia or other institutions. I grant Universiti Sains Malaysia the right to use the dissertation for reaching, research and promotional purposes.

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# ABSTRAK

Kajian ini bertujuan untuk menentukan penanda psikofisiologikal seseorang individu ke atas prestasi yang optimum di dalam sukan ten-pin boling. Seramai 32 peserta berumur daripada 15 ke 26 tahun (M = 17.58, SD = 2.575) yang juga merupakan pemain ten-pin boling turut serta dalam kajian ini. Purata tahun peserta terlibat dalam sukan ten-pin boling adalah M= 5.57 (SD = 3.131). Peserta di minta untuk bermain sebanyak 15 permainan di mana kadar degupan jantung akan diambil dan mereka juga perlu menjawab beberapa soalan kajian seperti IZOF, CSAI-2R dan DVT. Penanda psikofisiologikal individu dalam kajian ini adalah kebimbangan kognitif, kebimbangan somatik, kadar rangsangan, tahap keyakinan diri, konsentrasi dan kadar degupan jantung. *Multiple Linear Regression* digunakan untuk mengira kadar jangkaan terhadap prestasi ten-pin boling berdasarkan kepada kadar rangsangan individu, kebimbangan kognitif, kebimbangan somatik, tahap keyakinan diri, penumpuan dan kadar degupan jantung setiap *strike*, setiap *spare* and setiap *miss* dalam setiap sesi. Secara statistik, terdapat perbezaan ketara antara kesemua penanda psikofisiologikal (p <0.001 dan p < 0.05). Peserta juga mempunyai kadar degupan jantung paling tinggi sewaktu mereka tidak dapat menghabiskan pin mereka.

# ABSTRACT

The aim of this study was to determine the individual psychophysiological markers for optimum ten-pin bowling performance. A total of 32 participants aged from 15 to 26 years old (M = 17.58, SD = 2.575) of Pahang state ten-pin bowling player were recruited. In this study, participants average experience in playing ten-pin bowling was M = 5.57 (SD = 3.131). Participants is asked to play 15 games where the heart rate will be measured, and they also need to answer few questionaires such as IZOF, CSAI-2R and DVT. The psychophysiological markers measured in this study were cognitive anxiety, somatic anxiety, self-confidence, concentration and heart rate. Multiple Linear Regression was used to calculated the prediction of ten-pin bowling performance (score) based on their arousal level, cognitive level, cognitive anxiety level, somatic anxiety level, self-confidence level, concentrarion, average strike per session, average spare per session and average miss per session. There were statistically significant different in all the psychophysiological markers (p < 0.001 and p < 0.05). The participants also had the highest heart rate when they missed their throw.

# CHAPTER 1

# INTRODUCTION

## 1.1 Background of Study

Ten-pin bowling is an individual precision sport, which requires a bowler to grip the bowling ball firmly, walk in rhythmic step with a finishing sliding step and release the ball through the lane in order to strike all pins. In competitive ten-pin bowling, it is most probable that technical and psychological skills (Newton & Duda, 1993) contribute to high scores.

A game consists of ten frames, which start with a full rack of ten pins. In each frame, bowlers have two deliveries of the ball (Wood, 2008). In general, bowlers are competing with each other whether in individual event (singles), teams of two (doubles), three (trios), four or five persons.

The scoring system being used for all events are same. For instance, bowler A playing double event with bowler B. Thus, the total score of bowler A will be added with total score of bowler B. In trio event, all the three bowlers' scores must be total up. However, if it is a team event, it can be played by accumulating all the players' scores or by Bakers Format which 4-5 players shared 1 game and throw according to their fixed frames to complete a game.

The score will be displayed on the bowling score screen. If a player knocked down 7 pins then the screen will be displayed as '7', a strike will be displayed as (X), spare as (/), split as (S) and gutter or miss will be displayed as (-).

A spare is 10, plus the value of the next roll. For example, if a player throw a spare in the first frame. Then, in his first ball of the second frame, he throw a 7. The score for the first frame will be 17 (10+7) (Goodger, 2015).

For strike is 10, plus the value of the next two rolls. For example, in frame 5, a player get strike and in the next two rolls, the player also get strike. Therefore, the score would be 30 (10+10+10) on the fifth frame (Goodger, 2015).

Ten pin bowling is basically a self-paced and precision sports that needs a high mental toughness and concentration to perform well. The psychophysiological, cortical, behavioural, and kinematic features of self-paced tasks (e.g., ten-pin bowling, shooting, golf putting, dart-throwing, archery) have been usually studied involving a within-subjects approach by contrasting individual's best and worst performance patterns (Bertollo et al., 2013). Thus, by using various psycho-psychological markers, we can examine whether the ten-pin bowler player's psychological state is related with their performance.

First, the Individual Zones of Optimal Functioning (IZOF) model is a component of the psychobiosocial state conceptualised as a situational, multi-modal and dynamic manifestation of the total human functioning which holds that emotion develop in the naturalistic setting of elite sport (Robazza, Pellizzari & Hanin, 2004). It accounts for individuals' differences in emotion-performance relationship (Flett, 2015). Also, IZOF model holds that athletes have zones of emotional intensity associated with optimal and dysfunctional performance and the size and locations of zones vary between individuals (Flett, 2015).

There are two zones that describe the feeling intensity associated with best and worst performance levels referring to "in-out of zone" principle (Flett, 2015). The "in-out of the zone" notion was developed to predict that each athlete has her own optimal anxiety level and zones of intensity that are always individual and could be either high, or moderate, or even high (Figure 1). Later this work was extended to positive and negative emotions and other components of performance related states (Hanin, 2003). When pre-start anxiety is outside the zone, (too high or too low anxiety), poor performance is expected (Robazza, Bortoli & Nougier, 1999)
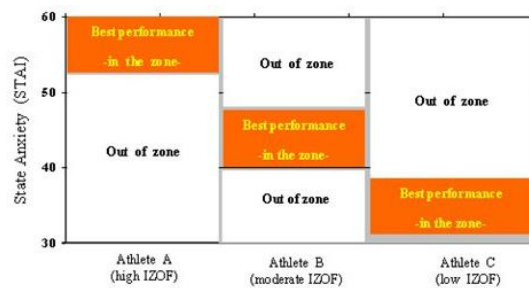


Figure 1: Individually zones of optimal functioning in three athletes

Second, concentration can be defined as person's ability to exert deliberate mental effort on what is most important in any given situation (Moran, 1996). Athletes, coaches and sport psychologist agreed that attentional skill such as concentration, or the ability to focus effectively on the task at hand while ignoring distraction, is one of the essential prerequisites of success in sport (Moran, 2004). Numerous aspects of focus and concentration appear to be important for dealing with pressure and adversity in various competitive sport contexts (Sarkar & Fletcher, 2014).

Lastly, anxiety can be defined as a feeling of worry, nervousness, or unease about something with an uncertain outcome or a nervous disorder marked by excessive uneasiness and apprehension, typically with compulsive behaviour or panic attacks. Martens et al. (1990) proposed that anxiety consists of two components: a cognitive component, associated with worry, and a somatic component, associated with nervousness or tension.  Anxiety usually issue in the terms of facilitating or debilitative anxiety, as some athletes may interpret their anxiety symptoms as facilitative to performance whilst others may interpret them as debilitative (Jones & Swain, 1995). Hanton et al. (2004) demonstrated that the frequency of cognitive anxiety symptoms tends to remain high in the run up to competition, whilst somatic anxiety increases dramatically as the competition nears.

**1.2 Research Objective**

**1.2.1 General Objective**

- To determine the association of individual psycho-psychological predictors and optimum ten-pin bowling performance.

**1.2.2 Specific Objectives:**

- To determine the association between individual heart-rate and optimum ten-pin bowling performance.

- To determine the association between individual concentration level and optimum ten-pin bowling performance.

- To determine the association between individual zone of emotion and optimum ten-pin bowling performance.

- To determine the association between individual anxiety state and optimum ten-pin bowling performance.

## 1.3 Research Hypothesis

$H_o1$: There is no significant association between heart rate and bowling score.

$H_a1$: There is significant association between heart rate and bowling score.

$H_o2$: There is no significant association between concentration level and bowling score.

$H_a2$: There is significant association between concentration level and bowling score.

$H_o3$: There is no significant association between zone of emotion and bowling score.

$H_a3$: There is significant association between zone of emotion and bowling score.

$H_o4$: There is no significant association between anxiety state and bowling score.

$H_a4$: There is significant association between anxiety state and bowling score.

## 1.4 Significance of Study

This research may be helpful for the future researcher who intends to study about ten-pin bowling player performance. It will also be helpful to the coaches and the teams to understand how arousal and emotions affect players' performance. Thus, they can train their player with psychological techniques such as mental training, self-talk, imagery training and so on for improving their player's performance.

Besides, this research result will also be helpful in planning future training session as coach know their players' advantages and disadvantages. The low-confident and highly-arousal player will be given more attention in training as they need more help compared to the ones that are already mentally tough and fit.

# CHAPTER 2

# LITERATURE REVIEW

## 2.0 Psycho-physiological markers for sport performance

Psycho-physiology is a combination of psychological and physiological processes such as heart rate, galvanic skin response, blood pressure and other physiological factors that tend to change following individuals' psychological state. For example, if someone is angry, the heart rate tend to increase.

## 2.1 Individual Zones of Optimal Functioning (IZOF)

The IZOF have been proposed to explain the link between athletic performance and affective experiences (Hanin, 2007). For instance, when we look into the IZOF model, it reflects the notion that affective experiences have idiosyncratic meanings, intensities, and functions associated with successful, average and poor athletic performance (Bertollo, 2013). Furthermore, this framework emphasises that affect, mood states, and emotional responses (above and beyond competitive anxiety) should be examined in order to gain a deeper understanding of the psychological functioning of athletes competing in various sports (Bertollo, 2013). As a result, the IZOF model is considered a leading framework in evidence-based applied sport psychology.

The IZOF model was conceived by Yuri Hanin, who expanded the notion of anxiety and showing how zones of optimal functioning use a variety of emotions and other psychobiosocial states such as determination, pleasantness, and laziness (Stegall, 2016). He viewed that for best performance to occur, athletes' needs individualised optimal levels not only of state anxiety but of variety of other emotions as well (Stegall, 2016).

An evolution in IZOF is the MAP model's 2 × 2 organisation which has been conceptualised to offer clear "multi-performance enhancement plans" according to four performance types (Filho et al., 2015). The multi-action plan (MAP) intervention model has been developed to help athletes attain optimal and consistent performance. The MAP conceptualization originates from different theoretical including the optimal experience framework, the mindfulness-acceptance-commitment based approach, the individual zones of optimal functioning model, and the identification-control correction program.

Bertollo (2013) viewed that the MAP model identifies four performance categories deriving in terms of performance level (optimal vs. sub-optimal) and conscious action control level (automatic vs. controlled). This conceptualisation leads to the identification of four performance categories: Optimal-automatic (type 1), optimal- controlled (type 2), suboptimal-controlled (type 3), and suboptimal-automatic (type 4) (Bertollo et al., 2013) in Figure 2.

Optimal-automatic (type 1) performance is typified by functionally optimal-pleasant emotional states (P+), self-confidence, perception of control of the situate ion, high levels of physical and mental energy, and effortless, smooth, autonomous, and consistent movement (Bertollo et al., 2013). This ideal state can be easily disrupted as a consequence of competitive stress, fatigue, or unexpected performance problems.

Consequently, performers can enter a suboptimal-controlled condition (type 3) characterised by dysfunctional-unpleasant emotional states (N-), excessive and task-irrelevant focus of attention on movement execution in an attempt to deal with problems and mistakes that, as a consequence, reduce movement smoothness and automaticity, with forced ''reinvestment'' (Bertollo et al., 2013).

Suboptimal performance can also occur when individual psychophysiological conditions are fine and feelings are pleasant (P-), but the performer is not much engaged or motivated and does not invest enough energy to execute the task (type 4) (Bertollo et al., 2013).

The resulting automatic behaviour is not coordinated enough for the task at hand. The fourth condition is typified by optimal-controlled (type 2) performance, in which the individual's perception of threat tends to prompt functionally optimal, although unpleasant, emotional states (N+) and action-tendencies that are properly directed toward the execution of the task (Bertollo et al., 2013).
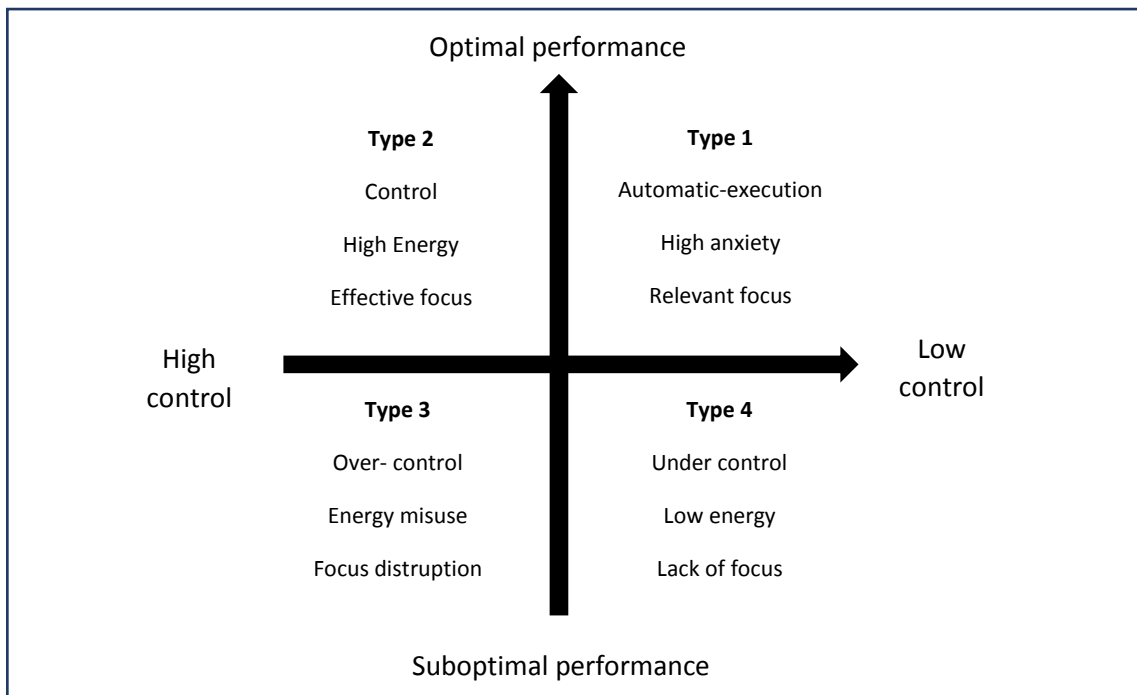
Figure 2: Key feature of 4 types of performance derived from interaction between performance and control level within MAP intervention model

## 2.1.1 Factors linking IZOF and Athlete Performance

Emotion intensity is a quantitative characteristic of affect. To optimize an individual's performance, the "in-out of the zone" concept can serve as a guideline (Roy & Suwarganda, 2015). The "in-out of the zone" concept is the most important dimensions as together with emotion content, it determines the effect of emotion on athletic performance (Hanin, 2007).

The IZOF was founded on the basis that top athletes have zone of optimal state anxiety in which their best performance occurs, anything outside this zone is considered poor performance (Stegall, 2016). In a short duration of task, pre-competition anxiety whether it is near the individual zone or outside the zone relates to performance success (Roy & Suwarganda, 2015). A high probability of individually successful performance is expected when combined maximum enhancing and minimum impairing effect (in the zone condition) are observed. In contrast, a high probability of poor performance is expected when low enhancing and high inhibitory effects (out of zone condition) are observed (Robazza, Pellizzari & Hanin, 2004).

IZOF suggests that an athlete can perform up to his or her potential when his or her state of anxiety is at the individually optimal level (Salminen, Liukkonen, Hanin & Hyvonen, 1995). Thus, it is unlikely that individual could share the same optimal level of anxiety during pre-competition and during the competition (Salminen et al., 1995). Bertollo et al (2012) also suggest that since affect is known to be a multidimensional construct, it become odd to see that two individuals could share the same level and intensity range of affect and psychophysical responses with respect to a particular performance task as arousal or activation and vigilance are manifested at multiple subjective and physiological levels.

Emotion during competition can have facilitating or debilitating effects on performance (Roy & Suwarganda, 2015). IZOF model was developed to account both the facilitative and debilitative effects of anxiety on performance and later extended to other emotional states (Bortoli, Bertollo, Hanin & Robazza, 2012).