The Role of Kinaesthetic Perception in Supporting the Acquisition of Skills in Sports Games

Y Hendrayana*
Faculty of Sport and Health Education, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi no 229, Bandung 40154, Indonesia

*yudy@upi.edu

Abstract. Success in sports performance depends on how effectively the performers detect, find and use relevant sensory information. Often, the winner of a game is the most rapidly detect a pattern of action on your opponent. The sources of sensory information are eksteroceptive and proprioceptive. The organs of eksteroceptive information source is eksteroceptor which rooted in two things: vision and hearing. While Resources is proprioceptor include proprioceptive sensory receptor specifically in muscles, tendons, joints and vestibular apparatus (which is part of the central auditory / maze). Proprioceptor called kinesthetic perception or kinesthetic senses, which means the sensory input that occurs in the body that serves as feeling responsible for the correctness of a movement. This study aims to determine the role of kinesthetic perception in supporting the acquisition of skill in sport game. The research method used was survey with correlation technique. Population and Sample are players early ages 12 to 13 Years of 40 people. Based on the results of data processing correlation coefficient of 0.77 and a coefficient of determination (R) of 0.60. It can be concluded that there is a contribution of 60% kinesthetic perception towards sports game.

1. Introduction
Success in sports performance depends on how effectively the performers detect, find and use relevant sensory information. In many cases, the winner of a competition is the one who is able to promptly detect the movement patterns of the opponent based on both exteroceptive and proprioceptive stimulations, the former consisting of seeing and hearing sensory organs [1].

Vision provides information of movements of the objects as well as one’s own movements in the surrounding [2]. The second exteroceptive information source is based on the hearing sensory part. Although it is not as significant, many types of activities are dependent upon hearing sensitivity which becomes well developed.

The other information source is proprioceptive sensor which is based on the body movements. This renders information from within the body such as the positions of joints, muscle strength and space orientation as in the upside position. Similar types of information are also known as kinesthesis whereby “kines” refers to motion and “thesis” to sense of feeling. Thus all can refer to the movements of the joints, the strains of the muscles and the likes. This is to say that these generally are a set of information sensors built in the body to detect the positions of joints, movements, and muscle strains within the space orientation [3].
Morphologically, the term “kinesthetic perception” means the perception or response stimulated through the sensory parts in the body [4]. A site in the internet describes that the term “perception” is the result of the interaction of two factors: the sensory stimulation received by someone and a driving sense that either regulates or counters the stimuli intra-physically. This interchanging process of the two factors, in which the associational process occurs, a certain interaction pattern comes about within a certain physical pattern. Meanwhile, the term “kinesthetic” refers to the awareness of the muscle movements. To put the two words together, the term “kinesthetic awareness” means the response of someone to sense the muscle movements based on the sensory parts [5].

The kinesthetic perception is also known as kinesthetic sense which means the sensory input with in the body. The physical response and information is delivered through the sensory system by the strain of the muscles [6]. Even in the stationary position the kinesthetic sense can detect the body position which shows that the function of this sense is to detect the organs related to body movements. The kinesthetic sensor is the sense that gives us awareness of the body positions or its parts as they move, because of this sense we are able to control the movements accurately. Similarly, the kinesthetic perception is the ability to sense the position of the body and its parts within a space [7]. Furthermore, the same way about this sensing ability in. The individual ability to control the movements accurately is based on the information from the sense or feeling sensor located in the tendon muscle fascia and the joints.

2. Kinesthetic Information Source
Philip and Hornak describes that the kinesthetic perception organ is the proprioceptor covering the sensory receptor particularly in the muscle, tendon, joints and vestibular apparatus in the inner section of the ear. It is sometimes knows as the muscle sense because traditionally the tension of the receptor in the muscle is the source of kinesthetic sense.

The proprioceptor develops high sense in the muscles, tendons and joints and turns the kinesthetic perception system highly sensitive. Allen and James states that kinesthetic sense is the ability to sense or feel the body position with the space and the position of the surrounding objects. The kinesthetic sense organ is the proprioceptor covering the special sensory receptor in the muscles, tendons, joints and vestibular apparatus (labyrinth). The kinesthetic or receptor sense is sometimes known as muscle sense as the tension of the muscle is responsible for the kinesthetic process.

The Kinesthetic perception is useful for both young and senior athletes who can consciously have good control on their movements of the muscles and joints. A research shows that proprioceptors can describe one’s performance in the future as well as determine better performance of an athlete by sensing the right movements, or, in other words, giving the awareness of the importance of the kinesthetic perception in every movement.

In addition, they should also be aware of the ability to sense the gravitation and the body position as well as the head through the sensor in the inner part of the ear which is called vestibular apparatus. Even with the eyes closed, when the limbs are folded, they can still sense how the body responds. This sense is given through the kinesthetic sensor. As one is blindfolded and lean the head, one is aware of the gravitation orientation sensing clearly which part is in the upright position. By moving the head to and fro the body can sense which part of the vestibular support that signals the head moving force.

This sensation comes in different ways. There are three types of receptor in the kinesthetic sense. The sensor consists of the special cells that give away signals to the brain as it is stimulated. The cell rods and cones in the retina give the signal of light and cells in the inner ear through vibration. This process is the sensory receptor in which there is vestibular sensitivity called mechanoreceptor since no sensor of light or sound is present but rather the mechanical stimulation of the movements. The mechanical receptor is found in three places: joints, muscles and tendons.

The joint receptors consist of special cells found in the end parts of most joints such as fingers, elbows and knees. These receptors are sensitive to pressure of the bones fractioning the joint ends which hint the brain to react the feel of the joint ends. This sensor is useful only in certain angles which are
relatively extreme since there are joint receptors hinting of the central position of the joint sequence movements.

The muscles are related to the tendons where there are special receptors which hint of the muscle tension which is called Golgi. It stimulates the sense of the tension caused by contraction or external stretch out.

The individual cells are mostly built up into muscles ending up on the tendons attached to the bones to support the movements. The muscle-spindle organ is connected to these cells and gives signals to the brain about the muscle tension. Thus they are called stretch receptors. The muscle-spindle organs forms not only several sensors but also reflex stretch which supports the body positions. In general, the joint receptors, golgi tendons and muscle-spindle organs generate the perception of the positions and movements of the body.

The vestibular sense hints the position and movement of the head and the receptor is located in the inner part of ear close to the cochlea as the receptor of sounds. Another set of receptor of vestibular sense is in the narrow space called sacculus and utriculus covered with jelly-like substance on the fine haired surface where the receptor cells appear. On this surface there are miniscule otoliths consisting of inorganic particles of calcium carbonate (limestone). When the head moves, the otoliths move the jelly deforming the receptor cell hairs giving hints to the brain that the head is moving.

Another part of this vestibular receptor consists of three semicircular canals. Each of these is on the right side of the other providing three different tubes is oriented in different directions. It is functioned to communicate the acceleration of the head to all directions. There is one angle in each of the canals where there is a little swell consisting of sensory receptor tips. When the head moves, the liquid in the canals moves and nudges the receptor since these canals are adjacent to one another on the right and left. The signals from the three canals are used by the brain to determine the up and down, left and right and to and fro movements. However, this receptor is limited to give response on the acceleration of the head. When the head is moving to direction, the liquid in the canals is stationary and gives no signals.

3. Application of Kinesthetic Perception in Sport Exercises
The kinesthetic perception and vestibular sensor are both involved in most of the reflex movements which contribute to the responding control. One of the important reflex movements in this type is reflex jerk. In other words, if a body part is in the sudden tension due to external force, the movement is countered by the muscle contraction. The muscle spindles are the main support for this reflex along through the muscles. The sudden jerk in the muscle stimulates the signal of the tension which is a direct connection to the cells causing the muscle contraction. The knee jerk reflex is included in this type. The mild strike onto the knee will pull the tendon connecting the thigh muscle and lower bone resulting in the muscle tension. The muscle spindle organs instantly signal this tension to the nerves in the backbone. The signal is sent back to the muscles resulting in the contraction by jerking lower part of the leg upward.

One function of the golgi tendon is to prevent from muscle damage caused by simultaneously over active movements. Some muscles are so stronger than others that they can damage the weak. The over tensions are buffered by the golgi tendons which at the same time give the signals promptly in time of contraction.

Most of the vestibular stimuli are not directly signaled from the sensory receptors but from a number of reflexes one of which is called post rotation nystagmus. Young kids like swirling their body making a circle and making a sudden stop. This causes dizziness and the feeling to swirl in the opposite direction. This is caused by the reflex eye movement slowly forcing the body to rotate in the opposite direction. Similarly, immediately after a football player makes a bicycle kick, he will focus his sight on an object carefully to avoid dizziness or the post-rotation nystagmus. Thus, one aspect of movement that should be included in the brain is the input of the vestibular sensor in the time of moving of the head whether it be consciously or not. One fact that we should know is whether the moving objects are caused by the facts that they are actually moving or that the head is actually moving. This is the case of the input of vision and the vestibular receptor which calculates the head movement which is perceived into its own
movement to indicate that the movement is from the moving objects. The vestibulo-ocular reflex supports the vision system to differentiate self-movements of body and eyes from the object movements.

Most eye movements are rapid and jerky so that one can follow the moving object with the eyes. In a football game, certain techniques of outwitting the opponents who in turns cannot follow the movements if there is no coordination between the eyes and the vestibular sensor.

These organs of muscle spindles, golgi tendons, and the joint receptors are involved in various reflects. However, disputes have been long taking place between psychology and physiology regarding the sensory receptor which stimulates the subconscious parts of the body. Based on the book, The Integrative Action of The Nervous System, a well-known neurophysiologist, Sir Charles Scott Sherrington, states that the muscle spindle organs are the main contributor. Whereas in 1950s these cases of the muscle spindle were weak. For example, it was claimed that the subject was unable to detect the movements by the eyes if the lenses were dark, but recently Sherrington’s theory stands proven.

In other words someone’s ability to sense the positions and movements of the body parts in a space are acquired based on the visual, hearing and verbal information. Each of the receptors has its own function in relation to the position and the movement. The muscle spindles support the postural reflexes and maintain the tension. The joint receptors also signify the perception of the positions and joint movements. The vestibular receptors are also functioned to maintain the balance and interpretation of the lateral, horizontal and vertical movements.

The kinesthetic perception operates its function through perceptual mechanism which basically relates to the information processing in an individual. The information received is detected and compared to result in an absolute decision. The success of the movement behavior depends on the ability of that individual to capture from the surrounding and distribute it to different parts of the body for a response. The sensitivity degree of the kinesthetic perception allows greater probability to make adjustments of the positions and movements to the appropriate function which can be essentially called suppleness skill.

The precision of the adjustment also depends on the feedback of intrinsic kinesthesia. This is to say that this feedback occurs automatically right after the movement. Thus it is obvious that the kinesthetic perception plays a very important role in controlling the movement suppleness. The awareness of the movement position is also important in the physical movement training. This works on up to a certain level until the body and its parts demands to go against the gravitation in exercises or even daily activities. This is significantly related to the balance and dynamic to come to maintaining proper patterns. In the complex skill of football this awareness enables the player to differentiate the spatial positions at high precision and consistency. It also enables him to make precise and effective movements. Furthermore, Barrow and McGee assert that the complex awareness skill acquisition is supported with the mental picture of the whole movements. The training process will take place faster if the sensation can be stored in the memory and reapply it in practice for better perfection.

From the elaboration above, it can be concluded that the kinesthetic perception is a sense derives from stimuli from the receptors in the muscles, fascia, tendons and joints which provide mechanical feedback that give the awareness of the positions of the body and its arts to control proper and accurate movements.

4. The Correlation between Kinesthetic Perception ($X_1$) and the Skill of Football Techniques ($Y$)

The hypothesis stating that there is correlation between the kinesthetic perception and the skill of football means that the higher the perception is the better the skill is or the other way around. Statistically the hypothesis can be formulated below:

$$H_0: \int y_1 = 0 \quad (1)$$
$$H_1: \int y_1 > 0 \quad (2)$$

Prior to the correlation test, simple linear regression is applied to determine coefficient significance of $b$ and the linearity between kinesthesia $X_1$ and the skill $Y$. i.e. 0.65 and the value of constituent $a$ is 17.64. Thus the correlation is formulated in the equation of single regression line $\hat{Y} = 17.64 + 0.65X_1$. 
The significance test and regression linearity equation is \( \hat{Y} = 17.64 + 0.65X_1 \). The variant analysis (Anava) is applied in F test. The criteria of the significance test are as follows: If \( F_{hit} \) is greater than \( F_{tab} \), the regression equation is significance. However, if this goes the other way around, then it is linear. The regression equations of significance and linearity of \( \hat{Y} = 17.64 + 0.65X_1 \) can be seen in Table 17 below:

| Sumber Varians          | dk | 4.1. JK         | RJK          | \( F_{hit} \) | \( F_{tab} \) |
|-------------------------|----|----------------|--------------|---------------|---------------|
| Total (T)               | 40 | 102728.21      |              |              |               |
| Regression (a)          | 1  | 100001         | 100001       | 56.82**       | 4.10          |
| Regresi (b/a)           | 1  | 1634.28        | 1634.28      | 28.76         | 7.35          |
| Sisa (S)                | 38 | 1092.93        | 28.76        | 1.04ns        | 2.19          |
| Tuna Cocok (TC)         | 28 | 814.42         | 29.09        |               |               |
| Galat (G)               | 10 | 278.51         | 27.85        |               |               |

** = Highly significant (\( F_{hit} = 56.82 > F_{tab} = 4.04 \))

ns = Linear (\( F_{hit} = 1.04 < F_{tab} = 3.03 \))

df = degree of freedom

Based on the above table, it can be concluded that the regression equation of \( \hat{Y} = 17.64 + 0.65X_1 \) is highly significant and linear. This means that if the kinesthetic perception is leveled up by one point, then the skill will also go up to 0.65 at the constituent 17.64. The following diagram is presented give clearer illustration (See Fig. 1)

![Figure 1. Regression Line \( \hat{Y} = 17.64 + 0.65X_1 \)](image_url)
After the above tests with the equation of $\hat{Y} = 17.64 + 0.65X_1$, another calculation is to determine the simple correlation coefficient obtained from $X_1$ and $Y$ ($r_{y1}$). Based on this calculation, $r_{y1}$ is 0.77. The significance of correlation of the coefficient of $r_{y1}$, based on the t-test, shows in the following result in Table 1.

| Correlation   | n | R  | $r^2$ | $t_{hit}$ | $t_{table}$ |
|---------------|---|----|-------|-----------|-------------|
| $X_1$ and $Y$ | 40| 0.77| 0.60  | 7.54***   | 1.68        |

**Description:**

*** highly significant

The above tables shows that $t_{hit}$ is 7.54 greater than $t_{table}$ that is 1.68. Thus it can be concluded that $H_0$ is rejected which means that there is positive correlation between kinesthetic perception and skill in football.

Based on the correlation coefficient of $r_{y1}$, the determinant coefficient ($r^2$) of 0.60 is obtained. This means that 60% of variants in the football skill can be determined by the kinesthetic perception.

5. Conclusion

There is positive correlation between the kinesthetic perception and the skill of football techniques. This means that the better the kinesthetic perception is the better the skill in football techniques or the other way around. Thus, the kinesthetic perception is the variable relevant to the skills.

Reference

[1] Hamilton, S. (2006). Screening for developmental delay: reliable, easy-to-use tools: win-win solutions for children at risk and busy practitioners. Journal of Family Practice, 55(5), 415-423.

[2] Tanaka, K., Hikosaka, K., Saito, H. A., Yukie, M., Fukada, Y., & Iwai, E. (1986). Analysis of local and wide-field movements in the superior temporal visual areas of the macaque monkey. Journal of Neuroscience, 6(1), 134-144.

[3] Vernazza-Martin, S., Martin, N., & Massion, J. (2000). Kinematic synergy adaptation to microgravity during forward trunk movement. Journal of Neurophysiology, 83(1), 453-464.

[4] Greene Jr, W. A. (1958). Early object relations, somatic, affective, and personal: an inquiry into the physiology of the mother-child unit. The Journal of nervous and mental disease, 126(3), 225-253.

[5] Batson, G. (2009). Update on proprioception: considerations for dance education. Journal of Dance Medicine & Science, 13(2), 35-41.

[6] Collins, D. F., Cameron, T., Gillard, D. M., & Prochazka, A. (1998). Muscular sense is attenuated when humans move. The Journal of physiology, 508(2), 635-643.

[7] Fitzpatrick, R., & McCloskey, D. I. (1994). Proprioceptive, visual and vestibular thresholds for the perception of sway during standing in humans. The Journal of physiology, 478(Pt 1), 173.