NORGES IDRETTSHØGSKOLE

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Visual Exploratory Behaviour of youth elite academy players in training and games

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Preface

For the most of my life I have been involved in sports. I have always loved different types of sports and have competed in several different sports (football, cross country, cycling), where football was the favourite. Sports have given me so much valuable lesions in life both on a personal and a social level. So, when my body broke down because of injuries I still wanted to be a part of it and took a small side job as an assistant coach for a woman`s football team. When the coaching staff was able to get a message through to the players and we made improvement and an impact during a session it made me feel very satisfied. So, I decided to learn more about the field and started a bachelor's degree at the Norwegian school of sport science. After I completed that I felt the urge to learn more about how people learn and took a year to study pedagogy. When that was completed, I still was not satisfied and thought there where more to learn in this field and started a master's degree on the same school. How people learn and how you can help them learn new things is something I find exciting. When players I am in charge of improve their skills and learn new abilities it gives me a great satisfaction. So, in search of a thesis to write about Geir Jordet suggested the topic of this thesis. I found the topic to be interesting as this is information I as a coach can bring into the training field to try improving players in one of the most important skills in football. Due to some life situations the thesis got delayed and at some point, I nearly gave up. Because of some particular circumstances (Corona virus) I got some time freed and was able to complete the thesis. The thesis gave me a lot of valuable lessons that goes far beyond what is represented in the results of this thesis, so I do not regret doing it.

Takk til bidragsytere

Veileder: Geir Jordet for muligheten til å gjennomføre en slik type prosjekt

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Mari Møller for hjelp med interreliabilitetsanalysen

Takk til familie og venner som har vært veldig støttende og motiverende og hjulpet meg så langt de har evnet.

Til slutt, men viktigst, samboeren min Mari Martinsen for støtte og tålmodighet av en annen verden som har vært helt avgjørende i denne perioden. Jeg håper jeg kan returnere den støtten en gang for den har vært høyt prissatt.

Abstract

The overall purpose of this study was to examine the visual exploratory behaviour on elite youth academy players during a normal week of training and in one game. The study is a real-world study and Gibson's (1979) ecological approach to visual perception was used as framework. I followed 3 male (aged 15 years) academy players from and Norwegian premier league club for 3 training sessions and one game. The aim was to investigate if the visual exploratory behaviour in training is aligned with what they do in games. The players where filmed with a high definition camera to get "close-up" video footage. The study also looked at player`s performance and the contextual factor of opponent pressure. The players where analysed frame by frame in Scratch play.

Results revealed that Rondo had lower visual exploratory behaviour than other training exercises such as ball possession games, game training and matches. However, there was no statistical significance found the results were trending towards significance. The visual exploratory behaviour of the player does not always align with the behaviour in matches. This suggests that different training exercises affect the visual exploratory behaviour in different ways. This study was an exploratory study so only cautious conclusions can be made. However, I hope the study can inspire more hypotheses and more research on an interesting area that have yet not been much explored despite football players spending most of their time on the training field.

Table of content

1.0 Introduction

Football- is one of the most popular sports in the world. According to FIFA about 270 million people worldwide in over 200 countries play the game regularly. Only about 100.000 (0.04%) of these people play the game at a professional level (FIFA, 2007). This indicate that the road to become a professional football player is highly competitive and difficult to achieve (Haugaasen & Jordet, 2012). Football skill can be described as "making appropriate decisions and actions to create and take advantage of situations of play in advantage of your own team" (Bergo, Johansen, Larsen, & Morisbak, 2002). The science in football is multifaced and multidisciplinary, and it requires input from a variety of scientific areas (Strudwick, 2016). In football it traditionally incorporates areas of physiology, psychology, biomechanics, skill acquisition, technical and tactical skills and it also have expanded to areas such as talent identification and player development (Haugaasen M. , 2015). As our understanding to improve these areas the incorporation of soccer science has become more regular to achieve the best possible results in the world of football (becoming experts) (Strudwick, 2016). The broad areas of scientific research in football is a result of the complexity in football. To expand the complexity players can also compensate their shortcomings in one area with strengthening another. This way expertise can be achieved with a unique combination of skills (Haugaasen & Jordet, 2012). However, a growing consensus has emerged that the anthropometrical and physiological attributes are not the key factors in separating the players at the highest level from the players on a lower level. Here researchers argue in what can be the key that distinguish the elite from the rest. Williams & Ford argues that tactical skill (decision making) and technical skill (passing and dribbling) and psychological abilities (resilience, mental toughness and coping with pressure) to be key attributes that separates the level of expertise (Williams & Ford, 2013). Several researchers argue the critical role of some cognitive processes such as attention (Savelsbergh G. J. P. Van der Kamp J. Williams, 2005), decision making (Ward, Ericsson, & Williams, 2013), anticipation (Roca, Ford, McRobert, & Williams, 2011), perception (Jordet, Bloomfield, & Heijmerikx, 2013) and intention in high level football performance (Jordet, 2005a). Perception has been shown to be an important factor in determination of football skill, where the ability to "read games" can be linked to level of performance (Williams M. A., 2000). Moreover, football is an activity with a lot of instable and unpredictable events (Singer, 2000). The game is played on a large

field (up to 90-120 meters long and 55-65 meter wide) and 22 players that are constantly moving, -making the game dynamic, information rich and complex which makes the demands of advanced perceptual skills are more necessary to perform at a high level (Jordet, Bloomfield, & Heijmerikx, 2013). The ability to perceive what's going on around and "read the game" is an important skill that distinguish players on different levels of expertise (Williams M. A., 2000). Most of the information gathered by the players, comes from their visual system, which consists of their eyes, head and body (Gibson, 1979). As an example there was a study that interviewed elite Brazilian football players and they reported that they used their visual system to gather information around the pitch and used that perceived information to perform subsequent actions with the ball (Tedesqui. R. A. B. & Orlick, 2015). Therefore knowing when and where to look to then sort out important information ques and eliminate lesser important ques is essential for elite performance (Panchuk. D. Vine. S. & Vickers, 2015). Because of this information, perceptual skills is then suggested to be one of the key abilities in elite performance in football (Jordet, 2005a). Most of the scientific research done on perception in sports has been conducted in laboratory environments and seemingly ignoring the actual sport context (Vealey, 2006). Therefore, researchers argue the need of supplementing this research with field research (real world) and investigate an phenomenon accruing in its natural context (Jordet, 2005a). In this study, I will examine some of the behaviours underpinning visual perception of football players, the way they occur on the field in real training sessions and a game.

2.0 Introduction to theory

There have been conducted extensive research on visual perception and visual perception in football. These studies have worked on explaining how players perceive the visual information they gain from highly dynamic and complex environments, then use this information to execute consistent and precise actions (Williams, Davids, & Williams, 1999). For football players the ability to process and interpret information and separate important information from lesser important information is an important skill and (is one key element that) separates the players that perform on an elite level from the rest (Williams M. A., 2000). The majority of research on visual perception and attention have been conducted in laboratory environments and mainly monitoring the

athlete`s eye movements (Savelsbergh, Haans, Koojiman, & Kampen, 2010). The research done have also compared skilled/elite performers against less-skilled/novice performers (Roca, Ford, McRobert, & Williams, 2011). As a contrast to the laboratory approach, Gibson`s ecological approach to visual perception emphasises the importance of studying perception behaviour in the real world (correct context) (Gibson, 1979). However during the last decades there have been conducted more field research in football (Eldridge, Pulling, & Robins, 2013) (Jordet, Bloomfield, & Heijmerikx, 2013). These studies are built on Gibson`s ecological theoretical foundations of visual perception where the focus is the link between perception and action in the real world (Gibson, 1979). My study is inspired by this theoretical framework.

This study is a pilot study that attempts to look into the phenomenon of visual exploratory behaviour in the training field where players spend a lot of their time in improving their skills. One goal of the study is that it will lead to further studies regarding visual exploratory behaviour and football training exercises. However, the main purposes of this study are:

- Compare visual exploratory behaviour frequency in different training exercises and a game of football
- Investigate the relation between visual exploratory behaviour and performance

2.1 Cognitive theory of perception

Cognition refers to all processes where the sensory input is elaborated, reduced, recovered, stored, transformed and used ((Neisser, 1967). Hypothetical stages of cognition includes some aspect such as perception, problem solving, pattern recognition and imagery (Neisser, 1967). Perception is the process that humans interpret and perceive and makes sense of the world from their visual information. For athletes it is that they perceive and interpret stimuli from within the environment in order to successfully perform their actions (Williams et al., 1999). The ideological basis in traditional cognitive psychology comes from the mind-body dualism, where internalised devices bring out the information derivation and cue elaboration (Williams et al., 1999). In essence this means that the humans make sense of the world from within themselves. Perception is the process of picking up geometrical shapes and objects with their visual system and having it interpreted and understood within the individual (Cutting, 1986). This means that in the perception-action relationship, what we perceive is a kind of

mental reconstruction of the environment and that we then can study perception separately from actions (William et al., 1999).

In the information process theory one assumption is that perception does not happen immediately. It is a result of a process being carried out over time (Haber & Hershenson, 1974). In this theory the Central nervous system and the long-term memory work together. Our senses transfer information from the environment into the central nervous system which interpret the information into something that makes sense. How efficient the central nervous system is to organize and interpret the information is based on previous experiences stored in the long-term memory (McMorris, 2004). The long-term memory theory states that skilled athletes are able to create domain specific memory structures. This means that they can quickly, efficiently, and precisely be able to code and obtain information when needed from the long-term memory (Roca et al., 2011). A phenomenon known as *Closure* is the ability to mentally "fill in the gap" in our visual tracking system. Because of human`s ability to recognize patterns we can see an object move towards us, then briefly lose sight of it and still be able to judge when and where it will appear by "filling in the gap" mentally (McMorris, 2004). These cognitive structures that facilitate planning and execution of actions is thought to distinguish novice from expert performance (Beilock & Carr, 2004). When reconstructing sport activities, the cognitive activities that is involved is remembering (long-term memory) and attending (selective attention) (Williams et al., 1999). The attentional demands and memorial substrate change as the players evolve and their skill increase through practice (Beilock & Carr, 2004). To better understand these processes some laboratory studies is presented below.

2.1.1 Laboratory studies

Laboratory studies have provided some empirical evidence for ball sports that experts are better to anticipate the opponents' actions, better to recall and better to recognize patterns of play than novices do (Abernethy & Russell, 1987; Jones & Miles, 1978; Starkes, 1987; Williams, Davids, Burwitz, & Williams, 1994). For football specifically the first empirical studies on perception in football were done in laboratory settings (for review, see McGuckian, Cole & Pepping, 2017). For the most part in these studies the researchers have shown simulation of football related situations on a screen and using eye tracking technology to monitor visual fixation-duration, frequency, location and

order (Cañal-Bruland, Lotz, Hagemann, Schorer & Strauss, 2011; Helsen & Starkes, 1999; Roca et al., 2011; Roca et al., 2013; Williams & Davids, 1998; Williams, Davids, Burwitz & Williams, 1994). These laboratory studies have contributed with essential, useful and reliable knowledge and information related to the field of perception of video simulated situations (Jordet, 2004).

Research in football have shown that experts possess a more relevant and effective search strategies than novices. They have fewer fixations of longer durations and they are able to fixate on more informative rich areas. Experts also have the ability to anticipate future actions at a higher level than novices (Williams & Davids, 1998; Helsen & Pauwels, 1993). Other studies that have compared skilled players vs lesser skilled players have concluded that skilled players are superior when it comes to context specific pattern recognition (North, Ward, Ericsson & Williams, 2011; North, Williams, Hodges, Ward & Ericsson, 2009; Williams & Davids, 1995; Williams, Hodges, North & Barton, 2006). One study have shown that as early as the age of 9 elite level athletes possess superior perceptual and cognitive skills when being compared to sub-elite level (Ward & Williams, 2003).

A study by Ward and Williams (2003) examined the relative contribution of visual, perceptual, and cognitive skills to the development of expertise in football. They used elite and sub elite players ranging from the age of 9 to 17. The elite players where recruited from English premier league academies and the sub elite was recruited from regular schools in the area. They measured four aspects of the visual function, static and dynamic visual acuity, peripheral awareness, and stereoscopic depth sensitivity. They also tested memory recall, anticipation that they used situational probabilities to test cognitive and perceptual skills. They divided the participants into groups U9, U11, U13, U15, U17. Tests of anticipatory behaviour and use of situational probabilities distinguished the age groups the most where the older performed better than the younger. It was tested by showing the participants video footage of a game situation and when the video froze, they should tell what the next best choice of action would be. Memory recall of patterns of play was also a factor that the older they were, the better they were. However the study showed that already at the age of 9 the elite players demonstrated superior perceptual and cognitive skills compared to the sub elite (Ward & Williams, 2003).

Williams et al., (1994) performed a study where they compared experienced football players with unexperienced football players when they were exposed to a video simulation of an 11v11 match play situation (Williams et al., 1994). The footage they were shown on a large screen from the perspective of a central defender in a defending situation having the entire game (field) in front of them. The results showed that the experienced players perform more visual fixations but also of a shorter duration than the unexperienced players. This behaviour is preferred for anticipating the opposition player pass direction. Expert players performed also more fixations away from the player with the ball suggesting that the experienced players have a more extensive search strategy that is facilitating their superior performance (Williams et al., 1994).

Williams and Davids (1998) published a study examining visual search strategies for players in 1v1 and 3v3 defensive situations using eye tracking. The results showed more fixation of shorter durations and longer fixations on the oppositions hip area from the experienced players in 1v1 situations. The results showed no difference in search strategies between the two groups in 3v3 situations. The researchers suggested that the lower search rates in 3v3 situations is the increased role of peripheral vision that picks up task specific information in a more complex situation. The study also showed that experienced players showed superior anticipation abilities than unexperienced players both in 1v1 and 3v3 situations (Williams & Davids, 1998). These findings were supported by a more recent study by Roca et al., (2011). This study also compared experienced football players and less-skilled football players in an 11v11 situation from the perspective of a central defender (Roca et al., 2011). The results from this study showed that skilled players have a different search strategy than less skilled players. They have more fixations of shorter duration and more fixations away from the player with the ball. The study also showed that the skilled players where more accurate at anticipating the intentions of the opponents and subsequently deciding an appropriate course of action (decision-making) (Roca et al., 2011). The studies by Williams et al., (1994) and Roca et al., (2011) suggest that experienced players make use of more relevant visual search strategies which may explain their ability to anticipate the opponents' actions (Roca et al., 2011; Williams et al., 1994).

In a study by Vaeyens et al., (2007) the researchers recruited elite youth players from football academies with the top division teams in Belgium and sub-elite youth players that where recruited from academies in the second or third divisions in Belgium. They

also recruited a control group of students that had not participated in a team ball sport during the last 5 years (Vaeyens, Lenoir, Williams, & Philippaerts, 2007b). The participants were shown videos of attacking sequences were the researchers monitored their eye movements using and eye-head integration system. The situations shown were designed to represent situations players would encounter in a real game, however the sequences involved a small number of players, varying from 2v1 to 5v3. The study showed that the elite players focused their vision more centrally than the other participants and thereby using their peripheral vision to a larger extent (Vaeyens, Lenoir, Williams, & Philippaerts, 2007b). This difference in search strategy shows that information can be processed quickly through the peripheral vision providing an advantage in time constrained situations. This also reduce the number of eye movements which reduce the number of saccades which is inactive periods of information processing (Wright & Ward, 1994). This study supported the findings of Williams et al., (1994) that the elite youth players had more searches away from the player with the ball than the other participants. This study also showed that football players where superior compared to the control group when comparing decision-making skills (Vaeyens et al., 2007b).

Helsen and Starkes (1999) performed a study using a multidimensional approach using both static slides and dynamic videos to investigate differences between experts and intermediates in offensive football simulated situations. In the static slide comparison, the results showed no difference in the fixation location and duration however the experts performed fewer fixations. In the dynamic film comparison, they found that experts performed fewer fixations of longer duration. This study also found that experts located their fixations away from the player with the ball than the comparison group. When comparing the decision-making the experts where superior in both the dynamic film and slide experiments. So the researchers concluded that the experts extract more relevant information with a single fixation, are better to find the best decision and respond quicker on the basis of fewer searches (Helsen & Starkes, 1999). These findings were supported by Cañal-Bruland et al. (2011) that showed video of defensive, offensive and unstructured football situations to skilled and less skilled football players. The study showed that skilled players performed fewer fixations of longer duration. These findings are in contrast to the findings of the studies of Roca et al., (2011) and Williams (1994) were participants performed more fixation of shorter durations. Roca et

al., (2011) argued that there are methodical differences that can explain the differing visual search strategies. An important factor to consider is the nature of the task which plays an important role in which the players applies different visual searching strategies (Williams M. A., 2000). Williams (2000) study showed different searching strategies when comparing 11v11 situations with 4v4 situations and offensive situations with defensive situations (Williams M. A., 2000).

Another example that different methods can give different results in the study of Cañal-Bruland et al., (2011) and Helsen & Starks, (1999). In the study of Cañal-Bruland et al., (2011) they measured performance of the participants by showing them two types of footage. One was manipulated and one was the original footage. The players had to respond using the spacebar on a computer and the computer mouse to indicate where they thought the manipulated player was. The results showed no difference between the skilled and less skilled players (Cañal-Bruland et al., 2011). In the Helsen & Starkes study they found that the skilled players had superior decision-making abilities (Helsen & Starkes, 1999). Roca, Williams and Ford (2014) may provide an explanation of the different findings. They examined if the cognitive strategies differed among football players who were exposed to video stimuli when sitting or interacted with the stimuli. The results indicate that the group that interacted verbalized more thoughts when predicting further options as well as planning an appropriate response (Roca, Williams, & Ford, 2014). The researchers express that to better identify processes and mechanisms related to performance, researchers need to design tasks that recreate the constraints and movement possibilities found in real performance settings. In the study of Helsen and Starkes (1999) it may have intensified the decision making difference compared to studies where they have to perform non-specific tasks such as keyboard typing and moving a computer mouse which they did in Cañal-Bruland et al. (2011) study.

A study by Romeas & Faubert (2015) used new technology to investigate athletes' perceptual abilities. The participants where university football players and non-athletes. The participant was in a fully immersive virtual environment. Virtual figures called point-lights that consist of 15 black dots that is creating a dynamic representation of a human on a white surface was displayed for the participants (Romeas & Faubert, 2015). The participants were wearing stereoscopic goggles and was asked to fixate straight ahead on the display where the point light walker and football kicks was shown.

Participants responded verbally left or right depending on the movement and kick of the point light walker. The study concluded that football players where superior in reaction time and accuracy for the point light movement and kick direction (Romeas & Faubert, 2015).

Neuro Tracker is a new addition in the cognitive approach on visual perception in sports. Neuro Tracker is technology based on scientific research and designed to optimize perceptual cognitive performance in sports (NeuroTracker, 2016). Neuro Tracker is the use of a set of 3D goggles where the user can see a number of spheres (usually between four and eight). At some point one sphere will be highlighted for one second, then the spheres start to move around. When the spheres stop moving the user must identify which sphere was the highlighted one. If the answer is correct the speed of the spheres increases, if the answer is wrong it decreases (Faubert & Sidebottom, 2012). The exercise is built on multiple object tracking (MOT). Classical theories of attention have assumed that attention is singularly focused. However, there are several everyday activities that demand our focus to attend to multiple stimuli at the same time. Cavanagh & Alvarez (2005) found that observers are able to track up to four different targets at the same time for several seconds (Cavanagh & Alvarez, 2005). A study by Romeas, Guldner and Faubert (2016) investigated 3D-MOT training could improve football players skills (passing, dribbling, and shooting). The participants where 23 Canadian university level football players that was tested in their skills in a small sided game. Then the participants were divided into three groups. The experimental group (n = 9) was exposed to 10 sessions of 3D-MOT training. The active control group (n = 7) watched 3D real football videos from the 2010 FIFA world cup. The control group (n = 7) did not receive any other training than regular football practise. The results showed no significant improvement in dribbling or shooting. The experimental group significantly improved their passing accuracy compared to the other groups (Romeas, Guldner, & Faubert, 2016). The researchers concluded that they had evidence in which non-contextual, perceptual-cognitive training has transferred effect into the football field. However it is important to note that there was no inter-observer reliability tests on the variables that was analysed and that one of the writers of the study is Chief Science Officer of Cognisens Athletics Inc who is the producer of the Neuro Tracker training program (Romeas, Guldner, & Faubert, 2016).

2.1.2 Laboratory studies and methodical limitations

For ball sports and football laboratory studies have generated a significantly amount of valuable knowledge about perceptual expertise (Jordet, 2005a). The typical laboratory set-up and procedures have several shortcomings in fully being able to capture the performers knowledge expertise and sport specific movements (Pinder, Headrick, & Oudejans, 2015). When observing skilled players in a football game they are constantly moving their heads and eyes to look around the pitch (Williams & Ford, 2013). Looking at a flat screen placed in front of the participants doesn't simulate motion parallax which compromises players perception (Cummings & Craig, 2015). The laboratory studies does not account for sport specific constraints such as opponent pressure, pitch position, body orientation and possibilities when making assumption of the perceptual expertise of the participants (Jordet, 2005a). Most of the research done in investigating decision-making and anticipation among football players have had to perform non sport specific tasks to respond to the situations such as verbal responses (Roca et al., 2013), writing on a paper (Ward & Williams, 2003) Stepping on response pads (Williams & Davids, 1998), multiple spheres selection (Faubert & Sidebottom, 2012) and computer mouse moving (Williams et al., 1994). In a football match, players have to move their head and bodies to perceive information, they also need to move their body and execute actions. The choice of the players' action is often a good predictor of what they player perceived as possible actions in the situation (Eldridge, Pulling, & Robins, 2013). Some published perceptual studies done in laboratory do not have any links between perception and actions. This is now stated as a key principle in perception development is coupling action and perception and contextual information as close to the related sport context as possible (Braodbent, Causer , Williams, & Ford, 2015).

Real world research (field research) involves investigating a phenomenon in the context it naturally occurs (Jordet, 2005a). There is an urgent need to provide research that have high ecological and external validity to supplement the laboratorial studies (Jordet (2005a); Jordet et al., (2013). In real football games there are some things that are nearly impossible to recreate what other studies did in the laboratory. For example, players conducting a verbal response before and after an action or manipulating of the visual stimuli players perceived such as editing a still picture or video film. Mapping several of the internal cognitive processes is difficult and the cognitive theory of visual perception is not adequate to lean on in real world research. Real world research is

conducted within an ecological framework emphasises the strong relationship between perception and action (Gibson, 1979). Having and ecological dynamic framework expert performance is best understood and described because the framework emphasise on the relationship between the performer and the environment (Seifert, Button, & Davids, 2013).

2.2 Ecological approach to visual perception

Football is extremely dynamic, complex and information rich (Jordet et al., 2013). To learn how football players perceive and act in real life situations, Gibson`s (1979) ecological theory can be used. Gibson (1979) is known as the founder of the ecological approach of visual perception. This theory is a contrast to many of the theories guiding laboratory studies and tries to provide an understanding of perception in real world situations (Jordet, 2005a). There are four main perspective from the ecological approach, Direct perception, affordance, visual system and perception of the real world. Football is a dynamic sport where expert performers have to adapt to the environment and continuously perceive information and regulated their actions in accordance to the information (Davids, Araújo, Seifert, & Orth, 2015).

In Ecological science a central theme is the study of organism-environment systems. This includes the information based behavioural transaction between the organism and relevant performance properties of the environment. The environment includes surfaces, objects, niches and terrain can is in the physical surroundings (Davids et al., 2015). The most important variable to study is the relationship between environmental information and the individual pick up of this information (Jordet, 2005a).

Direct perception refers to experiencing and perceiving something in natural surroundings (Gibson, 1979). For football players this can be playing a game of 11v11. This have been applied to the study of how action and perception regulate performance (Araújo & Davids, 2009). In football, midfielders and forwards are constantly surrounded by teammates and opponents (Jordet et al., 2013). Skilled players constantly look for information of the movements of teammates and opponents by moving their head and eyes around (Williams & Ford, 2013). This visual field that surrounds people is called by Gibson ambient optic array with information. The structure of the ambient

light specifies what information we perceive, which is characterised by the specific pattern in the energy fields of the environment and not the organism (Gibson, 1979).

Humans (football players) perceive and act on substances (smell of grass), surfaces (football pitch), objects (the ball), places (football stadium) and events (football match) in the environment (Araujo, Davids, & Hristovski, 2006). These opportunities and possibilities to act is known as affordance, a new concept that was made up by Gibson (1979).

Theory of affordances is an pillar of the ecological approach to perception and action in sports (Fajen, Riley, & Turvey, 2008). The starting point in the study of how humans learn, perceive, act, decide and know is affordance (Turvey, 1992). Affordances can be exemplified as using a ball placed on the ground. A football player will experience an affordance for kicking or juggling the ball. The players parents might pick up the ball and put it somewhere safe to be used another day (Jordet G. , 2003). In a game of football, affordances are everywhere meaning that the players need to discover affordances in a 360 degree surrounding environment using visual exploratory behaviour (movement of head, eyes and body) (Reed, 1996). According to ecological psychologists all information is available in what we see and indicate that there is no need to have prior experience when perceiving the environment (McMorris, 2004). In the dynamic, complex and informative rich game of football this will provide challenges to the players. Players will automatically scan for the most important information in the environment that can help them reach their goal (McMorris, 2004). Studies have shown that as players acquire expertise they gradually attune themselves to affordances that can support them in achieving their performance goal (Davids, Araújo, Seifert, & Orth, 2015).

The visual system is an important part of the perceptual system and consists of body, eyes and head used by the observer to gain information (Gibson, 1979). The information being picked up the visual system is not a projection of the ecological world but an outcome of the observers' awareness of her/his body in the world as part of the experience (Gibson, 1979). The exploratory activity can be divided into levels where the highest level of exploratory activity is moving the body to obtain information, Turning the head is the next level and eye movement is the lowest level (Gibson J. J., 1966). Because of this exploratory behaviour with body and head within the environment

enables players to perceive key constraining information (Tedesqui. R. A. B. & Orlick, 2015).

The goal of perception is to guide us into making good decisions (Jordet, 2004). The key element in Gibson`s ecological approach is the relationship between action, perception and intentions (Davids et al., 2015). Football players constantly move around creating continuous information about new opportunities for actions in an ever-changing environment (Davids et al., 2015). Prospective control is based on a player's perception of his/her relationship to the environment (Montagne, 2005). The perception of affordances allows the player to prospectively control his/her actions (Turvey, 1992). Visual exploration is the key to prospective control (Adolph, Eppler, Marin, Weise, & Wechsler Clearfield, 2000).

2.2.1 Field studies

In the last decades there have been done some studies investigating visual exploratory behaviour among football players in real world situations (Eldridge et al., 2013; Jordet, 2004, 2005b; Jordet et al., 2013). These studies commonly used close-up video film footage of players during a game and investigated their head movements. Geir Jordet (professor at the Norwegian school of Sport Sciences) is considered one of the pioneers in this type of real game research. In Jordet`s first study eight elite midfield football players where selected and participated in four different studies to provide information about their perceptual expertise in a competitive team context (Jordet, 2004). The first study used four elite international football players and they were filmed close-up by a video camera with the intention to map their exploratory behaviour, and how they use this information to prospectively control their actions. The results showed no link between exploratory behaviour and performance, Three of the four players in this study was interviewed in the second study to examine how they are perceiving information to prospectively control their actions. The players reported that they engaged in visual exploratory behaviour in order to map out opportunities before receiving the ball. The players also reported that playing style, stress and the ball was constraining factors for visual exploratory behaviour (Jordet, 2004). In the third study Jordet followed one of the players over a three-year period investigating the relationship between exploratory behaviour and performance. In periods where the performance was high the visual exploratory behaviour frequencies was higher, often forward oriented and shorter time

between the final scan before receiving the ball. This indicates a positive relationship between prospective control, visual exploratory behaviour and performance in football (Jordet, 2004). The fourth and final part of his study was done in 2004 but rewritten and published in 2005. In this study 3 elite football players participated in an imaginary training program over 10 to 14 weeks to investigate if it affected players visual exploratory behaviour and prospective control of their actions (Jordet G. , 2005b). Results showed that for two of the players increased their visual exploratory behaviour but only one of them marginal improved their performance. All the participant reported that they believed that the intervention had improved their perception and performance with the ball. The performance was rated using a very subjective seven scale rating (ranging from poor to good) and may be the reason for the low degree of effect on performance and visual exploratory behaviour (Jordet G. , 2005b).

A study by Jordet et al. (2013) explored the relationship between visual exploratory behaviour and performance on players in the English Premier League. Here they used the close-up footage from sky sports player camera on a total of 118 midfield and forward players were analysed (1279 situations). The visual exploratory behaviour was counted in the 10 seconds period before receiving the ball and the action was analysed. In this study they used pass and forward pass completion as a measure for performance. The results showed that players that explored much completed more passes forward than those that explored less. This remained largely significant for different positional roles and game conditions (defensive half and attacking half). The results shows that there seems to be a positive relationship between visual exploratory behaviour and performance with the ball (Jordet, Bloomfield, & Heijmerikx, 2013).

A study by Eldridge et al. (2013) used three male youth midfield players to investigate the relationship between visual exploratory behaviour and performance. The study only looked at when they received the ball on the middle third of the field and they did not count the search frequencies they only registered if the player executed exploratory behaviour. The players where filmed in five 9v9 games for a duration of 20 minutes on a 60 x 40 yard field. The results revealed that players that performed exploratory behaviour before receiving the ball performed more forward passes, did more turns, executed more passes into the attacking half and experienced less defensive pressure. The study encourages coaches who work with young players to focus on visual

exploratory behaviour in their daily work and encourage to conduct such behaviour (Eldridge, Pulling, & Robins, 2013).

A study in 2004 investigated visual searching strategies in defensive 1v1 situations in the field (Nagano, Kato, & Fukuda, 2004). The study used 8 subjects where 4 where expert players and 4 were novice players. The participant wore a cap-style head unit that that detected and tracked their eye movements in the 1v1 situations. The study showed that the expert players had more visual focus off the ball than novice players. Expert players focused more on the knee and hip region when the attacking players used feints. They suggested that experts get more information from looking at the body movement of the opponent in order to anticipate the opponents next move and that football players should not focus to closely on the ball (Nagano, Kato, & Fukuda, 2004).

A study by McGuckian et al. (2017) looked at spatial constraints regarding visual exploratory behaviour. They took six experienced football players and made them play a series of 3v3 games where they manipulated the size of the field. They looked at the exploratory behaviour both in possession of the ball and without. The players played 5 games of 3 minutes on three different sized fields. They played on a control pitch which gave them the same space as in 11v11 game (47 x 23.5 meters). One small field of 33.5 x 16.75 meters and one big field that was 66.5 x 16.75 meters. The study showed that players frequently performed more visual exploratory behaviour when playing on the small field compared to the control and big field. The study also revealed that they players conducted a large amount of visual exploratory behaviour when not in possession of the ball compared to when they had the ball. This is explained that when you are in possession of the ball a lot more focus goes into controlling the ball and making a decision because of a higher risk of losing the ball. The study encourages coaches to manipulate the size of training fields while working with players to encourage more visual exploratory behaviour (McGuckian, et al., 2017)

A study was conducted on five UK elite academy football players (U18) using and imagery intervention PETTLEP (Pocock, Dicks, Thelwell, Chapman, & Barker, 2017). The five players (2 central midfielders, 2 wide midfielder and 1 forward) were put through a six-week PETTLEP imagery intervention program. The study examined their visual exploratory behaviour and the results showed that the training program lead to

improvements in their visual exploratory behaviour, where the central midfielders improved the most (Pocock et al., 2017).

A study in 2018 included 32 semi-elite male football players from the Australian national premier league in 11v11 match-play and the participants was wearing and IMU (SABELSense, Nathan, QLD, Australa). IMU is an elastic headband worn that register the players head turn (visual exploratory behaviour) and how much of the environment is explored (head turn excursion) (McGuckian, Cole, Jordet, Chalkley, & Pepping, 2018). The results revealed a strong connection between head turn excursion and head turn frequencies. The results also revealed having a higher average head turn frequency and head turn excursion resulted in a higher likelihood of playing a pass in the attacking direction, turning with the ball or playing the ball to an area opposite of where it was received. The researchers concluded with that it is important to explore the environment sufficiently and employing a good search strategy that includes high head turn frequencies and excursions (McGuckian et al., 2018).

To improve your performance in football training is an important and necessary activity (Bartlett, O`Connor, Pitchford, Torres-Ronda, & Robertson, 2016). Studies have shown that representative tasks such as video-based simulations accompanied with feedback and appropriate instructions may be effective in developing perceptual expertise, although the evidence is lacking (Broadbent, Causer, Williams, & Ford, 2015; Williams, Ward, Starkes, & Ericsson, 2003; Williams & Grant, 1999). The study by Pocock et al. (2018) showed that visual exploratory behaviour was trainable using interventions outside the football field. However, it could be beneficial to examine where the visual exploratory behaviour occur most often which is on the training field and in the training exercises. During a week of training football players are exposed to different types of exercises that may vary in complexity. Less complex exercises (passing exercises) are considered stable and predictable allowing the players to prepare and execute (Singer, 2000). Complex exercises involves opponents, intentions of teammates, recognition of meaningful cues and execution of actions under time constraints (Singer, 2000). Tactical games, small sided games and ball possession games is examples of more complex exercises (Campos-Vazquez et al., 2015). An assumption could be that more complex situations require more visual exploratory behaviour to gather information from the environment to execute the most appropriate

action. The main purpose of this study is to try and map out the differences in visual exploratory behaviour (VEB) in training exercises and matches.

3.0 Method

3.1 Participants

The participants in this study is 3 Norwegian male elite youth academy players (aged 15) from a Norwegian Premier league club. The players where selected based on the position they played the most during games which was central midfielders. The participants also had to attend all 3 training sessions in the week of filming and the game at the end of the week. The game at the end of the week was postponed by one week because of bad weather (heavy snowfall) in the week of filming so it is one-week delay between the recorded training session and the game. The study was approved by the ethical committee (Appendix A). The players where presented with a written consent form (see appendix B) and had to be signed by their parents as a requirement of NSD (Norsk Senter for forskningsdata).

3.2 Real world studies

Investigating a phenomenon in the context it naturally occurs is called a field study (Jordet G. , 2005a). In these types of studies, the ecological and external validity is high, and researchers call for the need of these type of studies (Araujo et al., 2006; Jordet, 2004; Jordet et al., 2013; Cañal-Bruland et al. (2011). By doing these types of studies one sacrifices some internal validity and control (Jordet G. , 2005a). The laboratory studies have a low external validity, and one could somewhat humorously say that they are limited to predicting behaviour in other laboratories (Martens, 1979). Because this study is a real-world study, the external validity is often strong as there is no manipulation of the independent variables, which is important when testing hypotheses (Gray, 2013). However the problems with real-world studies is low precision of measurement and weak control of confounding factors (Carlson & Morrison, 2009).

3.3 Design

The data was collected using a high zoom (10x optical and 2x digital zoom) Canon XA10 AVCHD video camera to film the training sessions and the game from a heightened place. The goal with filming was to maintain the ball and most of the participants in the videoframe at all time. It was filmed 3 training sessions and 1 full game during one normal week of training for their team. The video files were after filming transferred over to an external disc for safekeeping as a demand of NSD. The video was used in a video editing software named Scratch. With the high resolution of the camera the software gave the opportunity to zoom in on the video footage to get a close up view of the participants to then analyse in according to the operational variables in an excel form (see Appendix C). The analysis of the players behaviour was done frame by frame with an accuracy within four hundred of a second (one frame was equal to 0.04 seconds) which was very helpful in registering the exact moment the participant started an exploratory behaviour.

In this study there was 3008 registered Visual exploratory behaviour, (VEB) 526 situation with the ball were 473 of them was passes. There was also done a inter-observer reliability test on the variables in this study. The inter-observer reliability test was done on 438 visual exploratory behaviour situations and 103 situations where the players received the ball (total about 14% of the data).

3.4 Procedure

One club was chosen as a first target for this study as it had the best team (at the time) at the age range we wanted to investigate. A Co-supervisor of this study also knew one of the coaches in the coaching staff of this team which made making contact quite easy. They agreed on participating in the study, and we agreed on a week where we could do the filming of the training sessions and the game. The choices of different training exercises and planning of training-session was entirely up to the coaching staff in the club, there were no interference or request from the researchers. The coaches were supposed to do what they had planned for the week, and do what they normally do during a training session. The filming researcher showed up at the training field some minutes before their training started and rigged the camera ready in an elevated location, so when the coaches started the training session the recording started. All their activity

was recorded, however several parts of it was not used in the study (see exclusion criteria). The week of filming was chosen because it had an official game at the end of the week (national league game). The game was an away game. Unfortunately, the weather was quite bad with a lot of snow in the chosen week. This affected one training session so much it was cut short and it also led to the game being postponed by one week. The warm-up and the game were recorded from an elevated location. The warm-up to the game is not included in the study because of the inclusion criteria.

3.5 Inclusion criteria

For the game they used five players that played in the three central midfielder roles. However, because the participants in this study also had to attend all three training sessions that was filmed, two were excluded and the three remaining players that played central midfielders in the game are included in this study. The study registered every VEB the participants did that was possible to see in each of the training exercises and the game. In Jordet (2005b) and Jordet et al. (2013) the inclusion criteria were that the player had to receive the ball from a teammate located closer to his teams' own goal. This would then make it more relevant to engage in visual exploratory behaviour to see what is relevant behind its back. This meant that all situations where the player received the ball with all information in front of him was excluded and the hypothesis was that it was less relevant for players to engage VEB in these situations (Jordet G. , 2005b). These criteria would not fit in with this study as it has several exercises where there are no goals or direction to decide where the ball came from and where to score, such as rondo and ball possession games. The ball had to be in open play for VEB to be registered, the analysis started when either the players or the coaches kicked/threw the ball into the field. For a situation with the ball to be included the players had to have the option to perform another action with the ball, as an example, in some of the training exercises the game stops when the defending team wins the ball (Rondo). If for instance the player in the middle in a Rondo (defending player) gains control over the ball the game stops and the player does not get to do follow up action with the ball after he gained control. For these situations there was not registered anything with the ball.

3.6 Exclusion criteria

This study has several exclusions criteria. The first exclusion criterion is that all activity that was without the ball was excluded. That meant that all the warm-up routines before the training session was not included because they used the FIFA 11+ warm up program that does not include the ball. The warm-up before the game included FIFA 11+ and ball possession game however only two of the three participants started the game and was not a part of the warm-up routine, so it was excluded. VEB performed when the player was in possession of the ball was not included as the study was interested in looking if VEB before receiving the ball could affect the performance. During the training session the coach and the players communicate to each other. Situations where it is clear that the participant is talking to either a teammate or coaches are not registered as VEB. Other situations where it is clear that the participants are not looking for information are not included; such examples are when player are accelerating when running or when they shake their heads in disappointment or other emotional body movements. One tactical game training exercise was excluded from the study as one of the participants acted as a keeper on the defending team and one of the other participants acted as a central defender for the defending team. The exercise was to play the ball out from the keepers' position in an 11v11. Only one team practised on it at the time. This made the time filmed in this exercise very skewed between the participants and that one player was keeper made it less relevant to study.

3.7 Dependent variables

The idea of this thesis was to get an overview over different training sessions and how they trigger VEB compared to each other and compared to a football game. With it, I also wanted to register the players actions with the ball, a brief description of the environment (pressure, no pressure) and how many VEBs were executed within a timeframe of 5 seconds before receiving the ball, and if that impacted the performance with the ball. There was also an attempt to describe the different exercises against each other (possession, small sided games) in more depths but no good measurement tool was found. This might be because it has not been done a lot of research on different types of training exercises and how they trigger visual perception (Broadbent, Causer, Williams, & Ford, 2015; Williams, Ward & Ericsson, 2013). Therefore, this idea was

scrapped. The set of variables is taken from other research which has been used and tested in other studies.

There was developed operational definitions to avoid as much variance and subjective measurements as possible in the study (Mackenzie & Cushion, 2012). Because some variables are adopted from other studies it can enable comparison of findings (Mackenzie & Cushion, 2012). The main variable here is the players visual exploratory behaviour which is adopted from Jordet et al. (2013) and is defined as:

> "A body and/or head movement in which the player's face is actively and temporarily directed away from the ball, seemingly with the intention of looking for teammates, opponents or other environmental objects or events, relevant to perform a subsequent action with the ball" (Jordet et al., 2013, p. 2)

All VEBs were registered (except those that is excluded) and it was noted down if the analysed player was on the team in possession of the ball (attack) or not in possession of the ball (defence). Attack was operationally defined as the period that the investigated player's team had control of the ball until they lost possession to the other team, the ball goes out of play, a free-kick is awarded or the coach is "freezing" the practice. We operationalized that a team had control of the ball when a player made two or more touches or was able to make a controlled pass/shot using his first touch. There was also registered which exploratory behaviours that occurred in a timeframe of 5 seconds before the player received the ball (regardless if it was from a teammate or opponent). The use of a timeframe of 5 seconds before receiving the ball is different from the 10 seconds that was used in Jordet et al., 2013. The reason for using 5 seconds in this study was that it was assumed to be exercises with high pace of passing and more stops and resets of the situations, because the ball goes out of play more often than in matches. For example, in a rondo the ball goes inn and out of play all the time and it was assumed looking for more than 5 second was not needed. Another example is in possession exercises, often when the ball goes out of play the coach kicks a new ball into the field often to a completely different location to where the ball went out of play. Then players have to again explore the field for other opportunities as the position of the ball is changed. This is unlike in a game, if a throw-inn is given, the ball gets thrown back into the field where it went out.

Performance has in other studies looked at passes made forward up the field, penetration through the opponent's lines or passes made into the opponent's half (Elderidge, Pullini, Robin, 2013; Jordet, 2013). These studies mainly looked at game-like conditions where there was a direction to play. This study involves several exercises that does not have a direction to play inn. There are several types of possession where the goal is not to score but to maintain possession of the ball as long as possible with no natural direction to play in. It also includes a rondo in which the main objective is to maintain possession of the ball. Therefore, in this study maintaining possession of the ball is looked as a measurement of performance. In more depth it was noted as a successful performance if the pass hit its target, the shoot leading to a goal or the dribble led to a goal/point in the exercise.

Visual exploratory behaviour frequency

The visual exploratory behaviour frequency (VEBF) was calculated in two ways. One way which was for the overall VEB data for each exercise and the game. The amount of VEB registered in the analysed exercise was divided by the effective time analysed to get a VEBF for that exercise. The second way was more specific for passing situations was calculated by dividing the number of searches done within the 5 seconds prior to receiving the ball (unless the ball was out of play the duration was shorter) (Jordet, 2005b; Jordet et al., 2013). Later the VEBF was merged into three search categories: Little (0-0,10), Some (0.11-0,25) and much (0,26-1) searches per second. The categories were based on percentiles to have three approximate equal sized groups.

Action

The actions a football player can do with a ball in a game is to either try and pass the ball (long or short was not taken account for), dribble the ball or take a shoot on goal. The players last action with the ball is always registered. For example, if a player dribble one opponent but failed to dribble the second the record would say unsuccessful dribble. If the player successfully dribbles one player and passed to a teammate after the dribble the analyse would record a successful pass.

Performance

Performance in all situations was measured if the player performed a successful pass, dribble or shot on goal (scored) after receiving the ball. The passing direction was not accounted for but for a pass to be registered as successful the pass had to hit the

intended teammate. The more in-depth study was only for passes and not for shots or dribbles.

Opponent's pressure

The environmental description of the situations we used the number of opponents in a five meters radius around the player that received the ball. The registration of opponent's pressure was done immediately as the analysed player touched the ball. The pressure was categorized into categories and operationalized as table 1.

Table 1 *Description of the different categories of pressure*

Very low pressure (0)	No players within 5 meters radius of the analysed player
Low pressure (1)	One player within 5 meters radius of the analysed player
Moderate pressure (2)	Two players within 5 meters radius of the analysed player
Much pressure (3)	Three or more players within 5 meters radius of the analysed player

3.8 Categorizing and describing the different training exercises

Ball Possession game 1

A ball possession game is a game with no goals or goalkeepers. The objective of the team in attack is to maintain the ball possession and play the ball fast where the team without ball possession was to press to retain the ball and close down spaces for the team with the ball (Campos-Vazquez, et al., 2015). In this game the size of the field was about 15 x 35 meters and was divided into 3 equal size sones. In each zone there was 3v3 situation where the players could not move into another sone. There were two Jokers that is defined as always on the attacking team to help create overload and these jokers (brown C in the figure) could also move freely between the sones. Two players also acted as wall players along the short sides. Wall players is players that can only move along the short side of the field and is always on the team that have possession of the ball (marked as a black C in figure 1). The drill lasted for about 20 minutes. One of

the analysed players was joker the entire session, one player was always in the central zone and one player spent about half of the drill in the middle sone and the remaining in an end zone.

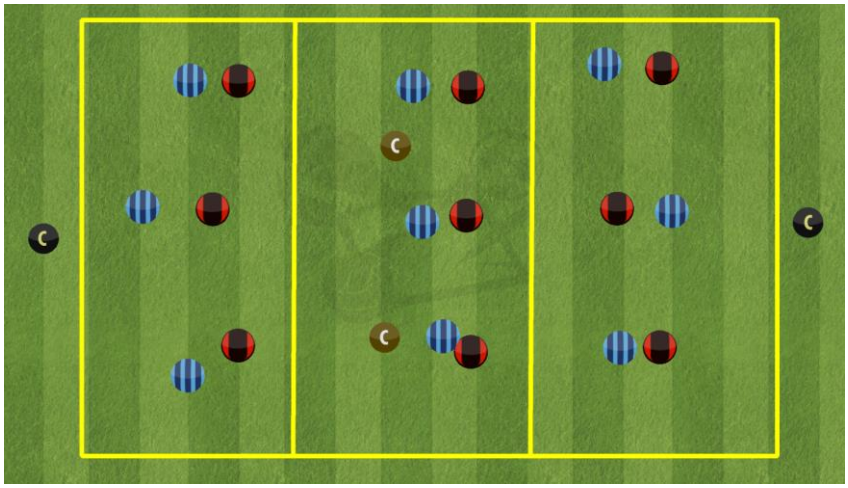

Figure 1 *An illustration of ball possession game 1. The yellow line marks the area field and the different sones. The blue represents players on one team and the red represent another team. Brown C represent joker role and black C represents the wall players.*

Ball possession game 2

This possession game was also played without goals or goalkeepers. The game was played on a 40x52 meter field. The field was divided into 3 sones and was played with 2 teams. The sone in the middle was larger than the end sones. In the end sones there was a 3vs2 situation with overload for the attacking team, in the middle sone there was a 4v4 situation. The goal of the game was for the attacking team to not lose possession of the ball and move the ball quickly and look for penetrating passes into the middle sone. When the defending team gained possession (control) of the ball the game reset and they started again from one of the end sones. The drill lasted for about 20 minutes. Two of the analysed players was always in the middle sone the third player was about 1/3 of the drill in the central zone and the rest in the end sone.

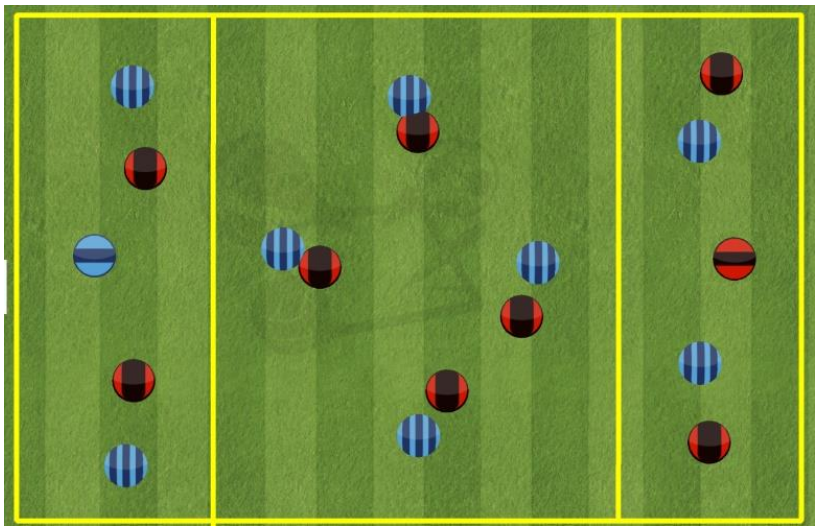

Figure 2 *Visual representation of ball possession game 2. The yellow line marks the area field and the different sones. The blue represents players on the attacking team and red represents players on the defending team.*

Ball possession game 3

This game was played without goals or goalkeepers. It was used a 20x35 meter field open field with 2 players acting as wall players and 5v5+2 jokers in the middle of the field. The goal was to not lose ball possession. The drill lasted for about 10 minutes. Two of the analysed players was jokers the entire drill, and the last player were regular outfield player.

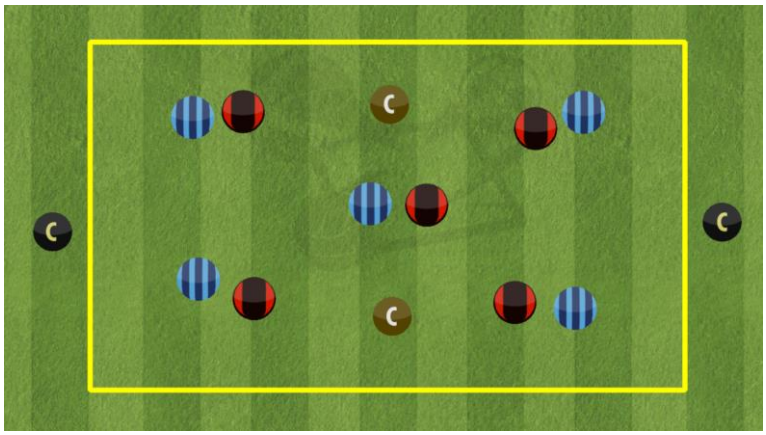

Figure 3 *Visual representation of ball possession game 3. The yellow line represents the are field. The blue represents players on one team and the red represents players on another team. The brown C represent jokers and black C represent the wall players.*

Tactical game 1

A tactical game is a exercise with the aim of training on game like situations with goals and goalkeepers and is often played with 16 or more players (Campos-Vazquez, et al.,

2015). This tactical game was to exercise playing out from the goalkeeper with short passes and try to move the ball into the opponent's half without losing the ball however, if the defending team gained ball possession the game kept going. The field was a 62 x 65 meter and played 10vs10. One team always started at their goalkeeper again when the ball got out of play, where they switched side about halfway. The attacking team scored by moving the ball past a line (yellow striped line on the figure) that was the full width of the field about 10 meters into the opponent's half. The drill lasted for about 20 minutes. One player spent most of the time as a wide central midfield, the other two had a deep central role when they where the team that was training on playing out. While on the defending team they took the role of central defenders.

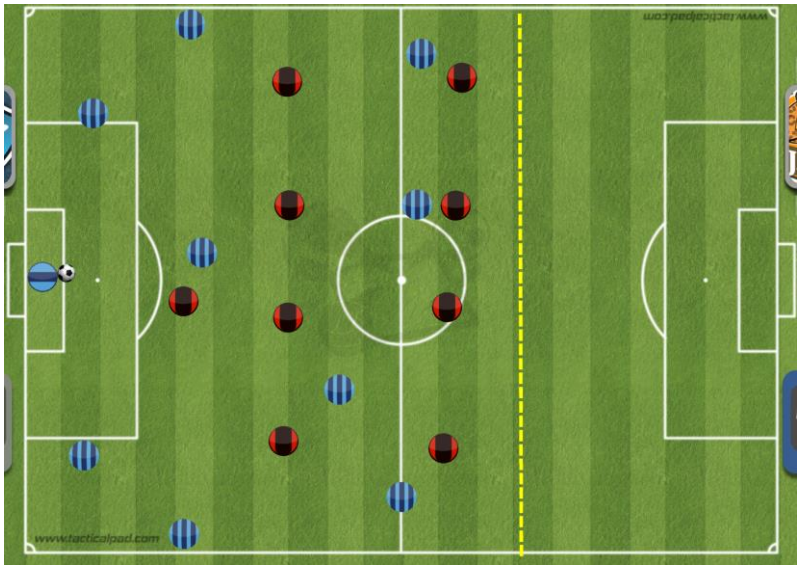

Figure 4 *Visual representation of the tactical game. The yellow dotted line represents the scoring line for the attacking team. The blue represents the players on the attacking team and the red represents players on the defending team.*

Game training 1

A 10vs10 game played against 2 goals with goalkeepers on a field size of about 62x70 meters, the drill lasted about 20 minutes. One player spent about half of the duration of the exercise as a central defender the remaining time as a central midfielder

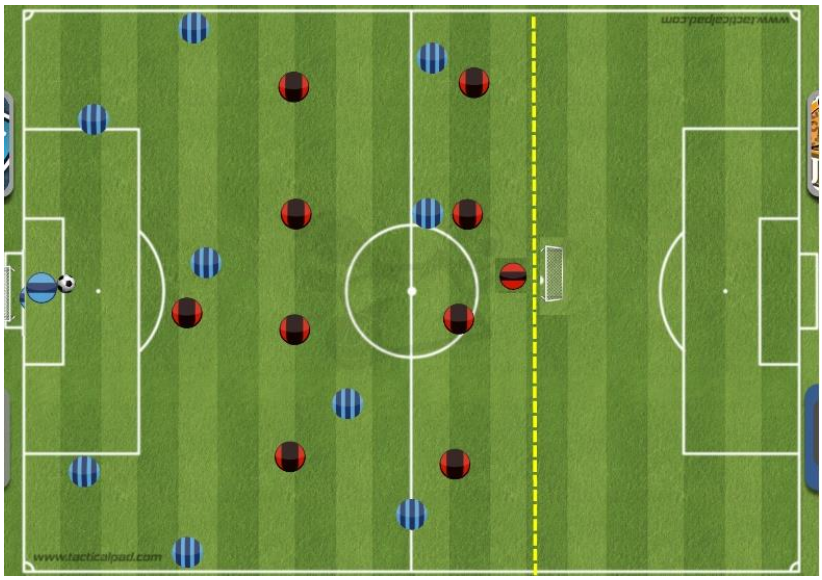

Figure 5 *Visual representation of game training 1. The yellow line represents the end line of the field's length. The blue represents players on one team and red represents players on the other team.*

Game training 2

A game of 8v8 played against 2 goals with goalkeepers. The game was played on a 40x52 meter field. The drill lasted about 15 minutes (cancelled early because of weather, heavy snowfall). All three analysed players were on the same team and two players had the roles of wide central midfielders and one had the role of central defender.

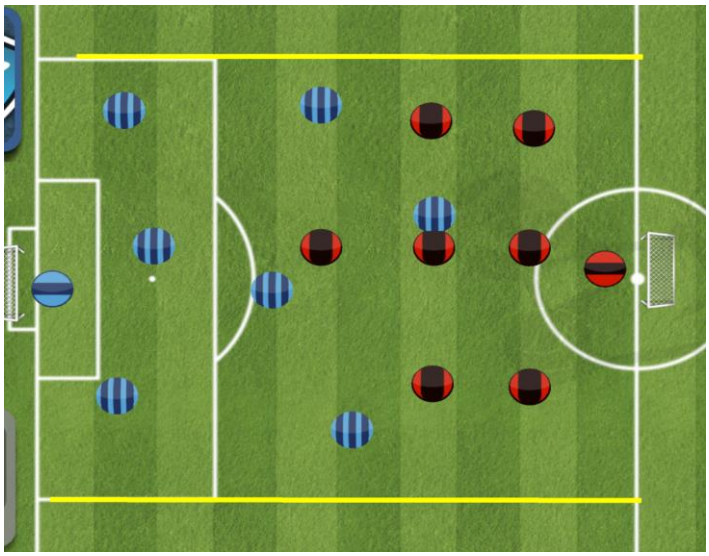

Figure 6 *Visual representation of game training 2. The yellow lines represent the side lines of the field. The blue represents players on one team and the red represents players on another team.*

Rondo

Rondo is an exercise often used as a warm-up. The players position themselves around a circle or square where 1 or more players are in the middle of the area trying to intercept the ball (Campos-Vazquez, et al., 2015). If the player in the middle intercept the ball he can go out of the middle and the player that lost the ball have to take his place in the middle. This exercise they used a 8x8 square where they played 6v2. The drill lasted about 10 minutes.

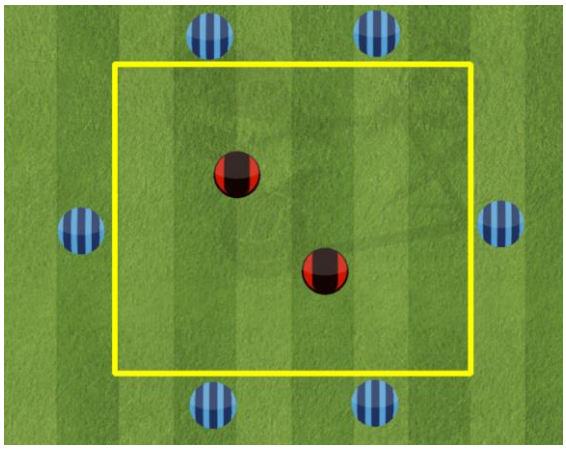

Figure 7 *Visual representation of Rondo. The yellow line represents the field size. The blue represents players on the attacking team and the red represents players on the defending team.*

Game

The game was an official match and played in an 11v11 match using the full-size field and normal football rules. They played a 2x 40 minutes game. Two of the players played for about 50 minutes and one player played for about 40 minutes.

4.0 Data analysis

The recorded video files from the match and training sessions were analysed in the video editing software scratch. The frames per second rate was set to 25 this made it possible to do a detailed analysis of the player following them frame by frame. The frame codes and variables was typed into Microsoft excel. The algorithms created in the excel form gave me the duration of the situations. The variables from the excel form was put into the statistical program IBM SPSS 24 for statistical analysis. An inter-

observer reliability test was conducted on the main variables and this is elaborated on below.

4.1 Inter-Observer reliability

To check for inter-observer reliability the author of this thesis analysed all the situations and then another analyst independently re-analysed about 14% of the situations with the main analysis variables. When conducting observational research it demands knowledge about the field one is doing research in (Kerlinger & Lee, 2000). Therefore, the interobserver test was conducted by a former football player who recently stopped playing. She has been playing football her entire life and have about 6 years of experience of playing in the second highest level in both Norway and Sweden. She went through a one-day training course to familiarise herself with the technical tools and the variables used in this study. The analyst used about 5 days to conduct the analysis on 438 Visual Exploratory behaviours situations, and 103 situations where the players received the ball where it was checked for VEBF, action outcome, type of action and pressure. In the area of sport science, reliability of measurement in performance analysis is critically important (Bloomfield, Polman , & O`Donoghue, 2007). When a human is part of the measurement instrument it can results in inaccurately data entering because of the subjective nature of interpreting movement recognition (Bloomfield et al., 2007). Because of this it is important to test the variables by calculating the inter-observer agreement. There are different types of inter-observer reliability tests so it is also important to assess the most appropriate test to the different types of analysis (Caro, Roper, & Dank, 1979).

In studies with observational data there are two common inter-observer reliability tests. One is the Cohen`s Kappa when analysing nominal variables and the other is Interclass Correlation Coefficient (ICC) for ordinal, interval and ratio variables (Hallgren, 2012). One of the original and most commonly used way to check inter-reliability for nominal data is Cohen`s Kappa (Gisev, Bell, & Chen, 2013). The Kappa coefficient is a measurement of agreement between to observers registrations of data (Sim & Wright, 2005). The Cohen`s Kappa coefficients (k) values in strength of agreement scale is poor (0-0,20), fair (0,21-0,40), moderate (0,40-0,60), good (0,61-0,80) and very good (0,80-1.00) (Gisev et al., 2013). Cohen`s Kappa have been used in other football analysis studies (Bloomfield et al., 2007; Tenga, Kanstad, Rongland & Bahr, 2009). The ICC

gives information about the magnitude of disagreement between two observers (Field, 2018). In the ICC small magnitudes of disagreement result in higher ICCs than larger magnitudes of disagreement. The ICCs scale values in strength of agreement as poor/questionable (<0.70). acceptable/fair (0,70-0,79), moderate (0,80-0,89) and very good (0,90-1.00) (O`Donoghue, 2012).

The inter-observer strength of agreement was very good for visual exploratory behaviour frequency (ICC= 0.99), Action type (K = 0.98), action completed rate (K = 0.98) and opponent pressure (K = 0.89). The test for visual exploratory behaviour was considered moderate (ICC = 0,84). The main reason the result is moderate is that in some situations it is very difficult to determine exactly when the player initiate exploratory behaviour when they are running and/or changing direction. The registered initiated exploratory behaviour was rarely off by more than one-two frames (0.04-0.08 seconds).

4.2 Statistical analysis

All variables were registered and analysed in the statistical program IBM SPSS statistics 24. A frequency analysis revealed that the data was not normally distributed. When the dataset is not normally distributed non-parametric tests should be implemented as these tests have no assumption of the distribution of the dependable variable (O`Donoghue, 2012). Friedman test and Wilcoxin signed rank test was used to explore differences in between training exercises and matches based on relevant situations per match and training exercise. Statistical significance was accepted at $p < .05$. Friedman test is a nonparametric test and bases its comparison on ranked data (Pereira, Afonso, & Mederios, 2015). The data is ranked from lowest to highest, where the lowest score is ranked 1 and second lowest is ranked 2 etc. The sum of the ranks from each of the independent samples is then compared (Pereira, Afonso, & Mederios, 2015). As Post-hoc test the Wilcoxin signed rank test was used to follow up the results from the Friedman test to find out where the differences were and illustrate the differences between the independent samples. The Wilcoxin test had its p-value adjusted (Bonferroni correction) by dividing it on the number of pairwise comparisons conducted in the test. This is done to reduce the probability of making a Type 1 Error (Pereira, Afonso, & Mederios, 2015). The results from the Wilcoxin test is shown with

the adjusted p-value (0,0033). Mean scores and standard deviations of visual exploratory behaviour frequency were calculated for each player separately, in addition the percentage of maintained possession for each player.

Binary logistic regression test was performed with maintained possession as the binary dependant variable and VEBF as the predictor variable. Binary logistic regression is used to test the likelihood of a categorical outcome variable to belong in a continuous or categorical predictor variable (Field, 2018). This test describes the response probability in the dependant variable when the predictor variable is changed. For binary logistic analyses the Odd-Ratio (Exp (B)) is viewed as a useful measure of effect size (Field, 2018). Spearman`s rho was applied as the non-parametric equivalent to Pearson correlation to determine the relationship between the mean VEBF and of each players maintained possession (Field, 2018). Friedman test was used to test the VEBF against pressure from the opponent, and a Wilcoxin test was used to follow up the results. It was created and passing frequency based on the mean passes each player did in each exercise or match. A Friedman test was used to check the passing frequency of each training exercise and match to look for differences in the number of passes.

5.0 Results

In this chapter the results of 3008 registered head turns across 7 training exercises is presented. Also presented is the results of VEBF and performance on 473 passes and the outcome and opponent pressure in those situations. To my knowledge no similar study have been published so this chapter focus on presenting descriptive statistics.

5.1 Descriptive data

There is a considerable individual difference both in the number of passes completed and the number of visual exploratory behaviours (see table 2). Table 2 shows the total of all analysed situations by each individual player. VEB varies from n = 636 (lowest) to m = 1285 (highest). The mean VEBF before they receive the ball is on average about one search within the 5 second timeframe before they receive the ball.

Table 2 *Descriptive data of each individual participant in an overall summary. VEB = Visual exploratory behaviour. Situations is the number of times they received the ball that was analysed. Mean VEBF = mean visual exploratory behaviour frequency. SD = Standard deviation*

	VEB	Situations	Mean VEBF	SD. VEBF	Passes	Maintained possession
Player 1	1285	192	0,22	0,25	176	81,22%
Player 2	656	208	0,15	0,2	184	82.54%
Player 3	1067	126	0,23	0,27	113	88,98%
Mean sum	1003	175	0,20	0,24	158	84,24%

There was also registered if the visual exploratory behaviour was done when the players where on the team that had possession of the ball (offensive) or if they where not in possession of the ball. There is a trend to lower visual exploratory behaviour when the players is in the defensive team (see table 3). Table 3 shows the visual exploratory frequency from the overall visual exploratory behaviour of each individual participant in offensive VEBF and defensive VEBF.

Table 3 *Descriptive data for the individual player`s offensive visual exploratory behaviour frequency and defensive visual exploratory behaviour frequency*

	Offensive VEBF	SD	Defensive VEBF	SD
Player 1	0,262	0,11	0,185	0,08
Player 2	0,115	0,05	0,090	0,05
Player 3	0,198	0,14	0,190	0,10
Mean sum	0,191	0,1	0,155	0,07

Visual exploratory frequency

The results of the 3008 registered VEB showed that 1990 is registered when the team of the participants is in possession of the ball (offensive) and 1018 VEB was registered when they were not in possession of the ball (defensive). Table 4 shows the overall data from each of the exercises and the game. The results from mean VEBF (+SD) is presented more visually in figure 8 and shows that Rondo is the one that stands out.

Table 4 *Overall descriptive data for each training exercise and game. VEB= the number of registered exploratory behaviour. SD = Standard deviation. Offensive VEB = the number of registered exploratory behaviour when the participants were on the attacking team. Defensive VEB= the number of registered exploratory behaviour when the participants were on the defensive team. Situation is the number of times the players received the ball. Mean VEBF = is the overall mean visual exploratory behaviour of all participants. Passes is the number of passes registered. Maintained possession is the percentages they maintained possession of the ball when making a pass.*

	VEB	SD	Offensive VEB	Defensive VEB	Situations	Mean VEBF	SD	Passes	Maintained possession
Game	1006	82,2	715	291	140	0.201	0.063	121	82,92%
Possession1	334	43,2	186	148	61	0.183	0.084	54	82,75%
Tactical game	308	24,5	207	101	34	0.223	0.085	31	84,37%
Training game 1	388	52	206	182	50	0.200	0.869	37	81,57%
Rondo	19	1,7	17	2	101	0.016	0.005	101	84,15%
Possession 2	327	34,7	193	134	44	0.199	0.077	44	86,36%
Training game 2	331	36,9	204	127	53	0.174	0.083	46	84,31%
Posession 3	295	34,6	262	33	43	0.262	0.111	39	76,19%
Sum	3008	38,7	1990	1018	526	0,184	0,172	473	82,90%

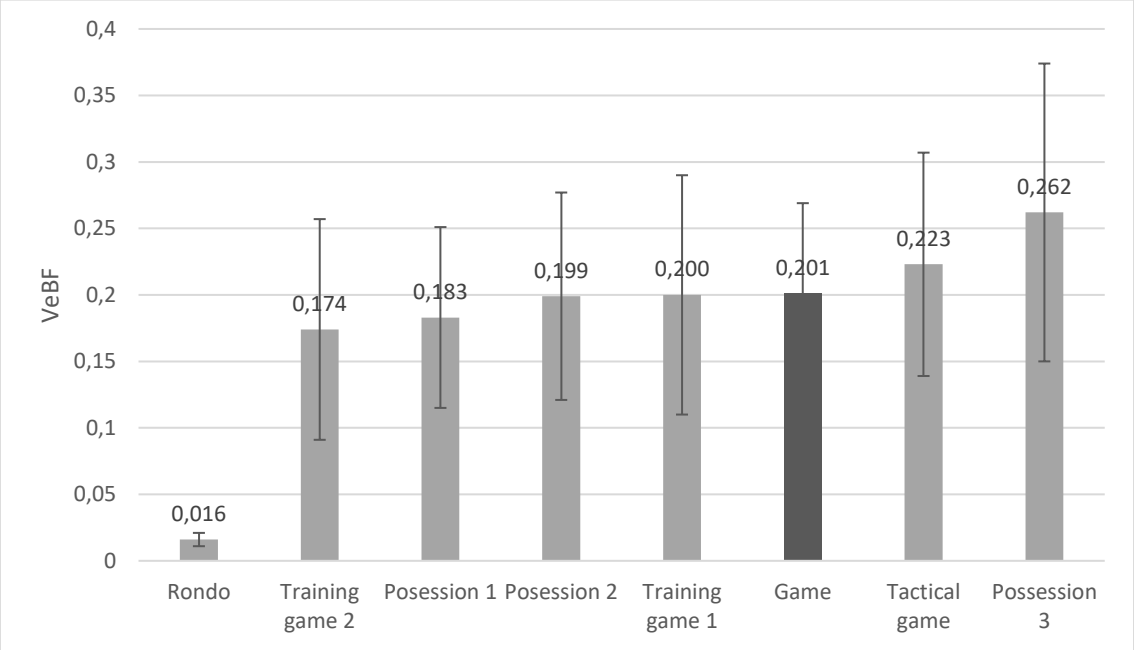

Figure 8 *Representation of the mean VEBF (+SD)*

Figure 8 is a visual representation of the total mean VEBF from each training exercise and from the game. Figure 9 have taken the same data but separated the data into offensive and defensive visual exploratory behaviour to show how it align with each other in the different exercises. The figure is based on the mean overall data from each

individual participant. To see the descriptive data of each individual player in each exercise see appendix D.

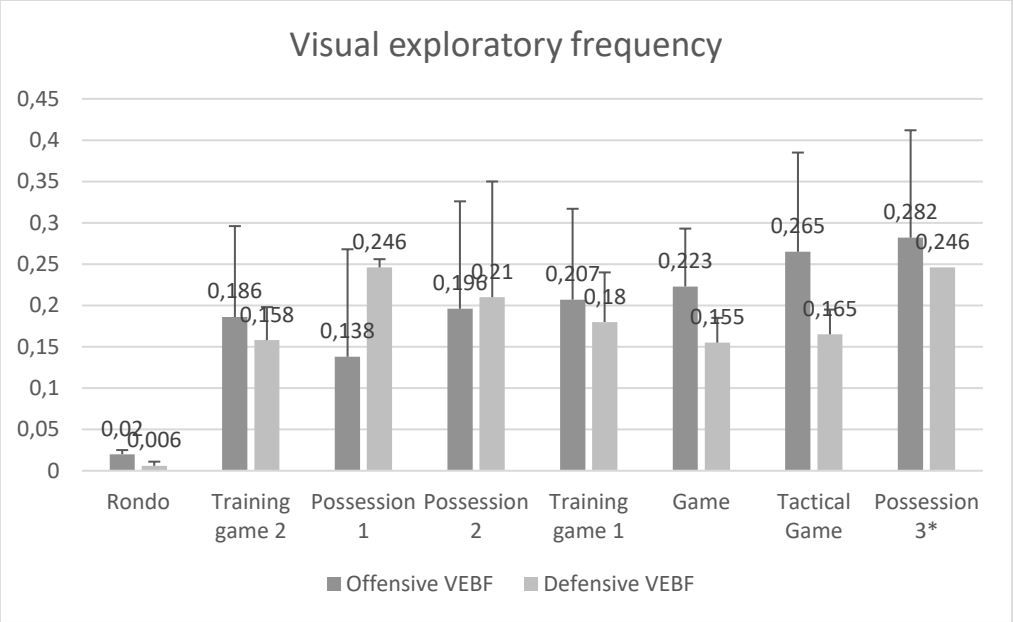

Figure 9 *The visual exploratory frequency in both offensive and defensive. * = for this exercise two of the players were jokers and always on the attacking side. With only 1 player having defensive data no SD was possible to calculate (see appendix D for details).*

The Friedman test revealed that there was no statistically significant difference between the total mean VEBF in the training exercises and matches $x^2(7) = 13.889, p = .053$. Because the Friedman test did not show statistical significant difference there is no need to proceed to do a post hoc test, but because there was a clear trend towards significance (.53), this was conducted anyway to see how the different exercises and the game were compared to each other (see table 5).

Table 5 *P values from the pairwise comparison of the mean VEBF and the training exercises and the game from the post hoc test. Adjusted p value = 0,0017 (Bonferroni correction)*

	Rondo	Training game 2	Possession 1	Match	Training game 1	Possession 2	Tactical game	Possession 3
Rondo	x	0.109	0.109	0.109	0.109	0.109	0.109	0.109
Training game 2	0.109	x	1	1	1	0.109	0.285	0.109
Possession 1	0.109	1	x	0.285	0.593	0.285	0.109	0.109
Match	0.109	1	0.285	x	0.593	1	0.109	0.109
Training game 1	0.109	1	0.593	0.593	x	0.593	0.285	0.109
Possession 2	0.109	0.109	0.285	1	0.593	x	0.593	0.285
Tactical game	0.109	0.285	0.109	0.285	0.285	0.593	x	0.109
Possession 3	0.109	0.109	0.109	0.109	0.109	0.285	0.109	x

Performance

The spearman rho correlation coefficient was used to assess the relationship between the VEBF and maintained possession. There was no significant correlation between the two in this study $r_s = -.19, p = .683, N = 473$. Because of no correlation a further investigation was conducted to explain why. Out of 473 passes registered 217 (46%) of them were done without any registered VEB within the 5 second interval before they received the ball. It was registered that they maintained possession of the ball 83,4% when there was no VEB registered within the 5 seconds before receiving the ball. When it was registered VEB within the 5 second window the total of maintained possession was 82,8%,

When investigating the performance of the players compared to the VEBF the binary logistic regression showed that when the participants do little VEBF (n = 217) they maintain the possession of the ball 83,4% of the time. When the participants explored some (n = 120) there was a small decrease that they would maintain possession with an odds ration Exp(B) of .907 however it was not significant (p = .746). When the participants explored much (n = 136) the chance for them to maintain the possession of the ball stayed about the same with and odds ration Exp(B) of .897 and was not statistical significant (p = .71). The results showed no difference in an increase of decrease in maintaining possession of the ball based on VEBF (see figure 10).

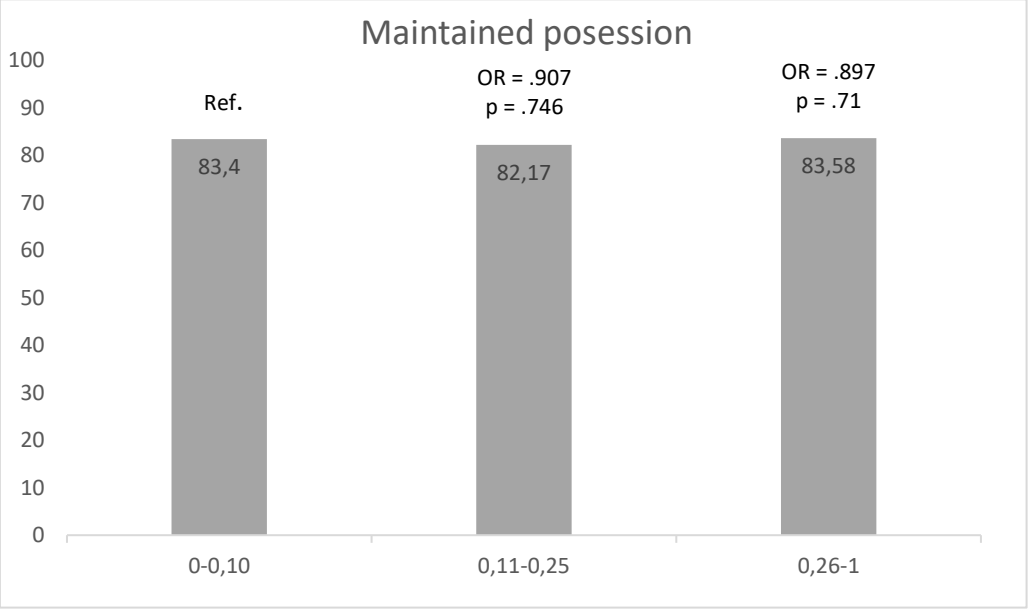

Figure 10 *VEBF (little 0-0,10, some 0,11-0,25 and much 0,26-1) and maintained possession (N = 3 players/473 situations)*

Pressure

When exploring the relationship between VEBF and pressure the Friedman test show that the difference in VEBF based on pressure is statistically significant $x^2(2) = 6{,}500, p = .039$ however the follow up post hoc test shows that its not statistically significant difference between the categories of VEBF based on pressure (see table 6).

Table 6 *Results from the post hoc test with adjusted p value p < .0167 (Bonferroni correction)*

	0-0,10	0,11-0,25	0,26-1
0-0,1	x	.068	.068
0,11-0,25	068	x	.713
0,26-1	068	.713	x

The players explored little the most in all cases based on the pressure category (see figure 11).

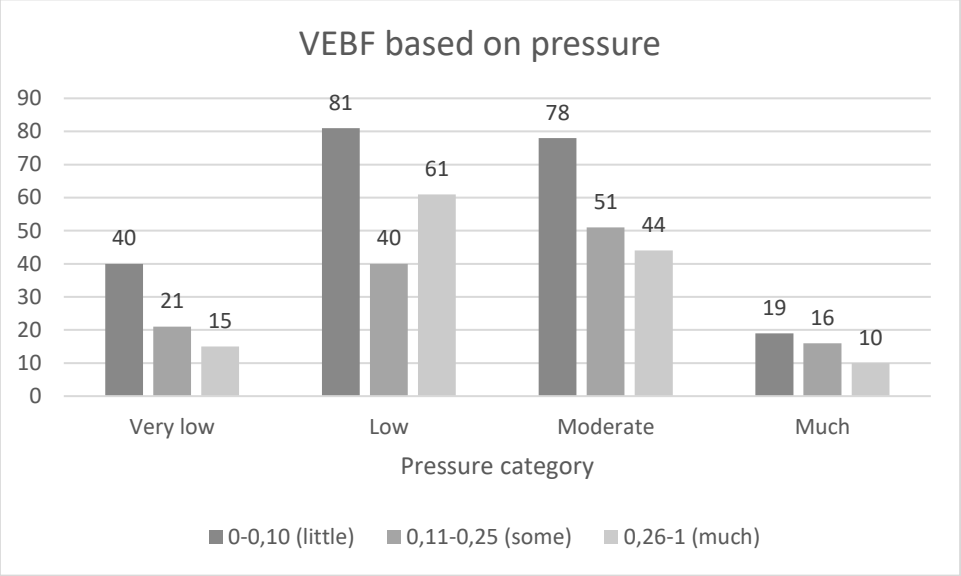

Figure 11 *The number of VEBF (little, some and much) in each of the pressure category (very low, low, moderate and much pressure). N=3 players/473 situations*

Passing frequency

Figure 12 shows the passing frequency from the game and the training exercises. The number of passes has been taken and divided on the effective minutes played creating a pass per second frequency. The Friedman test showed $x^2(7) = 12{,}801\ p =$,077 that there is no statistical difference between the passing frequency in the training exercises

and the match. Figure 12 shows that rondo have a higher passing frequency than it has VEBF and it shows that the game has the lowest passing frequency.

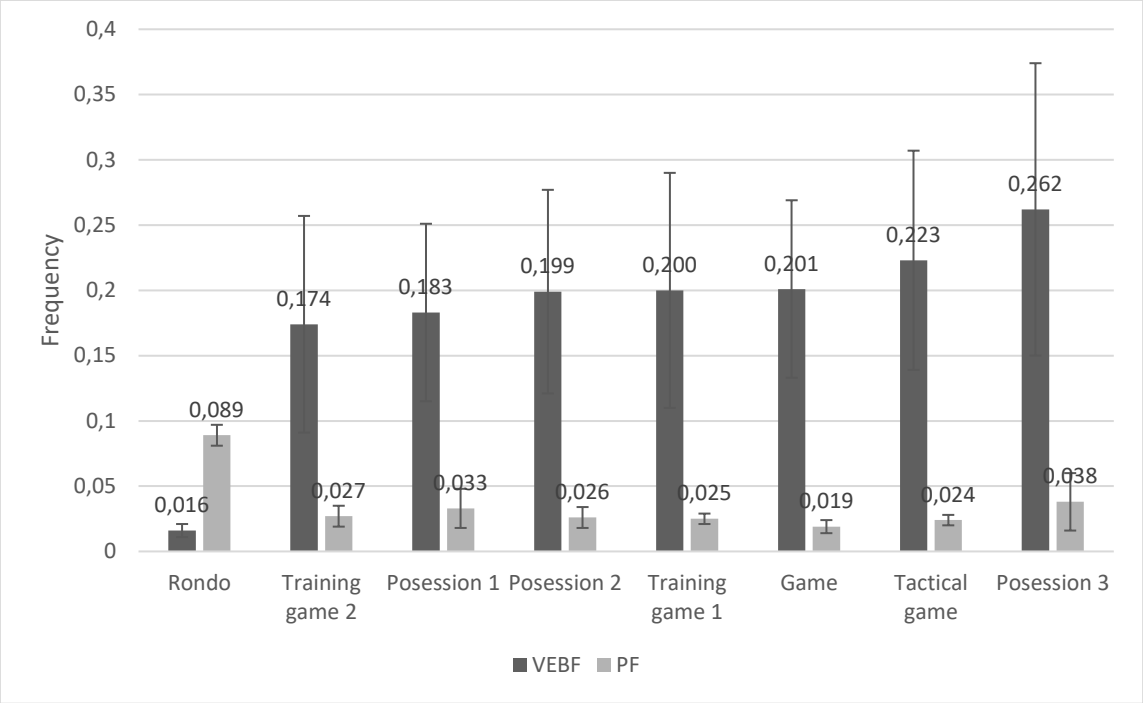

Figure 12 *An overview of the mean VEBF and the mean Passing Frequency (PF) in the game and the different training exercises.*

6.0 Discussion

The main purpose of this study was to compare the visual exploratory behaviour in different training exercises and matches, guided by an ecological approach to perception. The results revealed that players engage in more visual exploratory behaviour in games, training games and ball possession games than in Rondo. However, this difference was not significant, although there was a clear trend towards it being significant (p=.053). The results show that what is considered more complex exercises (games, ball possession games) trigger about equal amounts of VEB. In these complex exercise's players rely on their head and body movements to gather information when facing away from the ball. The one exception from this was Rondo, one could argue about the different scaling of complexity form a 6v2 rondo to a full 11v11 game. In normal situations players are surrounded by other moving players in an ever changing environment where they need to move their head and body to perceive the situation

(McGuckian, Cole, & Pepping , 2018b). In this Rondo exercise the players stood around a square which meant that there was no relevant information behind their backs and only had to focus on what was in front of them to make decisions. The study by Williams & Davds (1998) where they compared experienced and less experiences football players in a 3v3 situations they did not find any difference in search strategies. The reason they used was the increasing role of the peripheral vision. Vaeyens et al. (2007) study showed that youth players focused they vision more centrally and relied more on their peripheral vision. This was proposed as an advantageous searching strategy as information is processed quickly through the peripheral vision. A camera standing 40 meters away is not the best measurement of this and one could apply the same method used by Nagano et al. (2004) where they used eye tracking technology.

The study registered if the exploratory behaviour was offensive or defensive. The result for each individual player they seem to explore less when they were on the defensive team and a little more when they where on the attacking team. This could align with Williams (2000) study that showed players have different searching strategies in offensive and defensive situations. There is some laboratory research that have shown different searching strategies. However, there is different findings. Helsen & Starkes (1999) found that experts had fewer fixation of longer durations but Roca et al., (2011) found that experts had more fixations of shorter durations. This study did not register the duration of the exploratory behaviour, so it is impossible to conclude with anything. The players have quite large differences in VEBF for offensive and defensive searches in each exercise (see appendix D), which could suggest they have different visual exploratory strategies. Furthermore, it is hard to say anything since the players played in different positions on the field, spent more time in defence than in offence, had certain roles (joker) that could affect their visual exploratory behaviour. The way the frequency was calculated differed from other studies (Jordet et al., 2013). This study took the overall visual exploratory behaviours and divided it by the effective time analysed, other studies have used the duration of the situation. This could affect the value of the frequencies.

A secondary aim of the study was investigating the relationship between VEBF and performance. The results revealed no correlation between VEBF and performance. This is contradictory to other studies (Jordet et al. 2013; Eldridge et al. 2013). The binary logistic regression analysis shows no increase in performance based on the VEBF

categories (little, some and much). This is also contradictory to other studies (Jordet et al. 2013; Eldridge et al. 2013). This could be from flaws in the design of the study on how performance is measured and using 5 seconds and possible other issues. One also have to note that the VEBF before the players receive the ball on average is considered quite low and one might wonder if other mechanism is at play. This could be because that here all passes were included. A high amount of the passes (46% of the total passes) there where not registered any VEB before the participants received the ball. Including exercise like Rondo that had 101 registered passes but only 19 registered searches could affect such a result and arguably the need to have them inn seeing all information is in front of the players. Out of the 473 passes analysed 217 (46%) of all passes did not registrate any VEB before receiving the ball. The same argument for Rondo having so low VEB could in some cases also be represented in ball possession games. In a ball possession game, the goal of the attacking team is to keep possession of the ball (Campos-Vazquez et al., 2015). Unlike small sided games, tactical games, game training and matches there are more attacking principles in place. The team as a whole must coordinate their actions and move the ball in order to achieve and end goal which is trying to score a goal or move the ball into a scoring zone (Grehaigne, Bouthier, & David, 1997). As mentioned in the ball possession game the goal is to maintain the ball which could affect the players VEB. If the players have picked up a free player on their team in the peripheral vision or a free player just standing in front of them it could affect their decision with the ball and just play to that player to keep the ball and not find the need to look for more or other alternatives. The results still show that it triggers about the same amount of visual exploratory behaviour as a game or game like training exercises so there could be some other aspect that influence players visual exploratory behaviour.

Results from other studies have shown that visual perception is dependent on the constraints and action requirements of the task (Mann, Wiliiams , Ward, & Janelle, 2007). Some constrains the coaches can enable in a exercise to change the requirements of the drill. Examples of that can be size of the pitch, limited touched, number of extra players (jokers and wall players), zone restrictions and unique rules for a specific exercise (Davids, Button, & Bennett, 2008). In this study examples of that is zone restrictions in ball possession game 1 and 2. In ball possession game 2 there is a rule that only one team is in attack, so when the defending team gained control over the ball

the game stop and was played back to the team that was defined as attacking team. The study shows no big differences between these two exercises. The exercise that triggered the most visual exploratory behaviour was ball possession 3. That was the exercise with the smallest field size (besides from Rondo) and no zone restrictions. The exercise had two overload players (jokers) and two end line players (wall players). This could be in line with McGuckian et al. (2017) study that reducing the size of the field it increases their visual exploratory behaviour, however no statistical evidence is found in this study so further investigation is needed.

This study also looked at the relationship between defensive pressure and VEBF. The results do not show any statistically significant differences between the different pressure categories and the visual exploratory behaviour frequencies categories. The studies of Jordet (2004) where he interviewed players, they stated that they were mostly searching for teammates or opponents to either prevent or create opportunities. Jordet (2004) further argue that an increase in defensive pressure would lead to a decrease in VEB. The stress factor increases, and more attention is payed to control and maintain the ball at the cost of visual exploration. From figure 11 we get the number of each VEBF category and how many times it happens based on defensive pressure. The players experienced low and moderate pressure most often. When players experienced low pressure, it was the only time they explored much (VEBF 0,26-1) more than some (VEBF 0,11-0,25) exploring. This could be because they recognized that there were opponents near that made them do more visual exploratory behaviour to look what the opponent was doing, and still had the time and space to explore more. This could also just be something that happened in this study, there was no interview of the players to get their interpretation of the situation and what they were looking for. However little (VEBF 0-0,10) was always represented the most times in all the different pressure categories. One could argue if this was a good measure of pressure to use a 5-meter radius around the player. Another solution would be to get the distance to the closest opponent. The way pressure was measured here says nothing about if the opponent was had body contact (duel) with the analysed player or if he was 1 meter or 4 meters away. This is something that could affect their exploratory behaviour and is suggested that future studies take account for.

Figure 12 shows a presentation of passing frequency (pass per second) in each exercise together with the visual exploratory per second. The statistical analysis showed no statistical difference between the exercises, but it shows that the 11v11 game is lowest and Rondo has the highest passing frequency. Studies have shown that the less players and the smaller the field is the more involved the players is with the ball and make more decisions (Davids, Button, & Bennett, 2008). Rondo is the exercise that showed the lowest amount of visual exploratory behaviour. This could indicate that manipulating constrains and the environment, players get different stimuli (McGuckian et al., 2017). The Rondo used in this study, the players gets more repetitions on receiving and passing the ball than visual exploratory behaviour that require moving the head or body to look for information.

The strength of this study is its observational design that suggest high ecological validity. The study provided some new information on how different training exercises triggers visual exploratory behaviour. However, some limitation must be addressed as with most research. To my knowledge there are not any published studies with the current design that look at visual exploratory behaviour of football players through a whole training week. There have been done studies on visual exploratory behaviour in matches (Jordet et al. 2013) and there have been done some research on constraints and how they affect visual perception (Broadbent, Causer, Williams, & Ford, 2015; McGuckian et al., 2017; Williams, Ward, Starkes, & Ericsson, 2003; Williams & Grant, 1999). Consequently, there is no data with same methodology to compare the results with. A limitation is the way visual exploratory behaviour was measured in this study. We do not know what the players actually see and what they are looking for. As a consequence of that we can't say anything about the perceptual-cognitive processes such as anticipation, pattern recognition, information extraction and cue detection (Jordet et al., 2013). Another thing that should be considered a limitation in the study is that there was not done a performance analysis on each training exercise and compared it to the game and other exercises. Furthermore, one limitation to the study was how performance was defined and analysed. The definition of performance used here does not account for the direction and type of pass and neglects the type of risky decisions (Jordet et al., 2013). This study was an exploratory (pilot) study with a sub goal to inspire to future research on an interesting and little researched topic. Because of lack of comparing results on other studies a lot of the discussion is just pointing at trends or

possible explanations rather than the actual relationships between the variables. The age group, all male and player position that is used and the few players that participated could be limitations to the study in terms of generalization the results. The different training exercises is what the coaches of the team decided to do the week we filmed and was not manipulated in any way by the researcher, which also is a limitation and reduce the generalization of the study. To make any conclusion is difficult from this study because of the lack of more empirical data and one can only urge for the need of more studies of visual exploratory behaviour on the training field in different types of exercises and environment with the aim of developing training exercises that encourage to engage visual exploratory behaviour.

7.0 Future research

In this chapter we will go over some variables that should have been in this study and provide ideas and tips for other researchers to make better and more interesting studies. The first variable is a variable to say something about the direction of the passes, then one can add more information on players performance. Forward passes are said to require more accuracy and creativity and would be a good measurement of performance (Jordet et al., 2013). In this study there was no interference on the chosen training exercises but that is recommended for future studies to do. Future studies should try to have more control over the exercises, participants, and the constraints. Future researchers should have control over the field sizes, number of players, position of the players, rules, and goals of the exercise. This could give more information on how visual exploratory behaviour is influenced by constraints in the training. Future studies should also do a performance analysis on all the different training exercises and compare them to each other and the game. Finding a way to describe the players' position on the field would also be a useful tool. If researchers have control over the field size and placement of cones it could provide good reference marks to describe the position of the players when doing the analysis. Having control over where the players are will also help investigate on how much the environment can affect visual exploratory behaviour. As an example, in this study we can look at two of the three ball possession games. Ball possession game 1 & 2. These are both ball possession games with 3 zones. One of the differences of these exercises was that in ball possession 1 there was a wall player and the short line on each end. That means that people in the end sones had something behind them. In ball possession 2 players in the end sones had

nothing behind them. Unfortunately for this study only one participant appeared in both the central sone and end sone in both exercises. Because it was only one player all of this is just hypothesis and speculations because it's no foundation to make comparisons on. Looking at the data from these to exercises from this one player shows that in the ball possession 1, the players mean VEBF is 0,205 in the central sone and 0.165 in the end sone. Inn ball possession 2 the mean VEBF was 0.356 in the central sone and 0.062 in the end sone. The numbers in the end sones is of interest to investigate if the environment can affect the visual exploratory behaviour. The player has 0.165 as a mean VEBF when he has a player behind him and 0.062 as mean VEBF when he does not. If we had control over the position of the players and made sure all spend time in each sone we could compare results and say something if environment could affect visual exploratory behaviour. This would provide information to coaches on how to create exercises that encourage more visual exploratory behaviour. Future research should also try to get verbal reports from the players to get a better understanding of what they see and look for during training.

8.0 Practical applications

Some of the evidence showed in this study coaches should be aware over the different training exercises they use in their trainings and what they encourage the players to work on. Coaches should be aware that different training exercises could trigger players visual exploratory behaviour in different ways. Coaches should always encourage players to work on their visual exploratory behaviour before receiving the ball. Coaches should strive to obtain video footage of the training exercises so they can monitor players visual exploratory behaviour and investigate if players make improvements on the training field. They should try to get close-up video footage for players to use to be more aware of their visual exploratory behaviour

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List of Tables

List of Figures

Appendix

Appendix A

N

NSD Personvern

09.01.2019 11:27

Det innsendte meldeskjemaet med referansekode 810454 er nå vurdert av NSD.

Følgende vurdering er gitt:

Det er vår vurdering at behandlingen av personopplysninger i prosjektet vil være i samsvar med personvernlovgivningen så fremt den gjennomføres i tråd med det som er dokumentert i meldeskjemaet med vedlegg den 9.1.2019, samt i meldingsdialogen mellom innmelder og NSD. Behandlingen kan starte.

MELD ENDRINGER
Dersom behandlingen av personopplysninger endrer seg, kan det være nødvendig å melde dette til NSD ved å oppdatere meldeskjemaet. På våre nettsider informerer vi om hvilke endringer som må meldes. Vent på svar før endringer gjennomføres.

TYPE OPPLYSNINGER OG VARIGHET
Prosjektet vil behandle alminnelige kategorier av personopplysninger frem til 15.5.2019.

LOVLIG GRUNNLAG
Prosjektet vil innhente samtykke fra de registrerte til behandlingen av personopplysninger. Vår vurdering er at prosjektet legger opp til et samtykke i samsvar med kravene i art. 4 og 7, ved at det er en frivillig, spesifikk, informert og utvetydig bekreftelse som kan dokumenteres, og som den registrerte kan trekke tilbake. Lovlig grunnlag for behandlingen vil dermed være den registrertes samtykke, jf. personvernforordningen art. 6 nr. 1 bokstav a.

PERSONVERNPRINSIPPER
NSD vurderer at den planlagte behandlingen av personopplysninger vil følge prinsippene i personvernforordningen om:

- lovlighet, rettferdighet og åpenhet (art. 5.1 a), ved at de registrerte får tilfredsstillende informasjon om og samtykker til behandlingen
- formålsbegrensning (art. 5.1 b), ved at personopplysninger samles inn for spesifikke, uttrykkelig angitte og berettigede formål, og ikke behandles til nye, uforenlige formål
- dataminimering (art. 5.1 c), ved at det kun behandles opplysninger som er adekvate, relevante og nødvendige for formålet med prosjektet
- lagringsbegrensning (art. 5.1 e), ved at personopplysningene ikke lagres lengre enn nødvendig for å oppfylle formålet

DE REGISTRERTES RETTIGHETER
Så lenge de registrerte kan identifiseres i datamaterialet vil de ha følgende rettigheter: åpenhet (art. 12), informasjon (art. 13), innsyn (art. 15), retting (art. 16), sletting (art. 17), begrensning (art. 18), underretning (art. 19), dataportabilitet (art. 20).

NSD vurderer at informasjonen om behandlingen som de registrerte vil motta oppfyller lovens krav til form og innhold, jf. art. 12.1 og art. 13.

Vi minner om at hvis en registrert tar kontakt om sine rettigheter, har behandlingsansvarlig institusjon plikt til å svare innen en måned.

FØLG DIN INSTITUSJONS RETNINGSLINJER
NSD legger til grunn at behandlingen oppfyller kravene i personvernforordningen om riktighet (art. 5.1 d), integritet og konfidensialitet (art. 5.1. f) og sikkerhet (art. 32).

For å forsikre dere om at kravene oppfylles, må dere følge interne retningslinjer og/eller rådføre dere med behandlingsansvarlig institusjon.

OPPFØLGING AV PROSJEKTET
NSD vil følge opp ved planlagt avslutning for å avklare om behandlingen av personopplysningene er avsluttet.

Lykke til med prosjektet!

Kontaktperson hos NSD: Lisa Lie Bjordal
Tlf. Personverntjenester: 55 58 21 17 (tast 1)

Appendix B
Information letter

Are you interested in taking part in the research project ”Decision Making in Elite Youth Football Players (Visual Perception)” ?

This is an inquiry about participation in a research project where the main purpose is to conduct an initial pilot/screening of players “visual exploratory behaviours” in different clubs and the relationships with different contextual factors; and decision making/performance; and the extent to which these behaviours in match are aligned with the equivalent behaviours in training. In this letter we will give you information about the purpose of the project and what your participation will involve.

Purpose of the project

The purpose of the current project is to conduct an initial pilot/screening of players’ vis ual exploratory behaviours in different clubs and countries; and the relationships with d ifferent contextual factors (e.g.,positional role, pitch location, stress/pressure); decision making/performance; and the extent to which these behaviours in match are aligned wit h the equivalent behaviours in training. We also want to link the study outcomes directl y with implications for coaching and planning of sessions.

In our research program, players are filmed during a normal training week in a season. The players visual exploratory behaviours – head and body movements to perceive – are analysed. The study aims to analyse players visual exploratory behaviour to match situations, stress and the alignment between match demands and training when it comes to visual exploratory behaviour.

This is a research project that is planned to be a master`s thesis that is also a part of a bigger research program.

Who is responsible for the research project?

The Norwegian school of sport sciences is the institution responsible for the project.

Why are you being asked to participate?

The samples in this study is elite youth football players in academies in top clubs in Europe. There will be recruited 4-5 different clubs in Europe where the sample is their U15 teams.

What does participation involve for you?

The method in this study is to use a high-resolution camera to film a normal training week in a season. This includes all training session and one game in a week.

- If you choose to take a part in the project you will be filmed during the warm up and training session for a full week. This also includes that you are being filmed during the warm up and one game throughout the week. These films will then be sent to the research team for analyses of your visual exploratory behaviour during training and games.

Participation is voluntary
Participation in the project is voluntary. If you chose to participate, you can withdraw your consent at any time without giving a reason. All information about you will then be made anonymous. There will be no negative consequences for you if you chose not to participate or later decide to withdraw. It will not affect your relationship with your coach and club.

Your personal privacy – how we will store and use your personal data
We will only use your personal data for the purposes specified in this information letter. We will process your personal data confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act).

- The people that will have access to this data is people involved in this research project. That involves students, supervisor and a phd. student.
- The data will be stored in research server and on password locked hard drives to ensure that no unauthorized people can get access to this data.
- Your contact details and name will be replaced by a code and stored separately from the rest of the collected data.

In the publication all participants will be anonymous. There will be no personal information published that involves name, country or club you play for. The age span of all participants may however be mentioned.

What will happen to your personal data at the end of the research project?

The project is scheduled to end 15.05.19. Your personal information will be deleted after the end of the research project. The recorded films will be stored by the supervisor of this study for further master`s thesis, follow-up studies, verification and other research projects . This data is then completely anonymised.

Your rights

So long as you can be identified in the collected data, you have the right to:

- access the personal data that is being processed about you
- request that your personal data is deleted
- request that incorrect personal data about you is corrected/rectified
- receive a copy of your personal data (data portability), and
- send a complaint to the Data Protection Officer or The Norwegian Data Protection Authority regarding the processing of your personal data

What gives us the right to process your personal data?

We will process your personal data based on your consent.

Based on an agreement with the Norwegian school of sport sciences, NSD – The Norwegian Centre for Research Data AS has assessed that the processing of personal data in this project is in accordance with data protection legislation.

Where can I find out more?

If you have questions about the project, or want to exercise your rights, contact:

- Norwegian school of sport sciences via Geir Jordet (project leader) geir.jordet@nih.no and/or student Roar Halvorsrud via roarhalvorsrud@yahoo.no.
- Our Data Protection Officer: Geir Jordet
- NSD – The Norwegian Centre for Research Data AS, by email: (personverntjenester@nsd.no) or by telephone: +47 55 58 21 17.

Yours sincerely,

Geir Jordet (Researcher/supervisor)

Roar Halvorsrud (Student)

Consent form

I have received and understood information about the project “Decision making and in elite youth football players (visual perception)” and have been given the opportunity to ask questions. I give consent for my child:

- ☐ to participate in being filmed during one week of training and one game and his/her visual perception (head, eye and body movement) is being analysed for the purpose that’s been described in the project description.

I give consent for my child’s personal data to be processed until the end date of the project, approx. 15.05.19

(Signed by parent, date)

(Signed by participant (child), date)

Appendix C

Situasjon	Posession	Attack framecode start	Search begins	Attack situation ends	Situation duration	Defence framcode start	Search begins	Defence framecode end	Ball touch Framcode	Search within 5 sec
	1 = attack 2= defence 3= none									

Player action	Type action	Action direction	Oponent pressure	Oponent pressure 2
1succsesfull 2unseccsefful 3 other	1 pass 2 dribble 3 shoot	1. forward 2. backward 3. neutral 4. 99 not possible to tell	*1m* *2m* *3m*	0 no pressure 1 one player within a 5 meter radius of player 2 2 players inside 5 meter radius 3 3 or more players innside 5 meter radius

Appendix D

The table below shows the descriptive data of offensive VEBF and defensive VEBF as a total sum of the participants.

	Offensive VEBF	SD	Defensive VEBF	SD
Game	0,223	0,07	0,155	0,03
Possession 1	0,156	0,11	0,246	0,01
Tactical game	0,265	0,12	0,165	0,03
Training game 1	0,207	0,11	0,18	0,06
Rondo	0,02	0,005	0,006	0,005
Possession 2	0,196	0,13	0,21	0,14
Training game 2	0,186	0,11	0,158	0,04
Possession 3	0,282	0,13	0,246	-
Mean sum	0,192	0,09	0,17	0,04

The two tables below show the individual VEBF for each player in each of the exercises and in the match.

Offensive									
	Game	Possession 1	Tactical game	Training game 1	Rondo	Possession 2	Training game 2	Possession 3	Mean VEBF
Player 1	0,278	0,293	0,339	0,214	0,026	0,336	0,313	0,298	**0,262**
Player 2	0,133	0,088	0,122	0,088	0,015	0,189	0,147	0,137	**0,115**
Player 3	0,258	0,034	0,333	0,318	0,02	0,062	0,098	0,411	**0,198**
Sum means	**0,223**	**0,138**	**0,265**	**0,207**	**0,020**	**0,196**	**0,186**	**0,282**	**0,192**

Defensive									
	Game	Possession 1	Tactical Game	Training game 1	Rondo	Possession 2	Training game 2	posession 3	Mean VEBF
Player 1	0,184	0,238	0,209	0,237	0,011	0,212	0,206	0*	**0,185**
Player 2	0,117	0*	0,133	0,105	0	0,063	0,125	0*	**0,0905**
Player 3	0,165	0,255	0,154	0,199	0,007	0,354	0,142	0,246	**0,19**
Sum means	**0,155**	0,2465	**0,165**	**0,180**	**0,006**	**0,210**	**0,158**	**0,246**	**0,155**

Note: * = The player was never on the team in defence because he had the role of being the extra player (Joker).