

Svenska Ishockeyförbundet
Elittränarutbildning

The Swedish Ice Hockey Association
Thesis Elite Coaching Course (Level 5)

**How USA Hockey and
the Swedish Ice Hockey Association
Improve and Develop**

GAME SENSE

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2014-05-04

Abstract

Background: Research is relatively undeveloped in dealing with the concept of Game Sense as a whole.

Aim: The aim of this study is to acquire knowledge as to whether or not there is a common definition of Game Sense, or at least elements that seem to be generally agreed upon, as well as how to practically train Game Sense, and at what ages.

Methods: A review was conducted pertaining to information about Game Sense using material from or recommended by USA Hockey and the Swedish Ice Hockey Association. A search in the data bases PsycINFO and PubMed of research studies was conducted.

Results and Discussion: The searches in scientific databases yielded no results. Although thousands of scientific papers exists on many of the components included in the definitions, such as perception and cognition, this thesis chose not to delve into specific components, only the concepts of Game Sense as a whole. Different studies from or recommended by USA Hockey and the Swedish Hockey Association chose different vocabulary; hockey sense, ice-sense, small-area games, reading the play and the Swedish word spelförståelse (Game Sense). The author makes the presumption that all studies are working towards the same goal, and thus the vocabulary used means more or less the same; to make the player think ahead of the game. Training and developing Game Sense show no real contradictions between the studies, but chose to focus on either a more specific or a more holistic approach; small-area games that develop strengths as competitiveness, skills, offensive and defensive concepts and joy of the game, playing a variety of team sports in order to enhance such areas as gaining different perspectives and developing problem-solving mechanisms, analysing video to promote cognitive skills. Game Sense should be taught at all ages, just differently and depending on skills and maturity level.

Conclusion: The author of this thesis would like to see the ongoing discussion establishing a consensually agreed-upon definition of Game Sense, with clear concepts included in order to develop standardised references of teaching Game Sense. This would make it easier to teach Game Sense to coaches and players, as well as conduct scientific research and advance the area of understanding and training Game Sense. Key concepts in developing Game Sense should also focus on the coach's creativity, reaching the players through imagination, enthusiasm and joy.

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1. INTRODUCTION AND BACKGROUND

There is an ongoing discussion about the player's ability to think ahead of the game in sports, and whether or not it can be taught or if it is mere luck of the draw in the genetic lottery. Even though this discussion involves coaches, leaders, players, parents and other people associated with both team sports and individual sports, there is no consensually agreed-upon definition. Indeed, it is not consensually agreed-upon what words to use even to describe that that has not been clearly defined...should we use the word Game Sense? Sports IQ? Reading the play? Understanding the play? Game intelligence? Game recognition?

In Swedish, the word "spelförståelse" is more commonly used, but that might not make it easier to deal with, as "spelförståelse" is not defined either, and may encompass whatever the user chooses, based on context and each person's individual interpretation and experience.

So how do we define what differentiates a good player from a brilliant player who somehow always seems to be two steps ahead of everyone else on the ice?

Research is relatively undeveloped and few scientific studies deal with the concept as a whole. When conducting unscientific research among friends, colleagues and fellow coaches, a common definition of "What is hockey sense" yielded in many cases the answer "Wayne Gretzky". In many people's minds, therefore, hockey sense is embodied by a physical person, which does not really uncomplicate the matter. Unscientific search on the internet also resulted in Wayne Gretzky being personified as hockey sense. Numbers alone of Wayne Gretzky's accomplishments is only one aspect though; 2857 NHL points, whereof 894 goals. Second to Gretzky is Gordie Howe with over 1000 points less. What is more interesting however, is *how* Gretzky got there; backyard hockey rink with countless of hours of unstructured play from the age of 2. His father Walter was his personal coach, and at the dinner table they used salt and pepper shakers that Wayne would move around like chess pieces as they discussed the game. On route to games in the family car Walter would quiz Wayne about certain aspects of the game (Gretzky & Reilly, 1990). But does this mean that if we follow in the exact footsteps of Wayne Gretzky that we will also attain his level of success? No, it does not. This means that there are still more factors involved in the creation of greatness, and this thesis aims to gain a little more insight into those factors.

To simplify, the words *Game Sense* have been chosen by the author to be used in this thesis, and the general concept refers not only to the game of ice hockey, but also to other sports.

2. AIM OF THESIS AND OBJECTIVES

The aim of this study is to acquire knowledge as to whether or not there is a common definition of Game Sense, or at least elements that seem to be generally agreed upon.

The specific study questions and objectives of the thesis are:

1. To investigate Game Sense and related synonyms in medical and psychological scientific databases.

2. To gain knowledge and an understanding of definitions of Game Sense or related synonyms from USA Hockey and The Swedish Ice Hockey Association's elite coaching programs and from sources recommended by them.
3. To investigate which concepts are included in the definitions of Game Sense or related synonyms.
4. To gain knowledge and an understanding of ways of teaching Game Sense or related synonyms in USA Hockey and The Swedish Ice Hockey Association's elite coaching programs and from sources recommended by them.
5. To discuss at what age players should start learning about Game Sense.

3. METHODS

A review was conducted pertaining to information about Game Sense using material from or recommended by USA Hockey and the Swedish Ice Hockey Association. The material was chosen as the author of this thesis has elite coaching certification from both countries, and would therefore like to explore similarities and differences in discussing Game Sense. The material will be discussed in terms of studies, even though they are not scientifically peer-reviewed.

3.1. Inclusion criteria

- 1) Searches in medical and psychological scientific databases
- 2) USA Hockey's American Development Model Coaching Education Program Manual
- 3) Presentations from USA Hockey's elite coaching programs
- 4) The Swedish Ice Hockey Association material on *spelförståelse*
- 5) The Swedish Olympic Committee information on *spelförståelse*
- 6) An article concerning reading the play, handed out at Level 5 to elite coaches

3.2 Studies included in the thesis

1) Searches in PubMed and PsycINFO

PubMed is a free search engine accessing primarily the MEDLINE database of references and abstracts on life sciences and biomedical topics. PubMed has over 23 million records going back to 1966, selectively to the year 1809, and about 500,000 new records are added each year (NCBI, 2005). PsycINFO is a database of abstracts of literature in the field of psychology. It is produced by the American Psychological Association. The database, which is updated weekly, contained over 3.5 million records as of October 2013. Approximately 175,000 records were added to the database in 2012 (APA, 2000).

A search in the data bases PsycINFO and PubMed of research studies was conducted. The key words used were *sports IQ*, *hockey sense*, *game sense*, *reading the play*, *understanding the play*, and *game intelligence*.

2) American Development Model Coaching Education Program Manual by USA Hockey for their Coaching Program.

3) Presentations from USA Hockey's elite coaching programs

Four presentations regarding Game Sense were selected from USA Hockey. The selection was mediated by contacts at USA Hockey who were kind enough to provide material relevant to this thesis, as well as material from USA Hockey's Level 4 and Level 5 elite coaching education presented to the author.

- a) "Teaching Hockey Sense" by Ken Martel from the National Team Development Program.
- b) "Teaching Concepts and Skills Through Small Area Games" by Roger Grillo, USA Hockey – American Development Model.
- c) "Training Ice-Sense – Without the Ice: The Brain Gym Era" by Ken Martel, Director, American Development Model, USA Hockey & Danny Dankner, CEO, Applied Cognitive Engineering, Inc.
- d) "The Hockey Coach's Guide to Small-Area Games - A Practical Guide to Implementing Small-Area Games in Practices" by Paul Willet, Hockey Skills Instructor & Consultant.

4) The Swedish Ice Hockey Association's coaching program "Spelförståelse i ishockey" by Christer Höglund, Vägen till Elit.

(5) and (6) Two documents, not hockey-specific, were included in this thesis due to recommendations by USA Hockey; "Reading the play in team sports: yes it's trainable" by Damian Farrow. This article was handed out to Level 5 elite coaches. The Swedish Olympic Committee's "Spelförståelse" by Per-Olof Ström & Magnus Frisk was recommended by personnel at the Swedish Ice Hockey Association.

4. RESULTS

The searches for the keywords sports IQ, hockey sense, Game Sense, reading the play, understanding the play, and game intelligence on PubMed and PsycINFO yielded no results. However, thousands of scientific papers exist on many of the components included in the definition of the presentations and documents utilised in this thesis, such as perception and cognition, and have been well-documented and established in peer-reviewed articles. This thesis will not delve into specific components, only the concepts of this thesis as a whole.

In all eight studies from USA Hockey, the Swedish Ice Hockey Association and the Swedish Olympic Committee, or recommended by those organisations, were assessed as relevant and included in the thesis. They are summarised in Table 1.

Table 1. Studies included in the thesis

<u>Study</u>	<u>Author & Affiliation at Time of Authorship</u>	<u>Publication/ Presentation & Year</u>	<u>Title</u>	<u>Concept</u>	<u>Definition of Concept</u>
1	USA Hockey	USA Hockey, American Development Model, 2012	USA Hockey Coaching Education Program	Hockey Sense	Hockey Concepts and Awareness Training
2	Ken Martel, USA Hockey – National Team Development Program	USA Hockey Coaches at Elite Level, 2012	Teaching Hockey Sense	Hockey Sense	Awareness, anticipation, creativity, vision, alertness, decision making, adaptability to change
3	Roger Grillo, USA Hockey – American Development Model	Women’s Worlds Championship, 2012	Teaching Concepts and Skills Through Small Area Games	Small-Area Games	Teaching concepts rather than systems.
4	Intelligym; Ken Martel, & Danny Dankner, CEO, Applied Cognitive Engineering, Inc.	2009	Training Ice-Sense – Without the Ice: The Brain Gym Era	Ice-Sense	Main Cognitive-Related Elements: Rapid and frequent changes on the rink. Dynamic planning, puck control, finding free ice, identifying and creating opportunities, getting into shift, team play, scanning the ice due to limited view, reading numbers - assessing offence and defense situations. Cognitive Skills: decision making, ice sense, peripheral vision, concentration, reading plays, anticipation
5	Paul Willet, Hockey Skills Instructor & Consultant	Publication, 2003	The Hockey Coach’s Guide to Small-Area Games	Hockey Sense	Hockey sense is a skill that a coach cannot teach. Players only gain hockey sense through experience and repetition. Over the course of a season, small-area games can give players hundreds of quality repetitions in various situations that are commonly seen in real games. Traditional drills are all too often scripted, eliminating the thought process and decision making skills. Outcomes of small-area games, while containing specific guidelines and rules, are never predetermined.
6	Damian Farrow	Skill Acquisition, Australian Institute of Sport, Vol 27:3, 2004	Reading the play in team sports: yes it’s trainable!	Reading the Play	Definition of Reading the Play: Pattern recall or recognition
7	Christer Höglund	Vägen till Elit, The Swedish Ice Hockey Association, 2009	Spel-förståelse i ishockey	Spel-förståelse	A collection of concepts including: speluppfattning, spelintelligens, kognitiv förmåga, mönsterigenkänning, splitvision, problemlösning, automatisering, social spelförståelse, spelfilosofi, styrt och fritt spel och spelets olika roller.
8	Per-Olof Ström & Magnus Frisk, Sveriges Olympiska Kommitte	Report for The Swedish Olympic Committee, 1997	Spel-förståelse	Spel-förståelse	Arv, Träning/retning Spelintelligens Speluppfattning Social spelförståelse Intellektuell förmåga Perceptuell förmåga Fysiska kvaliteter

4.1 Designations and definitions

Hockey sense was used as the main concept in **study 1,2** and **5**. In study 2 it was defined as “awareness, anticipation, creativity, vision, alertness, decision making, adaptability to change”. Study 5 explained that “Players only gain hockey sense through experience and repetition. Over the course of a season, small-area games can give players hundreds of quality repetitions in various situations that are commonly seen in real games.”

Study 3 did not define a specific concept. Instead, the study stressed teaching concepts rather than hockey-specific systems.

Study 4 used the word *ice sense* and presented it as part of “Cognitive Skills: Decision making, ice sense, peripheral vision, concentration, reading plays, anticipation”.

Study 6 explained *reading the play* as “pattern recall or recognition”, and aims to create time and space.

Study 7 and **study 8** used the Swedish word *spelförståelse*. Study 7 described a collection of concepts including “speluppfattning, spelintelligens, kognitiv förmåga, mönsterigenkänning, split-vision, problemlösning, automatisering, social spelförståelse, spelfilosofi, styrt och fritt spel och spelets olika roller” (translation by the author of this thesis: game perception, game intelligence, cognitive ability, pattern recognition, split-vision, problem solving, automation, social understanding of the game, game philosophy, playing hockey controlled or freely, and different roles in hockey).

Study 8 had the most holistic approach with a definition that seems to combine the previous studies’ concepts and definitions, and is explained in Figure 1.

Förklaringsmodell

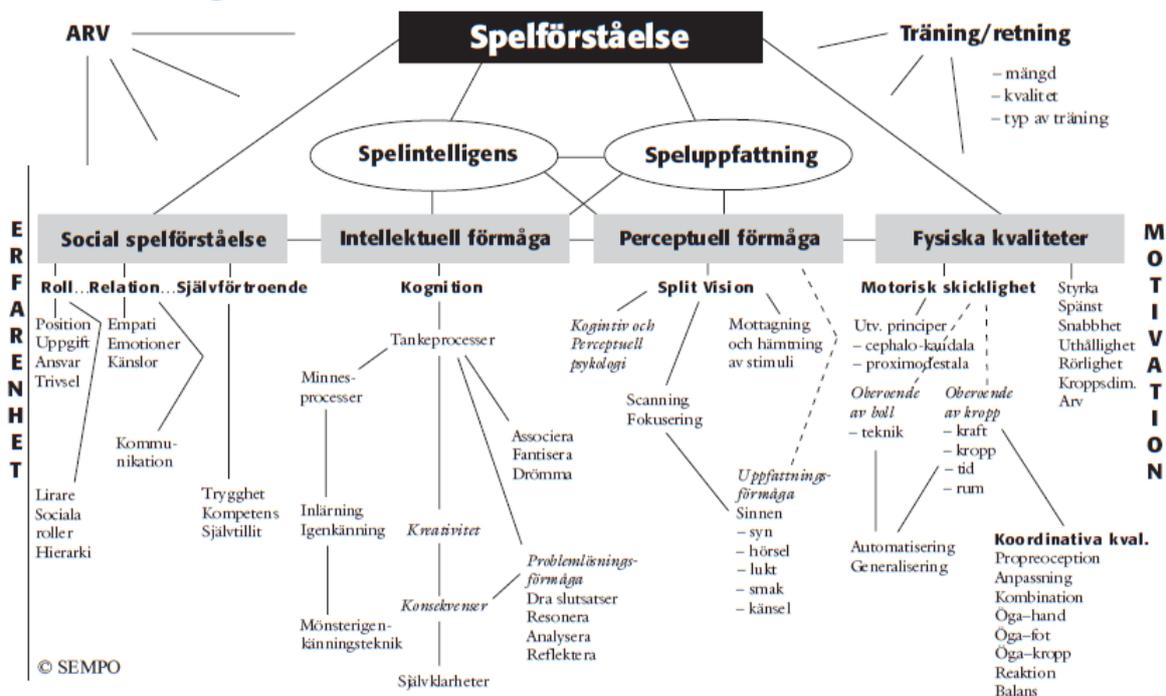


Figure 1. Model of Spelförståelse (Frisk & Ström, 1997)

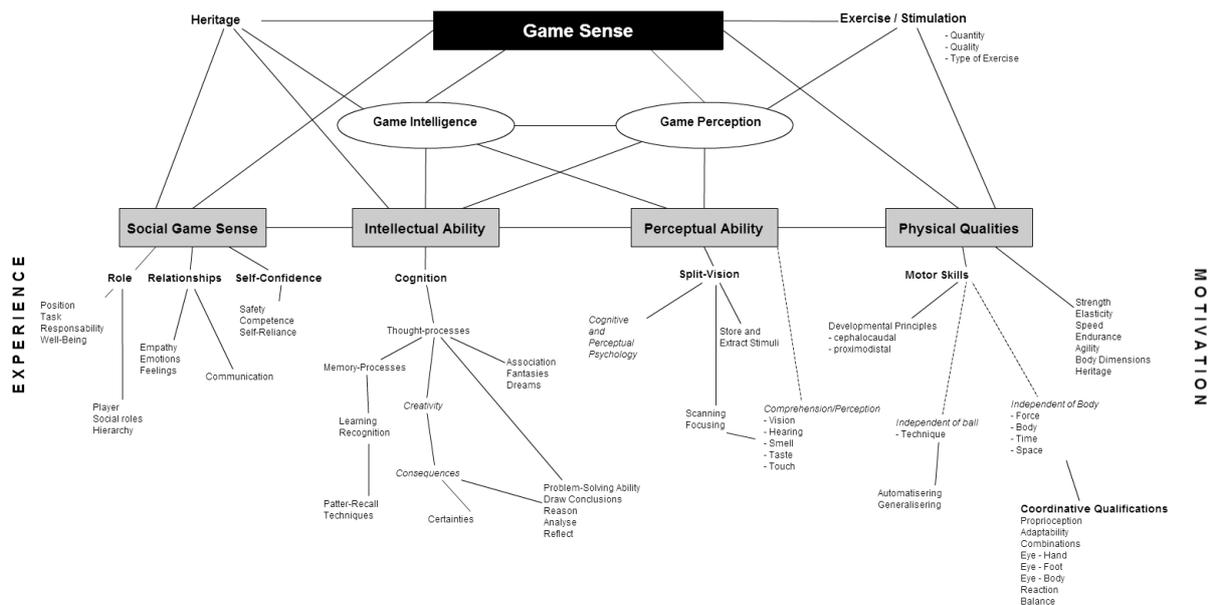


Figure 1. Model of Spelförståelse in English (translated by the author of this thesis) (Frisk & Ström, 1997)

The model (Figure 1) is explained in English. Game Sense is explained as an overall concept interacting with many factors. Heritage and exercise/stimulation including quantity, quality, and type of exercise influence Game Sense, as well as experience and motivation (Frisk & Ström, 1997). Game Sense is in turn dependent on game intelligence and game perception. Four factors affect game intelligence and game perception; social Game Sense, intellectual ability, perceptual ability and physical qualities (Frisk & Ström, 1997) and are described below in more detail.

Social Game Sense

This factor includes role, relationships and self-confidence, and stresses the importance of understanding other players and their actions in order to understand the game. Communication is dependent on open relationships where players can communicate their thoughts and intentions. Getting to know other players areas of competence increases respect and acceptance of one another, whether or not the players like each other outside of their sport. There should be transparency and clarity concerning every player's role on the team, and every player is in turn expected to perform within that role (Frisk & Ström, 1997).

Intellectual Ability

Cognition is the central concept of intellectual ability. Cognitive psychology explores how a person gets to know, understand and perceive the surroundings and ones self. Focus is on how the person processes information. The information can reach the senses in the present, or be accessed from the person's memory, or from future possible events (Granhag & Cristianson, 2008). Cognitive psychology concentrates on information-processing (Hassmén, Hassmén & Plate, 2003). Memory, learning, recall and problem-solving ability makes cognition a central feature of Game Sense (Frisk & Ström, 1997). The increasing speed on the ice over the past few decades means less time to think about what choices to make. Even though our intellectual abilities differ from one person to the next, it is possible to influence a player's way of thinking in a game situation (Frisk & Ström, 1997).

Perceptual Ability

Once information reaches our senses, a person can sense, perceive and interpret the information. Our sensory registry can hold information from 1/3 second to a about 2 seconds before it either disappears or by selective perception ends up in our work memory where it is processed for about 20 seconds. Information stored more than 20 seconds usually ends up in our long-term memory. The importance of perception has to do with our work memory, which can hold between 5-9 units, an important fact which is relevant for pattern recognition (Granhag & Cristiansson, 2008). The reception and retrieval of stimuli is what the brain processes, and is needed in order to quickly perceive details and structures and patterns from our senses (Frisk & Ström, 1997).

Physical Qualities

Motor skills in Game Sense are dependent on the proficiency to perform the movement we intend to execute. Collaboration between nerves and muscles is needed to program the body to send the right nerve signals to the right muscle groups. Good coordinative qualities and body control, together with motor skills, ensure that focus can be more on the game instead of thinking about what the body has to do (Frisk & Ström, 1997).

4.2 Summary of concepts included in studies

Table 2 shows that the number of concepts used in the various definitions were more than 51, as only the concepts with their own headings were included in the count.

Table 2. Summary of Concepts included in the definitions

Study	Concepts Included in Definition	Number of Concepts
1	Hockey concepts, awareness training	2
2	Awareness, anticipation, creativity, vision, alertness, decision making, adaptability to change	7
3	Small-area games	1
4	Cognitive Skills: decision making, ice sense, peripheral vision, concentration, reading plays, anticipation	7
5	Experience, competition, thought process, decision-making skills	4
6	Pattern recall, recognition	2
7	Game perception, game intelligence, cognitive ability, pattern recognition, split-vision, problem solving, automation, social understanding of the game, game philosophy, playing hockey controlled or freely, and different roles in hockey	11
8	Heritage, exercise/stimulation, experience, motivation, game intelligence, game perception, social game sense, intellectual ability, perceptual ability, physical qualities, role, relationship, self-confidence, cognition, split-vision, motor skills, coordinative qualities	17
	TOTAL	=51

Many of the studies have a number of sub-headings that are not represented in Table 2.

4.3 Training and developing the concepts

All studies offered solutions and tips to improve the concepts.

Table 3. How to develop concepts

Study	Concept	How to Develop Concept
1	Hockey Sense	Offensive and defensive awareness with and without the puck is key. This includes the ability to read the level of pressure by an opponent and make correct decisions according to the play (read and react). Concepts involve development of all of the key hockey concepts that are used by all players. This would include but is not limited to:

		<ul style="list-style-type: none"> • moving to open space • offensive- and defensive-side body position • offensive support and defensive support • puck pressure and containment <p>Small area games with a distinct purpose are the best way to develop these mental skills in our game.</p>
2	Hockey Sense	Timing drills to eliminate whistles to start drills. Add extra passes to players in line and use drills that change puck focus. Adding or subtracting players to change the playing situation, and disorientating players to change responsibilities. Game situation drills with one puck and/or small-area games, with concept development in order to see the big picture elements. Decision-making is stressed together with dynamic repetition which creates growth in the player. Skill experimentation and competitiveness.
3		Aim: To find the balance between teaching skills/ hockey sense and systems play while keeping your players focused, entertained and passionate about what they are learning
4	Ice-Sense	Conceptualizing a Game-Like Training Environment through Cognitive elements in video-game settings
5		<p>Players learn to excel in tight situations.</p> <p>Your players will develop game strategies, make better decisions and have greater enthusiasm for practice.</p> <p>Players of all ability levels improve.</p> <p>Small-area games foster a love and enjoyment of the game because players and coaches have fun!</p>
6	Reading the Play	<p>Chess – pattern recall or recognition</p> <p>Extensive team-based game-play as children (backyards, local parks, ex 2-on-2 street basketball)</p> <p>Variety of team sports before specializing into a profession</p> <ol style="list-style-type: none"> 1. Videotape a selection of elite-level games of your sport from television. 2. Draw to scale a blank version of your playing field or court. 3. Select passages of play that contain structure and then show approximately ten seconds of the play to allow the players to get a feel for the scenario before quickly stopping the tape. 4. Test the players in a variety of situations that occur in a match. For example, stop a tape of Australian football just as the fullback prepares to kick the ball into play. The footage shown from behind the goal often provides an excellent perspective of the patterns that a fullback is attempting to read. <p>Creates time and space</p>
7	Spelförståelse	Each concept is trainable.
8	Spelförståelse	The potential for understanding the game and that many of the elements a player is able to influence and improve

Study 1 recommends offensive and defensive awareness, reading and reacting. Small-area games is the best way of teaching mental skills.

Study 2 focuses on drills with many timing drills to eliminate whistles to start drills. Add extra passes to players in line and use drills that change puck focus. Study 2 also recommends adding or subtracting players to change the playing situation, and disorientating players to change responsibilities. Game situation drills with one puck and/or small-area games should be practiced with concept development in order to see the big picture elements. Decision-making is stressed together with dynamic repetition which creates growth in the player. Skill experimentation and competitiveness are also recommended.

Study 3 recommends using practice time efficiently and getting as much activity as possible in the allotted time. All practices should be skill sessions, competitive or fun drills in station work are critical. Drills or games should be 10 minutes maximum in order to keep the players moving and guessing what is next. The same stations can be run a few practices in a row before moving on to the next station. A coach should teach through small games, having a concept or a goal in mind, as well as teaching in a progression based on the players' skill level. Take extra time off the ice in order to make sure that the ice portion runs smoothly, and bring passion and excitement to the rink. If the coach has fun then the kids will have fun (Grillo, 2012).

Study 4 suggests drills and practicing concepts through game-like training environment in video-game settings. With a personalized training program, computer game environment, progress reports, basic training and ongoing maintenance training, the player will improve skills such as decision making, team work, execution, recognizing opponent's moves and eliminating bad tendencies. Intelligym believes that the brain functions like a muscle, it can dramatically enhance its performance if properly trained (Martel & Dankner, 2009).

Study 5 discusses small-area games and suggests that they are game-like competitive drills that utilize a playing surface that has been reduced in size. The number of participants is lowered in small-area games and special rules and conditions are applied. They are designed to focus on multiple skills and situations, increasing puck touches and situational repetition. Small-area games promote creativity and experimentation, and create a more competitive practice environment. Small-area games eliminate the need for traditional conditioning drills, keep more players moving, and develop and improve individual and team skills (Willet, 2003).

Study 6 suggests the following to enhance the ability to read the game; extensive team-based game-play as children (backyards, local parks, ex 2-on-2 street basketball), and a variety of team sports before specializing into a profession. A specific approach is presented; videotape a selection of elite-level games of your sport from television, draw to scale a blank version of your playing field or court, select passages of play that contain structure and then show approximately ten seconds of the play to allow the players to get a feel for the scenario before quickly stopping the tape. Test the players in a variety of situations that occur in a match (Farrow, 2004).

Study 7 focuses some of its drills on four *situationsrelaterade roller* (situational-related roles), where the player automatically does a rehearsed play in order to accommodate the need for quick decisions in hockey. The four roles are puck-carrier, offensive player without the

puck, defensive player against puck-carrier, and defensive player against non-puck-carrier. Every time the puck turns over, the players are forced into a new role (Höglund, 2009).

The puck-carrier is often the player steering the game (play-making) and gives consideration as to whether or not to take the offensive risk or the defensive security. Offensive player without the puck helps the team secure offensive pressure as well as quickly being able to play defensive if needed. Defensive player against puck-carrier tries to prevent the opposition to make a play and score. Defensive player against non-puck-carrier; the players need to participate in the defensive pressure where the aim is to reclaim the puck. Practising each part enhances Game Sense (Höglund, 2009).

Höglund (2009) also suggests working on Game Sense through small-area games with interruption for explanation, controlled small-area games with positive feedback, and play-back of the practice so that the player can view the person's own actions. Methodological learning starts at the basics with technical skills (offensive/defensive skills, speed and precision), moves on to split-vision (looking up from the ice, understanding game-situations and teammates and opponents). Creative thinking follows (the player gets different choices), and reaches the hardest stage with stress-management (time and space shrinks and the player is forced to make quick decisions offensively and defensively).

Study 8 does not suggest specific drills, however, Game Sense can be acquired through playing a variety of games. Game Sense is a cognitive process, which means that the player needs to have own thoughts about the game, make mental preparations, and understand what to look for and not just see details in the game. It is important to draw conclusions of the player experiences, as well as to see the consequences of one's own actions (Frisk & Ström, 1997).

Game Sense is capable of development; the players need to find ways to solve their own problems as they arise. The importance of spontaneous sports on the players' own terms and conditions, through the joy of playing, often results in game-situations that promote Game Sense. The players learn through repetition and creatively come up with their own solutions (Frisk & Ström, 1997).

4.4 When to start practicing Game Sense

Study 7 suggests to start practicing Game Sense in children as early as possible. Basic skills for Game Sense requires motor skills that have a strong learning curve between the ages of 7 to 13 years old. Good motor skills create potential for Game Sense and the ability to concentrate on multiple tasks. Automated technique means that the player can look up from the ice and recall patterns, in order to read and react within the game (Höglund, 2009).

The cognitive training should mostly be conducted between the ages of 12 to 15 years old, depending on maturity. Myelination, which is essential for the proper functioning of the nervous system, has developed enough that the player is able to do several tasks at the same time; for instance puck control and pattern recognition (Höglund, 2009).

Ice hockey is one of the hardest games to execute due to the speed, increasing force, complicated regulations and the thin skate, which implies that the player's technical skills are very important. The technique should be so developed that the player does not need to think

about how to execute the various elements on the ice. The optimal learning period for technical abilities is between the ages of 7 to 13 (Höglund, 2009).

Situational-related training, which deals with the game's (the player's) different roles relates to various kinds of small-area games, from 1 on 1, to 5 on 5. Players between the ages of 14 to 16 years old should be well-versed and in full development (Höglund, 2009).

Study 1 discusses the three S's; skills, sense and systems. The skills should be practiced in different amounts depending on the age group. USA Hockey's American Development Model defines skills as hockey skills and habits training, and systems is defined as team play training (ADM, 2012).

Table 4. USA Hockey's American Development Model's guidelines on practicing hockey sense depending on age

	Skills	Sense	Systems
8 and Under	85%	15%	0%
10 and Under	75 %	15%	10%
12 and Under	65%	25%	10%
14 and Under	50%	35%	15%
16 and Under	50%	30%	20%
18 and Under	50%	25%	25%

5. DISCUSSION

5.1 Why did the searches in scientific databases yield no results?

The searches for the keywords sports IQ, hockey sense, game sense, reading the play, understanding the play, and game intelligence on PubMed and PsycINFO yielded no results. However, thousands of scientific papers exist on many of the components included in the definition of the presentations and documents utilised in this thesis, such as perception and cognition, and have been well-documented and established in peer-reviewed research. This thesis chose not to delve into specific components, only the concepts of this thesis as a whole. What started like a simple research question on Game Sense, could potentially develop into enormous volumes of written work due to the many concepts involved. The concept of perception, by itself, generated over 380 000 results in the medical database PubMed. Cognition generated 175 000 results. In this thesis alone, more than 50 such concepts have been identified!

5.2 What can be gained from using the same vocabulary?

Table 1 elucidates several complexities of vocabulary. The first complexity arises in choosing concepts to define; three studies described *hockey sense*, one study *ice-sense*, one study described *small-area games* and one study outlined *reading the play*. The two Swedish studies depicted *spelförståelse* (Game Sense). The author of this thesis assumes that all studies are working towards the same goal, and thus the vocabulary used means more or less the same; to make the player think ahead of the game. However, this is just an interpretation. Reaching a consensually world-wide standardized agreed-upon vocabulary across all sports,

would simplify teaching players to associate common-word concepts to a certain mind-frame, as well as mediate research into the area.

5.3 Why is it important to define Game Sense?

It is important to note that the studies included in this thesis do not really contradict one another on the major points. It seems, however, that the focus of the studies has been more or less specific and chosen various concepts to include in the definition. Are the definitions all just synonyms? Perhaps they are different approaches and angles of the same goal? The author of this thesis believes that reaching a universally agreed-upon definition would make it easier to teach specific concepts of Game Sense.

The Swedish Olympic Committee's study, in contrast, is holistic, including variables that are both teachable and trainable, as well as variables that are outside the player's control, such as heritage. The model shows that the factors interact with each other. However, scientific research is still unable to say in many instances in what ways and how much the factors interact with each other. Does this make it more or less relevant to have a holistic approach?

5.4 How should we train and develop Game Sense?

As with the above definitions, training and developing Game Sense show no real contradictions between the studies, but chose to focus on either a more specific or a more holistic approach.

Many studies stress the importance of enhancing a player's perceptual ability, which can be done in a variety of ways; from small-area games, to drawing unfinished drills on the board in the ice rink, to Intelligym's computer-program. This is important for pattern recognition. The essentials of perception has to do with our work memory, which can hold between 5-9 units (Granhag & Cristianson, 2008). For instance, if a person has no knowledge of what an ice hockey game is, the person may walk into the arena and perceive 5-9 units; walls, seats, people, ice, persons moving on the ice, sporadic loud music. Then the "memory is full". However, if a person has prior knowledge of hockey games, that person will group all the information together into one unit; a hockey game. That leaves 4-8 units left to fill with additional information, such as distinguishing the teams on the ice from each other and the referees, what the score is, and most importantly; recognising the patterns on the ice and being able to understand the systems being played and trying to foresee what will happen.

The quicker a person can perceive and process information, the better it is for the game (Frisk & Ström, 1997). *Don't go to where the puck is, go to where the puck is going to be.*

Although many of the studies have more or less specific tips and guidelines, small-area games are stressed in five of the eight studies for developing such strengths as competitiveness, skills, offensive and defensive concepts and joy of the game. Playing a variety of team sports in mentioned as important for Game Sense in two of the studies in order to enhance such areas as gaining different perspectives and developing problem-solving mechanisms. Analysing video is described in two studies for different reasons, one is to promote cognitive skills. However, the author of this thesis believes that no study would negate the next, and acceptance of creative ways of teaching Game Sense would surely be encouraged by all.

5.5 At what age should we teach Game Sense?

USA Hockey's American Development Model and the Swedish Ice Hockey Association complement each other's findings. It is important to remember that both organisations believe in individual development and maturity, and that the age recommendations and percentage guidelines are just that; guidelines and should not be seen as accurate for every individual, or even every team of a specific age group. The important aspect is that Game Sense should be taught parallel to all other elements of the game from the very beginning.

Game Sense should be taught at all ages, just differently and depending on skills and maturity level. The importance seems to be on the coach's creativity. Whether it be Walter Gretzky's salt and pepper shakers moving around the dinner table, or an iPad replaying the player's defensive mistake to be analysed, reaching the players through imagination, enthusiasm and joy seem to be the keys to Game Sense.

In a purely physical sense, Wayne Gretzky could not be said to be, compared to many other NHL players, a particularly great athlete. Team doctors tested Gretzky in endurance, strength, reflexes and flexibility with machines, bicycles and drills. Gretzky told an interviewer. "They tested every guy on the team and I did *bad* in all the tests." Yet Gretzky holds just about every hockey scoring record there is, and is the best player in the sport's history. The *Two-Second Advantage* by Ranadivé & Maney (2011) argues that "Gretzky did not get so good in spite of his unimpressive physical attributes – he became so good *because* of them." The book goes on to explain that "Since Gretzky couldn't out-physical his opponents, he developed a different kind of weapon: his brain. "When I was five and playing against 11-year-olds, who were bigger, stronger, faster, I just had to figure out a way to play with them," Gretzky explained. "When I was 14, I played against 20-year-olds, and when I was 17, I played with men. Basically, I had to play the same style all the way through. I couldn't beat people with my strength; I don't have a hard shot; I'm not the quickest skater in the league. My eyes and my mind have to do most of the work." He added: "I had to be ahead of everybody else or I wouldn't have survived." Gretzky's father taught him anticipation, and Gretzky memorized hundreds of tricks and shortcuts – and then perfected them, because he had no other way of succeeding on the ice. The more he played, the more that sense of anticipation became instinct. Before long, he could see the whole evolving situation – everything that was happening on the ice and the movement of every player – in his mind. "When you're 170 pounds playing with 210-pound guys, you learn to find out where everybody is on the ice at all times," Gretzky noted. Being small forced Gretzky to develop an exquisite hockey brain. He built a predictive model of hockey in his head, so that as a game unfolded he could use memories of past games and tactics, and a reading of the immediate situation, to predict what would happen next. Every other good player does this to some extent. But Gretzky could do it just a little bit faster and a little more accurately than everyone else."

5.6 Suggestions for future research

The author of this thesis would like to see the ongoing discussion establishing a consensually agreed-upon definition of Game Sense, with clear concepts included in order to develop standardized references of teaching Game Sense. This would make it easier to teach Game Sense to players, as well as conduct scientific research. Semi-structured interviews would be a good way to start, so that people with great knowledge in hockey can give their point of view on Game Sense based on their own experiences. Furthermore, longitudinal studies are warranted to see the effect of implementations over time.

5.7 Methodological considerations

One of the weaknesses of this review is that it is not systematic regarding identification of studies, regarding assessment of relevance of studies and regarding data extraction. There is an interdisciplinary approach to this thesis, searching studies from different scientific disciplines using various search strategies, but the conclusion is that not very much has been done in the field of sports.

5.8 Conclusion

A lot can be gained from reaching a consensus regarding the definition of Game Sense; namely, once the various parts have been identified, measures to enhance and strengthen these areas can be implemented. How do we know if we have done enough to develop our players' Game Sense, if we have not agreed on what Game Sense is? As coaches, we want to improve our players and teams, and being able to do that systematically on evidence-based science, would be a big step forward. In medicine, it was not until an agreed-upon definition of a concept such as insomnia was established, that measures to cure and alleviate the problem could be implemented, and scientific research develop into the knowledge we have today.

Furthermore, the author believes that well-developed Game Sense might be the defining factor if the player is to become a pro-athlete or playing for fun, or hopefully both. To add the dimension of Game Sense to people with influence over players is important in this area of research, as it, if occurring together with good technique and the well-being of the team might have not only an additive but even a multiplicative effect.

The author suggests the word Game Sense, but any vocabulary will do that is agreed-upon. As hockey becomes more and more international, and collaborations between countries among players and coaches is becoming more and more the reality, would it not further the development of hockey if Game Sense would mean the same to a little girl in Skellefteå AIK's U12 team in Northern Sweden, as a pro-hockey NHL player? The author suggests that this could be a discussion perhaps not only for USA Hockey and the Swedish Hockey Association, but also for the International Ice Hockey Federation. Reaching a common consensus may have a bearing not only on the quality of our hockey players, but an overall perspective of the hockey player where cognition, skills and well-being of the hockey players in question, but also on the prospect of recruiting and retaining more girls and boys into the joyous sport.

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