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Game sense and at what age to start developing it.

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Abstract

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This thesis is a literary review of game senses.
Game senses is the ability to make the best decision available, it's to read and react to patterns (offence and defensive), to anticipate the movement of the opponent, team-mates or the puck. All of this is done during a competition or training session.

The main result was that children can develop at different rate but coaches should start training game senses at the age of 10-12 year old. Children under seven years old are not developed enough (logical thinking still in its infancy) to understand tactics. Even children under the age of 12 years would have a hard time taking in all the information that a player needs to develop game sense. Ideal age would be to start from the age of 12 years and up to late teens.

Better skilled players are better at understanding the game. The better core skills (shooting, skating and stickhandling etc.) the easier it is for players to develop game senses. Better skilled player spend their time on developing game senses and maintaining their skills, while other players that are lacking skills will have to work harder to develop both skill and game sense.

Developing game sense is all about high quality training that puts the player into a situation that will challenge him physically and mentally. The player needs to be put into a game like situation over and over again. That will help him feel at ease with game scenarios that are similar to his training. Coaches need to guide the player to the right direction and not tell the player directly what to do but allow to think and solve problems for themselves. Good decision making players, see patterns and their outcome before they touch or get the puck. Making decision with or without the puck in the right time and executing it, is what coaches desire to teach.

The aim of this thesis is to help coaches to gain knowledge about game sense and how to develop it and at what age we should start training it with children. Flyer was made to use as a teaching tool for coaches.

Keywords
Game sense, Early specializaton, multiple sport particepant, Ice Hockey, IntelliGym.

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1. Introduction

Ice hockey is one of the fastest team sports in the world. To be able to play ice hockey players need a good core skills (e.g. stickhandling, skating and shooting…), motor skills (movements) and cognitive skills (reading and understanding movements of opponents and teammates…). A well rounded player has good qualities in all of the skills mentioned, but what makes the best players stick out from the rest? Is it motor skills where he is faster and stronger than others, is it core skills with his stickhandling and shooting or is it cognitive skills where he can read and understand the plays around him better than anyone else.

Wayne Gretzky or "The Great One" is considered to be the best Ice hockey player to have played the game. Gretzky at his best was not the biggest or the strongest (183 cm/84 kg) so what made him so special, why is he considered to be the greatest mind in history of ice hockey?

What made Gretzky special was his anticipation, he would visualize what would happen and predict where his teammates would be and give a no look pass without a doubt. Schwartz quotes Gretzky saying that "My eyes and my mind have to do most of the work." (Schwartz.)

From an early age Gretzky's father made a small ice rink in their backyard during winter. It's on that home ice rink where Gretzky got hours on hour to train skating, shooting and stickhandling at an early age. These repetitions would help him to become the Great One but it was not only skating on his home ice that made him great but playing above his age with more skilled players that challenge him. (Gretzky 2015.)

At the age of five he was playing against 11 years old, at the age of 14 he was playing against 20 years old players. Gretzky's father had an advice for him: skate to where the puck will be not to where it has been. For most of his youth carrier he was smaller, slower and physically weaker, therefore Gretzky had to do what he could with his abilities to survive against older and bigger players. (Schwartz.)

Responsibilities of a coach to an athlete are great and one of those responsibilities is to develop game sense or decision making. Essence of game sense is to understand a game and make the right decision without a thought or doubt, e.g. where to pass or when to shoot, in the least amount of time. Players that have good game sense get out of tackles, sticky situation with the puck and without being aware of it.

”the athlete performs the skill automatically in a more dynamic environment without having to focus on execution because mixed skills is practiced in game play” (Kaya, A. 2014, pp. 335.)

Developing game sense is all about high quality training that puts the player into a situation that will challenge him physically and mentally. The player needs to be put into a game like situation over and over again, that helps him feel at ease with game scenarios that are similar to his training. Coaches need to guide the player to the right direction and not tell him what to do.

> According to the theory of deliberate practice (Ericsson, Krampe, & Tesch-Romer, 1993), expertise in a given domain is the end result of extended engagement in high-quality training (i.e. deliberate practice). The theory of Ericsson et al. (1993) is based on the assumption that the most beneficial form of training for acquiring sport skills involves activities that are highly relevant to performance improvement, which require much effort (either cognitive or physical) and which are performed for the purpose of improving current performance rather than inherent enjoyment. . Indeed, related research demonstrates that perceptual, attentional, and cognitive skills play an important role in expert sport performance (e.g. Abernethy & Russell, 1987). (Memmert 2010. pp 94).

Coaches that guide there player rather than telling them what to do, take on the responsibility to help the player to think and solve problems for themselves. The player takes also a lot of responsibilities for himself to keep on developing flexible skills with his coach that he can use on the field.

According to Damian Farrow better game sense player have superior core skills in a video lecture on IIHF hockey center. We can see a correlation with Gretzky, who de-

veloped his core skills in his own backyard and harnessed them playing and training against older players, to what Farrow says in his lecture. Gretzky's game sense was and probably still is the greatest that hockey has seen (Farrow 2012.).

Neuroscience research has shown that biggest development in creativity is reached during childhood and that numbers of synapses get weaker with age, making creativity difficult to develop later on (Memmert 2010, pp 93.). To develop games sense, we need to do it in the earlier stages of training but how early?

The following piece will familiarize itself how to develop game sense and at what age we should start to focus on game sense with children. A flyer to help coaches get a fast over views how to teach game sense and what to do with children at different ages.

2. Game sense

Game senses is the ability to make the best decision available, it's to read and react to patterns (offence and defensive), to anticipate the movement of the opponent, team-mates or the puck. All of this is done during a competition or training session. What differentiate the best from the rest is a set of core skills (shooting, skating, stickhan-dling etc.) and making more accurate decisions faster than the rest (Holden 2012.).

2.1 Developing game sense

A beginner steps up to the free throw line and takes a shoot. Right before he takes the shoot he was thinking to bend his knees, having a right hand placement, etc. For the beginner it's hard to perform consistently and execute the skill perfectly. After some training the beginner is capable to start to perform more consistent and execute his skills better but it's still not instinctive to throw the ball to the basket in a game, he has to think to shoot and how to use his skill. It takes years of training to know the right pass, to know the right timing, the right player to take one on one. So to learn how to act unconsciously/instinctively takes time and has to be mentally and physically devel-oped. When the player is mature enough he has a better understanding of the game

and skills, so he can use all his skills without a thought and his actions become smooth. Thinking can actually interfere with his skill execution (McCormick 2010.).

Good decision making players, see patterns and their outcome before they touch or get the puck. Making decision with or without the puck in the right time and executing it, is what coaches desire to teach (Farrow 2012, min: 25:00). By over loading the players, putting pressure on them, coaches can force decision making. Different places on the ice surface challenge the player to work his way out of a situation. Game pressure has an effect on handling of skills, no matter how skilled the player is. Training game sense has an effect on skills, the more game sense trained, the less core skills the player will develop so there is a need for a balance between training skills and game sense. (Farrow 2012, min: 35:00 & min: 36:00).

The golden rule in music is 10 years and over 10.000 hours of training to become successful. Research with musicians indicated that the difference between expert and non-expert pianists and violinists maybe due to the amount of time spent training alone (in deliberate practice). The best musicians had spent over 10,000 hours training alone while their less successful counterparts had no more than 7,000 hours (Baker.2003. pp 87).

Deliberate practice is an informal training at a relevant setting at home, open field or school yard that is available to play on like what Gretzky had in his backyard. This training isn't done under the eye of a coach but with friends and other children that want to join. This training will involve experimentation, repetitions, trial, errors and contact to different weather conditions, rules, terrain and amount of players that will play at any given time. It is theorized that skills learned in informal settings are influenced less by fatigue and stress and that the skill itself is learned without knowledge of it through informal training (Malina 2010. pp 366).

2.2 Technical vs. tactical

Some coaches believe that the player needs a basic platform off technique (skills) to be able to play the game and use tactics (decision making/games sense), while other coaches believe that you can teach skills in tactics during training.

Better skilled players are better at understanding the game. Having better core skills earlier on will help you have more time to develop you game sense while other players that are lacking skills will have to work harder to develop both skill and game sense. Training game sense has an effect on skills, more game sense less skill the player will develop so there needs to be a balance between training skills and game sense. Coaches will need to do both

Farrow talks about skill execution/action (technical) cannot be without decision making/perception (tactical), those two are integrated. You need skill to be able to perform decision making and vice versa (Farrow 2012, min: 36:00).

2.3 Novice against an expert in sports.

There is no significant difference found between amounts of hours spent training, that an expert trains or a non-expert until after 18 years of age. After reaching 18 years old player increase their commitment to their sport drastically. It takes minimum of 10 years of experience and 10.000 hours of training to become successful international athlete. The little bit extra is what differentiate players from being expert or a non-expert. (Baker 2003, pp 90)

The 10 year rule can be explained by quality and quantity of training. This rule was based on finding that indicated the differences between experts and non experts/novice is the ability to organize information into more significant patterns (chunks). Since first researchers started to research the matter, no dependable differences on physical abilities (eyesight, reaction time or memory) have been found concerning experts and novices. The difference between an expert and novices is the ability to read and process information, structure and movements of opponent.

> (1) Experts have greater task-specific knowledge (McPherson, 1993; McPherson & French, 1991).
> (1) Experts interpret greater meaning from available information (Abernethy, 1987,1990, 1991).
> (2) Experts store and access information more effectively (McPherson, 1993). (3) Experts can better detect and recognize structured patterns of play (Allard & Starkes, 1980; Simon & Chase, 1973).
> (4) Experts use situational probability data better (Abernethy & Russell, 1984, 1987). (5) Experts make decisions that are more rapid and more appropriate (Williams, 2000). (Baker 2003. pp 86-87)

The ability to process information is the big difference between experts and non-experts, these differences are the result of years of training rather than innate early specialization in Sport. Genetics have some part in the development of experts like intellect but abilities like pattern recognition and strategic thinking is more likely to do with quality training, but not genes.

Baker states that training is not enough but it needs to be deliberate training or training that "develops required skills under continuously evolving conditions where training stress and recovery are optimally balanced so that maximal training adaptations occur and training plateaus are minimized." to accomplish becoming expert (Baker. 2003. pp 86-87).

When watching a tennis pro (expert) playing it can feel like they have all the time in the world to hit the ball. While you can put two novices on a tennis court and let them play, they will be running around trying to get to every single ball that is not hit directly to them with effort that isn't as smooth as from an expert in the sport. So why is it that expert have so much time to read and react to a ball coming towards them at over 200 km/h?
Studies have shown that expert read different body movements than the novice. One such study was done with players in wheelchairs and the main finding was that the experience player, trained wheelchair tennis for more than three years, started reading the free-arm (arm without a racket), head and shoulder area. While novices, that had not competed in wheelchair tennis and trained less than 30 months, put their focus on the

ball's path and spend less time fixating on upper body movement. Their findings correlate with similar study where more experienced ambulatory tennis players focused more on arm-racket shoulder and tracked the ball as it was tossed in the air. Novice player's followed the ball from toss to the end or focused on the head as most important area of information (Reina, Moreno and Sanz. 2007, 257&264-266).

Results in both studies showed that expert or more experience player had more time to react or "extra time" because of cues that they gather with experience. Cues or key information that the expert gathers from the opponent (e.g. racket-arm movement) helps them to act on the information with faster motor responses. Novices spend more time on visual cues that are not useful and have shorter time to react to the stroke (Reina, Moreno and Sanz. 2007, 266). Expert can predict earlier on where the ball will land and how fast it comes, with this information they make "extra time" to react and have a bigger advantage on the less skilled player. That is why we see a big difference when players like Roger Federer (world ranking nr. 2) plays against player like Peter Polansky (world ranking nr. 129 last time they played but currently 256) (RogerFederer.com 2014: ATP Tour, Inc 2015).

Good playmakers can make a no look passes with certain ease while other decent players seem to not see their teammates on the field, inattention blindness is it called. Scholars believe that conscious perception requires attention processes, so if the decent player isn't focused enough he can fail to notice a simple pass that is right in front of him. Players like Lionel Messi and Henrik Sedin most likely have better attentions to multiple elements in the sport they play, while players that are not professional (novice) will miss an obvious play to a player that is unmarked.

> Empirical evidence has revealed major differences between experts and novices in different perceptual skills such as visual anticipation, pattern recognition, and knowledge of situational probabilities (Memmert 2010, pp 94).

2.4 Early specialization or multiple sport participation

Not all experts agree on the risks or benefits of early specialization in sports. The main argument for the experts are, is it harmful to focus on one sport from a early age or is it beneficial to have only one sport to train and put full focus on.

2.4.1 Multiple sports participation

Most expert that are pro multiple sports participant believe that training one sport from an early age can limit free time, other interests and lead to burn outs, physically as much as emotionally (McCorkel & Bockersette 2005. pp 9).

By limiting children to one sport they will not know if there is a sport that they will enjoy more or if they are simply better at it, so as a player you are putting all your eggs in one basket and hoping that it will work out. Athletes that play one sport will not have motor skill as well rounded as a multiple sport athlete, muscles and variety of movements will be specialized to one particular sport and the risk of over training specific muscles group increases (McCorkel & Bockersette 2005. pp 5).

Some experts believe that children's development models in sports need to be diversified early on, with game like (play-like) training with low amount emphasis on skill development and competition. That comes from results that elite athletes have tried a wide range of different sports during childhood but decide to specialize in one sport in their adolescence. In a study by Baker about expert decision makers from team sports (basketball, netball and field hockey) indicated that participating in other sports or activities during childhood would transfer and help them in their main sport later on. Baker suggests that transferring of learning and the effects of crossover training in two sports has to have similar elements so the transformation of skill will flow fluently over to the main or secondary sport (Baker 2003, pp 89-90.). Transferable elements that can be shared are for e.g. throwing a handball and an overhand serve in tennis (movement). Ice hockey and floor ball share the need to read the actions of their opponents to be successful (Cognitive decision making). Basketball and netball share similar rules, that can be transferable (similarities between sports). Baker states that benefits from multiple sport participation (transferring of learning) is most effective during early

stages of participation. The better trained the athlete becomes, the smaller the improvements become from participating in multiple sports (Baker 2003, pp 89-90.).

Some sports are exempt from multiple participation like figure skating and gymnastics, which are early specialization sports where it is almost a requirement to specialize early to gain elite performance level. In these sports peak performance is during early or mid adolescence. While other sports like ice hockey and Olympic wrestling have peak performances during adulthood.

To utilize multiple sport participants two elements are crucial, first, sports need to have similarities in tactical-view and movements so it will be useful crossover. Second, it needs to be done in early childhood so skill transfer is possible. When the player reaches adolescence most training is elite level and transfer of skill decreases between sports at elite level. (Baker 2003. pp92)

2.4.2 Early specialization

An early specialization has it pros and cons. Training a single sport from an early age will help the child/player to focus only on it and create player like Wayne Gretzky, Tiger Woods and Lionel Messi. But focusing on one sport can also have its drawbacks like over training, limited skill sets and movement patterns for example.

Baker states that the sooner a player specializes the greater chances are for him/her to achieve elite status in their sport (Baker 2003, pp 87.). Early specialization has shown us great players like Tiger Woods, his story is well documented from youth to adulthood training for success with a driven father. Some early specializations are influenced by parent, where they see their dreams to become a professional been fulfilled by their offspring. Some cases you see organizations pushing for early specialization so they can gain from their investment.

> A talented 5-yr-old soccer prodigy in the Ajax system was described as "well worth this investment of time and attention, because one day he might be sold to Chelsea or Real Madrid or Juventus for millions" (54). (Malina 2010. pp 369)

Like mentioned before, in music, chess and other activities you need to train 10,000 hours and have 10 years of experience to become an international success. This view has been taken up by sports around the world as this is the golden ticket to success, by doing so it pushes parents and organizations to specialize early so their child/player can have a reasonable shoot at clocking in the hours needed (Malina 2010. pp 366.).

Specializing early, in sports can limit range of movements and skills that may affect participation in other physical activities. Limiting a child to one sport can also reduce the opportunities to socialize and develop psychologically. Sports are a great area to grow social skills but spending too much time training can lead to isolation. Burnouts and overuse injuries are known to develop with excessive training, common factor in early specialization. Baker states that dropout rate are higher for players that participate in early specialization and the main reason for high dropout rates is lack of enjoyment (Baker 2003, pp 88.).

All of the items mentioned above are on the road to dropout area from sports but "burnouts" are general given most credit for dropouts. It may be caused many things like if the coach is not supportive enough or he is too harsh, player is simply not coping with the physical strains that the program offers or not meeting expectations from family and coaches. Affects can be stress, sleep disturbances, loss of interest in sport, lack of energy and frequent illnesses etc (Malina 2010. pp 368.).

In tabel 1 you see movement of athletes from one educational step to another in the United States (US). There is a large difference going from senior in High school to being enrolled as a student athlete in a collage, even smaller percentages goes from senior in collage to professionalism. Dropout rate is high, because the standard only gets higher (elite).

Table 1. Malina (2010) Movement of athletes from High school to college and collage to professionalism in the USA.

TABLE 2. Estimated percentages of athletes moving from high school to college, high school to professional, and college to professional in several sports in the United States.[a]

	Men's Sports					
	Basketball	Football	Baseball	Ice Hockey	Soccer	Women's Basketball
High school athletes						
Total	549,500	983,600	455,300	29,900	321,400	456,900
Seniors	157,000	281,000	130,100	8500	91,800	130,500
College freshman athletes	4500	16,200	7300	1100	5200	4100
High school to college, %	**2.9**	**5.8**	**5.6**	**12.9**	**5.7**	**3.1**
College athletes						
Total	15,700	56,500	25,700	3700	18,200	14,400
Seniors	3500	12,600	5700	800	4100	3200
Athletes drafted	**44**	**250**	**600**	**33**	**76**	**32**
College to professional, %	**1.3**	**2.0**	**10.5**	**4.1**	**1.9**	**1.0**
High school to professional, %	**0.03**	**0.09**	**0.46**	**0.39**	**0.08**	**0.02**

[a]Adapted from the National Collegiate Athletic Association (47), percentages are based on estimated data and thus are approximations. Estimates for the professional level are based on athletes drafted; there is no guarantee that they qualified for the playing roster.

Tabel 2 shows the age of specialization and background for collage female athletes. Early specialization in swimming, diving and tennis begins at 10-11 year of age. Volley-ball and basketball are the only team sports (track & field can be a team sport but is mostly individual) on the list and they rates highest with participation in other sports over 95%. Players in team sports have later specialization rates than in individual sports.

Table 2. Malina (2010) Specialization and background for collage female athletes in USA.

		Age (yr)		Age (yr) at First Participation in Organized Sport		Same Sport (%)	Participants in Other Sports (%)	Total Number of Other Organized Sports		Age (yr) at Specialization in Current Sport	
	N	Mean	SD	Median	Range			Median	Range	Median	Range
Swimming	83	18.7	0.8	6	4–12	71	70	2	1–7	10	5–16
Diving	22	19.4	1.6	7	4–18	32	96	3	1–7	11	4–16
Tennis	29	18.9	1.1	8	5–13	45	86	3	1–6	11	8–15
Golf	35	19.1	1.1	9	6–16	34	89	3	1–5	13	10–18
Basketball	56	19.2	1.2	9	5–15	48	95	3	1–5	14	9–18
Volleyball	44	19.0	0.9	9	5–13	21	98	4	1–6	14	11–18
Track & field	107	19.4	1.4	10	4–16	46	77	3	1–10	14	7–19
Total sample	376	19.1	1.2	8	4–18	47	83	3	1–10	13	4–19

[a]Malina (unpublished data), female intercollegiate athletes in a Division I program. SD = standard deviation.

2.5 Background of a good decision maker

Farrow mentions in his lecture during IIHF Youth Symposium in Helsinki (IIHF YSH.) that him and his colleagues have done research on what background good deci-

sion maker from rugby have. Farrow's idea of a background of a good decision maker (game sense) consists of multiple components (Farrow 2012.).

Playing against higher skilled player during earlier age will help the player to develop into a good decision maker, if he has the core skills to play against older and faster players. Wayne Gretzky as mentions above played already at the age of 5 against players above his age 11, this is maybe an extreme example but it shows us that playing sports with older players is good if the player has good core skills and is mentally and physically developed for his age (Farrow 2012.).

Playing his/hers sport without structured training, sometimes structure will put restrains on a player's creativity. Coaches should want to limit their structure/restrains to allow fluency of a player but there is a fine line in having no or limited structure during training. Without structure players can feel lost during training sessions (Farrow 2012.).

Being active and participating in different sports can be beneficial to the player. Participating in different sport before the ages of 12-14 years old has shown to be a good step to develop game sense. Different sports will bring more creativity to a player and also help him to read different plays during games (Farrow 2012.).

Coming from a smaller community preferable from the country side or training a smaller sport with fewer participants. Players will have opportunities to train more frequent and be more evolved in the sport when there are fewer participants. Player's are likelier to play and train above their age and get a bigger challenge playing against physically stronger and faster players. More training will help you become a better player and players will have more time to train core skills at the same time tactic (game sense). Player evolvement can increase when it's in a small community or sport, players are likelier to stay in the sport longer and feel as they are part of family (club). Early specialization can hinder the creative thinking that a player could develop if he trains in different sports. They play different sport until older ages (Farrow 2012.).

3. At what age to start teaching game sense

Coaches will try to start teaching children game sense and tactics from ages below ten. But when are children develop enough to start teaching them to think, understand the situation, learn from their mistake and remember how to get out from a particular situation?

Merriam-Webster dictionary defines cognitive as relating to something or someone, conscious mental activities (thinking, understanding, learning and remembering). So what age do we start thinking cognitive (Merriam-Webster, Cognitive.)?

Leading scholar in this field was Jean Piaget, he was the first psychologist to systematically study cognitive development (McLeod, S. A. 2009.).
Piaget theory did not focus on learning or specific behavior like other psychologist had but on development of infants, children and teens. Piaget stages are a blueprint for normal intellectual development from infancy to adulthood. His theory splits into four stages:

- Sensory motor. In infancy (birth through ages 18-24 months) the child will be busy just learning how to control motion and sorting through sensory information, all of its thinking capacity will be focused on balance and touch. Babies have no concept of time or engage in rational though.
- Preoperational. Toddlers, 18-24 months through early childhood age 7, they are acquiring motor skills during this stage, and the ability to consider multiple aspects of a situation begins to develop. At this stage, the child is still unable to think logically and perceive the world through childish thinking and animism (make-believe friend and believing that dead object might have a soul or be alive).
- Concrete operational. Ages 7 to 12, children begin to understand logical or rational thought but only in relation to things they can see or touch (visual and tactile aids). At that age they are better at considering feelings of others and seeing their point of view.
- Formal operational. From the age of 12 and through adulthood, the individual beings to develop abstract reasoning skills, can think logically and rationally,

without having to depend on aids such as visual or tactile. Complex abstract thought is now possible (LearningRX.).

Piaget states that a child will go through all the stages no matter what but not all of them at the same age, some will pass through the stages earlier or at later ages. Cognitive development will follow this order of stages and they can't be skipped because one stage will prepare you to take the next step to intellectual development and understanding (Crown 2007. ISBN 978-1-84478-886-6.).

If hockey coaches or any other sport coaches would follow the Piaget stages then they would understand that kids under 7 years old are not developed enough (logical thinking still in its infancy) to understand tactics. Even children under the age of 12 years would have a hard time taking in all the information that a player needs to develop game sense. Ideal age would be to start from the age of 12 years and up to late teens. Like listed above not all children will develop at the same time frame, then their logical and rational thinking is coming to gather and they are not in so much need of help to understand like younger children.

4. Tools for developing game sense

4.1 IntelliGym

IntelliGym is a computer based hockey sense, cognitive, training tool. What you need is a computer connected to the internet and normal keyboard and mouse. Players spend up to 30 minutes, once to twice a week on the program for 5-8 weeks. Results on the ice should be visible after working that short time on the program, according to ACE (Applied Cognitive Engineering) owner of IntelliGym. (USA Hockey)
Beginnings of the program were from military usage, fighter jets pilots from Israelis and the US air force use a computer program to enhance their cognitive process, to minimize errors and damages to personal and expensive equipment. Professor Daniel Gopher of the Techion in Haifa did the initial research for DARPA (the Defense Advance Research Project Agency) and NASA.

> Gopher and his colleagues thought they could train pilots' brains on land, using a cognitive simulator, or "cognitive trainer", to the point where anticipating challenges in flight became completely instinctive, thereby vastly reducing the chance of making costly mistakes. (ACE)

Pilots that played 10 hours on the software improved 30% in flight performance. Similar results are show in hockey or up to 40 % improvements on the ice (goals, assists, giveaways, etc.) and basketball where it varies from 20-40%. (USA Hockey) IntelliGym individualizes the software to the person playing it by detecting strengths, weaknesses and progress in player's game, through the software. The software tries to encourage the player to improve with positive reinforcement and simulates a surface not unlike the ice rink (ACE.).

> The training system is therefore designed as a tool that trains multiple cognitive skills in a unified and comprehensive task environment. Trainer components are mapped to the cognitive skills that were identified in the initial task analysis (following years of research on the sports field / court / arena) and are incorporated as integral parts into a computerized game. (ACE)

4.1.1 US National Team Development Program

USA Hockey started a National Team Development Program (NTDP) in 1996 to develop and gather the best student-athletes for there under-17 and under-18 national teams in the country (USA Hockey-National teams.).

> The leadership of USA Hockey, responsible for the game's continuous evolution in the U.S. and for the development of its best players, was thrilled to discover that perhaps hockey sense *can be improved,* with the proper technology to cultivate players' minds. (USA Hockey)

NTDP have been using IntelliGym since the season of 2009-2010. USA Hockey wanted to see if there investment into IntelliGym had showed result by lunching a case study on the difference between pre and post IntelliGym season 09/10. Study shows that players that have used the software for 8 weeks improved by 42% in goals and

assists during the season of 09/10. There was a big margin also in the win ratio from pre to post IntelliGym (USA Hockey-National teams.).

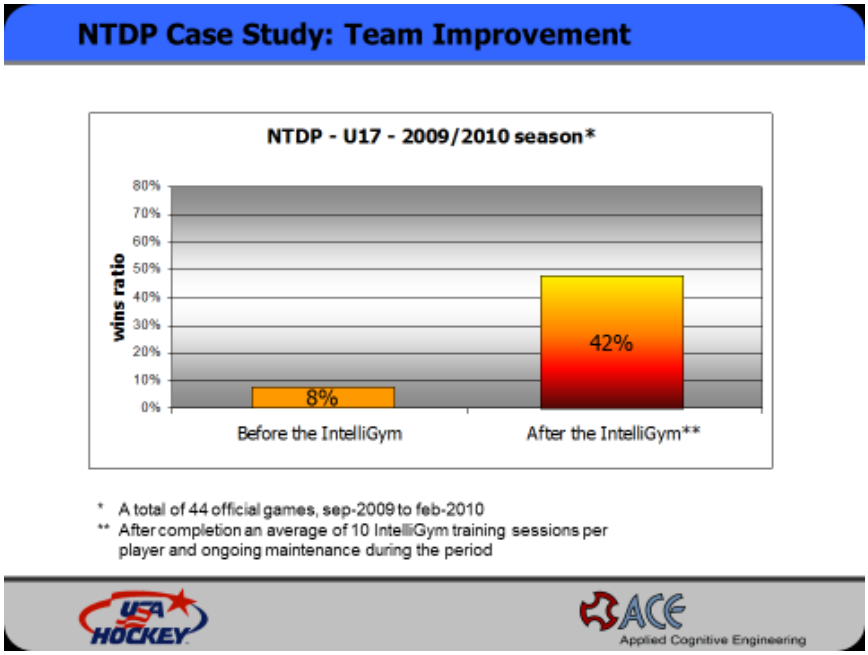

Figure 1 USA Hockey, U17, season 09/10 team improvements with and without IntelliGym.

Figure 1 shows that NTDP U17 team season 09/10 started out the season without IntelliGym and had poor results. After NDTP started to use IntelliGym as a training tool win ratio of the U17 team increased dramatically from 8% to 42%. Higher win ratios can be explained also that most team will come better together later in the season because of training together over the season.

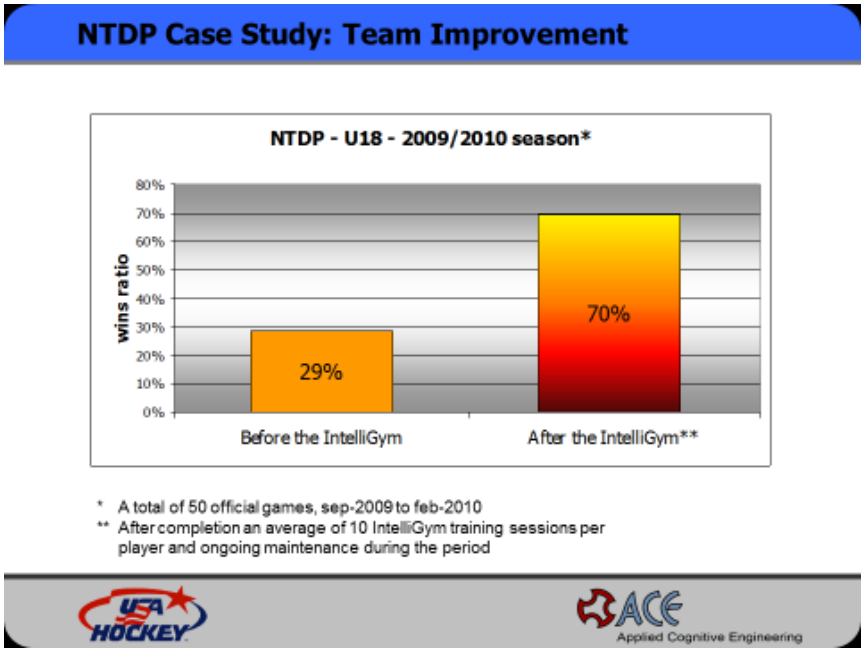

Figure 2 USA Hockey, U18, season 09/10 team improvements with and without IntelliGym.

Figure 2 shows similar results for NTDP U18 team season 09/10, where win ratio for pre IntelliGym is 29% but jumps up to 70% after each player has used IntelliGym on average 10 times.

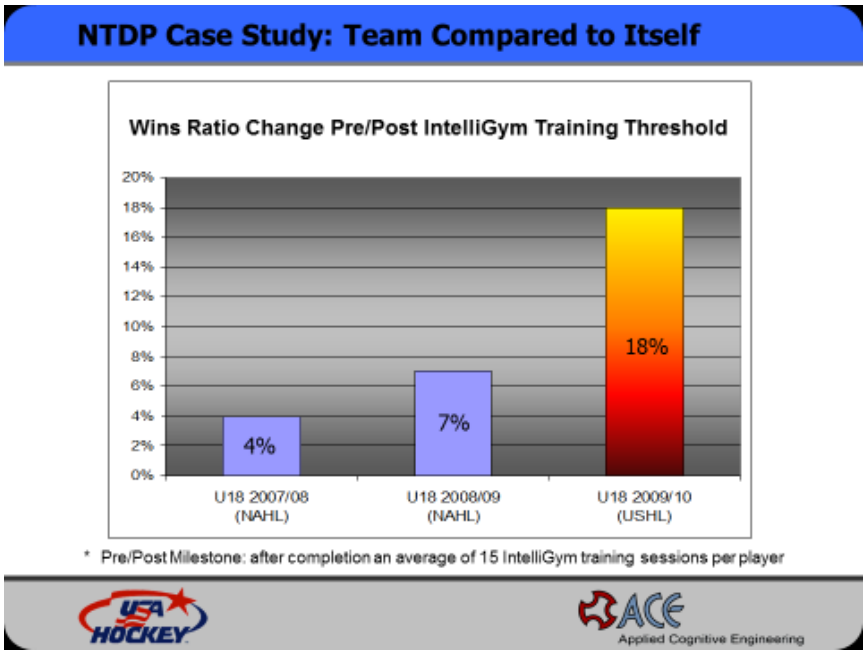

Figure 3 USA Hockey ,Comparing U18 win ratios during three (07/08, 08/09 and 09/10) seasons.

Figure 3 show NTDP U18 team comparing win ratio between seasons 07/08, 08/09 (where played in NAHL) and 09/10 (played in USHL). There win ratio for 09/10 season goes up by more than double the percentage from previous season. The interesting thing is that USHL is a Tier I but NAHL is Tier II, so the NTDP took a step forward with going up a level and still increasing their win ratio.

Critics say that there is not a big difference between USHL and NAHL in coaching, players or any other aspects but numbers of team and travel. USHL is a smaller league and would save USA Hockey money on travel.

4.2 Drills

According to Confucius it is not enough to talk to your players, coaches need to show and let the players try.

> Tell me, and I will forget! Show me, and I will remember! Involve me, and I will understand! (Hakim & Brooks 2005. pp 5).

Brian McCormick runs basketball clinics where he allows player to create a solution rather than telling them what to do. He believes that a coach should not tell his player where to go, what to do or how to play but creating the right drill to emphasize what he wants from the players. To do that he needs to challenge his players by creating drills or game scenarios that allow the player to find the right play/right decision with comments on execution. McCormick thinks that some coaches set up set plays because it is easier to play after guidelines then it is to develop players to act on the best play available. His clinics often look terrible according to McCormick but that is because players are not fully developed. Player will be terrible in the beginning that is foreshadowing for skilled-unconscious level (McCormick 2010.).

> Players need the time and opportunity to learn the game through exploration and discovery with minimal interference, as opposed to the constant structure and explicit instructions in today's game. (McCormick 2010)

Damian Farrow talks about in his lecture, "the game is about making decisions", that training in a game like scenarios and a drill without offence or defense is not likely to happen during a game. Without a defense or offensive elements you are executing a

drill with a player, without making a decision so the process of training to develop is turned to simple give and go and no game sense is trained (Farrow 2012, min: 25:00). During training you can influence each drill with rules, minimizing space, time, numbers of participants and whether the player is passive or aggressive.

Table 3 Farrow (2012) Tools to use when designing training.

CONSTRAINT	EXAMPLE	ACTION ENCOURAGED	LEARNED OUTCOME
Rules	3sec rule	Must move puck quickly	Faster team responses
	No voice	Visual scanning	Awareness
Field Markings	No behind goals	Direct attack	Moving puck directly through traffic
	Hourglass shape	Use of width and then angling back to mid-rink	Using width to clear defence & commence attack
Team Numbers	2 Att v 3 Def in back half	Promote 2v1 counter attack	Better connection with loose teammate
Level of Defence	Full-Active-Passive	Execution under relative time stress	

Damian Farrow had table 1 at his lecture, at the IIHF YSH, he talked about how to influence your training/drills with these tools (2012). Rules can be e.g. player is only allowed to hold the puck for 3 seconds or one pass then player is allowed to attack. Minimizing space for a player has to stay under the hash marks in offensive zone. The amount of players coach can use in a drill is to minimizing the space from the player, coaches can do that with more offensive players also to create 1on2 or 3on1 situation similar to what happens in a game scenario. Time given or taken away to force players to move the puck or better control it. Coaches can have structure in their drill but also free flowing where the coach allows players to be creative in his sett environment. Using speed correctly can change things up, where players come in slow or fast into a drill to set the pressure. Passive or aggressive, amount of pressure or lack of you want form a drill. Progression is one of tools that a coach has, he can go from 1on1 to 2on1 to 2on2 etc. (Farrow 2012, min: 35:00)

The last tool that Damian talked about was focus and change of attentions focus. Coaches can have a broad focus e.g. starting offence from a faceoff dot or have a nar-

row focus with only e.g. wining the ball/puck from your opponent (Farrow 2012, min:38:00)

Restricting players with rules you force them unconsciously/consciously to follow the aim of the drill. It's up to the trainer if he feels that restricting the players is negative or positive with certain rule he can enforce it or take it out of his drill.

4.2.1 Examples on drills

Online drawing tool called Drillfy was used for the drawings in the attachment 1. (Drillfy)

A. 1on1 battle from corner to the goal (Attachment 1. A.).
   Any small area game with less numbers then the real game are played with and smaller surface so we force our players to have less time and space to react.

B. 2on1 from any point you want to try simulating the game as much as you can (Attachment 1. B.).

C. Drill progress- 3on0 start from middle, dump the puck to the corner and let them break out of their own defensive zone.
   3on2 same drill but now you add a for-checker and a defenseman that plays passive in his offensive zone (Attachment 1. C.).

D. 1on1, 2on1 start top of circle. Forwards in both corners and defensemen are next to coach at top of circle. Goalie starts with the puck and gets rid of it in the corner where a forward picks it up and role of defenseman is to be between goal and puck carrier. Forward attacks the goal, after the forward scores or defenseman get the puck coach will pass a new puck to the other corner and the drill will be 2on1 (Attachment 1. D.).

E. 5on5 breakout, for-check drill: set up two lines from any faceoff dot, you can have a normal faceoff or you can let the breakout team start with it. Let the drill flow (Attachment 1. E.).

4.3 Video-Based training

Video based training is a valuable tool, studies have shown that it can enhance players performance (Farrow & Abernethy 2002.: Schweizer, Plessner, Kahlert & Brand 2011). Trainer can use video in different ways: stop a video and ask the player to predict what will happen next or what would he/she do in that situation. Players can then do similar situations over and over to improve their anticipation and decision. Trainer can also control the environment by telling the player how much is left of the game time or telling them that they are in a cup finale to change the pressure on the player (Spittle, Kremer & McNeil 2010. pp 38).

Study on football referees has shown that video based training will help develop decision making. The improvements are small, referee made one-fourth fewer mistakes after the study the before it. Considering the amount of decisions that a referee (or a player) has to make over a season, even a small improvement will improve the statistics of a right call for a referee (Schweizer, Plessner, Kahlert & Brand 2011, pp 438-439).

Damian Farrow shows good examples during his presentation at IIHF YSH (Farrow 2012, min: 6:57& min:15:20) where a netball player is passing the ball to a team mate that she thinks is the best passing option. This is done with projecting a picture of her team mates up to a wall and letting the player pass into the wall.

Using video to develop games sense can be quiet easy with the right tool. Trainers will need a computer with video editing software, projector or a big screen will be useful to view on.

Discussion

Training game sense needs some criteria like, game like scenarios, open play with an aim, high quality training that challenge mentally and physically, selected information from coaches and core skills etc. I can list up things like fields and facility too, but soccer players from South-America in the 90's did not have the best facilities but they still where able to produced elite level players. Game sense has more to say about creating the right creative atmosphere, where players can read a situation and react instinctively in matters of milliseconds.

Participation in more than one sport and early specialization have pros and cons. Both can cause over training and lead to dropouts. They will both develop game sense but in different speed. But one thing separates them, specializing at an early age will limit motor skill and in some ways cognitive thinking to only one sport. Deciding to specialize at an early age can give a player big advantages that is, kids can focus on one sport earlier and that step will help them get closer to 10 years of experience and over 10.000 hour of training. We can see examples in the sports world like Tiger Woods, Wayne Gretzky and the Williams sisters in tennis. Their parents made up their mind and dedicated their children's youth into one sport unknowing if there is another sport more suited to their physical and mental abilities.

Developing game sense is not only about structured high demanding drills/trainings that are game like, but also players using their free time to play at home, deliberate or unstructured training where they can fail and succeed, unknowing that they are training their skills and game sense.

Showing how to shoot and stickhandling around pylons are a safe way to train your youth, but training game sense is hard. Coaches need to explain to player what the goal is in the drill or training without over simplifying it or telling him what to do. If the coach is telling the player what to do, then his method is flawed. Do I use videos based training, computer games like IntelliGym, off-ice or just stay on the ice? I think using all the tools available is the right step to develop game sense, some will not work for a number of cultures. But over all if a coach looks away from a useful tool just because

it's something new or computer related I think that coach's need some serious rethinking about his profession.

> Athletes should be encouraged to make a decision by evaluating options and being allowed to make mistakes and purposely inspect these mistakes so that it does not occur in the future.
> However, if coaches mainly rely on this style and give their athletes the answers to most of the problems they face, then the athlete never learns to address issues themselves"(Kaya. 2014. pp 336)

Drills for game sense need to be open but with an aim, open drills are when a coach leaves spaces on the ice/field open for the player to explore their own solutions to a drill. Drills without an aim will leave the player confused, the aim of the drill will give the player small goal to finish the drill with. Finding the right balance between drawing up the complete drill and guiding the players to the aims of the drill can be real difficult to do. The need to be creative for drills, or small area games, is crucial. Taking drills straight from a text book can be useful but a lot of the time it is not game related but only skill related.

When planning training you should always have in mind is this drill relevant to ice hockey, if not why do it? Most coaches are training a specific sport so the focus should be on improving at that sport. There is off course some benefits from crossover training and coaches should challenge their players by letting them play a different sport once in a while but during your training you need to have the goal of training for your sport to improve in it.

So can I start game sense with 6 years old? Piaget's theory states that children under 12 years of age do not have full understanding of logic or rational thoughts. So how can coaches hope to teach games sense, which is mainly to be rational and logical? Not all children develop at the same speed so we can't generalize to all children. But a large majority will not have fully develop rational thoughts or understand logic, so teaching children under the age of 12 would in most cases be not beneficial to the children because they would not be collecting information for future decision making situations.

Coming from a small nation, where we have three junior clubs and 20-30 teens to pick from for the U18 national team. I wondered how can we improve as a nation, strength, speed or shooting. So what are we missing? Before turning 20 years old Icelandic players will play on average in total 88 games (if the player only plays in their own age group) from the age of 6 years in the Icelandic championship. That is total 88 games from 6 to 20 years old, 14 years. We have a hard time adding more games into the schedule because of limited ice time, distances between teams and lack of players. It is then I realized that training decision making is something that must be possible, we are not lacking skills, speed or strength but we are lacking different opponents (same three clubs with the same players from youth to senior) and understanding of the game. Could Icelandic clubs develop players inside Iceland that have much better understanding of the game with training and fewer games and at what age do we start?

First and foremost knowing what your player is missing from his game (knowledge or core skills) is the first step and then a coach can start using the tool available and be creative with the drills he uses. Pushing children to specialize early or to take part in different sport is not the job of the coach, he needs to support each child and make sure that they are happy in what they are doing. Trying to do some NHL tactics/systems with 7 years old might impress some parents in the stands but you are not helping them if you are not building up the core skills with game like scenarios. Children need skill training all the way up to adulthood, so just focusing on game sense and tactics from the age of 12 is not the right step. The main idea is a seven, eight and nine year olds are not NHL stars they need time to develop and have fun with a challenge during training.

I think with the right education for coaches here in Iceland anything can be possible. We need to start from the basics core skills with the youth and allow them to develop good values and push for more games and more challenging training at the clubs.

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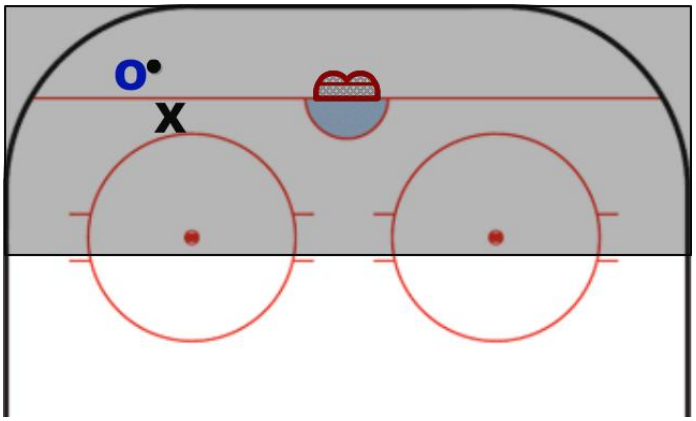
Attachment

1. A.



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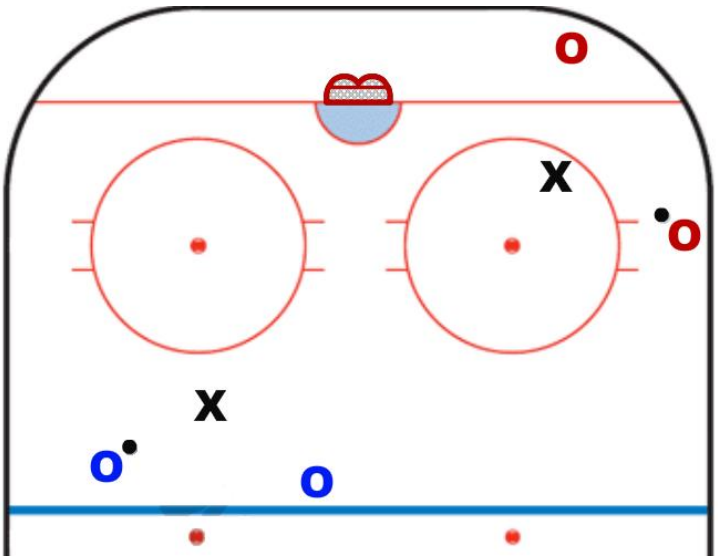

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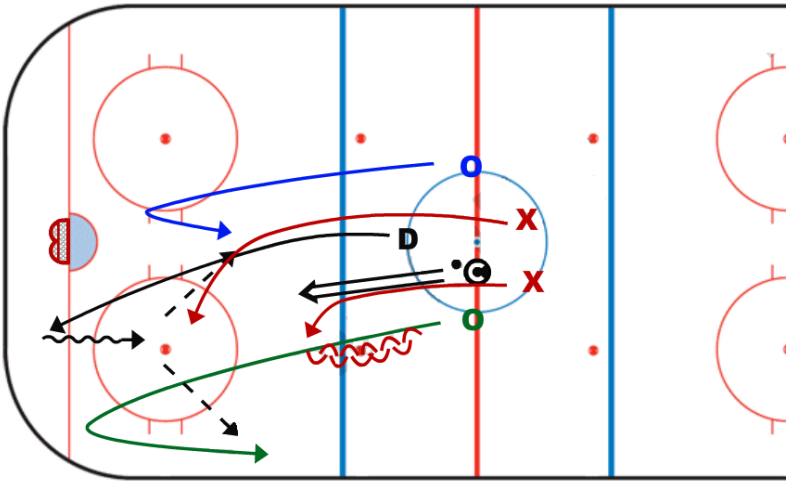

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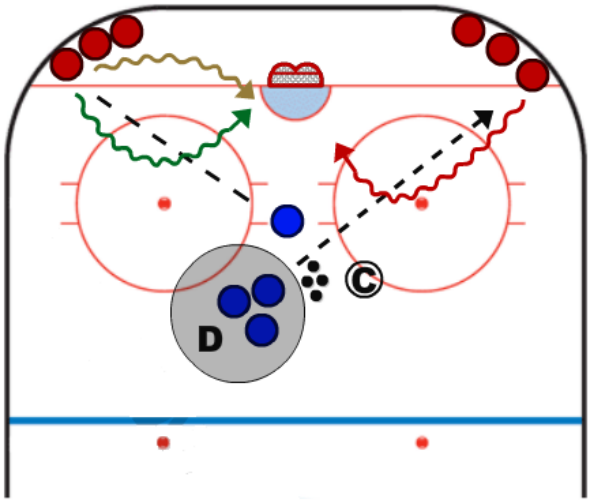

1. E.