Competition preparation by terrain simulation in orienteering

- Can terrain simulation of an embargoed terrain improve performance in orienteering?

Hans Jørgen Kvåle

THE SWEDISH SCHOOL OF SPORT
AND HEALTH SCIENCES
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Supervisor: Emma Hawke
Examiner: Karin Söderlund
Abstract

Aim
The aim of this study was to examine if simulating an unknown competition terrain with the computer game Catching Features improved orienteers performance in the real terrain compared to a terrain they had not simulated.

Method
This study examined the effect of simulation by asking elite level orienteers to simulate an unknown terrain with a computer programme for approximately one hour per day, for six days prior to an orienteering test. The participants were divided into two matched groups and one group simulated one forest terrain while the other group simulated another forest terrain. On the test day the participants ran one course in each forest terrain, in a crossover-type design.

Results
This study shows that simulation of an unknown terrain did not statistically significant increase an orienteers performance, however it had a small effect on orienteering and navigational performance indices. The use of simulation also had a large impact on how well the participants felt they prepared for the race.

Conclusions
Although simulation of an unknown terrain increases an orienteer’s self-rating of prior knowledge of the terrain, there was no clear improvement in race performance. Terrain simulation had a small effect on navigational performance, possibly at the cost of a slower running speed. This may have been as a result of an increased awareness of the difficulty to relocate in the terrain after simulation, which may have prompted orienteers to try to follow a more detailed terrain model to avoid navigational errors. Following a more detailed model may have cost them as much time as they gained from not making mistakes and this resulted in no change in race performance. In the flat terrain that was tested there were not many challenging route choices and it was not possible to detect any effect on the route choice performance by simulation.

Keywords
Orienteering, simulation, competition preparation, terrain knowledge.
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Preface

The process of writing this thesis have been challenging with a difficult design and delays because of the weather. This study could therefore not have been done without help, so I would like to thank the following for being patient and flexible.

First of all I would like to thank all the orienteers and the coach of the training group that took part in and helped in the study. Thanks also to LIVI Test Centre for letting us use their GPS watches.

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1. Introduction

Orienteering is a sport where competitors navigate independently through unknown terrain. The winner is the competitor that visits a number of control points marked in the forest in the shortest possible time using only map and compass. The course, defined by the location of the controls, is not revealed to competitors until they start. (IOF 2013)

In the lead up to important orienteering championships, like world- and national-championships the organizers embargo the competition terrain for all participants, team leaders and others who can give the athletes information about the terrain. This is done to try to make the competitions as fair as possible according to the International Orienteering Federations (IOF) definition of orienteering; “Independently navigation through unknown terrain” (IOF 2013). To be able to do this the athletes are supposed to behave with fairness and honesty - “The Fair Play rule”. The organizers shall also bar from the competition any competitor who is so well acquainted with the terrain or the map, that the competitor would have a substantial advantage over other competitors. (IOF 2013)

Since it would be impossible to find a new terrain for every new competition the organizers often have to choose an area in which a competition has been held before or one that has been mapped before. The organizers then display the most recent map for all the competitors so everyone has equal opportunity to become familiar with them. (IOF 2013)

How orienteers prepare for competitions today varies, but no one is allowed to enter the area and everyone has access to the old maps of the area. To perform optimally it is of interest to know the area as well as possible without breaking “the Fair-Play rule”. Today most orienteers use the following techniques to become familiar with the competition areas:

- Study and visualize the terrain by looking at the old maps
- Planning courses and routes on the old maps to have worked through the potential route-choice difficulties they may meet and to be prepared for what challenges they may encounter during the race
- If there have been previous competitions in the area, acquisition of courses from the event to see what challenges the organizers presented, as well as studying which routes were optimal by use of split-times and GPS routes from the competition.
- Looking at the terrain by use of satellite pictures, Google street view and other pictures of the terrain available on the internet to be able to visualize the forest.
Orienteer in terrains in the surroundings of the competition terrain or other forests known to be similar to the competition terrain to get to know how to deal with the challenges that will be met in the competition.

Orienteer on orienteering maps created by the competition cartographer.

Take part in competitions with the same competition course planner or look at old courses by the competition course planner.

Obtaining information from people who have good knowledge of the embargo area. (Eccles, Ward and Woodman 2009)

These are good exercises to get familiar with the map and learn how to orienteer in the terrain type without being allowed to run in the forest. When the orienteers manage to combine these forms of prior knowledge it is possible to imagine what the terrain is going to look like and how they should be orienteering in the terrain. These tactics require a lot of time, research and expensive training camps and it is still not guaranteed to be accurate or worthwhile.

Recently, a computer game has been developed, Catching Features (CF), where users can program their own games from maps and set preferences for the forest and terrain to make it look identical to the original (figure 1).

![Figure 1 – Screenshots from the Catching Features computer game](image)

This gives orienteers a whole new possibility to prepare for competitions whereby they can practice with a map in a simulated forest without breaking the “The Fair Play rule”. If the terrain simulation is indeed realistic enough and can prove to be a positive training tool for optimizing orienteering performance in unknown terrain, utilization of this software could be one of the biggest advances for competition preparation in orienteering.
2. Literature review

In orienteering the orienteers need to read the map while they are running at a high physical intensity. This makes the map reading harder than it would be if they stood still. To combine the mental challenge of map reading with the physical challenge of running, makes orienteering different to other endurance sports. Orienteers are always under high psychological stress, because they know that even a minor orienteering technical mistake will have a large impact on the final result in a competition. This means they need to be able to maintain maximal concentration during the whole competition and can never mentally relax. The most common mistakes or technical actions resulting in time loss in competitions is route choice mistakes, navigational errors or using too much time reading the map (Bliznevskaja & Bliznevskij 2008). An incorrect route choice occurs when the orienteer does not take the fastest route between two controls. This is a consequence of assessing the time taken to do the route wrongly and time taken is therefore longer than optimal. A navigational error occurs when the orienteer has not been able to follow the planned route or has not been able to find the control point. When the orienteer uses too much time to read the map, running speed decreases and the orienteer may even have to stop to read the map.

2.1. Technical demands in Orienteering

Orienteering is an endurance sport with high demands both physically and mentally. While many studies on competition preparation and tapering have been done on endurance sports (Wenger & Bell 1986; Mujika & Padilla 2003; Mujika 2010), few have focussed on more complex endurance sports such as orienteering. Orienteering differs to most other endurance sports such as track and cross country running or road cycling, as the technical skills required are predominantly cognitive-based skills. In orienteering the technical challenges are reading the map, building an image of the terrain, comparing this image with the real terrain, checking terrain features and having the ability to relocate one’s position on the map after having lost contact between the map and the physical surrounds. These are all highly demanding cognitive processes, which characterise the sport of orienteering. (Nilsson 1980; Ottozon 1986; Murakoshi 1986, 1988; Seiler 1988; Dresel, Fach & Steiler 1989)

The field of orienteering research is quite broad, with studies focused on a range of areas from improving orienteering technique, to route choice analysis, injuries, spread of diseases between athletes, aerobic analysis, physical demands and the impact of orienteering events on
local vegetation (IOF 2009). This literature review will concentrate on the technical skills required for orienteering.

2.1.1. Map reading and relocation

Studies have shown that more highly-skilled orienteers are able to maintain their concentration levels to a greater degree during a race and make less route choice mistakes and less navigational errors than less skilled orienteers (Eckerman & Jansson 1985). As Bliznevskaja & Bliznevskij also point out in their review of technical training for orienteering (2008) the number of route choice mistakes and navigational errors decrease the more experience the orienteer has.

Fach (1985) asked orienteers to perform orienteering tasks while running on a treadmill with increasing intensity. He demonstrated that when orienteers are performing above the anaerobic threshold they show a dramatic loss in visual attention and concentration and this may be related to an increase in the number of route choice mistakes. This means it is very important for an orienteers anaerobic threshold to be as high as possible.

2.1.1.1. Map understanding

Murakoshi (1986, 1988) examined the relocating process, during which orienteers look at the surrounding terrain and gain an understanding of their position on the map. Murakoshi showed orienteers of different abilities photographs from a terrain and asked them to point out on the map where the photographs were taken (called photo orienteering). He showed that experts could identify the photographed location on the map more correctly than novices. Additionally, he observed that experts used more time on the difficult tasks and less time on the easier tasks than novices, suggesting that experts registered the difficult tasks more accurately and subsequently allocated more time to these to make them correct (Murakoshi 1986, 1988).

In another investigation Murakoshi (1990) asked expert and novice orienteers questions about the conditions at different places on the map. Here he found that experts could gather a lot more details from the map than novices. The experts could even interpret many details about how the terrain would most likely be, beyond what was shown by the map symbols. For example, they could estimate the width of a stream passing a control point or the visibility of a path from the infrastructure shown on the map. The experienced orienteers did this by comparing the map to earlier experiences in similar forests. Murakoshi confirmed this in later
studies (1994a, 1994b) and showed that experts use prior knowledge when interpreting maps. Expert orienteers, when confronted with a new map, will access map and terrain connections through similar maps experienced before (Murakoshi 1990, 1994a, 1994b).

2.1.1.2. Cognitive processes in orienteering

This concept of connecting terrain through similar map experience is developed alongside findings from several other orienteering studies (Ottosen 1986; Seiler 1988, 1990; Dresel et. al. 1989; Murakoshi 1989) and discussed in a review of cognitive processes in orienteering by Seiler (1996). Seiler eloquently describes map reading as the following; “Map reading is a process of constructing a model of the terrain from the map symbols. This model, or plan, is beloved in advance and predicts how the terrain will be when arriving at a certain point in the model (route planning). The model is not as detailed as the reality. The construction of the model is based on the information the map contains, but is also affected by expectations and prior knowledge. Semantic knowledge, i.e. the meaning of map symbols, as well as a general geographic model may be learnt easily, whereas much of the knowledge used for more elaborated model is acquired be experiencing covariation of terrain and map information. This results in a difference between novice and expert orienteers in terms of elaborated terrain model when looking at the map” (Seiler 1996). This confirmed what Murakoshi (1990, 1994a, 1994b) found in his photo orienteering studies where experts could tell a lot more from the terrain than what the map symbols showed, since they could connect the terrain through similar map experience (Figure 2) (Murakoshi 1990, 1994a, 1994b).
Figure 2 – The expert (left) and the novice (right) orienteer may build up different terrain models from the same map (from Seiler 1988, p. 137)

Seiler (1996) further discussed that the more fragmentary and incorrect the model or plan is, the higher the probability that errors will occur. On the other hand, there is also the possibility that a too perfect and detailed model may be too time consuming to compare with the terrain (Seiler 1996). Crampton (1988) describes the more efficient route navigation, as used by experts, as the "corridor found". "Corridor found" means that the orienteers simplify features and only use the important features which are easily detectable for navigation. This means they can cover large distances quickly and without an excessive cognitive load (Crampton 1988). Since this way of orienteering only includes the important and easily recognisable features, the risk of missing them is less high than when using less important and less visible features (Seiler 1996).

Once an orienteer becomes aware that he or she has lost the contact between his or her map model and the terrain they need to relocate where they are. This process uses the technique that Murakoshi (1986, 1988) used in his photo orienteering experiments (Murakoshi 1986, 1988). Lost orienteers normally look around and may even walk some meters to find features that they can relocate on the map. During this process, prior knowledge gained in previous competitions help to develop a map model. Novice orienteers normally have difficulties to
transform a three-dimensional world into a symbolic two-dimensional one (Figure 3) (Seiler 1996).

Figure 3 – The map model of an expert (left) and a novice (right) orienteer (from Seiler 1996, p. 61, adapted from Nilsson 1980, p. 13)

To conclude, the following model based on Neisser’s perceptual cycle (1976) may help to understand the cognitive processes in map reading and relocation (Figure 4). Information which is thought to be important is taken from the map based on prior and general expectations to build a terrain model. While running, the orienteer is using the terrain model for control of the terrain features. Terrain models with rich details will ensure that many terrain features will be checked. Experienced orienteers will have terrain models with the important information whereas less experienced orienteers will use the wrong information or have too many details. If the orienteer loses control over the actual position, information extracted from the terrain is used to build up a map model. This model is then compared to the map and used in different hypothesis about the actual position. (Seiler 1996)
2.1.2. Route choices in orienteering

Route choice is the process of deciding the optimal route between two controls, adapted to the technical and physical abilities of the individual orienteer (Seiler 1989 p.74). A good route choice according to Dresel et. al. (1989) is a route that allows sufficient definition by terrain features that can easily be controlled while running and that makes relocation easy if needed. Dresel et. al. (1989) therefore reasons that the planning and selection of an optimal route is one of the most important factors for good performance in orienteering.

When orienteers decides their choice of route they have to consider the advantage of a longer, easy running and/or technically simple route compared to a shorter but steep, hard running and/or technically demanding route (Weltzien 1983; Kübler 1985).
Seiler (1989) represents in his model (Figure 5) how successful orienteers decide and plan their route choices. The model shows that the base thought is always to take a direct route. If there appears to be any hindrance to this direct route after studying the map a detour will be considered. The model also shows that successful orienteers check for difficulty to find the control and look for possibilities to take shortcuts from the detour if the forest unexpectedly proves to be easily runnable.

![Figure 5 – Route planning and decision strategy of a successful orienteer (from Seiler 1989 p. 82)](image)

In Myrvolds review of route choices analyses (1996) he tried to decide what an optimal route choice is. He showed that in orienteering it is very hard to decide which route choice will be the best for all orienteers. The individual best route choice is often depending on one’s physical and navigational capacities. On legs which the orienteers perceived as interesting
route choices (not obvious for an orienteer which route should be the fastest), Myrvold was unable to find statistically significant differences between the best possible route choices. In light of these findings the current study will only clarify poor route choices where the participants loose time on their route compared to their performance on legs when they do not make mistakes.

2.1.3. Competition preparations

Eccles, Ward and Woodman (2009) have examined how orienteers mentally prepare for orienteering competitions. Most of the preparations are focused around trying to find out as much as possible about the competition terrain. Orienteers look at old maps of the area, train in similar terrains and try to learn the course setters’ characteristics (Eccles et. al. 2009).

As discussed previously, earlier studies have shown that orienteers develop a model (or image) of the real world from the map in advance when they are navigating through the terrain. They show that more experienced orienteers can make more detailed and efficient models easier than novice orienteers. Much of this advantage is due to the use of knowledge from similar terrains (Seiler 1996). This study will examine the idea that if orienteers get prior knowledge of the competition forest, they will be able to perform better since they then can make more detailed models.

According to the definition of orienteering, which states that orienteers “independently navigate through unknown terrain”, it is very clear that orienteers are not allowed to physically be in the competition forest prior to an event (IOF 2013). Therefore, orienteers must find a way in which to simulate future competitions terrain to get prior knowledge of it. One way to achieve this could be with computer simulation.
2.2. Computer simulators

Since the 1960’s computers have been used in sports and sport science (Dabachki & Baca 2008). In the beginning computer technology was mostly used to accumulate and share information between scientists and to make it easier to access for coaches (Less 1985; Link 2009). More recently, the use of computers has become increasingly important, for example they are used by media and for time keeping, analysis, keeping statistics, scoreboards, design and product development. In addition, sports clubs, teams and federations use the internet to promote themselves and allow their fans to stay up to date with the latest news and developments. (Baca 2006; Perl 2006)

Computer programs have been developed to simulate and analyse movement in medicine and human science (Bernstein 1967; Boccardi, Pedotti, Rodano & Santambrogio 1981; Pedotti 1977; Pedotti, Krishnan & Stark 1977). Athletic performance has also been improved by computer analysis and movement simulations (Pedotti, Frigo & Rodano 1983; Seireg 1983). These have given valuable information to scientists and coaches in the development of today’s sports.

Simulators have also been used for educational purposes. One of the great successes is driving simulators. These have been shown to be a good supplement for optimising driving education since they makes learner drivers pay more attention to critical situations and relevant areas in the visual field and thereby make their driving more safe (Petzoldt et. al. 2012).

Computer simulators seem to be a valuable tool in test, development, educational and learning purposes. In the field of sport performance and coaching, the use of a computer simulator prior to upcoming events has the potential to provide an innovative and valuable tool for competition preparation and subsequent performance. However, there are very limited studies exploring the use of simulators in sport performance. Prior to the Olympic Games in Vancouver 2010, Holmberg (2009) used a treadmill simulator to prepare members of the Swedish Cross Country team. Skiers roller skied on a treadmill while watching a big screen which showed a video from the competition track. The treadmill automatically changed incline following the course profile (Holmberg 2009). The skiers could this way visualize and memorize the competition track (see figure 6). To date, this research has not been published.
Fraser (2013) successfully performed a study on orienteers where they used the same simulation software as used in this study to test the key predictions of the Processing Efficiency Theory (PET) in orienteering. The PET theory tries to explain the performance-anxiety relationship and Fraser examined this by letting the participants simulate an orienteering course under high and low pressure. But this study never examined any impact of simulation on orienteering performance. This is the only study found that use computer simulation in orienteering.

Currently, no studies have been done on the recognition from simulators in the real world and if this can improve orienteering performance.
3. Aims

The aim of this study was to examine if simulating an unknown competition terrain with the computer game Catching Features improved orienteers performance in the real terrain compared to a terrain they had not simulated. Specifically:

- Do orienteers rate their preparations better for an event when they have been able to simulate the terrain compared to when they have not simulated the terrain?

- Do orienteers perform better in a terrain after they have simulated on a computer compared to a terrain they have not simulated?

- Do orienteers make less navigational errors after simulating the terrain than in a terrain they haven’t simulated?

- Do orienteers make less route-choice mistakes after simulating the terrain than in a terrain they haven’t simulated?

- Can the orienteers maintain a higher running speed after simulating the terrain than in a terrain they haven’t simulated?

Hypothesis: If orienteers simulate a future competition terrain in the computer game Catching Features they will perform better in the competition than without preparing for it.
4. Methodology

The study was conducted as an experimental study where the participants first had an intervention for 6 days where they simulated a terrain on a computer. The study participants were divided into two groups matched for performance level in orienteering and prior knowledge of the simulation software. The two groups simulated two different terrains. On two separate test occasions each orienteer ran one course; first in one terrain and then in the other, thereby running a terrain they had simulated knowledge of and a terrain they had no simulated knowledge of (figure 7). The order of the courses was randomised in a balanced manner between the groups. This study design was approved by the Research Ethics Board at Dalarna University (DUC 2012/2016/90).

The magnitudes of change in race-, orienteering- and running performance as well as how well the orienteers felt they knew the simulated terrain compared to the non-simulated terrain was analysed to see if simulation of an unknown terrain alters performance in orienteering.
4.1. Study participants and information

The study participants were from an elite orienteering training group in Sweden. A total of 14 aged athletes were recruited into the study, however due to sickness, injury and inadequate completion of the course simulations a total of 9 male orienteers from the training group completed the simulation and test races. The groups consisted of senior and junior orienteers (20.8± 4.4 years old) from Sweden, Norway and Czech Republic with top 30 results from a national championship last season. All athletes in the training group received an information letter (Appendix 2) that explained the study in detail and asked if they wanted to take part in the study. The information letter explained that participation was voluntarily, their names would be treated confidentially and they could at any time choose to end their participation in the study without any reason. Since the test occasion was a part of the groups’ scheduled training they could still take part in the test race without being a part of the study. All participants completed the consent form (Appendix 3) and provided details of their knowledge and experience of the simulation software. They rated their knowledge of the simulation software according to one of three statements; (1) “have never played the simulation software before or don’t remember how it works”, (2) “have tested the simulation software before and know how it is played, but haven’t played it more than 10 times” or (3) “have played the simulation software more than 10 times before and am confident with how to play it”.

The participants were supposed to simulate four courses each day for six day and were encouraged to do as many of the course simulations as possible. If they not where able to do all the courses one day they were required to do them the day after. To be included in the study they had to have simulated 75% of the courses given to them. Injured and sick athletes did not take part at the test races and were therefore also excluded from the study.

In order to determine the effect of terrain simulation it was important that the test terrains and maps were novel to all participants. Participants with prior knowledge of the test area and associated maps were excluded from the study.

The participants were divided into two groups matched for experience in playing CF and equal performance level. Performance level was decided from the previous season’s national championship results. All athletes were ranked in the top 30 in at least one of the national championship events from 2011-2012, which shows that all the participants were of a high level.
To ensure that any change in performance was due to simulation alone, participants were not allowed to use any other kind of competition preparation to get to know the test areas, like looking at old maps or satellite photographs during the intervention. Allowing participants to utilise these normal preparation methods would also be problematic to standardize since participants would likely have different levels of motivation and interest in looking at other maps in addition to the simulation.

4.1.1. Preparations for test occasions

Before the test races the participants were encouraged to prepare in their normal manner, as if they are preparing for a race. They were required to avoid any hard strength or endurance training the day before both of the test occasions.

Participants used their own normal orienteering kit on the test occasions, including compasses and SPORTident punching system card (SPORTident Card 6-9, SPORTident, Sweden).
4.2. Design

To assess whether the computer simulator had any effects on orienteering performance in an unknown terrain the participants were tested in a crossover-type design. In orienteering it is impossible to blind the design since once the participant has run a course it is no longer novel and improvements will be observed after running it a second time, due to the learning effect of remembering route choices and precise location and appearance of control features. In this study it would also be difficult to blind the test since participants are supposed to recognise one of the terrains and not the other.

The two groups with equal orienteering level and knowledge of the simulation software simulated two different terrains. Group 1 simulated terrain 1 and consisted of 4 participants (aged 21.5 ± 5.5 year old) and Group 2 simulated terrain 2 and consisted of 5 participants (aged 20.2 ± 3.9 years old) for six days (see figure 6).

In the morning after 6 days of intervention the orienteers ran the first post-test. Half of the participants ran the course in the terrain they had simulated while the others ran the course in the terrain they had not simulated. 5 hours after the first test, in the afternoon, they changed terrain so those running the course in terrain 1 in the morning then ran the course in terrain 2 in the afternoon and vice versa (see figure 7).
Figure 7 – An overview of the intervention groups and test-races
4.3. Apparatus/material

4.3.1. Computer simulation

The orienteering simulations were undertaken on the orienteering simulation software, Catching Features. Each participant received a licensed version of the software and an instruction guide on how they were supposed to install and register the software.

The instructions also showed them the control configuration and how they should control the simulation. All participants were asked to test some of the demo courses in the software to get used to the controls. This way all participants should be able to do the simulation. If any of the participants had any problems they were asked to contact the study leader for help.

When the participants had got the software installed and learnt how to control the simulation they started the intervention. In the intervention they simulated four courses each day for six days prior to the test occasions, in total 24 different courses.

4.3.1.1. Training diary

Each day during the intervention after their simulation session, participants filled in a training diary (Appendix 5) with the time taken for each of the courses and on a scale from 1 to 10 estimated how well they felt they knew the terrain. This training diary made it possible to check that the participants conducted the intervention and it worked as motivation and a reminder for them to do the simulation. It made it also possible to see if any of the participants have had problems with the simulation or if they spent a very long time on the simulated courses.

4.3.1.2. Making the simulated terrains

All the simulated terrains were made based on the orienteering map in the Catching Features Map Editor (CFME). The terrain was made as similar to the test terrains as possible by the use of similar trees, ground graphic, tree density etc. from the test leader’s prior knowledge of similar terrains.

4.3.1.3. Simulating training courses

In the intervention the participants had four courses to simulate every day. Each course was made as similar to the test race competition course as possible. They were between 4 and 5
kilometres and consisted of 13 checkpoints (controls) with 1-2 long route choice legs in each. None of the courses or legs were similar to the test race courses but during the six intervention days the participants had encountered (through the simulation) half of the control points that they would be encountering in reality in the post-test. This is a number of control points it would be natural to encounter in a competition with 13 controls when 312 controls are placed in the forest.

4.3.1.4. Pilot testing of the simulated terrains and training courses
Two orienteers that were familiar with the simulation software and how the simulated terrains are produced with CFME tested the courses and the simulated terrains before the study started to check that the maps and training courses were made appropriately.

4.3.2. Test races
The participants were required to run the test races as competitions. Between the first test and the second test race they were given 5 hours recovery time and the opportunity to eat, drink and recover as they decided individually.

4.3.2.1. Equipment
The participants ran both test races with GPS watches (Forerunner 305, Garmin, USA) that recorded their route. Data from the watches was used to analyse route-choice mistakes, navigational errors and running speed to determine if simulating an unknown terrain had any effect on performance. The GPS watches also acted as a backup time keeping system, since it was possible to determine accurate split times and overall time from the GPS route.

The participants started their test races separated by 3 minute intervals so that they were unlikely to see each other in the forest and get “drafting” advantage by following other orienteers. They were given their map with the marked course immediately prior to the start of the race and the controls were marked with orange and white orienteering flags in the forest, according to standard orienteering race procedures. Upon arrival at each control the participants punched their race card using the SPORTident control station system (SPORTident, Sweden). From the electronic SPORTident punch mark it was possible to analyse split times and determine at which legs the participants lost or gained time.
4.3.2.2. **Terrains and courses**

Terrain 1 and 2 were fairly similar terrains with the same kind of forest. Terrain 1 (map in appendix 6) consisted of more flat marsh areas while terrain 2 (map in appendix 7) had poorer visibility in the partly denser forest.

The courses for both test-races included the same challenges with one long route choice leg longer than 1000 meters, one half-long route choice leg between 500 and 1000 meters, 4 medium long legs between 200 to 500 meters, 7 short legs shorter than 200 meters and equal difficulty in control points. They were both 5,1 kilometres and included 13 checkpoints (controls). This way the two courses were comparable, but diverse enough to make a difference if one of the terrains had been simulated.

Both courses were made by the study leader and the coach of the training group to ensure that the courses were appropriate for the standard that the athletes would meet in competitions and that it would be possible to compare the courses.

4.3.2.3. **Questionnaires and map drawing**

After both test races the participants completed a questionnaire (Appendix 4). The questionnaire targeted their prior knowledge of the specific test race terrain, self-perceived ratings of familiarity of the terrain as a result of using the simulation software and self-perceived performance. They were also given the opportunity to write comments about their race and how they felt about the simulation software.

They were also asked to draw the route they took on the map with a red pen, mark their mistakes with a black pen and draw better route choices if they identified any after the race with a blue pen. This is a standard post-event evaluation tool used in competitive orienteering.

4.3.2.4. **Test race analyses**

The test races were analysed by using the GPS tracks and the participant’s own drawings to identify two different time losses; route choice mistakes and navigational errors.

A time loss for route choice mistake is defined as when the participant did not take the best route choice and thereby lost time. For example, in hilly terrains a route choice mistake could be to run over a hill instead of around it (Weltzien 1983; Kübler 1985). As Myrvold (1996) explains it is not possible to show any significant difference between the route choices that for an orienteer has an obvious best route. In this study the split times relative to the overall
performance for each participant was compared to decide which route choices were the best and on which route choices participants lost time (see best routes for Course 1 and 2 in Appendix 6 and 7). A route choice was only considered as a mistake if a participant took an alternative route to the ‘best’ one and lost time compared to his mistake free performance, running speed, it was considered to be a route choice mistake.

Navigational errors were detected by the participants’ own drawing and from any additional information detected by the GPS tracks.

Since the participants had different running speeds in the test, the time they were behind the best split time is not necessarily what they have lost on route choices or navigational errors. For each leg a performance index (PI) was calculated, based on how well the participant’s split time was compared to the other participants. PI is calculated from the average of the 25% best split times divided by the participant’s time. Higher PI is a better split time compared to the other competitors.

Thereafter, the average PI from the legs without any route choice mistakes or navigational errors was used as a mistake free PI, an index of the running speed when the participant made the right route choice and did not make any navigational errors. From the mistake free PI the possible split time the participant could have had on the leg if he had ran the best route without any navigational errors was calculated. From this possible split time the time lost on either navigational error or on the route choice was calculated.

Time lost on running speed is the time the participant lost on running speed through the forest and is a combined measurement of both how fast the participants ran and how much they had to slow down to read the map. Time lost on running speed is the difference between the best possible split times and the participant’s race time less the time lost on navigational errors and route choice mistakes.

4.3.2.5. Performance measures

The race performance was the participant’s performance index in the race.

The orienteering performance was the participant’s potential performance index if he had been able to hold the pace of the fastest participant. It was calculated by subtracting time lost on running speed from the race time.
The navigational performance was the participant’s potential performance index if he had ran the course on the best route with the pace of the fastest participants, but still made the same navigational errors. It was calculated by subtracting time lost on route choices and running speed from the race time.

The route choice performance was the participant’s potential performance index if he had been able to hold the pace of the fastest participants and not made any navigational errors. It was calculated by subtracting time lost on navigational errors and running speed from the race time.

The speed performance was the participant’s potential performance index if he had run at his own pace on the best route without any navigational errors. It is calculated by subtracting time lost on orienteering mistakes, navigational errors and route choices from the race time.

All indexes are based on the average of the 25% best absolute race times.
4.4. Validity and reliability

In orienteering sports reliability is always difficult since there are big variations in the participant’s performance. To increase reliability orienteers of a high level were selected for the study, since, as in all sports, their performance is more stable compared to less skilled orienteers. Participants were also asked to prepare for the test races the same way as for a competition and not to perform high-intensity endurance or strength training the day prior to the test races.

Repeatability and validity were difficult to ensure since this was a new study design and due to the nature of orienteering one always needs to use new terrains and courses, otherwise the participants will have an advantage of knowing the terrain in the later tests. The repeatability of the study came from using similar terrains and since the participants were required to prepare for both tests in the same way. They also ran the test courses as a crossover-type study. Since the participants not could be running the same course more than once it was not possible to do a true crossover. The test participants were not told if they were running in their simulated terrain or not, but still it was not blinded since the participants would realize if they were in the simulated terrain or not by looking at the map. But this was also the aim of the study. The crossover that was used in the study is explained in figure 7 and was to let half of the participants in each group run in the simulated terrain in the morning while the rest of them ran in the non-simulated terrain in the morning. In the afternoon those that had run in the simulated terrain ran in the non-simulated terrain and vice versa. This way the effect from running the simulated terrain first or last should not influence the result and an improved performance in the simulated terrain will most likely be due to the simulation and thereby terrain recognition.
4.5. Statistics

All data is given as mean ± SD. Differences between performance in simulated and non-simulated courses were tested for statistical significance using student’s paired $t$ test. Relationships between variables were determined using Pearson’s correlation coefficients. The alpha level of significance was set at $P<0.05$.

The quantitative effects of terrain simulation on race-, orienteering-, navigational-, route choice-, and speed performance were estimated with a spreadsheet (Hopkins 2008) by way of the unequal-variances $t$-statistic computed for the difference between simulated and non-simulated performance for both groups. All raw data was log transformed to reduce bias arising from non-uniformity of error. The effect size statistic (Cohen 1988) was used to assess the magnitude of the difference following simulation and interpreted based off Cohen’s effect size criteria (Hopkins, Marshall, Batterham & Hanin 2009).
4.6. Implications and relevance of study

4.6.1. Ethical considerations
The study design was ethical investigated and approved by the Research Ethics Board at Dalarna University. (DUC 2013/1408/90).

4.6.2. Information
The study participants received an information letter that explained the study in detail (Attachment 2). The letter explained the aim of the study, the study design and what the study participants were expected to do. They were also informed that their participation in the study was voluntary and that they at any time could choose to end their participation in the study without any reason.

4.6.3. Consent
The participants voluntarily chose to participate in the study, and were in the information letter informed about volunteering in the study. A consent form (Attachment 3) was signed by all the participants before the study started.

4.6.4. Confidentiality
In the information letter the participants were informed that all information and data would be treated confidentially. All data would be assigned a code, so individuals would not be identifiable. All data was stored in a secure manner. No names were published and only results significant for the study were published.

4.6.5. Benefits
The study participants were informed about what the data would be used for and that it would only be used to answer the aim of the study.

The project was going to benefit all orienteering athletes and coaches that are trying to optimize performance in an unknown terrain without breaking “the Fare Play rule”.

The participants would also benefit from the study after they have tested this way of preparing for an event and can later use that in their later competition preparation.
5. Results

All participants reported they had not been in either of the two forests before, conducted at least 75% of the simulation and ran the two test courses in competitive conditions.

5.1. Performance measures

The orienteers did not perform significantly better in terms of race, orienteering, navigational, route choice or speed performance indexes in the simulated terrain than in the non-simulated terrain (Table 1). However, the ~2% differences in orienteering and navigational performance indexes represent small effects of the simulation on performance in the test races. Figure 8 shows the individual data points for overall race performance (a), and the two performance indices which showed small effects of simulation: orienteering and navigational performance, (b) and (c), respectively.

When orienteers ran the test terrain that they had simulated, they made 0.8 ± 0.8 fewer navigational errors than when they ran the non-simulated terrain (P=0.020, Figure 8d). However, they did not rate their performance as better after running the simulated terrain (P=0.757). No relationships were found between the self-rated prior knowledge and any of the performance measures or self-rated performance (P>0.05)
Table 1 – Difference in race-, orienteering-, navigational-, route choice-and speed performance indexes individually and magnitude based Cohen effect differences between groups, in simulated and non-simulated terrain (n=9)

<table>
<thead>
<tr>
<th>Performance Index</th>
<th>Index on Simulated course</th>
<th>Index on Non-simulated course</th>
<th>Difference in performance(%) (95% CL)</th>
<th>P-value for difference between simulated and non-simulated terrain</th>
<th>Effect size for difference between simulated and non-simulated terrain (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race performance</td>
<td>87,1 ± 7,6</td>
<td>87,3 ± 14,3</td>
<td>0,60 (8,26)</td>
<td>0,963</td>
<td>0,04 (trivial)</td>
</tr>
<tr>
<td>Orienteering performance</td>
<td>101,7 ± 6,8</td>
<td>100,0 ± 10,2</td>
<td>1,96 (5,49)</td>
<td>0,541</td>
<td>0,20 (small)</td>
</tr>
<tr>
<td>Navigational performance</td>
<td>103,7 ± 6,7</td>
<td>102,0 ± 11,2</td>
<td>1,99 (6,98)</td>
<td>0,650</td>
<td>0,20 (small)</td>
</tr>
<tr>
<td>Route choice performance</td>
<td>112,4 ± 3,9</td>
<td>112,5 ± 3,2</td>
<td>-0,11 (3,25)</td>
<td>0,957</td>
<td>-0,03 (trivial)</td>
</tr>
<tr>
<td>Speed performance</td>
<td>97,0 ± 9,1</td>
<td>98,3 ± 12,4</td>
<td>-1,03 (9,14)</td>
<td>0,774</td>
<td>-0,08 (trivial)</td>
</tr>
</tbody>
</table>

95% CL: add or subtract this number to the mean effect to obtain the 95% confidence limits for the true differences. Interpretation of effect size is based off Cohen’s effect size criteria
Figure 8 – The participant’s race- (a), orienteering- (b) and navigational- performance indexes (c) and number of Navigational Errors (d). § = significantly different to non-simulated terrain. P = 0.02.
5.2. Prior knowledge of the terrain

During the intervention the participants self-reported knowledge of the terrain increased significantly (P=0.018). On a scale from zero to ten, where 10 is the maximal knowledge of the terrain, they reported a rating of $2.33 \pm 1.97$ on the first day and by the final day they felt their knowledge had increased to a rating of $6.50 \pm 2.35$ (Figure 9). At the post-test all athletes reported that they felt they knew the terrain they had simulated better than the one they had not (P=0.003), but they rated their knowledge of the terrain lower than the day before when they did their final day of simulation training (P=0.058) (Figure 9).

![Figure 9 – The daily self-reported knowledge of the terrain during the intervention and on the race day for the simulated and non-simulated terrain. § = significantly different to Day 6. # = significantly different to non-simulated terrain at race day. P < 0.05.](image)
5.3. Comments from the participants

In general the participants felt that they knew the terrain they had simulated quite well, but when they got into the forest it was harder to recognize it. They found the terrain flat and without any distinct features, as it was very stony with small branches on the forest floor. There were also some new areas of felled trees not shown on the map. This made them feel that it was difficult to find ‘the flow’ that they had when they were simulating the terrain.

One of the participants commented after the race; “In general, a bad map made it hard to get any flow. I never came into contact with the map even though I recognized the terrain from the simulation in many places”. Another participant commented; “In this terrain you really have to go for it. As soon as you lower the speed to read the map more carefully, you get stuck in all the stones and branches”.

One participant commented that he could recognize the map and route choices and this made him feel more secure, but it was hard to recognize the terrain; “The simulation gave me an extra safety especially given how you orienteer in this kind of terrain. I was not very familiar with the forest, but I recognized my location on the map”.

Some of the participants also commented that they thought the simulation would have greater impact in other, hillier terrains. One of them said; “I think this flat small detailed terrain where everything looks the same is where you have the least advantage of the simulation. In a hillier terrain the simulation would make you recognize the landscape easier and thereby make better route choices. I think the simulation would then have a major impact on route choice performance and you could be running faster because you didn’t have to spend so much time reading the map to understand it”.

6. Discussion

This study examined if terrain simulation using the computer software, Catching Features, could improve orienteering performance in unknown terrain. Areas of particular interest were the effect of simulation on navigational errors, route choices and running speed.

This study examined the effect of simulation by asking elite level orienteers to simulate an unknown terrain with a computer programme for approximately one hour per day, for six days prior to an orienteering test. The participants were divided into two matched groups and one group simulated one forest terrain while the other group simulated another forest terrain. On the test day the participants ran one course in each forest terrain, in a crossover-type design.

This study shows that simulation of an unknown terrain had a large impact on how well the participants felt they prepared for the race. The use of simulation also had a small effect on orienteering and navigational performance indexes, however there were only trivial effects seen on route choice, speed performance and overall race performance indices.
6.1 Results discussion

6.1.1. Race performance

Seilers (1996) theory showed that experienced orienteers can make detailed and correct models of the terrain based on their prior knowledge of similar terrain. It should be expected that when orienteers run in the simulated terrain, since they have rated that they know this terrain better than the non-simulated terrain, that they will perform better than in the non-simulated terrain. This study did not find any difference between the race performances in the simulated and non-simulated terrains, in either self-rated or actual race performance.

From Table 1 and Figure 8 it is possible to see large variations in the individual performances. This is due to some of the participants making crucial mistakes in the technical terrain. Figure 8 also depicts a greater level of variation in the non-simulated than in the simulated condition. Under closer scrutiny of the individual data points, it is interesting to note that the three individuals who performed the best in their non-simulated terrain also performed the best when they ran the terrain they had simulated. The lower degree of variation in the simulated condition is affected not by a decrease in performance of the three better performers, but by a better performance by the individuals who performed less well in their non-simulated terrain test. It seems that using the simulation programme may have more benefit for those orienteers with a greater potential to improve while the best athletes lose some their advantage, since it is easier for a poorer performing athlete to improve than an already good one.

Because of the nature of orienteering it is a challenge to design a study to distinguish clear differences. A larger sample is needed to clearly identify any improvements in race performance.

6.1.2. Orienteering performance

Despite large variation in the number of mistakes, there was a small, beneficial effect of terrain simulation on orienteering performance. This was a consequence of a small increase in navigational performance, as opposed to an increase in route choice performance.

As the participants commented, the terrain didn’t allow many route choices. The terrain was flat and rolling and mostly without any large obstacles. Seiler (1989) shows in his model (Figure 5) that orienteers preferably choose the direct route if it does not contain any hindrance. This was the case in this forest, with little hindrance in the terrain, and except for
the longest legs, the participants ran a direct route between the controls. This is why there were very few route choice mistakes in either course, so it is not possible to see any effect of the simulation.

One explanation for the decreased number of navigational errors following simulation in the corresponding terrain, is that, as Seiler (1996) discussed, experts use prior knowledge of similar terrains to make a model of the terrain they see on the map. In this study, the terrain simulation has possibly provided the orienteers with enough prior knowledge to simplify the map and pick out the important and easy to identify features to make a “corridor found” (Crampton 1988). This way the orienteer may have been more sure and able to orienteering on safer and more distinct features, as one of the orienteers commented, and thereby not make so many navigational errors.

6.1.3. Speed performance

Assuming Cramptons (1988) “corridor found” concept is accurate, they should also have been able to run faster, since there were fewer and more easily detectable features to orienteer on. However, in this study there was a trend towards a slower running speed in the simulated terrain.

Speed performance is a combined measurement of how fast the participant could run in the forest while keeping contact with the map. It is therefore a major factor in race performance in orienteering.

The participants may have decreased their running speed while running in the simulated terrain, because once they recognised that they were in the terrain they had simulated, they may have known from the simulation how vague and indistinct the area was. They would then have known that if they made any mistakes it would be very difficult to relocate in the flat terrain. Therefore, if the participants had made terrain models that were very rich in details to be sure they were going the right way, this would have given them many features that had to be checked and thereby lowering their running speed (Seiler 1996). They may even have been trying to detect features that they remembered from the simulation. In the real terrain some of these features were not as easy to detect as in the simulation and therefore, they may have had to slow down to orienteer on these features in the real forest. At the same time, a reduction in running speed to be sure that they were in the right place may have also resulted in less
navigational errors. However, the overall decrease in speed must have had a greater impact than a reduced number of navigational errors, resulting in no time gain in the race.

This demonstrates that prior knowledge gained through simulation may not be as effective as prior knowledge gained from orienteering in similar terrains. Prior knowledge from simulation is knowledge from a computer processed world. This may be less accurate in terms of the real appearance of features in the actual terrain. Conversely, prior knowledge from similar terrains is more closely matched to reality and orienteers also gain valuable experience identifying them in a similar forest. This may explain why prior knowledge of similar terrains may allow orienteers to attain a higher running speed (Crampton 1988), while this study did not show any improvement in running speed.

6.1.4. Prior knowledge
It is interesting to see that although the participants increased their self-reported knowledge of the terrain over the period of simulation, they rated their knowledge of the terrain after they had run the test race lower than on the last day of simulation. This possibly indicates that the simulated terrain was not as similar to the terrain as it could have been. The terrains had less visibility and were much stonier than the simulation and it made it hard for the athletes to find any orienteering flow.

The self-reported knowledge of the non-simulated terrain was rated very low, lower than after the first day of simulation for the simulated terrain. This indicates that even after only one day of simulating the terrain, the benefits in terms of self-reported knowledge are evident. This may have an important impact on athlete self-confidence and psychological preparation for performance, such that even though the effect of terrain simulation on performance maybe small or unclear, the psychological impact on the athlete may be important, particularly if a method of preparation, such as Catching Features is openly used by other competitors.

Figure 9 shows that there was a great degree of variation in the individual rating of terrain knowledge gained from the simulation (from 2 to 8 on the scale). Curiously, some participants rated the terrain they had not simulated or ever been to before as 3 and 4 on the scale. This shows that there was huge variation in how well the participants rated their knowledge of the terrain and also that the definition of ‘knowledge’ could have been clearer. Therefore, these results should be interpreted with caution.
6.2. Methodology discussion

All the participants included in the study had completed more than 75% of the simulations and the majority of them had completed all the courses. The computer programme only logged the course which completed, so this value reflects the minimum volume of simulation. The exact volume of simulation practiced is difficult to assess as individuals may have re-run some of the courses that they were unable to complete the first time. The participants may even have re-run some of the courses to see if they could perform better. In this case, this would be positive for the simulation trial, since they would potentially have an even greater gain in knowledge of the terrain.

It is unknown if 18-24 courses in the unknown terrain is sufficient to gain prior knowledge of the terrain. However, it is clear from Figure 12 that participants rated their prior knowledge after the simulation as greater than that before, and that it was also greater than when they ran the course in the non-simulated terrain. This is of course a measure based on the participants rating and could have been affected by the aim of the study. Regardless, their ratings of prior knowledge do not seem to have had any impact on how well they rated their performance in the two terrains.

As Table 1 shows there was a large degree of variation between the participant’s performances. This occurred because some participants made big navigational errors. These navigational errors are the nature of orienteering, a reason why the reliability for orienteering performance is low. A larger sample size is needed to determine a clear effect of terrain simulation in orienteering. With a small sample size, such as in this study, the results were very affected by major navigational errors made by one orienteer in the terrain he had been simulating.

Since the test had to be conducted in an unknown terrain, the test forest which was selected had to be some distance outside the training group’s immediate area. This required the participants to travel for 3 hours to get to the test forest. Logistical and practical constraints meant that both test races were held the same day, with a 5 hour recovery period in between. To reduce any impact of residual tiredness from the first test race on performance during the second, half the participants ran their simulated terrain test in the morning and the other half ran their simulated terrain test in the afternoon, in a blinded manner.

Two orienteering courses in different terrains will never be exactly the same and therefore not directly comparable. The participants were divided into two matched groups where the groups
simulated different terrains. Then their performances were converted into performance indexes (see section 4.3.2. for explanation) so that the simulated and non-simulated terrain over the two different courses could be analysed. Obviously due to the nature of orienteering it was not valid to use only one group running one course with a simulation intervention, the classical intervention study design, because the second time they ran the course it would not be novel and any effect would be due to learning.

Due to the time constrains caused by late snow-melt, the creation of the simulation was made on prior knowledge of the terrain in the area chosen for the test. Unfortunately the terrain failed to offer any great route choice challenges and this study could therefore not show any impact of terrain simulation on route choice performance. Despite using the most recent map available, 6 months old, some unforeseen changes in the terrain (new areas of tree felling) and hence the map quality were apparent. This made the mapped vegetation inaccurate in some places. Orienteers are quite used to dealing with this problem from training maps and since the heights and other details in the terrain had not changed they could continue without any sizable problems. None of the controls were in these areas.

The utilisation of a terrain where the map was more accurate and the terrain contained more route choice challenges could have made it clearer to assess the effect of simulation on orienteering performance.
7. Conclusion

The results presented in this study demonstrate that simulation of an unknown terrain increases an orienteer’s preparations by increasing their self-rating of prior knowledge of the terrain but there was no clear improvement in race performance. Terrain simulation had a small effect on navigational performance, possibly at the cost of a slower running speed. This may have been as a result of an increased awareness of the difficulty to relocate in the terrain after simulation, which may have prompted orienteers to try to follow a more detailed terrain model to avoid navigational errors. Following a more detailed model may have cost them as much time as they gained from not making mistakes and this resulted in no change in race performance. In the flat terrain that was tested there were not many challenging route choices and it was not possible to detect any effect on the route choice performance by simulation.

7.1. Implications and further research

As the participants also pointed out, it could be valuable to repeat a simulation study such as this in a more hilly terrain, where the knowledge of the terrain formations would have a greater impact on route choices and running speed. It is also possible to speculate that gaining prior knowledge of a terrain in an urban area, such as those that orienteers use for sprint competition, might have a larger impact than for forest orienteering. In an urban environment it would be of greater advantage to have control and understanding of all alleys and blind alleys. This would also be the case for other orienteering disciplines such as mountain bike- and ski-orienteering where there are more defined route choice possibilities and a need for quicker decision making skills.

The participants felt they got to know the simulated terrain much better by using the simulation programme, but it seems they may have slowed down, possibly to be able to detect all the features in their terrain model. It may have been more effective to combine terrain simulation with attending training camps in similar terrains. This way it should be possible to make the simulation more accurate and the participant could try to visualise how the features appear rather than what they see in the simulation. Then the orienteers could learn both the landscape and what the features would look like in the unknown terrain.
References


Appendices

Appendix 1 – Literature search

**Aim:** The aim of this study was to examine if simulating the unknown competition terrain in the computer game Catching Features improved orienteers performance in the real terrain compared to a terrain they had not simulated.

- Do orienteers rate their preparations better for an event when they have been able to simulate the terrain compared to when they have not simulated the terrain?

- Do orienteers perform better in a terrain after they have got to know the terrain by simulating it on a computer compared to a terrain they have not simulated?

- Do the orienteers make less navigational errors after simulating the terrain than in a terrain they haven’t simulated?

- Do orienteers make less route-choice mistakes after simulating the terrain than in a terrain they haven’t simulated?

- Can the orienteers maintain a higher running speed after simulating the terrain than in a terrain they haven’t simulated?

**Which keywords have been used in the study:**

<table>
<thead>
<tr>
<th>Keywords that were used to find articles in the study were: Orienteering; route choice AND orienteering; navigational errors AND orienteering; orienteering AND map reading; simulation; computer simulation; computer simulation AND orienteering; computer simulation AND sport; driving learning AND simulation; competition preparations AND orienteering; competition preparation AND sport; competition preparation AND competitive sport; tapering AND sport</th>
</tr>
</thead>
</table>

**Where have you search for articles:**

To find the articles used in this study PubMed and Google Scholar were used.
**Searches that gave relevant results:**

<table>
<thead>
<tr>
<th>Source</th>
<th>Search Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Google Scholar</td>
<td>route choice AND orienteering</td>
</tr>
<tr>
<td>Google Scholar</td>
<td>orienteering AND map reading</td>
</tr>
<tr>
<td>PubMed</td>
<td>driving learning AND simulation</td>
</tr>
<tr>
<td>PubMed</td>
<td>tapering AND sport</td>
</tr>
</tbody>
</table>

**Comments:**

It proved to be quite hard to find studies were they tested competition orienteering. One of the problems was that the word orienteering is used for a lot more than just orienteering. The literature search gave me some studies that were related to orienteering, but most of them were about spread of diseases, injuries and the impact of orienteering on the environment. These articles led me to the Scientific Journal of Orienteering, published by the International Orienteering Federation – IOF. This Journal had a lot of articles that was more related to how orienteers navigate and interpret the map.

It was only found one article in my topic with terrain simulation in orienteering, Fraser (2013). To find any background on how computer simulations could be used it was search for simulation in other sports and also in the society.
Appendix 2 – Information letter

Information om studien: Can simulation of the competition terrain by the computer game Catching Features improve competition performance in Orienteering?

Du tillfrågas härmed om deltagande i denna undersökning.

Definitionen på orientering är; ”valfri väg i okänd terräng”. Med bakgrund i detta blir områden vart större orienteringstävlingar skall arrangeras avlyst för tävlande fram tills start. ”Fair-play” regeln gäller så alla tävlar på lika villkor och de som har för stor terrängkännedom inte får tävla. För att prestera bäst möjligt använder elitorienterare i dag sig av gamla kartor över terrängen samt satellit foto för att göra sig kända med terrängen utan att överstrida ”Fair-play” regeln.

Att simulera terrängen på en dator kan göra att man känner igen terrängen bättre och bildar sig bättre mentala modeller av hur terrängen ser ut jämfört med att se 2D kartor och bilder av terrängen. Därmed skulle de tävlande kunna förbättra prestationen i orienteringstävlingar av avlysta områden.

Denna studie vill undersöka om orienterare presterar bättre i terräng de har simulera än i terräng de inte har simulerat. Det är viktigt att studien genomförs för att visa om orienterare och tränare bör lägga tid på att simulera tävlingsterräng eller inte. Det är viktigt att studien är därför viktig och vill utveckla orienteringssporten.

Studien kommer att inkludera 20 svenska elitorienterare, båda män och kvinnor som har lägre än 20 Sverigeranking poäng. Ett bekvämlighetsurval kommer att användas, det vill säga att de som anmäler sig till studien får delta. Testerna kommer göras som en del av era träningar vid Dala Sports Academy, men det är helt frivilligt att deltaga i studien eller bara följa med på träningarna.

Under testloppen kommer studie deltagarna bli tilldelade GPS klockor att springa med och efter testloppen skall ett frågeschema fyllas i samt att ni skall rita vart ni har springit med en röd penna. Bommar markerats med en svart penna och om man efter målgång upptäcker bättre vägval ritas det in med en blå penna.

Ditt deltagande i studien är helt frivilligt. Du kan när som helst avbryta ditt deltagande utan närmare motivering.

Ytterligare information lämnas av nedanstående ansvariga.
Samtyckesformulär

Undertecknad har tagit del av den skriftliga forskningspersonsinformationen och har haft möjlighet att ställa kompletterande frågor och fått dessa besvarade.

Samtycke via namnunderskrift lämnas till deltagande i studien och behandling av personuppgifter.

Datum: __________________

Namnunderskrift: ________________________________

Namnförtydligande: ______________________________

Personnummer: __________________________

Vilken kategori passar dig med tanke på orienteringsspelet Catching Features?

☐ 1. Har inte spelat Catching Features tidigare eller kommer inte ihåg hur man spelar
☐ 2. Har testad Catching Features tidigare, men kommer inte helt ihåg hur man spelar
☐ 3. Har spelat mycket Catching Features tidigare och vet hur man spelar
Appendix 4 – Questionnaire Test-race

Frågeschema Orientering simulator studie

Namn: __________________________

Testtillfälle (markera): Post-test 1 Post-test 2

Tid: __________

Har många gånger har du sprungit orientering på kartan tidigare: ________

Hur väl kände du terrängen innan start? (markera från 1-10, vart 10 är bäst):

1 2 3 4 5 6 7 8 9 10

Hur nöjd är du med loppet? (markera från 1-10, vart 10 är bäst):

1 2 3 4 5 6 7 8 9 10

Rita in på kartan vart du har sprungit med röd penna, om du ser bättre vägval nu efter tävlingen rita de med blå penna och markera bommar med svart penna
Appendix 5 – Training diary

Träningsdagbok Orientering Simulator studie

Namn: __________________________

Dag 1:
Tid: Bana 1:________ Bana 2: ________ Bana 3:_______ Bana 4: ________

Hur väl känner du terrängen (markera från 1-10, vart 10 är bäst):

1 2 3 4 5 6 7 8 9 10

Dag 2:
Tid: Bana 1:_______ Bana 2: ________ Bana 3:_______ Bana 4: ________

Hur väl känner du terrängen (markera från 1-10, vart 10 är bäst):

1 2 3 4 5 6 7 8 9 10

Dag 3:
Tid: Bana 1:_______ Bana 2: ________ Bana 3:_______ Bana 4: ________

Hur väl känner du terrängen (markera från 1-10, vart 10 är bäst):

1 2 3 4 5 6 7 8 9 10

Dag 4:
Tid: Bana 1:_______ Bana 2: ________ Bana 3:_______ Bana 4: ________

Hur väl känner du terrängen (markera från 1-10, vart 10 är bäst):

1 2 3 4 5 6 7 8 9 10

Dag 5:
Tid: Bana 1:_______ Bana 2: ________ Bana 3:_______ Bana 4: ________

Hur väl känner du terrängen (markera från 1-10, vart 10 är bäst):

1 2 3 4 5 6 7 8 9 10

Dag 6:
Tid: Bana 1:_______ Bana 2: ________ Bana 3:_______ Bana 4: ________

Hur väl känner du terrängen (markera från 1-10, vart 10 är bäst):

1 2 3 4 5 6 7 8 9 10
Appendix 6 – Map of terrain 1 with best routes Course 1
Appendix 7 – Map of terrain 2 with best routes Course 2