

## KIF350 1 Bacheloroppgave

# Kandidat 31

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### KIF350 1 Bacheloroppgave

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# Seksjon 1



## Informasjon

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Task-specificity and transfer in balance training.

Oppgavespesifisitet og overføringsverdi innen balansetrening.

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**Index**

Index.....	i
1.0 Introduction.....	1
2. Method.....	5
2.1 Study design.....	5
2.2 Participants.....	6
2.3 Balance devices.....	7
2.4 Balance task.....	7
2.5 Rationale.....	8
2.6 Testing procedure.....	8
2.7 Training.....	8
2.8 Data capturing and data processing.....	9
2.9 Analyses.....	9
3. Results.....	9
4. Discussion.....	11
4.1 Task-specificity of the training effects.....	12
4.2 Comparisons to other studies.....	13
4.3 Study limitations.....	13
4.4 Consequences for training programs.....	13
5.0 Conclusions.....	14
References/Bibliography.....	15

## 1.0 Introduction

This study takes a look at transfer of learning, and how specific training must be to achieve transfer. Transfer of learning from one performance situation to another is an integral part of skill learning and performance. Having knowledge about transfer of learning, a trainer can use this knowledge to improve the training for an athlete

We practice a skill to improve a performance, and to increase our capability to performing the skill in a situation that requires it. Accomplishing specific action goals when we need to, whether it is everyday skills, work skills or sport skills is why we train. To achieve these goals, we need to practice the skills that we need to perform the appropriate actions involved.

These skill performance examples involve an important motor learning concept known as transfer of learning. This concept lies at the very heart of understanding motor skill. An important focus of this concept is the capability we acquire through experience to perform a skill in some novel situation. To do what we have done before, in any situation we may have experienced, is what we want to be able to do again. This suggest that one of the goals of practicing a skill is developing the capability to transfer performance of the skill from the practice environment to some other environment in which the individual must perform the skill so that he or she can achieve the same action goal. (Magill, 2011)

So what is transfer of learning? Transfer of learning is defined by learning researchers as *“the influence of previous experiences on performing a skill in a new context or on learning a new skill.”* (Magill, 2011). This influence can be neutral (no influence), negative or positive.

Neutral transfer of learning is the same as no transfer at all. It occurs when former or previous experience does not influence on the performance of a skill in a context that is new to the subject or if the subject is learning a new skill.

Negative transfer can occur when the earlier experience hinders or interferes with the performance of a skill in a new context or learning of a new skill.

Positive transfer occurs when previous experience facilitates performance of a skill in a new context or the learning of a new skill. (Magill, 2011)

In addition to these, noted forms of training transfer above, we also encounter indifferent transfer, though not so often. This can be found when training high-level athletes who use a whole complex of different exercises, and depends on their coordination structure and strength of their influence. At that time, the interrelationship between the exercises are complex and unpredictable, and they may have a double effect on one another. For example, there might possibly be a positive effect on increasing the functional capabilities of the body systems and at the same time a negative effect on the technique in an exercise. (Bondarchuk, 2007)

The principle of transfer of learning is a very important part of educational curriculum development and instructional methodology, the development of pre-competition practices in sports, and as the development and implementation of systematic approaches to rehabilitation protocols. From a practical view, the transfer principle is very significant for establishing effective motor skills learning environments. However, the transfer principle also has theoretical significance, because it helps us understand processes underlying the learning and control of motor skills. (Magill, 2011)

As we look at transfer of learning, we have to remember what lies beneath it. Learning a new skill is something we all go through many times throughout our life. To sum it up very briefly: crawl before you walk, and walk before you run. With that in mind, we need to think of how we learn skills. Magill, 2011, provides a good example on the transfer principal using the sequencing of mathematics skills.

*“The curriculum from grades K throughout 12 is based on a simple-to-complex sequence. Teachers presents numeral identification, numeral writing, numeral value identification, addition, subtraction, multiplication and division in this specific sequence, because each concept are based on the concept that preceded it. A person presented with a division problem needs to know how to add, subtract, and multiply in order to solve the problem. We do not teach algebra before basic arithmetic. We do not teach trigonometry before geometry. We can make the same point about skills taught in a physical education program or a sports program. Those who develop a curriculum, program or protocol should incorporate the transfer of learning principal when they sequence skills. Learners should acquire basic or foundational skills before more complex skills that require mastery of these basic skills. In other words, there should be a logical progression of skill experiences. An instructor should decide when to introduce a skill by determining how the learning of that skill will benefit the learning of other skills. If the*

*instructor does not use this approach, time is wasted while people “go back” to learn prerequisite basic skills.” (Magill, 2011, s.290-291)*

Knowing that learning of skills is best when done in a specific order, one need to look at the skill itself. Since this study bases itself on the skill balance, we need to know what balance is and what it requires to achieve balance.

In biomechanics, it says that balance is an ability to maintain the line of gravity of your body inside the base of support with as little postural sway as possible.

There are two basic types of balance. The first one called static balance. Static balance is a person maintaining equilibrium at a stationary position. The other one is dynamic balance. Here the person maintains equilibrium while moving. In this study, dynamic balance, and the improvement of that skill, is what we are focusing on.

So, is balance just one skill? We know that dancers need good balance, and we know that gymnastics need good balance. We also know that people who walk on slacklines needs good balance to be able to do what they do. Nevertheless, is it so, that the gymnasts and the dancers will automatically be able walk on a slackline without having done it before just because they have good balance? If they have good balance, they surely must be able to do so. If we look at balance as one single skill, then that should be the case. However, studies over the years have shown that balance is more complex than that (Horak F.B., 2009) (Donath L, 2013). Studies imply that balance is a very specific skill that cannot be viewed as only one skill. If it were so that balance was just one single skill, one would see huge positive transfer of learning from training one balance task to another task.

Unfortunately, some might say, it is becoming clearer as more studies are being conducted that it is in fact not so simple. Studies imply that balance is task-specific, and therefore one can almost say that there are as many types of balance as there are tasks.

There has been attempts to divide balance into subcategories that seem to have little overlap. One example of this is the BESTest. This is a clinical balance test battery developed by Fay Horak, Diane Wrisley and James Frank in 2009. The test consists of 36 tests in six categories, and it has shown that patients with deficits in one category score poorly in that category but not in other categories. This suggest that a general balance ability does not exist, and therefore one should not expect that the training of one balance task would improve performance in another task. (Horak F.B., 2009)



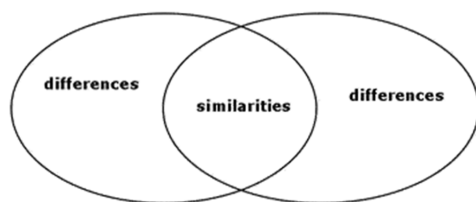
Other studies that can relate to this papers study are (Donath L, 2013) (Kovacs E., 2013); (McMurdo M.E., 2000). These studies also had a different task tested than the task trained, finding no effect of the training. In addition, several studies have shown an effect of balance training on other balance tasks that were not trained. (Hirase, 2015); (Sayenko, 2010)

So why does positive transfer of learning occur?

Learning how and why transfer occurs, we will have a clearer understanding of what a person learns about a skill that also enables him/her to adapt to the requirements of the performance to learn a new skill or of a new situation.

There have been proposed many reasons to explain why transfer of learning occurs. Two of them will be presented here. This is because these are the theories that have two of the most prominent hypotheses. Both of these theories consider the similarities between the two situations to be critical for explaining transfer. However, they do not agree of which similarities account for transfer. One proposes that transfer of learning occurs when the components of the skill and the context in which the skill is performed are similar. The second says that transfer occurs because of similarities between the amounts and types of learning processes required. (Magill, 2011)

The first and a more traditional thought of why transfer occurs is that of the similarity between the components of the two skills or situations. Here, the more similarity between the components parts of two skills, the greater the amount of positive transfer between them. A question that one can ask when learning about this is; what is a “component part”? A component part can be any movement part of a skill. In other words, a foot kicking a ball or a movement of an arm etc. However, do note that the similarity of movement parts also can be considered in terms of their kinematic characteristics.



*Figure 1.1: The circles represents two skills. The amount of overlap between the circles represents the degree of similarity between the skills. The more similarity between the skills, the more transfer one might expect.*

The similarity of components view go back to some of the earliest research on motor learning carried out by E.L. Thorndike at Columbia University in the beginning of the 20<sup>th</sup> century. Thorndike proposed in 1914 the “identical elements theory”. Here, “elements” are general characteristics of a skill or performance context - such as the purpose of the skill or the attitude of the person performing the skill – or specific characteristics of the skill, such as components of the skill that are being performed. Thorndike also considered identical elements to include mental processes that shared the same brain cell activity as the physical action. (Thorndike, 1914)

The other hypothesis explaining why positive transfer occurs, says it results from the similarity if the cognitive processes required by the two skills or two performance situations. This view maintains that although similarity in skill and context components explains some transfer effects, it cannot explain all transfer effects. A very important part of the “transfer-appropriate processing theory”, which it can be called, is that the similarity between the learning or performance cognitive processes required by the two performance situations. Here, two components of positive transfer are critical; the cognitive processing activity a person must do to be successful in performing the transfer task, and the similarity between that activity and the activity required during the training experience (Magill, 2011)

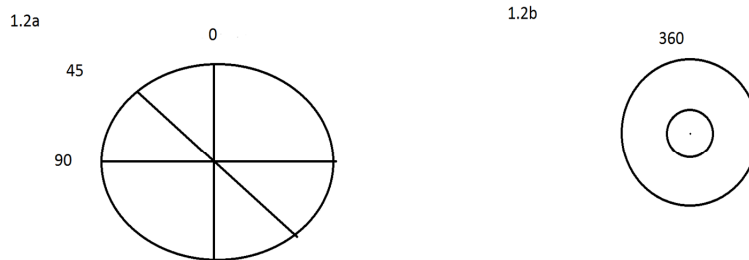
Having gone through many studies and viewing the results of them, it would be interesting to find out just how specific the balance training needs to be to find transfer.

Does an increase in the similarity between two tasks increase the chance of finding transfer?

## **2. Method**

### ***2.1 Study design***

In the first set of test (pre), balance was assessed with two balance devices. Two custom-made balance boards. One board had a 360-degree range of motion, the other one were a tilt board. The tilt board was used in three of the four test the participants were tested in. The tilt board was marked with the angles of 0, 45, and 90 degrees angle to the foot of balance. Each angle were tested.



**Figure 1.2a:** This figure shows the angle of the tilt board compared to the angle of the foot. The tip of the foot (toes) always pointing upwards. **Figure 1.2b:** This figure show the balance board used in the 360-degree motion balance test. Here the participants has no limitations to movement in any direction.

The participants were then divided inn three different groups. Participants were divided in groups by visual observation only based on which participants were most similar inn performance in the first four tests (pre). The control group was selected due to scheduling reasons, as they could not participate in a training period.

## 2.2 Participants

The local research ethics committee at Nord University approved the experiments. The participants of this experiment were students at Nord University, Levanger, Norway. Most of the participant had a physical activity level that came to an average of minimum 4h of moderate intensity per week. Four participants had an average physical activity level of 2-3h per week. Only one participant had an average physical activity level of 1h per week (assessed via questionnaire). The participants came from different fields of study. The participants came from sports studies (7), music studies (1), teacher education (4) and nursing education (1). (8 men, 6 women, age 23years  $\pm$  3-4years, height 170cm  $\pm$  13,5 cm, weight 87,5  $\pm$  34,5kg). Total of 14 participants.

None of the participants had any history of injuries or current injuries in lower extremities that could influence the result of the tests and training. Nor did any of the participants have any diseases associated with balance impairments. The participants gave an informed consent before taking part of the study and was told not to take part in any other form of balance training while participating in the study.

### **2.3 Balance devices**

The balance boards that were used in both sets of tests, (pre and post) were the same boards that were used in the training period for both training groups. Both balance boards had a round shaped platform.

Under the platform on the custom-made tilt board was a semi-circular wooden block with a height of 7cm. The wooden blocks height combined with the platform on the board, which was 1 cm, gave a total height of 8 cm from the floor to the top of the platform on which the balancing foot was placed.

The balance board with a 360-degree angle had a rounded ball like center. With a height of 6 cm, and the platform combined made a total height of 7 cm from the floor and to the top of the platform on which the balancing foot was placed.

The balance boards are common devices in training of balance and testing balance and was therefore chosen for this test. They also gave the information we needed to discover if any of the participants did achieve any transfer from one test to another.

### **2.4 Balance task**

During pre- and post - test, each participant completed four balance tests. (1) To balance the board with the board rotation axis aligned with the longitudinal axis of the foot, resulting in a Medio -lateral direction (ML) of the perception. (2) The balance board with the board rotational axes perpendicular to the longitudinal axis of the foot, resulting in an anterior -posterior direction (AP) of the perception. (3) On the balance board with the board tilted at a 45-degree angle from the sagittal axis of the foot. This results in both a Medio -lateral direction (ML) and anterior -posterior (AP) direction on the perception. The objective on each task were to keep the balance board in a horizontal position and reduce movement as much as possible, avoiding oscillation of the board.

During both test (pre and post), and during the training period, the participants always used the same leg (self-selected preferred leg). The tests and training, participants preformed the task without shoes. All subjects used socks. During tests and training, the subjects had to start the task with the same starting position every time they repeated it. This meaning the starting position always were with one foot in the ground, and the other on the balance board in a tilted position with the foot in a supinated position.

The subject were to putt the preferred foot on the balance board, lift the other foot of the floor and the tilt the board to a horizontal position and maintain this horizontal position for as long as they were able in each try (20sec). If the subject were not able to maintain balance on the board and fall of or if the oscillation became so severe that the platform of the board touched the floor, the subject would have to start over from the starting position. The execution was controlled by the experimenter and corrected when necessary.

### ***2.5 Rationale***

The reason why we chose this specific study design was that we wanted to make the experiment as similar to the experiment done by Giboin, 2015 as possible. This experiment follows the same procedure, but we go one step further in the research on transfer and specificity. By adding some of the same perception in the training as in the pre and post-test, and therefore increasing the similarity, one might be able to tell just how specific balance training needs to be to achieve transfer. Additionally we might be able to answer the question if increased similarity leads to increased transfer.

### ***2.6 Testing procedure***

The tests were completed to assess balance in all four tasks described above. Participants who were given the participants number 1-9, took the tests in the following order; 0 degrees, 45 degree, 90 degree and finally 360 degree of motion. Participants with number 10 and over did the test in a reverse order; 360 degree of motion, 90 degree, 45 degree and finally 0 degrees. Each test consisted of 5 trials with a durance of 20 seconds with a pause of 10 seconds between each trial. Between each test of 5 trials, the participants was given a resting period of 1 minute before starting the next test. The first two trials of the set of 5 was used as familiarization trials. The last 3 trials in each test (pre and post) was used to assess the balance result from the tests.

### ***2.7 Training***

Participants were divided into 3 different groups, in which 2 of the groups completed a training period consisting of 6 trainings over a 2 week period with at least 1 day of rest between each training. The 3.group had the function as a control group. The participants for the training groups was divided in groups by visual observation only in which participants were most similar inn performance in the first four tests (pre). The participants in the control group were selected due to scheduling reasons, as they could not participate in a training period. Both training groups followed the same training procedure. Each training consisted of 4 sets with 5 trials of 20 seconds with a 10 second break between each trial. Between each set of trials in the training,

there was a resting period of 1 minute. The total amount of time in each training was approximately 15 minutes.

### ***2.8 Data capturing and data processing***

The data capturing were done at the test lab at Nord University at Levanger Norway. The same method to get data was used in this study as in the one conducted by (Giboin L., 2015). Reflective markers were placed on the edge of the balance boards. Four markers were placed on the 360 degree of motion board and 6 markers were placed on the 45-degree board. Position, angle and motion of the boards were recorded and analysed with a motion capture system at 400 Hz(Qualisys Oqus). The amount of observations from the motion capture system came to a total of 8000. The performance of a trial was evaluated by reviewing the amount of movement of the balance board throughout the trial. The performance was defined as the mean of the recorded trials of each task.

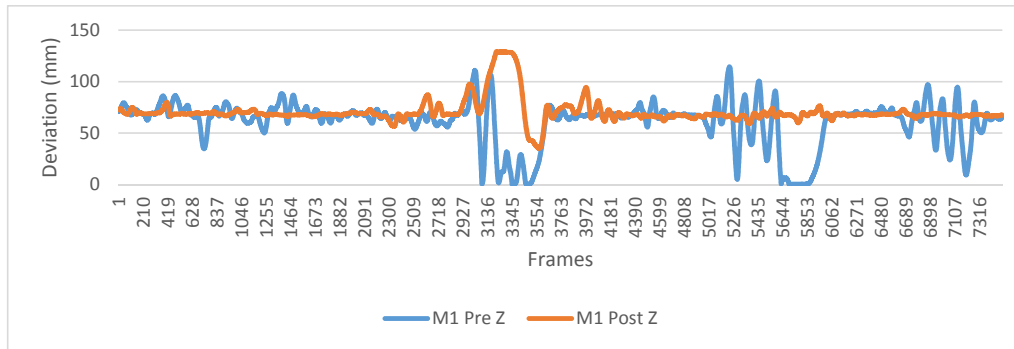
### ***2.9 Analyses***

Descriptive analysis of the results are presented in figures 2.1-2.5. The first 150 frames were not analysed because this is approximately the time the subjects used to tune in to the experimental task. The other 7311 frames are presented in the figures as the difference between the pre- and the post-test.

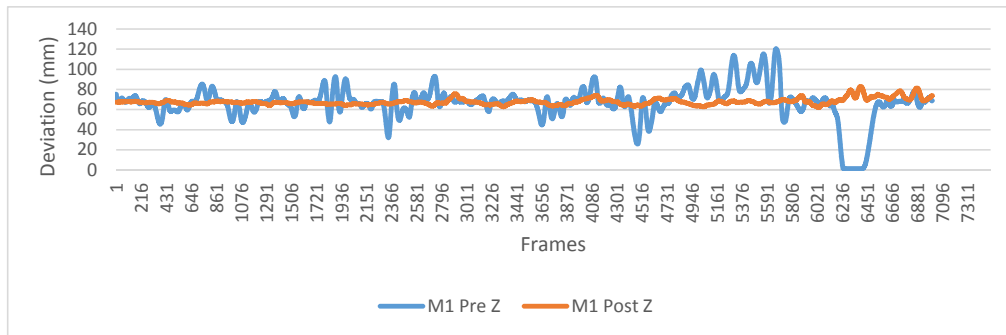
### ***3. Results***

Reviewing the results from the testing, we find an interesting observation. The result shows that the specific training has given improvement to the task-specific balance (Fig 2.3 and 2.4). Both groups improved performance on the task that was trained. This supports the results in (Giboin L., 2015). However, what is interesting is that both groups also showed significant transfer from the task trained to the task with a board angle of 0 degree (lateral movement). As can be seen in Fig.2,2, the test of the 45-degree angle training group, equilibrium was maintained throughout the whole sequence. The 360 degree angle training group was also able to maintain equilibrium throughout the whole sequence, except for one small motion midway (Fig.2,1). That small motion came at the exact same time in the post-test as it did in the pre-test. This showing an improvement in performance from both groups, and a clear transfer of learning from one task to another.

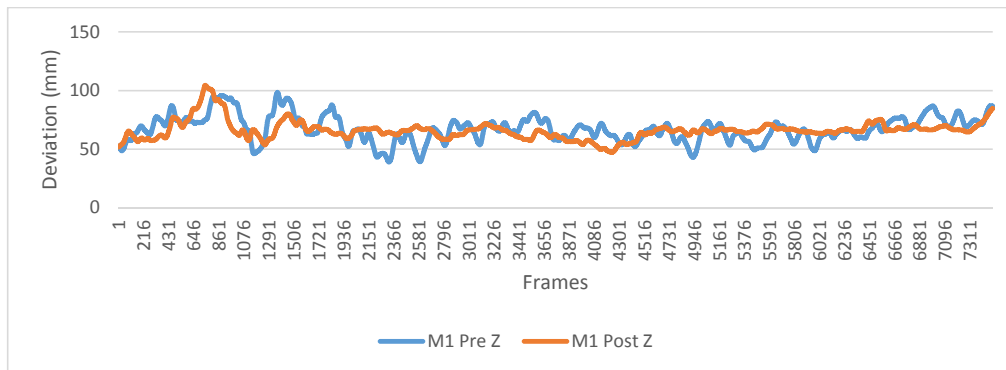
No other transfer were found in either of the groups to other tasks. Fig 2,5 shows an example of this.



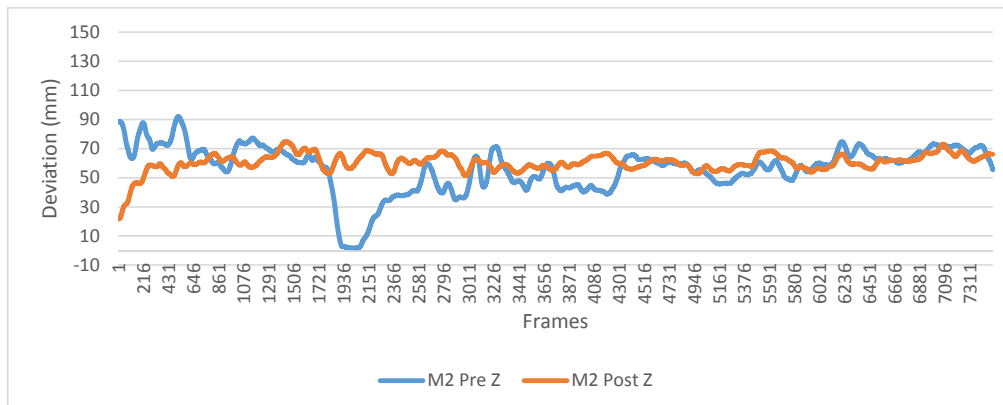
**Figure 2.1:** This graph shows the difference in performance in the lateral balance task (0-degrees) pre and post for the 360-degree training group.



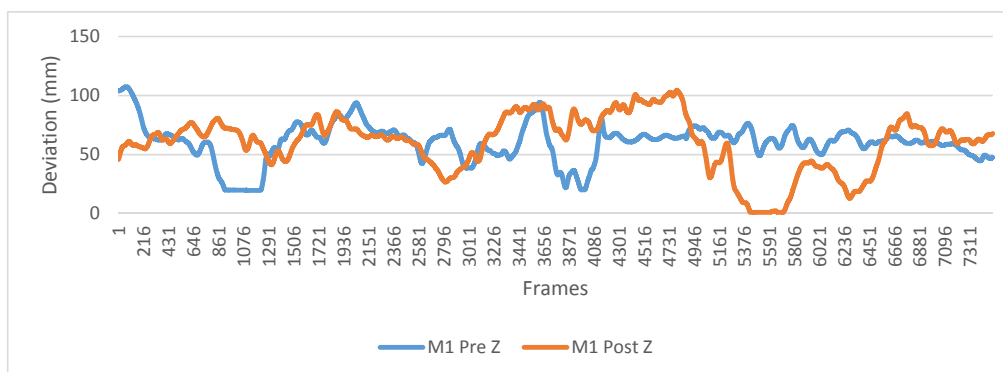
**Figure 2.2:** This graph show the difference in performance in the lateral balance (0-degrees) task pre and post for the 45-degree training group.



**Figure 2.3:** This graph shows the difference in performance in the 45-degree angle task pre and post for the 45-degree training group. This task was the one that the group trained during the training period.



**Figure 2.4:** This graph shows the difference in performance in the 360-degree balance task pre and post for the 360-degree training group. This task was the one that the group trained during the training period.



**Figure 2.5:** This graph shows the difference in performance in the anterior-posterior balance task (90-degrees) pre and post for the 360-degree training group.

#### 4. Discussion

This study can be viewed as a continuation of the study done by Giboin, 2015. Finding no significant transfer between the tasks trained and the tasks tested, therefore suggesting that the effects of balance training are highly task-specific. Reading the Giboin, 2015 study, a question came to mind; how specific do balance training need to be to find transfer?

The findings in this study tells us that effects of balance training is very task specific and that task specific training is the best type of training to increase performance in a task. This study also shows a significant improvement of performance in a skill not trained, suggesting that transfer has occurred.



Now what is strange about these findings is that the transfer only occurs in one direction (lateral). One would think that the effects of training would go both ways if it first were to have any effect. That the transfer is positive when going over to lateral movement and natural transfer to posterior-anterior raises questions that we yet do not have knowledge to answer.

Trying to answer this question without further research is just speculation. Still, one possible explanation can be that it might be easier to make minor adjustments to maintain balance when motions are made in a lateral direction unlike a posterior-anterior. Here the arms are used actively to adjust the upper body relative to the lower body. Using arms as levers makes it possible to avoid unwanted movement in the hip and chest region, something that might be an easier way to maintain balance and achieve equilibrium on the board. The human body's ability to make adjustments in a posterior-anterior direction is not as easy as the lateral movements. This is because of the muscles that are used to adjust the body, in that direction (lateral) the lateral movements are adjusted mainly by the arms. Posterior-anterior movement uses the abdominal and muscles in the back region to control and adjust movement forward and backwards. Since these muscle groups are of considerable size, minor adjustments are harder to achieve than using arms. When having a posterior-anterior movement whilst on a tilt board, the adjustments to maintain balance is moved from the upper body down to the ankle where minor adjustments can be made. When making adjustments with the ankle, the movement of the board increases and is recorded by the motion capture system and resulting in a lower level of performance on the task.

Again, this only being speculations, further research is necessary to answer this question.

#### ***4.1 Task-specificity of the training effects***

After completing the training, the 45-degree training group performed much better at the 45-degree task than the other groups as expected. Thus, they did not perform better than other groups in any other task, except the control group in the lateral balance task. The same goes for the 360-degree training group. They performed better than the other groups in the 360-degree balance task.

Both the 45-degree training group and the 360-degree training group had a better performance in the post-test than in the pre-test when performing the lateral balance task. This suggests that the training gave a positive transfer of learning between them. This also suggests that balance

training is not entirely task specific, and that transfer between the learning of skills is possible when level of similarity is high.

#### ***4.2 Comparisons to other studies***

Earlier studies have shown some effect of balance training on other balance tasks that were not trained (Hirase, 2015) (Sayenko, 2010). Though some studies do find some effects of balance training in other tasks, the study done by (Giboin L., 2015) did not find any significant effect between the task tested and the task that were trained. Balance seems to be very task specific. This is supported by (Donath L, 2013), (Giboin L., 2015).

This study is based on the study done by (Giboin L., 2015). Using the same methods in testing and training. Though testing and training were similar, the result differs. The difference between these two studies were the task trained. The reason for this difference in results is unknown. An explanation might be that the increase in performance come from improvement of other components, and not from transfer of balance skills gained through training. Maximal strength (Gusi N, 2012) and rate of force development (Gruber M., 2004) can be improved with balance training. Now if this is the case is yet not clear.

#### ***4.3 Study limitations***

There are some limitations in this study that are worth mentioning. First, the duration of the study was no longer than 3 weeks from the first collection of data to the final one. Because of such a short period of training, the training may not have been sufficient to develop skills that could transfer to the other tasks. Secondly, also presented in (Giboin L., 2015), that hence the study only uses one-legged stance, potentially limiting the generalizability of the results, e.g., to two-legged stance or walking.

#### ***4.4 Consequences for training programs***

Giboin, 2015 suggests that we should avoid the general term “balance training”, as it favours a view of balance as a general ability and overall transferability of training effect from one balance task to another. Though our findings are slightly different from theirs, and the result from this study shows that there is possible to achieve some transfer, we agree with Giboin on this matter. What can be argued is that the term “balance training” favours an overall transferability of training effects is incorrect. Even though other studies have found no significant transfer between balance tasks, this study suggests that it is possible. To use the words overall transferability would be misleading. A more specific term that implies that transferability is possible, but not guaranteed would be more accurate.

Even though if the effects of balance training is mostly task specific, we now see that, it might not be entirely task specific. This suggesting that even though high specific training is the best way to increase performance, training programs might not need to be entirely task specific to increase performance of a skill.

### **5.0 Conclusions**

The training that were used in this study showed improvement not only in the specific task that were trained, but also improvement in the task with a lateral movement (0 degrees). Even though that the effects of balance training seems to be highly task-specific, this shows that transfer to different tasks are possible. So to answer the question if increasing similarity between two skills will increase the chance of finding transfer between them. The result of this study surly suggest so. By increasing the similarity between the skills to a higher level than (Giboin L., 2015), we were able to find transfer between two skills.

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**SAMTYKKE TIL BRUK AV PROSJEKT, KANDIDAT-, BACHELOR- OG MASTEROPPGAVER**

**Forfatter(e):** Vidar Estensen

**Norsk tittel:** Oppgavespesifisitet og overføringsverdi innen balansetrening.

**Engelsk tittel:** Task-specificity and transfer in balance training.

**Studieprogram:** Faglærerutdanning Idrett og kroppsøving

**Emnekode og navn:** 350 KIF

**Vi/jeg samtykker i at oppgaven kan publiseres på internett i fulltekst i Brage, Nords' åpne arkiv**

**Vår/min oppgave inneholder taushetsbelagte opplysninger og må derfor ikke gjøres tilgjengelig for andre**

**Kan frigis fra:** 26.05.2016

**Dato:** 26.05.2016

Vidar Estensen

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