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Music, verbal feedback and power output on  
a submaximal load in explosive bench press

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## **Preface:**

**I want to thank my supervisors Rolf Petter Ingvaldsen, Tore Kristian Aune and Håvard Lorås for guidance and support. The process of this master thesis has not only been long and time-consuming. It has led to challenges and frustration, but also mastery and an increased interest in the field. I would like to thank the participants, who took the time to assist in this study. And last but not least, my friends and family, who has been there for me in everyday life. You have been both my worst distractors and greatest supporters.**

# **Music, verbal feedback and power output on a submaximal load in explosive bench press**

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## **Abstract**

Many research studies have shown the effect of both music and verbal feedback on sport performance. The reversal theory supports the theory that external stimuli can increase performance, if the arousal level is optimal. This study's purpose was to determine the pros and cons of using music and verbal feedback during explosive bench press performance, and to assess which one has the greatest effect. The hypotheses were that the power output would increase during both conditions, because of the increased arousal level. Twelve female and male participants (Mean age = 22.8 yr., SD=1.3; M body mass = 76.5 kg, SD = 14.2; M height = 171.8cm, SD = 8.1) were tested in power output in bench press. They completed one repetition maximum (1RM) in bench press, and 4 sets of 5 reps on 40% of 1RM. Power output was presented in peak power, and was measured using the Muscledlab™ system, via a linear encoder. Statistical analysis showed significant increases on power output, supporting the hypothesis that music and verbal feedback would amplify arousal level. Verbal feedback had greater effect on peak power compared to music. The conclusion is that using music and verbal feedback during explosive bench press can be beneficial for power output, and that verbal feedback has greatest effect.

## **Musikk, verbal tilbakemelding og power på en submaksimal belastning i eksplosiv benkpress**

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### **Sammendrag**

Mange forskningsstudier har vist effekten av både musikk og verbal tilbakemelding på sportsprestasjoner. Omvendt teorien støtter teorien om at ytre stimuli kan øke ytelsen dersom nivået av arousal er optimalt. Formålet med studien var å fastslå fordelene og ulempene ved å bruke musikk og verbal tilbakemelding under eksplosiv benkpressprestasjon, og å vurdere hvilken som har størst effekt. Hypotesene var at powerproduksjonen ville øke under begge forhold, på grunn av økt nivå av arousal. Tolv kvinnelige og mannlige deltakere (Gjennomsnittsalder = 22,8 år, SD = 1,3; G kroppsmasse = 76,5 kg, SD = 14,2; G høyde = 171,8cm, SD = 8,1) ble testet i powerproduksjon i benkpress. De fullførte en repetisjon maksimum (1RM) i benkpress, og 4 sett med 5 reps på 40% av 1RM. Powerproduksjon ble presentert i peak power og ble målt ved bruk av Musclelab™-systemet via en lineær enkoder. Statistisk analyse viste betydelige økninger på power, og støttet hypotesen om at musikk og verbal feedback ville forsterke nivået av arousal. Verbal feedback hadde større effekt på peak power sammenlignet med musikk. Konklusjonen er at bruk av musikk og verbal feedback under eksplosiv benkpress kan være gunstig for powerproduksjon, og at verbal feedback har størst effekt.

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## **1.0 Introduction**

When going to a gym you experience, whether you are aware of it or not, different influences from the surroundings. The typical atmosphere characterizing the gym, is the music from the loudspeakers. Music is, in the gym, mainly used as a background accompany to exercise (Johansson, 1996). There are different reasons for the use of music. Some are ambivalent to the use of music during exercise, others use music only to share references when working out with others, and some even try to facilitate increased effort by sophisticating tailoring of playlists. Even though there are background music playing in the gym, many also choose to listen to their own music on their personal listening devices (Hallett & Lamont, 2014). This means that you do not escape music in the training situation, when exercising at the gym.

A somewhat different stimuli, occurring at the gym, is the influence of a personal trainer. A personal trainer can, like music, motivate and increase effort in an exercise. The stimuli of a personal trainer occur as a form of verbal feedback. The short definition of verbal feedback is social help given by a person, helping performers perform at their optimal level, and help them overcome challenges (Wallace, Baumeister, & Vohs, 2007). Both stimuli from music and verbal feedback can give three different outcomes. Either increased performance, decreased performance, or have no effect. The purpose of this study was to examine the effect of music and verbal feedback on power output in bench press, and to see if there were any differences in power output between the two external stimuli.

### ***1.1 Reversal Theory***

The reversal theory is a general psychological theory of motivation, personality and emotion. The theory describes eight pairs of opposites that in various combinations determine one's experiences and motives at a given time. It is applicable to all domains of human experience and behavior. The theory says a lot about what people desire, their vicissitudes and emotional makeup, personality, self-management, relationships and interpersonal dynamics, and about differences among people (Svebak & Apter, 1997).

So instead of describing what people generally desire, reversal theory describes the different things that people desire at different times, when they are in different states. In doing so, the theory focuses more on intraindividual differences (differences within the person over time) then on interindividual differences (differences between people). (Svebak & Apter, 1997, s. 4)

What someone want is in a way always temporary. As a result of frustration, satiation or contingencies it occurs switches between opposite states, which is called reversals. One cannot be in two opposite states at one time, nether in none of them (Svebak & Apter, 1997).

One can experience distinctly emotions, process information and think quite differently, when in different states. Telic and paratelic are two of the total eight opposite states described in this theory (Svebak & Apter, 1997).

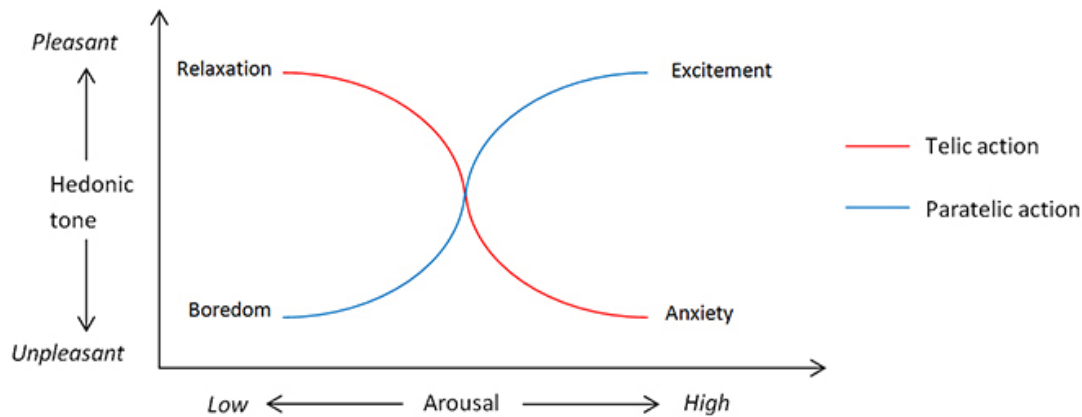


Figure 1: The relationship between felt arousal and hedonic tone in the conformist metamotivational state

The main aspects of the telic state focus on a serious, goal-oriented presence, and a desire for progress-achievement. Should there occur a threat to the goal, or a feeling of high felt arousal, one may recognize feelings such as fear and anxiety. When in the paratelic state on the other hand one occurs more playful, excitement-seeking and activity-oriented. Any emotion involving high arousal will in this state be perceived enjoyable (Svebak & Apter, 1997).

### 1.2 The inverted-U-hypothesis

*“The inverted-U-hypothesis states that performance will improve as arousal increases up to an optimal point, after which further increases in arousal debilitate performance”* (Martens, Vealey, & Burton, 1990, s. 93).

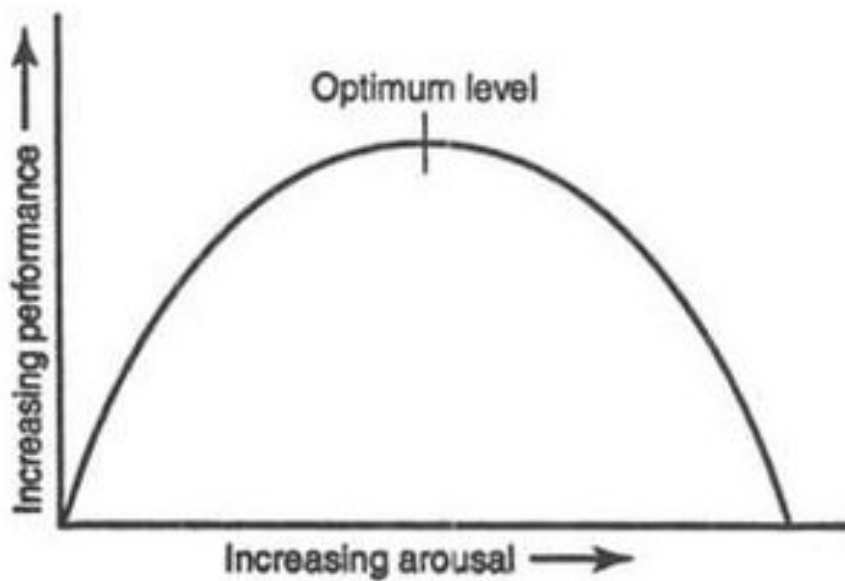


Figure 2: The inverted-U-hypothesis-graph; relationship between arousal and performance

The curvilinear function has the ability to shift to the right or left depending on the type of task (i.e., complex or simple) and individual characteristics (i.e., low or high skilled, introverted or extroverted). In the motor performance and psychological literature, the inverted-U relationship has been tested and used through several studies. It is argued that a moderate level of arousal should result in optimum performance (Arent & Landers, 2003). Furthermore, Oxendine (1970) suggests that weightlifting and other gross skills necessitate a higher level of arousal to reach an optimal performance, compared to fine motor skills like golf and archery.

### ***1.3 Music as stimulus during exercise***

Acoustic stimuli such as music or metronomes are often used in sports. Either its dance, a beep-test, workout at the gym, or going for a jog. Compared to other stimuli, music as an acoustic stimulus has motivational qualities that may enhance performance further (Bood, Nijssen, van der Kamp, & Roerdink, 2013). Some suggests that music may increase the overall training experience by making the exercise activities environment more pleasant. Even in situations where music don't seem to benefit performance, like high-intensity exercise, music is used due to the increased feeling of enjoyment, motivation to continuing the activity for a longer amount of time, and tolerance of effort (Hallett & Lamont, 2014).



Music influences human psychology by having an impact on attitude (Stork & Martin Ginis, 2016), behaviour, mood, cognition, emotion affect and fatigue (Copeland & Frank, 1991). Music also have the ability to draw the attention away from the feeling of pain and fatigue (Hutchinson, 2017), and make time pass (Karageorghis & Priest, 2011). When music is used this way, it can be described as a distractor in a way that may increase performance (Hutchinson, 2017). It seems that the reduction of pain is caused by the blood pressure and the respiratory rate decreasing. This might also lead to a reduction of anxiety (Koelsch & Jäncke, 2015). Karageorghis & Priest (2011) claims that music reduces perceptions of effort by ~10% in low-to-moderate intensity activities. One may also distinguish between pleasant and unpleasant music. The pleasant music has a higher ergogenic effect by increasing pain tolerance compared to unpleasant music (Silvestrini, Piguët, Cedraschi, & Zentner, 2018). According to general emotional theories, emotional response to music seem to be explained by arousal as the key factor (Richard, 2004).

Hutchinson (2017) describes a phenomenon, regarding the use of music in sports, called “the sweet spot”. Saying it occurs within a frequency between 125 to 140 bpm. This tempo seems to be connected to heart rate. Frequencies beyond 120 bmp is also characterized to be motivational music. Music beyond this threshold has shown ergogenic effects, compared to motivational natural music, which occurs at a frequency below 120 bpm (Karageorghis C. M., 2009).

There has been done a lot of research lately on the effects of music and its ergogenic effects on performance during physical activity and sports. The studies primarily focus on aerobic exercise (Biagini, Brown, Coburn, Judelson, & Statler, 2012). Still there are some studies regarding exercise forms like resistance training. Biagini et al. (2012) did a study on how self-selected music affect performance in an explosive exercise and found that it might be beneficial in acute power performance.

A study done by Yu (2014) investigated the effect of volume and tempo on background music in a manual lifting task. The music was used to determine maximum acceptable weight. The results indicated an increase in performance, using fast tempo background music, without enhancing perceived exertion. Both maximal acceptable weight of lift and heart rate was influenced by the tempo of the music.

In a sport related context, we can sum up the effect of music by describing three different outcomes. First, decrease performance, either by the music e.g. making us relax or distracting us from the task. Second, increase performance, by e.g. motivating us to increase our efforts,

or by distracting us from the feeling of fatigue or pain. The third outcome is music having no effect on performance.

### ***1.3 Verbal feedback***

Feedback is correcting an ongoing movement (Magill & Anderson, 2014). There are many different terms describing the same phenomenon; verbal feedback, social support, supportive audience etc. Wallace et.al. (2007) distinguishes between supportive audience and social support. They consider social support to be a more general concept than supportive audience. The broad definition of social support is help given from a person or anticipated by someone, which may help performers to overcome setbacks and challenges, and achieve the level of performance they are capable of.

*Indeed, the benefits of a supportive audience seem clear when one considers the large clinical literature showing benefits of social support. In particular, evidence that social support can provide a buffer against the detrimental effects of stress (e.g. Cohen & Wills, 1985) would seem to suggest that social support could reduce the performance pressure that can lead to choking. (Wallace, Baumeister, & Vohs, 2007, s. 430).*

Studies show the effect of supervision of a personal trainer on performance during resistance training. It led to a greater self-chosen workout intensity, greater initial 1RM strength values, and greater rating of perceived exertion values under resistance training (Ratamess, Faigenbaum, Hoffman, & Kang, 2008). In a study using moderately trained men, the results of direct supervised, heavy-resistance training were an increased magnitude and rate of training load. This resulted in an increased maximal strength gain compared with the unsupervised training group (Mazzetti, et al., 2000). Other studies show that informational feedback is important in facilitating student engagement, promoting positive perceptions of ability, and enhance performance in a demanding task (Fredenburg, Lee, & Solomon, 2013).

### ***1.4 Aim of this study***

We can draw a line between the states described in the reversal theory and the conditions (baseline, music and verbal feedback) in this study. The two different states (telic and paratelic) has two different outcomes based of the level of arousal. The telic state symbolizes the baseline condition, which is a passive condition. No external stimuli or deliberate manipulation. The paratelic state symbolize the two active conditions; music and verbal feedback. The idea is that the external stimulus will increase the arousal level in the situation. A higher arousal level occurs by giving the subjects either music or verbal feedback during

this condition. According to the reversal theory, arousal, when in the paratelic states, leads to a feeling of excitement. Therefore, this condition has the ability to positively influence the performance by increasing arousal.

When using the theory of the inverted-U-hypothesis in a sports context, we want to apply the optimal level of arousal to a situation, to achieve the best performance (Martens, Vealey, & Burton, 1990). There are many similarities between how the reversal theory is being used in this study and the inverted-u-hypothesis. Music and verbal feedback can be used as stimulus to enhance arousal level in a task. According to the inverted-U-hypothesis, performance will, to a point, increase synchronously with the level of arousal. If the arousal level from one of the stimuli gets too high the performance decreases.

The purpose of this study was to examine the effect of using music and verbal feedback as external stimulus on power output in explosive bench press. *Hypothesis:* The external stimuli will increase the arousal level, which will lead to an increase in tempo and power output. Differences is also expected between the two conditions, considering which one is more optimal for the bench press exercise.

## 2.0 Method

### 2.1 Subjects

Twelve recreational weight-training athletes (5 female and 7 male) aged 21-25 volunteered to participate in this study. All subjects had at least two years of resistance training experience, they were familiar with the bench press exercise and was absence of any illnesses and injuries that could affect the study. All the subjects are friends and acquaintances who study at Nord Univerity. I recruited them by asking those I knew had training background. Many of them are active football players, who play on the same student team as me.

Prior to testing, all subjects signed a consent form. The one used was the ethical principles for research by the Declaration of Helsinki, 1964.

Table 1: Characteristics of participants

	<i>Min</i>	<i>Max</i>	<i>Mean</i>	<i>SD</i>
<i>Age (years)</i>	21	25	22,83	1,27
<i>Bodyweight (kg)</i>	57,5	114	76,46	14,24
<i>Height (cm)</i>	161	187	171,75	8,1
<i>1RM (kg)</i>	30	110	69,17	26,27

<b>40% of 1RM (kg)</b>	12	45	27,9	10,71
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All subjects n = 12 completed the study.

## **2.2 Procedure**

### **2.2.1 1RM-test**

The subjects completed a warm up session before testing, based on submaximal loads. The participant was asked to predict their one repetition maximum (1RM) before coming in for testing. Submaximal loads, used in the warm up, was calculated out of their predicted 1RM.

They performed 10 repetitions (reps) at 50% of predicted 1RM, 5 reps at 70%, 3 reps at 80% and 1 repetition at 90%. The subjects got 3 min rest between sets. After the warm up, 3 attempts, with 3 min rest between tries, were given to determine their actual 1RM.

Between the 1RM-test and the experiment the subjects got 20 min rest to avoid muscle fatigue.

### **2.2.2 The experiment**

The 1RM-test were used to find each individual participant's submaximal load, which in this case was 40%. The 40% of 1RM was selected based on the fact that this percentage is near maximum for power output in explosive bench press. Multiple studies show that peak power occurs between 40-50% of 1RM (Thiesfield & Lovell, 2017), and some even at a load of 55%. These numbers are applicable to trained athletes, while for recreational weight-training athletes - which I'm using in this study – the peak power will occur at somewhat lower % of 1RM (Baker, Nance, & Moore, 2001).

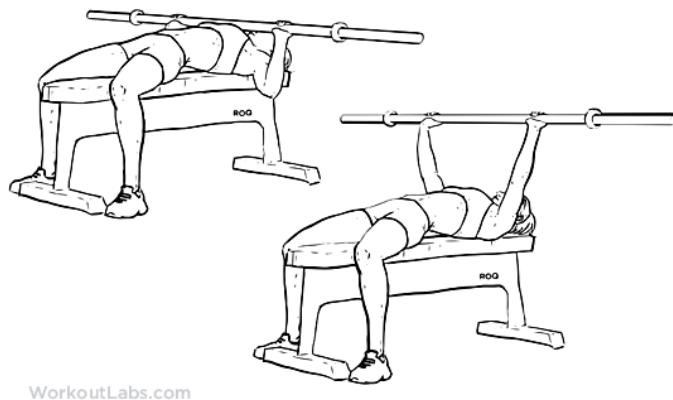
All participants were through four conditions; baseline, music, verbal feedback and posttest. In the baseline (B) and posttest (PT) condition, there were no deliberate manipulation. They were used as standard situations for comparisons. The order of the two other conditions were randomly selected, making half of the subjects doing the experiment in this order: baseline – verbal feedback – music-posttest, and the other half: baseline – music – verbal feedback-posttest. The verbal feedback (VF) was giving the subject on their performance during the exercise. I used phrases like: “give it all you got”, “that was a good one”, “keep it up”, “come on”, “I want to see you give it all on the last rep” and “good job”. The music condition (M) was based on the use of background music as an external stimulus. It was given prior to and during the condition. The music came from a loudspeaker placed close to the bench. The volume was set to high. The song used in the music condition was “Tiësto – Secrets”. The

same song was used for all subjects. It was chosen due to bpm (beats per minute). As describes in the introduction the song classifies as motivational music, and had a bpm of 128, which corresponds with the theory of the “sweet spot”.

On the submaximal load of 40% the subjects performed a set of 5 repetitions in each condition. They were instructed to perform the eccentric phase calmly and controlled, and the concentric phase explosive and at their maximum effort.

### ***2.2.3 Lifting protocol***

Prior to testing, the subjects were instructed on body position. Regulations by the International Powerlifting Federation (IPF) were used. The subjects had their buttocks, shoulders and head in contact with the bench, feet to the ground and back arced (International Powerlifting Federation, 2019). The subjects were allowed to find the position they deemed comfortable, if they did not violate any of the adjustments. They were instructed not to bounce the barbell on their chest, but to lower it for a touch.



*Figure 3: Demonstration of the bench press movement matching the regulations by (IPF)*

### ***2.3 Equipment***

The equipment used in this study was a linear encoder, which was attached to the barbell. The encoder was connected to a DSU (Data Synchronization Unit) which also was connected to the MuscleLab<sup>TM</sup> database on the computer. The speaker used was the JBL boombox.

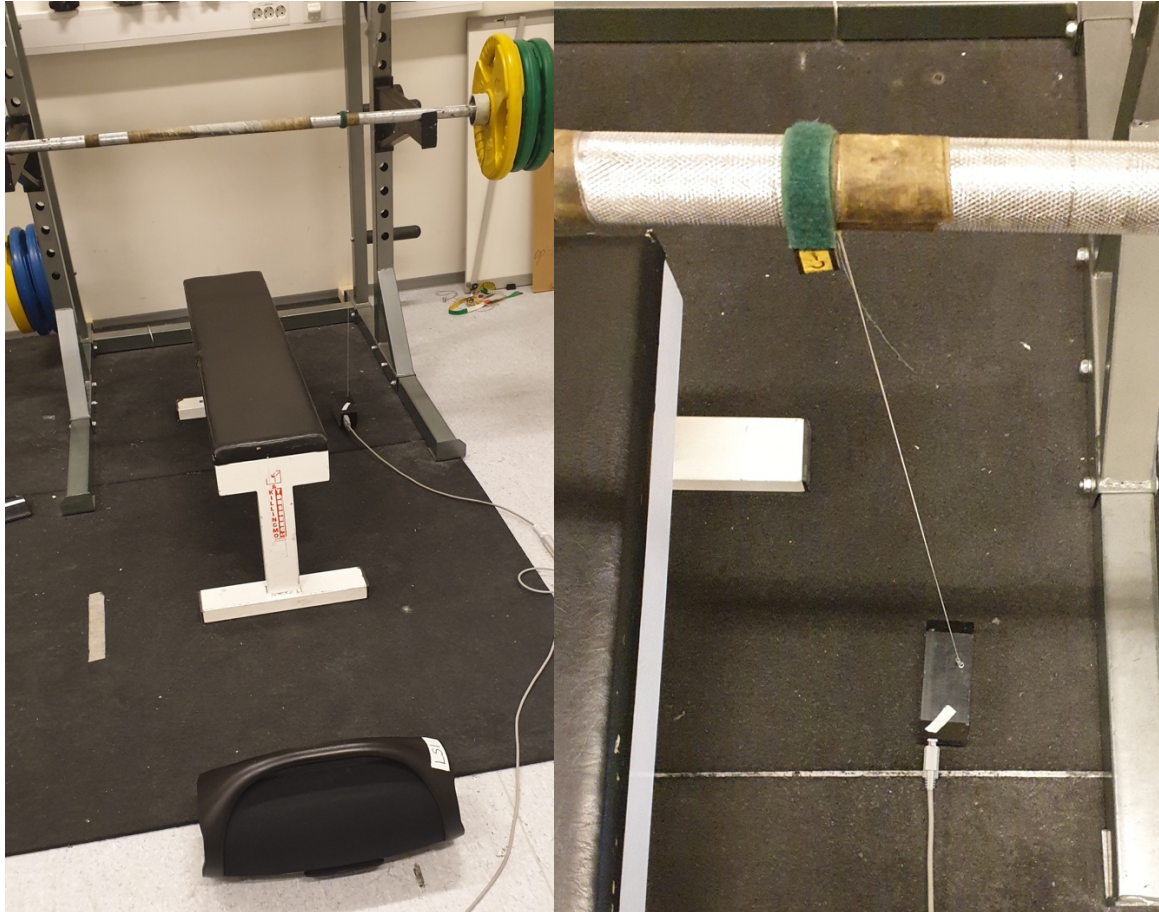


Figure 4: Setup and placement of bench, encoder and loudspeaker

## ***2.4 Statistical analyses***

Through all conditions, bench press measurements were taken for the submaximal load of 40% or 1RM. Results are presented in measures of peak power. The significance level was set at  $p \leq 0.05$ . IBM SPSS Statistics 23 was used to perform all statistical analysis. The hypothesis that the dependent variable (power output in bench press) could be changed by the independent variables (music and verbal feedback) was tested using the Friedman test. For calculating mean and standard deviation, standard statistical methods in IBM SPSS were used. A Wilcoxon signed ranks was used to compare the different conditions, and to see if the differences was significant. For the analysis of the reps within conditions, a Friedman test was used to compare all reps, and a Wilcoxon test was used between the lowest and highest value of reps in each condition.

## **3.0 Results**

Across all conditions (baseline, music, verbal feedback and posttest) measures of power output was done on a submaximal load of 40% of 1RM in bench press. For measurement,

peak power was used. Each subject performed a set of 5 reps in each condition. A Friedman test, comparing all conditions showed a significant level of  $p=0.000$ .

The data for peak power from all conditions are shown in figure 5. The figure shows a significant increase (7,7% of average peak power) between the baseline and music ( $p=0,00$ ). Posttest had a sig. increase (6,58%) from music ( $p=0,000$ ). There was also a small increase (1,87%) between Posttest and verbal feedback, but it was not significant ( $p=0,363$ ). The greatest increase (16,16%) occurred between baseline and verbal feedback ( $p=0,000$ ). This shows that, out of all conditions, verbal feedback had the greatest effect on peak power. The biggest difference between conditions was found between Baseline and verbal feedback.

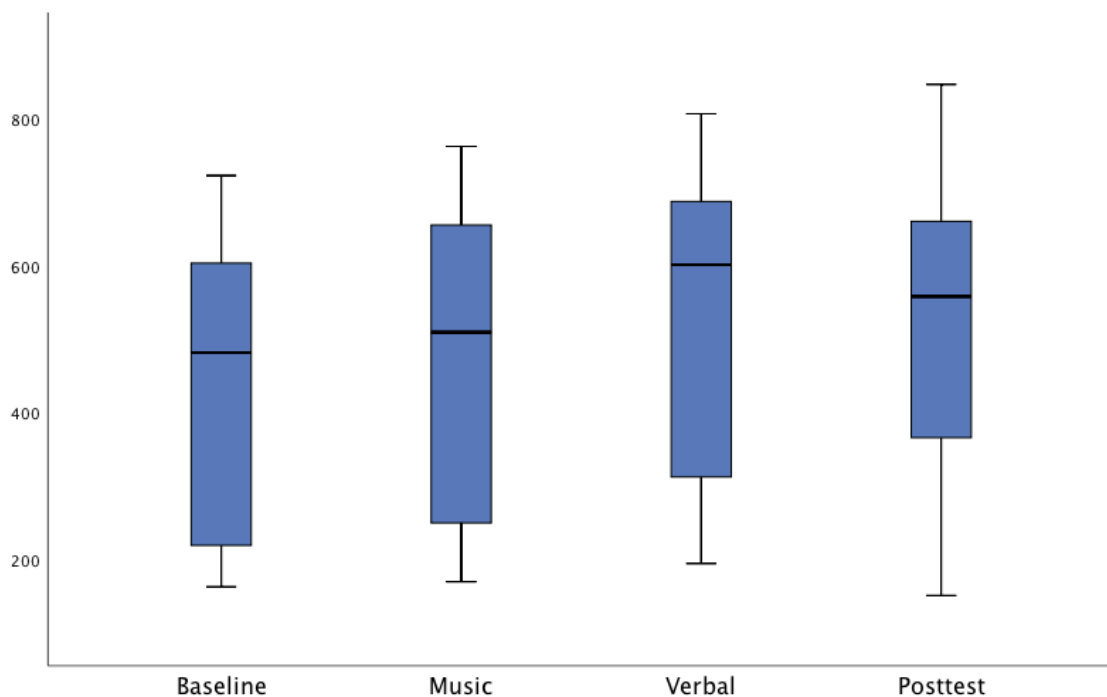


Figure 5: Peak power by condition

Figure 6 shows peak power arranged by rep. There were no significant differences between reps within conditions, when comparing all reps. Comparing the lowest and highest value of reps in each condition, also resulted in a nonsignificant score.

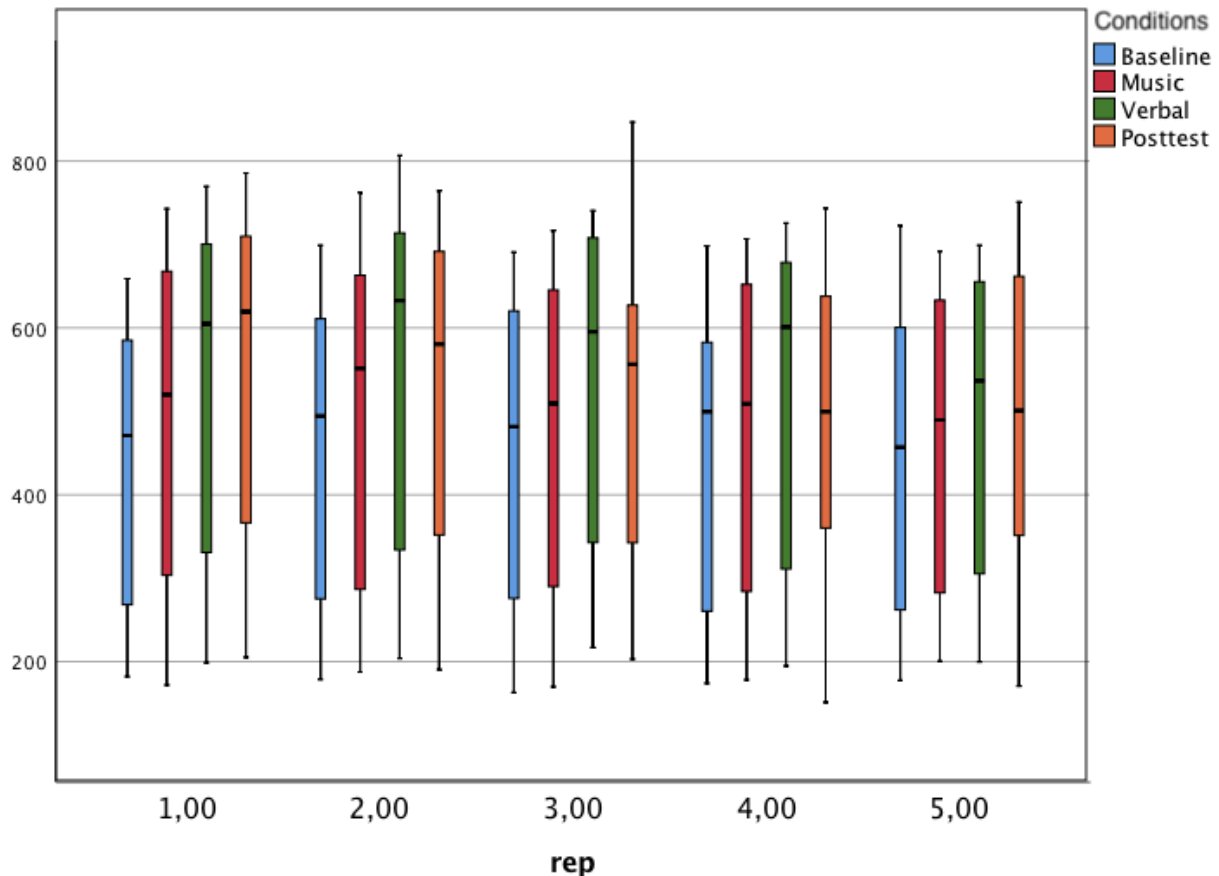


Figure 6: Peak power arranged by rep

#### 4.0 Discussion

The purpose of this study was to test if two external stimuli (music and verbal feedback) had an effect on power output in bench press. These stimuli were chosen due to the hypothesis that increased level of arousal would increase performance. The hypothesis was that music and verbal feedback would both increase power output by increasing tempo.

The main findings were the significant increase from baseline to music, and from music to verbal feedback. In this particular task both the external stimulus (music and verbal feedback) had a positive effect on power output. It seems that verbal feedback is a better fitted stimulus for this particular exercise compared to music, even though both stimuli resulted in an increased performance. The hypothesis has been confirmed due to the increase of peak power.

These results also support the theory that the increase between baseline and music visualize the difference between the telic and paratelic state. The baseline condition symbolizes the telic state, having low arousal level. A feeling of low arousal in this state will be perceived relaxing (Svebak & Apter, 1997).



The paratelic state is symbolized by the external stimulus. In this state a high level of arousal leads to the feeling of excitement. That fact that music and verbal feedback symbolizes the paratelic state, and baseline symbolizing the telic state is more of a hypothesis than a fact. The reversal theory describes two states whom, depending on which state a person is in, determines the outcome of the arousal. Had the arousal level of the stimuli been too high, it could have resulted in a decrease of performance. Power output being the unit of measure.

Based on the results, the verbal feedback condition had a greater effect on increasing power output compared to music. Using the reversal theory, verbal feedback seems to have a more optimal level of arousal. It seems that the participants felt a higher level of arousal through verbal feedback than music.

The inverted-U-hypothesis is a theory based on the relationship between arousal and performance in athletes (Raglin, 1992). When looking at the results in a light of this theory, these are the main reflections; baseline had a low arousal level leading to a low level of performance. Music had an improved level of performance. Based on this theory the improvement can be explained by the music enhancing the level of arousal. compared to baseline, music had a higher level of arousal. The inverted-U-hypothesis is based on the idea that a moderate level of arousal is ideal for an optimized athletic performance. However, due to individual differences and sport requirements, the placement of the inverted-U on the arousal continuum vary (Spielberger, 2004). In principal, this means that the music condition either was too low or too high compared to the optimal level of arousal. The subjects achieved the greatest score of peak power during the verbal feedback condition. This means that the arousal level was closer to optimal during this condition.

Previous studies have also shown effects of verbal feedback. Verbal feedback has proven to be an effective and simple aid when producing optimal power output (Staub, et al., 2013). The level of arousal making the optimal performance level is relative. In this particular study, verbal feedback seems to have the most suitable level of arousal for this certain task and group of individuals.

#### ***4.1 Individual differences within use of music***

My participant group was a non-homogeneous group, with big dissimilarities in terms of strength in bench press (1RM). Their 1RM ranged from 30 to 110kg. Brownley et al. (1995) describes a difference between the effect of music on athletes compared to novices. It seems that novices have a higher benefit from listening to music, and that the effect on athletes was counterproductive. The athlete's internal rhythm is higher compared to novices, and therefore

the music seems to be more of a distraction than an aid. This might be caused by the music not matching the athlete's higher internal rhythm, which makes it harder to entrain to the music.

Concentration and distraction also appear to be central concepts. Novices and regular exercisers seem to benefit from the music, by distracting them from the task and the feeling of fatigue. Athletes however, seem to require more concentration in carrying out tasks. This suggests that due to the difference in internal tempo, a personalized tempo would be more beneficial for athletes (Brownley, McMurray, & Hackney, 1995). It should also be said that athletes aren't able to use music during contests and performance, as in athletics, team sports, marathons, powerlifting or cycle races (Storheil, 2017). Based on Brownley et al. (1995) theory, the participant may react differently to the music, which may weaken the effect of the music.

Music research is difficult because of its individual factors. Music has the ability to influence human psychology, including mood (Copeland & Frank, 1991). Performance may also vary due to if the participant finds the music pleasant or not (Silvestrini, Piguet, Cedraschi, & Zentner, 2018). By using the same song for all participants, I achieve equal stimuli, but cannot control the extent to which they find the song pleasant or unpleasant. This may cause the participant to either perform at a lower or a higher level compared to not using music. Should some of the participants react negatively to the music, then this will affect the results of the music condition. In this case a different song or using a self-chosen song could give a different result. A self-chosen song will maximise motivational benefits (Priest & Karageorghis, 2008).

#### ***4.2 Methodological reflections***

The result showed no statistical difference between the verbal feedback and the posttest ( $p=0.363$ ). Still there was an extensive difference between the baseline and the posttest. Neither of the conditions had external stimuli. Their function was comparison. This big dissimilarity between them might be described by the effect of learning. But, because of the small number of reps in this study, a learning effect is unlikely. A better explanation is the effect of arousal, and how it does not simply vanish after a condition. There were only minutes between conditions. This means that the high level of performance in the posttest condition is the sum of the arousal given in both music and verbal feedback condition. Staub et al. (2013) experienced this as well during an experiment using feedback. The external stimuli did not only enhance performance during their condition, but also had an effect on performance during the subsequent conditions. In this study, this means that the participants

perform at an enhanced level in the posttest condition, despite no external stimuli. They describe this mechanism as speculative, but points to feedback's important abilities when fatigue is present (Staub, et al., 2013).

## **5.0 Conclusion**

Music and verbal feedback both seem to have an effect on peak power in explosive bench press. Verbal feedback increased peak power further compared to music and seem to have the greatest effect.

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Figure 1: Retrived from <http://www.dsource.in/course/designing-children-play-and-learn/play-theories-and-design/apter's-reversal-theory>

Figure 2: Retrived from <https://www.togsoccer.com/single-post/2015/10/27/Applying-the-Inverted-UTheory-to-Soccer>

Figure 3: Retrived from <https://workoutlabs.com/exercise-guide/barbell-bench-press>