The effect of performance feedback on current behaviour versus performance feedback in terms of health outcomes on cycling performance in older adults

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The Effect of Performance Feedback on Current Behaviour versus Performance Feedback in Terms of Health Outcomes on Cycling Performance in Older Adults

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Abstract

This study examined the effects of feedback valence and feedback type on cycling duration in older adults (age 56-98) living in a rehabilitation centre or care facility. Data were collected from participants who cycled on an indoor bicycle in a laboratory setting (N=50). Results demonstrated that participants who received feedback that was explained in terms of the effects of physical activity stayed longer on the bicycle than participants who received feedback solely about their current cycling behaviour. No differences were found for feedback valence. Furthermore, results suggested mediation effects of self-efficacy, indicating that after receiving feedback participants stayed longer on the bicycle because it increased their self-efficacy.

Keywords: persuasive technology, stroke, physical activity, self-efficacy, intervention

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1. Introduction

In the Netherlands in 2000 over 41.000 people suffered from a stroke and in 2003 216.500 people who suffered from a stroke were living independently at home. Because of the ageing population this number is expected to increase as well as the number of repeated strokes. The Netherlands National Institute for Public Health and the Environment indicates a stroke being in the top ten of most expensive diseases because of the complex treatment (Rijksinstituut voor Volksgezondheid en Milieu, 2011).

A stroke is a cardiovascular disease, which affects the blood vessels that supply blood to the brain. A stroke is caused either by a blockage of an artery supplying blood to the brain or a bleed into the brain from a burst blood vessel. As a result, the affected area of the brain is unable to function, which might result in an inability to move one or more limbs on one side of the body, inability to understand or formulate speech, or an inability to see one side of the visual field (Rijksinstituut voor Volksgezondheid en Milieu, 2011). After having been hospitalized patients that have lost such brain functionality are admitted to a rehabilitation centre. The major goals of stroke rehabilitation are improving mobility and help people regain their independent lives (van de Port, 2006). When back home, an active lifestyle will contribute to maintaining or even improving both physical and cognitive functioning (Hertzog, Kramer, Wilson, & Lindenberge, 2009) that were regained during the rehabilitation program as well as decrease the risk of repeated stroke (van de Port, 2006). However, between one and three years after rehabilitation, about one fifth of the patients showed significant mobility deterioration. Inactivity, as well as cognitive problems, fatigue and depression have shown to be important predictors of this mobility deterioration (van de Port, 2006).

In this thesis, we assume that an active lifestyle will increase a patient's quality of life and decrease the amount of patients depending on continuous and expensive (physiotherapeutic) care. It covers a quantitative study that investigates a way to motivate stroke patients, by means of technology, to keep an active lifestyle when returning home. The current research is part of the international project SUSTAIN (InveStigating and Stimulating long Term walking Activity IN stroke) that aims to gather knowledge about the optimal measuring of walking activity of stroke patients living at home and to explain the factors underlying this behaviour. Specifically, the quantitative study covered in this thesis focuses on the question

whether specific types of feedback during activity have an effect on the activity level of the patient and on the patient's belief he can be physically active. The insights gathered in this study can be used as a basis for the design of a tool, product, or service targeting this group, meeting their needs, and physical, and mental abilities to help patients to form the belief that they can become more physically active.

The report is set up as follows: Chapter 2 presents findings from literature. It discusses two cognitive models that attempt to predict behaviour and elaborates on the most important factors that account for mobility deterioration in stroke patients living at home. It also shows findings from studies involving applications that (aim to) increase physical activity levels or behaviour relevant to the current project. The applications presented in this chapter cover a wide variety of current developments in the field. Chapter 3 states and motivates the research questions that are addressed in the study. Chapter 4 describes the study that investigates the relationship between physical activity, specific feedback about physical activity and self-efficacy. Chapter 5 reveals the results of the study and finally, Chapter 6 concludes and discusses the project.

2. Literature study

The current study attempted to find a way to motivate stroke patients to engage in more physical activities. Motivation is the driving force by which humans achieve their goals, it initiates, guides and maintains goal-oriented behaviours and causes us to act (Petri, 1996). Motivation can be either extrinsic or intrinsic. Extrinsic motivations stem from outside of the individual and often involve rewards such as trophies, money, social recognition or praise. Intrinsic motivations come from within the individual, such as solving a complicated puzzle purely for the personal satisfaction one gets out of solving a problem (Petri, 1996).

Earlier research has investigated the factors that underlie individuals' motivation to engage in physical activities and a large number of determinants have been identified to be either directly or indirectly related to the degree of participation in exercise and physical activity (McAuley & Courneya, 1993). Two of the more commonly applied cognitive models that attempt to predict behaviour will be explained in detail in the following sections. Those are Bandura's (1997) self-efficacy theory (Section 2.1) and Fishbein and Ajzen's (1991) theories of reasoned action and planned behaviour (Section 2.2). Over the past, both theories have gained a lot of attention in the domain of physical activity and exercising behaviour (McAuley & Courneya, 1993).

2.1 Theory of Self-Efficacy

Self-efficacy theory has been widely used in research on health-promoting behaviour and *self-efficacy* has been shown to be one of the most important determinants of physical activity or exercise behaviour. Self-efficacy plays a central role in Albert Bandura's (1997) social cognitive theory and has been defined as "the *belief* that one is capable of performing certain behaviours and to attain certain goals" (Bandura, 1997). It answers the question whether we belief that we *can* do something. Self-efficacy beliefs influence how we feel, the choices we make, as well as the effort we put into something and how long we persist when we confront obstacles. The stronger one's self-efficacy beliefs, the more likely the individual will initiate and persist a specific behaviour. Self-efficacy beliefs affect how we motivate ourselves (Bandura, 1997) and it has been shown that self-efficacy mediates the influence of motivations on behaviour. If motivation is present, but people see the behaviour as impossible, the behaviour will not be executed (Bandura, 1997). Thus even though

our target group is motivated to engage in physical activities, if they do not have the *belief* that they are capable of performing physical activities they will tend to continue living a sedentary lifestyle.

2.1.1 Sources of self-efficacy.

In order to change patients' sedentary lifestyle and help them to become more physically active, we need to know more about the sources that influence people's beliefs about their efficacy. According to Bandura (1997) four different sources of influence can be distinguished: mastery experience, vicarious experience, verbal or social persuasion and physiological states.

Mastery experience, the first source of influence, is a result of performance accomplishments by the individual. Successes increase one's self efficacy level. However, if this success is reached in an easy way one is also more quickly discouraged by failure. For example, "Bronkie game" is a kids game to manage asthma, where they have to manage Bronkie the dinosaur's asthma with tasks that are similar to those for human asthmatics. Playing the game for 30 minutes showed increased self-efficacy in caring for their condition and believed they can successfully manage their asthma. The interactive game-experience increased self-efficacy more than passive experiences, like watching a videotape on the same topic. Probably the possibility to repeat the behaviour and gave children confidence about their ability to perform the behaviour in the real world (Fogg, 2003).

The second source of influence is *vicarious experience*; seeing people similar to oneself succeed by sustained effort raises observers' beliefs that they too possess the capabilities to master comparable activities required to succeed. Community and group-based walking led to increased exercise behaviour and increased self-efficacy (McAuley, 1994). However, in research done where cardiac patients had to exercise with their spouse, self-efficacy was only increased when the spouse was watching. When the spouse was participating, patients' self-efficacy and level of physical activity dropped significantly (Taylor, 1985), possibly because of the difference in fitness. Therefore it is important to find a good source of comparison when using vicarious experience as a source of influence.

Thirdly, people who are told, by for example others, that they possess the capabilities to master given activities are likely to mobilize greater effort and sustain it. This is called *social persuasion*. In a 24-week intervention study De Greef (2010)

found that telephone support had a lasting positive effect on physical activity. However, to raise unrealistic beliefs of personal capabilities only invites failures that will discredit the persuaders and further undermine the recipients' beliefs in their capabilities. To most people the term *social* refers to a characteristic of living organisms, therefore we would like to extend the view of *social persuasion* to passing along a *persuasive message*. People tend to treat computers and other media as if they were either real people or real places (Reeves & Nass, 1996), therefore not only living organisms, but also media or technology, like a robotic agent, can tell us we possess the capabilities to be physically active.

The final source of providing information about efficacy beliefs are *Physiological and affective states* such as anxiety, stress, arousal, and mood states. For example, in activities involving strength and stamina, people judge their fatigue, aches and pains as signs of physical debility. The elderly are not aware of the contribution of physical activities to their health, but mention poor health as a barrier to engage in physical activities (Schutzer & Graves, 2004;King, 2001). An example of anxiety is the fear of falling among older adults, which is specific a health problem in which older adults show low perceived self efficacy at avoiding falls during essential, non hazardous activities of daily living (Scheffer, Schuurmans, van Dijk, van der Hooft, & de Rooij, 2008).

As some of the examples above have shown, previous research suggests that self-efficacy can be a predictor of diverse forms of health-related behaviour, however will be most predictive when measured in relation to the specific behaviour in question (Bandura, 1997). Furthermore, it has shown that giving feedback about physical performance has been shown to improve perceived self-efficacy and therefore physical activity in various types of populations (Bandura, 1997) such as the elderly (Ashford, Edmunds, & Fren, 2010; McAuley, Jerome, Elavsky, Marquez, & Ramsey, 2003), type 2 diabetes patients (De Greef, et al., 2010), Cardiac patients (Taylor, 1985) and COPD patients (Toshima et al. 2009).

2.1.2 Self-efficacy and outcome expectancies.

Self-efficacy is a judgment of one's ability in performing certain behaviours, whereas an outcome expectation is a judgment of the likely consequences such behaviours will produce. For example, the belief that one can run a marathon is a *self-efficacy judgment* and the social recognition, applause, self-satisfaction or physical

health benefits form the *outcome expectations*. Where performance (or accomplishment) determines outcome, efficacy beliefs account for most of the variance in expected outcomes. It has been shown that when the differences in efficacy beliefs are controlled, the positive outcomes expected for given performances make little or no independent contribution to prediction of behaviour. That is, in general people are aware of the positive effects of physical activity on their health (outcome expectancies); however, they have the belief they cannot be physically active themselves (self-efficacy) and therefore continue their sedentary lifestyle (e.g. King, 1998; Ashford et al., 2010). For example, in a study done by Shannon et al. (Shannon, Bagby, Wang, & Trenkner, 1990) it was found that outcome expectations were not predictive of eating behaviour and the intention to lose weight, but rather self-efficacy contributed significantly to explanation of eating behaviour. People might be aware of the positive health effects of certain behaviour, but when they have low self-efficacy they will not perform this behaviour. McAuley and Cournya (1993) have suggested an intervention strategy that underscores the effect of physical activity on the quality of life, or other goals with respect to regular physical activity, and convincing people that they are efficacious of physical activity in achieving such goals. In sum, giving people the belief that they can successfully change their physical health not only by giving them feedback about their current behaviour, but at the same time by showing them the effects their current behaviour has on their health might boost self-efficacy and therefore increase physical activity.

2.2 Attitudinal Influences

The attitudinal approaches that possibly gathered the most attention in the domain of physical activity are the theory of reasoned action and its extension, the theory of planned behaviour (Fishbein & Ajzen, 1975; Ajzen, 1991; Ajzen, 1985). The theory of planned behaviour states that personal attitude, subjective norms, and perceived behavioural control (PBC), together shape an individual's behavioural intentions and behaviours. People will intend to perform a behaviour when they evaluate it positively (personal attitude), believe that important others think they should perform it (subjective norm) and perceive it to be under their own control (PBC). PCB and self-efficacy are essentially the same concept using different names, however, self-efficacy is incorporated within the individual an solely cognitive while

PCB also takes environmental and other external aspects into account. For example, health practitioners tend to have high self-efficacy for hand washing (believing that they are able to do it). However, they may report lower PBC due to external constraints such as lack of time or the absence of a sink. As with self-efficacy, attitudes and subjective norms should be measured in relation to the behaviour in question (e.g. physical activity), target (improve health), context and time.

In a comparison of Social Cognitive Theory (SCT) and the theories of reasoned action and planned behaviour, Dzewaltowski (1990) found positive relationships between exercise behaviour and intention, attitude and self-efficacy. Attitude and perceived control predicted intention, and intention predicted physical activity participation. Attitude has been shown to be a better predictor of intention than subjective norm. SCT variables significantly predicted physical activity participation; self-efficacy and self-evaluation of the behaviour contributed significantly to prediction. The greater the confidence in participating in physical activity and the greater the satisfaction with present physical activity, the more physical activity performed. SCT constructs were better predictors of physical activity than those from the other theories and self-efficacy showed to be a significant unique predictor of exercise behaviour. If a person is not self-efficacious about their ability to, for example, impact their physical health, they are not likely to change their attitude or behaviour about physical activity. Consequently, in order to change a persons physical activity level it would be necessary to influence a persons self-efficacy. As discussed in Section 2.1.1, feedback about physical performance improves self-efficacy and therefore physical activity in various types of populations. Technological solutions create opportunities to give feedback about physical performance.

2.3 Feedback by means of Persuasive Technology

The current section shows findings from studies involving applications that aim to increase physical activity levels or behaviour by giving feedback about this behaviour, therefore it is important to know what feedback actually is. Feedback can be defined as "specific information about the comparison between an observed performance and a standard, given with the intent to improve the performance" (van de Ridder, Stokking, McGaghie, & ten Cate, 2008). Feedback can be either *positive* or *negative*. Research done in the field of self-efficacy has mainly focussed on giving

positive feedback such as praise or compliments, but the combination of positive and negative feedback is more usual. Research done in other fields has shown positive effects of giving negative feedback as compared to giving positive feedback (e.g. Ham & Midden, 2009; Vossen, Ham, & Midden, 2009). Negative feedback has shown a greater behaviour change; it has been suggested that negative feedback can help people change their behaviour because they now have an indication of what they could change while positive feedback tells people they are already doing well so there is nothing to change.

There are various ways to provide feedback, like factual, evaluative, social, or ambient feedback. *Factual feedback* is, as its name already suggests, based solely on facts. Examples of factual feedback are the amount of calories burned displayed on an exercise machine or a pedometer showing the amount of steps a person has taken. Feedback in terms of good or bad performance is called *evaluative feedback* (Vossen, Ham, & Midden, 2009).

Social feedback may come in the form of social praise and compliments or signs of disapproval. Social feedback can be provided by real people as well as an (intelligent) robotic agent. Research on self-management in dieting and exercise behaviour used a persuasive computer assistant that provided feedback about participants goals (Figure 1, Blanson Henkemans, van der Boog, Lindenberg, van der Mast, Neerincx, & Zwetsloot-Schonk, 2009). The facial expressions of a robot cat (iCat) were used to show whether it was satisfied about participants reached goals. The results showed that when making use of this assistant participants filled in their online diary regularly and lost more weight than the control group that did not use the assistant.

Ambient feedback is a form of feedback that is easier to process than for example factual feedback. It uses technology that is embedded into our surroundings and that responds to our presence and reacts to our behaviour without us being fully aware of it and without the need of conscious processing (Maan, Merkus, Ham, & Midden, 2011). This type of feedback can be given by, for example, sound, airflow, water movement or light. An example of an ambient display is UbiFit's Glanceable Display (Figure 2, Consolvo, et al., 2008), an aesthetic image that is displayed on the background screen, or "wallpaper," of the individual's mobile phone. It shows information about physical activity behaviour and goal achievements.

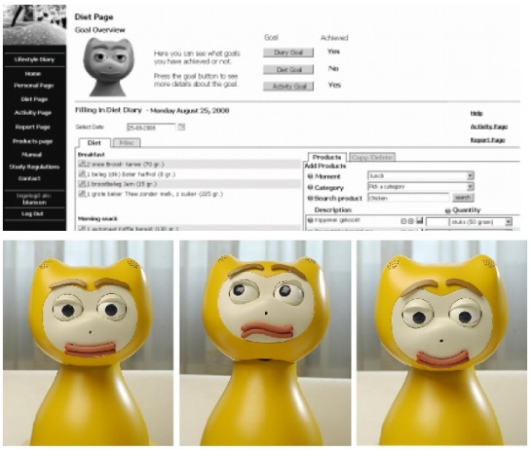

Figure 1 Persuasive computer assistant providing social feedback on self-management in dieting and exercise behaviour (Blanson Henkemans, van der Boog, Lindenberg, van der Mast, Neerincx, & Zwetsloot-Schonk, 2009)

Figure 2 UbiFit display (Consolvo, et al., 2008)

The examples of applications are known as *persuasive technology* which are defined as "interactive computing systems designed to change people's attitudes or behaviours" (Fogg, 2003). For example "Dance Dance Revolution" uses video, music, and a dance platform to capture interest and engage children in the activity without their being fully aware that they are exercising. The emerging field of persuasive technology has great potential for promoting physical activity and healthy behaviours (Fogg & Eckles, 2007) and allows us to visualize the future health effects of our current behaviour and at the same time give feedback about our performance and helps us change people's behaviours.

2.4 Conclusion

In general people are aware that an active lifestyle leads to better health (e.g. King, 1998; Ashford et al., 2010), but why don't we live an active lifestyle? In this chapter two theories of explaining physical activity and health related behaviour have been discussed. Self-efficacy has been shown to be a remarkably consistent predictor of exercise, physical activity and other health related behaviours. Self-efficacy has been defined as "The *belief* that one is capable of performing certain behaviours and to attain certain goals" (Bandura, 1997). People know what the consequences are of an active lifestyle, but we simply do not have the belief that we are capable of realizing such an active lifestyle (e.g. King, 1998; Ashford et al., 2010). Earlier research on physical activity in older adults mainly focussed on exercise behaviour, while the current research focus is on physical activity in daily life. The scope of the

current research falls within the intervention strategy suggested by McAuley and Cournya (1993) that has not yet been investigated in much detail, especially not in relation to stroke patients. They propose that making people aware of the health benefits of their behaviour and convincing the individual that they are efficacious of physical activity might increase self-efficacy. Moreover, feedback about behaviour has been shown to have an effect on self-efficacy. Nevertheless, research investigating the effects of performance feedback on self-efficacy has mainly focussed on solely praising and rewarding people and telling them they have performed well, while research done in other fields found interesting effects of negative feedback. Also receiving a combination of both positive and negative feedback seems more common. Therefore it would be interesting to investigate the effects of a combination of both positive and negative feedback, or realistic feedback, and it's relationship to self-efficacy.

Persuasive technology has proven itself to be able to change behaviour and get people to engage in more physical activity (Fogg & Eckles, 2007). Especially in health-care, the use of persuasive technology can be a cost-effective solution for the labour shortage that health care institutions are facing today. The use of technology allows us to visualize the future health effects of our current behaviour and at the same time give feedback about our performance.

3. The current research

The literature study suggested that feedback about behaviour has an effect on self-efficacy and therefore on performance (Bandura, 1997) and that positive outcome expectancies do not have an independent contribution to the prediction of behaviour. Nevertheless, as suggested by McAuley & Courneya (1993), making people aware of the health benefits of their behaviour and at the same time convincing patients that they are efficacious of physical activity might increase their self-efficacy. Furthermore, literature suggests self-efficacy can directly be influenced by a *persuasive message*. Technology allows us to give people real-time feedback about their current behaviour and at the same time visualize the future effects of that behaviour, therefore, in the current study this persuasive message will be in the form of performance feedback passed along by persuasive technology. Specifically, it allows us to praise patients' achievements and simultaneously showing the direct effect those achievements have on their health. The current research aims to build scientific theory that explains the effects of a persuasive technology-based form of feedback that influences self-efficacy, and therefore patients' performance, by giving patients performance feedback about their current physical-activity behaviour (behaviour-based feedback) and performance feedback in terms of health outcomes (outcome-based feedback). In order to investigate the effect of this specific feedback the following research questions were defined:

Q_1: What is the effect of positive versus realistic feedback in terms of health outcomes, as compared to positive versus realistic feedback about the current behaviour, on indoor cycling performance in older adults?

Q_2: Are these effects mediated by self-efficacy?

Based on the literature study the following hypotheses are proposed regarding the first research question (relationships in question are illustrated in Figure 3):

$H_{1.1}$: Feedback about behaviour has been shown to increase self-efficacy and therefore performance (Bandura, 1997), hence it is hypothesized that all types of feedback are expected to increase performance.

$H_{1.2}$: Performance feedback in terms of health outcomes, as compared to performance feedback about current behaviour, will lead to a greater increase in physical activity.

$H_{1.3}$: Various studies have shown positive effects of giving negative feedback as compared to giving positive feedback (e.g. (Ham & Midden, 2009); (Vossen, Ham, & Midden, 2009)) Therefore it is hypothesized that realistic feedback, when it leads to receiving a combination of negative and positive feedback, will lead to a greater increase in performance as compared to solely positive feedback.

$H_{1.4}$: Following the argumentation in $H_{1.2}$ and $H_{1.3}$ an additive effect is expected as shown in Table 1, as it hypothesized that realistic feedback as well as feedback in terms of health outcomes lead to a greater increase in performance.

Table 1 Additive effect of the four types of feedback on performance

Feedback Valence	**Feedback type**	
	Behaviour-based	**Outcome-based**
Positive	+	+++
Realistic	++	++++

The following hypothesis is proposed regarding the second research question:

H_2: Self-efficacy predicts physical activity (Bandura, 2005). Therefore it is hypothesized that the effect of performance feedback on physical activity is fully mediated by self-efficacy. Other research suggests that giving negative feedback or negatively framing a health related message will increase an individual's self-efficacy. Therefore it is hypothesized that performance feedback in terms of health losses, as compared to performance feedback in terms of health gains, will increase participants' level of self-efficacy and therefore the effect of positive verses realistic feedback on performance will be mediated by self-efficacy in physical activity.

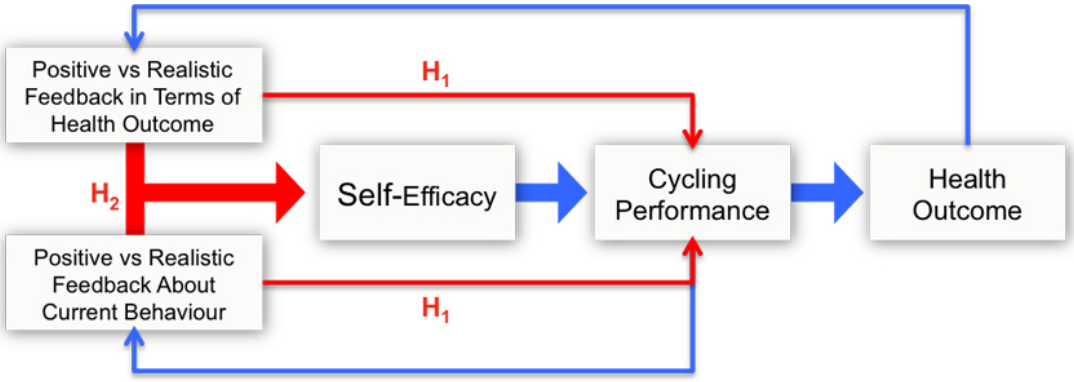

Figure 3 Diagram illustrating the relationships regarding both research questions and their hypotheses (H_1 and H_2).

4. Method

4.1 Participants and Design

Fifty Participants with an age ranging from 56 to 98 years *(M = 75.02, SD = 10.95)*, gender evenly distributed (52% female), were recruited from a rehabilitation centre/nursery home where they were currently living. Participant characteristics can be found in Table 2. All participants were currently under physiotherapy treatment, in which they performed various exercises and activities of which cycling is a regularly returning activity. Among participants there was a large variability in type of care, ranging from day-care to nursery; participants in nursery were cognitively and physically able to participate in the experiment. A majority of participants rated their health being fair to good. Thirty-eight percent of the participants had suffered a stroke, which was the primary target group of the current research.

Table 2 Patient characteristics.

Socio-demographic	
Age (years)	56-98 (M=75.02)
Female gender (%)	52
Type of care (%)	
Rehabilitation	26
Day-care	18
Temporary care	18
Care	24
Nursery	14
Disease (%)	
Stroke	38
Broken	14
No home care	14
Dementia	10
Other	24
Physiotherapy (%)	
Once a week	66
Every other day	18
Every day	16
Self rated health (%)	
Poor	28
Fair	32
Good	32
Very Good Excellent	8

To investigate the hypotheses mentioned in section 3 , participants participated in a 2 (feedback type: outcome-based vs. performance) × 2 (positive vs. realistic) × 2 (pre- vs. post-manipulation) mixed design, with type of feedback as independent variable, performance as dependant variable and self-efficacy as mediator variable.

Each participant participated in one of the four experimental conditions (Table 3). All participants completed the whole experiment.

The lab-experiment took place on an indoor bicycle in the exercise area of the physiotherapist (Figure 4) and was spread over two sessions, one session per week. In the first session a baseline measurement of performance was assessed and during the second session the manipulation took place. To keep conditions as equal as possible throughout sessions, both sessions took place on the same day and time of the week. The experiment lasted a maximum of an hour per session for which participants received a plant as a thank-you for their participation.

Table 3 Experimental conditions and the number of participants per condition

	Feedback	
	Behaviour-based	**Outcome-based**
Positive	12	12
Realistic	13	13

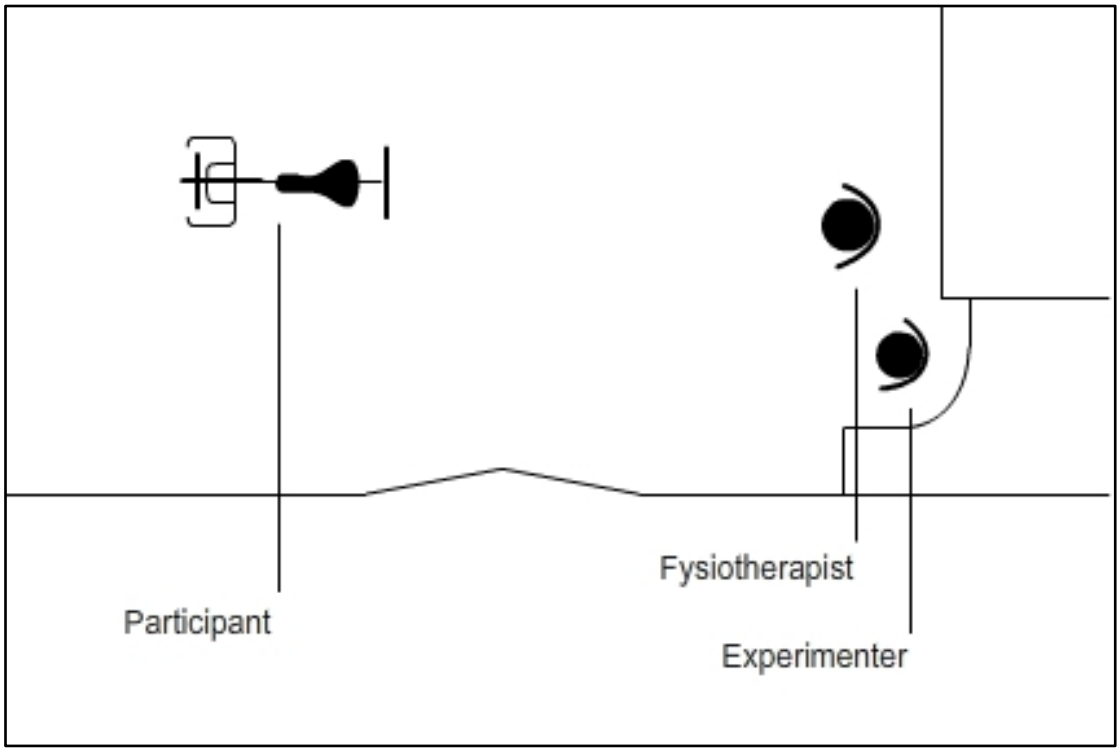

Figure 4 Experimental setup

4.2 Materials

4.2.1 Measurement of self-efficacy.

Self-efficacy was measured with the Exercise Self-Efficacy Scale (ESES) (Kroll, Kehn, Ho, & Groah, 2007). The ESES contains a single scale consisting of ten items, which can be found in Appendix A and B Responses range on a 4-point Likert scale, from “not at all true (1)” to “always true (4)”. The experiment leader took the questionnaire orally, since some participants were cognitively impaired and were not able to read or write well. Participants were asked to point out their answer on a 4 point scale printed on A3 size paper (Figure 5).

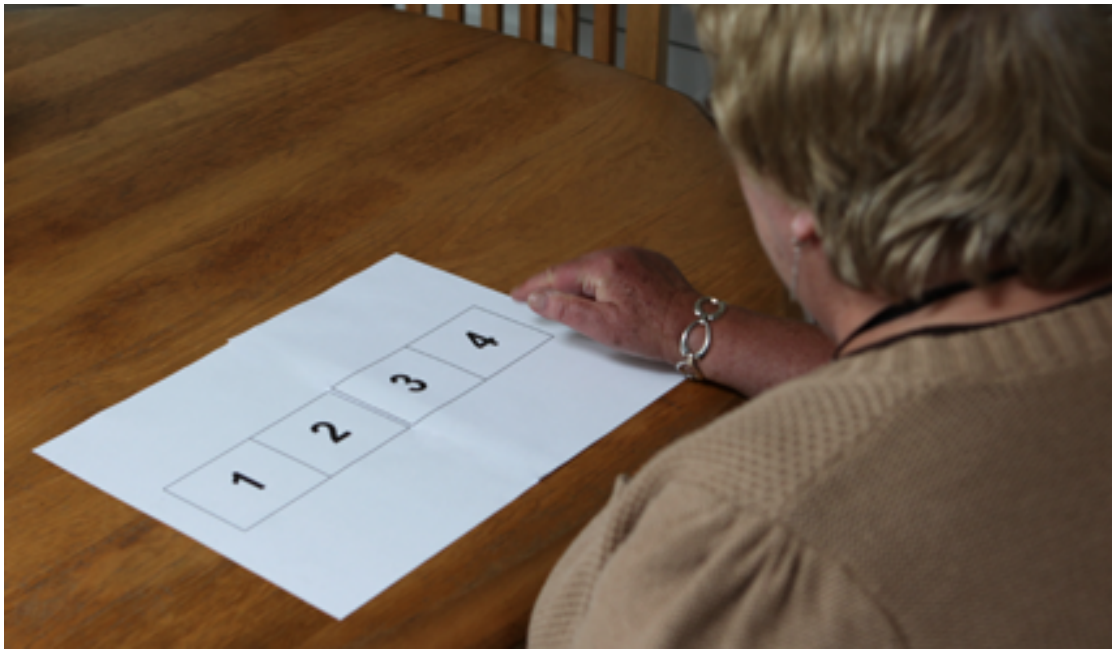

Figure 5 Participant pointing out her answer

4.2.2 Measurement of performance.

The first performance measure is the duration the participants cycled on the bicycle. Participants were told they could quit any time. The second measure of performance was energy in watts, which is a standard functionality on indoor cycles. During each session the amount of watts was saved every *30* seconds.

4.2.3 Feedback

The feedback (independent variable) was shown on a 3.5-inch (iPhone) display attached to the handlebars of the bicycle and consisted of a movie clip of a virtual flower (Figure 6) that became more lush and beautiful as the participants’ performance increased and became less lush and beautiful as participants’

performance decreased. The duration of the movie clip was variable between participants depending on their performance during the baseline session. When, for example, a participant cycled for 5 minutes during the first session, the movie clip of the growing flower took 10 minutes to complete during the manipulation session.

In the performance feedback condition, feedback was framed as being feedback about their current performance. That is, participants were told that as the plant grew their performance increased. In the outcome feedback condition, feedback was framed as being a visual metaphor for participants wellness (behavioural outcome). That is, participants were told that the growing of the flower stood for them becoming more healthy as they were exercising.

Furthermore, participants received either only positive feedback, or realistic feedback. In the realistic feedback condition participants also received feedback about bad performances, while in the positive feedback condition participants only received continuous feedback about their cycling duration. Negative feedback was calculated using the energy in watts. Participants were told to cycle as constant as possible, thus when energy was reduced with 5 watts or more for more than 30 seconds the flower started to decline, when participants produced the same energy for over one minute the flower started to grow again.

A manipulation-check revealed that all participants had understood the feedback.

Figure 6. Visualization of the feedback

4.3 Procedure

The experimental procedure as showed in Figure 7 is described in this section. General questions such as demographics were assessed a week before the start of the experiment or retrieved from the physiotherapist. All participants were picked up from their room by the physiotherapist. The physiotherapist was present during all sessions in case of emergency, but did not interfere during the sessions.

Participants were welcomed upon arrival and seated in front of a desk to answer the self-efficacy questionnaire to establish their baseline self-efficacy (mediator variable). Participants were asked to point out their answers on a 4 point scale printed on A3 size paper. Answers were entered in the computer by the experimenter. Item scores were summed to obtain an overall self-efficacy score for physical activity. They were then told that they were going to cycle on an indoor cycle as long as they could at a constant speed and that they could quit any time, within the duration of the experiment. Baseline performance (time participant stayed on the bicycle) was established and no feedback was given. Ultimately the self-efficacy questionnaire was assed. Participants were thanked for their participation and reminded that they were expected again the next week.

During the second session, in the next week, participants again cycled on the indoor cycle. Before the second session participants received information about the type of feedback and were again told that they could quit their workout any time. During the second session participants received feedback regarding their performance on a separate (iPhone) display attached on the handlebar of the bicycle. To control for order effects or other extraneous variables like day of the week, conditions were selected at random. Ultimately, participants filled in the ESES questionnaire again.

After the experiment participants received some questions to asses whether they had understood the feedback and were debriefed about the purpose of the study. The participants were thanked for their participation and received a little plant as a gift.

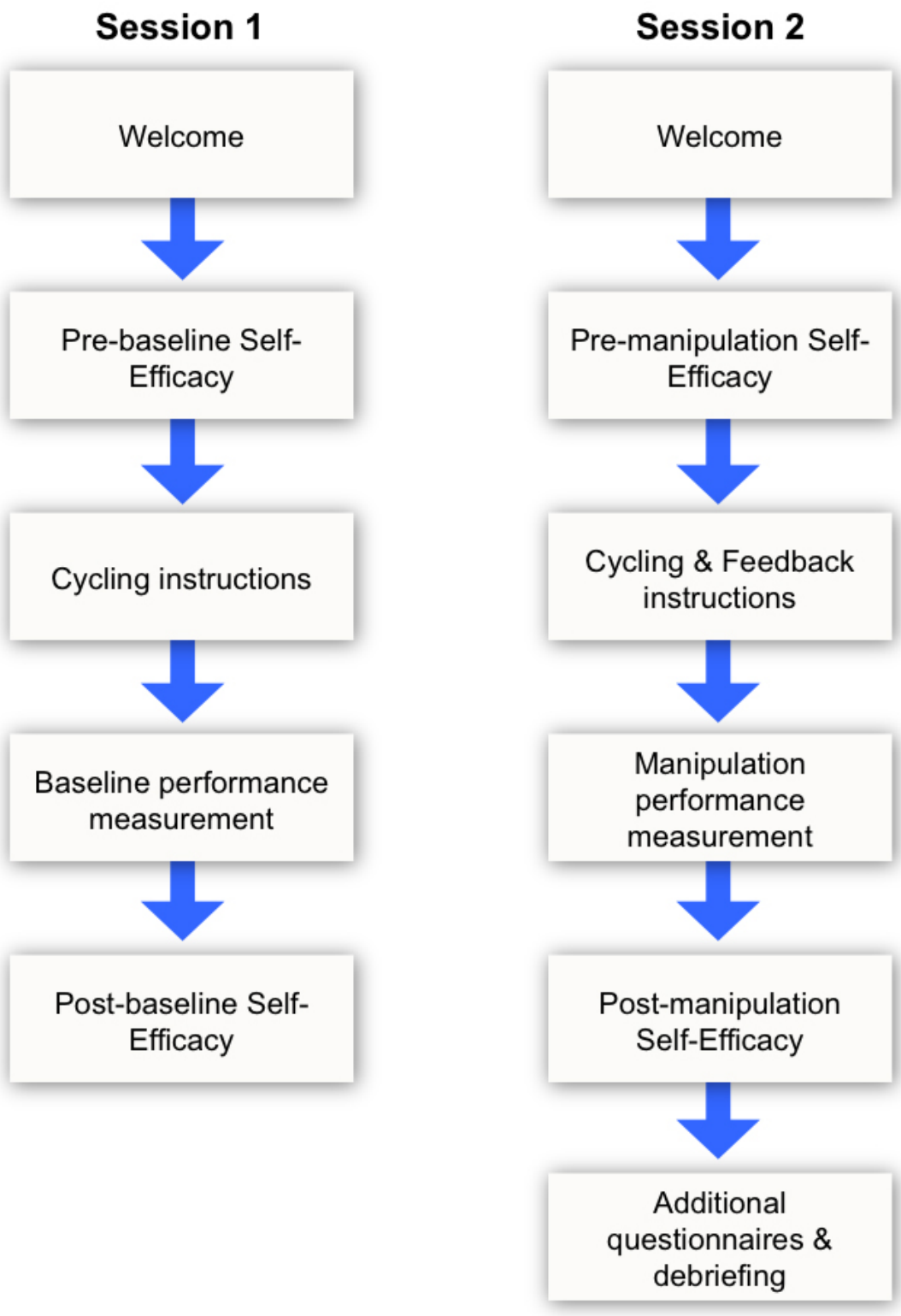

Figure 7 Overview of the experimental procedure

5. Results

5.1 Assessing the Effect of Type of feedback on Performance

To answer the first research question (Q_1) investigating *the effect of positive versus realistic feedback in terms of health outcomes, as compared to positive versus realistic feedback about current behaviour, on indoor cycling performance in older adults* the first hypotheses ($H_{1.1}$, $H_{1.2}$, $H_{1.3}$, $H_{1.4}$) were tested. Therefore, the variables corresponding to the 2 (feedback type: outcome-based vs. performance-based) × 2 (feedback valence: positive vs. realistic) × 2 (performance: pre- vs. post-manipulation performance) design were submitted to a repeated analysis of variance with feedback type and feedback valence as between-subject variables and performance, expressed in seconds, as within-subject variable.

In support the first hypothesis ($H_{1.1}$), regarding the effect of all types of feedback (positive behaviour-based; negative behaviour-based; positive outcome-based; negative outcome-based) on performance, the results of the analysis of performance showed a main effect of performance, $F(3, 46) = 311.18$, $p < 0.0001$, $r = 0.96$. The time participants stayed on the bicycle was significantly affected by the moment of measurement. Before the manipulation, the time participants stayed on the bicycle was shorter ($M = 395.40$, $SD = 154.02$) than after ($M = 578.26$, $SD = 258.72$), meaning that the manipulation had the effect of increasing performance. As shown in the graph below (Figure 8), performances were different for all four types of feedback and performance increased in the pre-manipulation session as compared to the post-manipulation session for all conditions. More specifically, a simple main effect of performance was found for all types of feedback meaning that all types of feedback lead to an increase in performance as illustrated in Table 4.

In support of the second hypothesis ($H_{1.2}$), stating that outcome-based feedback, as compared to behaviour-based feedback leads to a greater increase in performance, results provided evidence for a performance × feedback type interaction effect $F(3 ,46) = 20,14$, $p < 0.001$, $r = 0.53$. This effect indicates that the change in performance in the group that received outcome-feedback was significantly different to the change in the group that received behaviour-based feedback. Specifically, there was an increase in performance ($M = 428.31$, $SD = 149.68$ pre-manipulation, versus $M = 675.18.25$, $SD = 237.73$ post-manipulation) in the group that received outcome feedback, but a much weaker increase in performance ($M = 361.83$, $SD = 154.23$ pre-

manipulation, versus M = 473.25, SD = 243.00 post-manipulation) in the group that received feedback solely about their current behaviour.

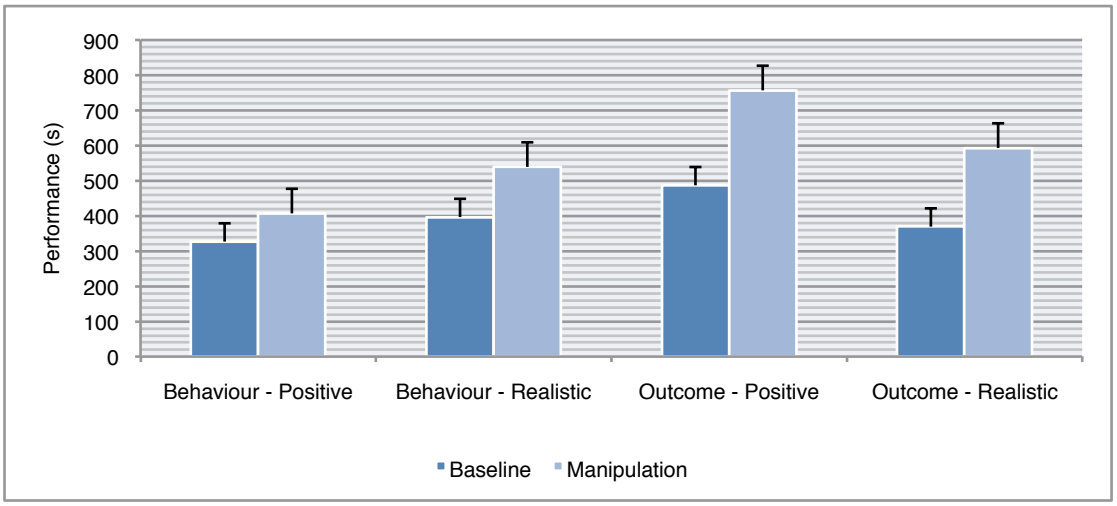

Figure 8. Mean performance scores and standard error for all four types of feedback over the two sessions (Performance score is the time in seconds participants stayed on the bicycle)

Table 4 Mean differences between pre-manipulation and post-manipulation performance measurements

Condition	Mean pre-manipulation	SD pre-manipulation	Mean post-manipulation	SD post-manipulation	Difference	F(1,46)	r	P
Behaviour-Positive	327.00	121.93	407.17	178.27	79.83	6.78	0.76	<0.05
Behaviour-Realistic	396.67	179.50	539.33	286.63	142.66	21.48	0.90	<0.001
Outcome-Positive	487.08	187.85	757.01	269.38	269.93	83.31	0.97	<0.001
Outcome-Realistic	369.53	62.51	593.33	175.10	223.8	57.25	0.96	<0.001

No support was found for the third hypothesis ($H_{1.3}$) that states that realistic feedback, as compared to positive feedback, will lead to a greater increase in performance. No interaction effect was found for performance × feedback valence which indicates that the change in performance in the group that received realistic feedback was not significantly different to the change in the group that received positive feedback.

The fourth hypothesis ($H_{1.4}$) regarding additive effects of feedback type versus feedback valence was only partially confirmed. No significant three-way interaction effect was found for performance × feedback valence × feedback type, meaning that the performance × feedback type interaction described above is different for positive and realistic feedback. As expected, outcome-based feedback lead to a greater

increase as compared to behaviour-based feedback. Furthermore, in the condition where participants received feedback solely about their current behaviour realistic feedback worked better in increasing participants performance. For the conditions where participants received outcome-based feedback, positive feedback worked better than realistic feedback, which is the reverse of what was expected.

5.2 Assessing the Effect of Type of feedback on Self-Efficacy

In order to test hypothesis 2, regarding the mediation effects of self-efficacy, it is necessary to test whether there is a difference in self-efficacy levels. To do so, a repeated measures analysis was conducted again, this time to asses the effect of type of feedback on self-efficacy. All variables corresponding to the 2 (feedback type: outcome-based vs. performance-based) × 2 (feedback valence: positive vs. realistic) × 2 (performance: pre- vs. post-manipulation performance) design were entered in the analysis, with feedback type and feedback valence as between-subject variables and self-efficacy as within subject variable.

The results of the analysis of self-efficacy showed a main effect of self-efficacy, $F(3, 46) = 69.993$, $p < 0.0001$, $r = 0.76$. Self-efficacy was significantly affected by the moment of measurement. Before the manipulation, self-efficacy was lower (M = 26.38, SD = 7.93) than after (M = 27.90, SD = 8.36), meaning that the manipulation had the effect of increasing self-efficacy. Figure 9 shows that self-efficacy increased after participants received feedback, which was confirmed by the results of a simple effects analysis. More specifically, a simple main effect of self-efficacy was found for all types of feedback meaning that all types of feedback led to an increase in self-efficacy. As displayed in Table 5, self-efficacy ratings at the end of the manipulation session were higher than those at the beginning of the manipulation session for all types of feedback.

The self-efficacy × feedback type interaction was significant $(F(3 ,46) = 9,09, p < 0.05, r = 0.37)$ indicating that the change in self-efficacy in the group that received outcome-based feedback was significantly different to the change in the group that received behaviour-based feedback. Specifically, there was a significant increase in self-efficacy in the group that received outcome-based feedback (M = 28.92, SD = 7.13 pre-manipulation, versus M = 30.96, SD = 7.06 post-manipulation), but a much weaker increase in self-efficacy in the group that received behaviour-

based feedback (M = 23.63, SD = 7.97 pre-manipulation, versus M = 24.58, SD = 8.52 post-manipulation).

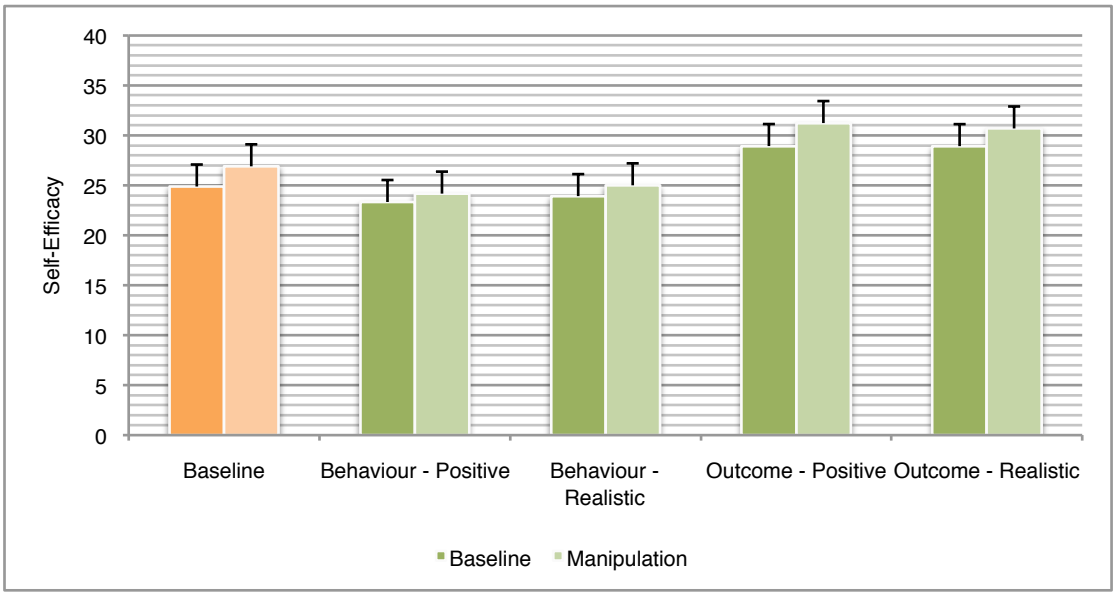

Figure 9 Mean self-efficacy scores and standard error for all four types of feedback over the two sessions.

Table 5 Mean differences between pre-manipulation and post-manipulation self-efficacy measurements.

Condition	Mean pre-manipulation self-efficacy	SD pre-manipulation Self-efficacy	Mean post-manipulation self-efficacy	SD post-manipulation Self-efficacy	Difference	F(1,46)	p	r
Behaviour-Positive	23.33	7.63	24.17	8.36	0.84	5.20	<0.05	0.28
Behaviour-Realistic	23.92	8.61	25.00	9.03	1.08	8.79	<0.05	0.37
Outcome-Positive	28.93	7.38	31.23	7.49	2.30	43.23	<0.001	0.68
Outcome-Realistic	28.92	7.18	30.69	6.91	1.77	25.41	<0.001	0.57

No significant interaction effect was found for self-efficacy × feedback valence which indicates that the change in self-efficacy in the group that received realistic feedback was not significantly different to the change in the group that received positive feedback. Furthermore, there was no significant three-way interaction effect was found for self-efficacy × feedback valence × feedback type, meaning that the self-efficacy × feedback type interaction described above is different for positive and realistic feedback.

Ultimately, a paired samples t-test revealed that, on average, participants reported greater perceived self-efficacy after cycling *(M = 26.92, SE = 1.19)* during

the first session, than before cycling *(M = 24.88, SE 1.14, t(49) = -4.283, p < 0.001, r = 0.52)* (Orange bars, Figure 9).

5.3 Mediation Effect of Self-Efficacy

A mediation analysis following the procedure by Judd, Kenny and McClelland (2001) for testing mediation in within-group designs was conducted to test hypothesis two (H_2) concerning the mediation effects of self-efficacy. Specifically, answering the question whether the difference in self-efficacy mediates pre-manipulation and post-manipulation performance differences for either type of feedback (Figure 10).

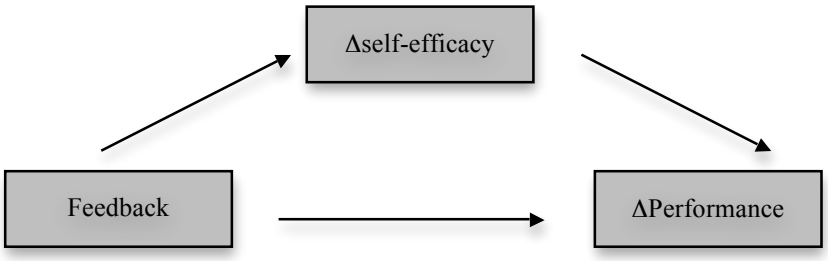

Figure 10 Relationship in question: self-efficacy beliefs mediating the relationship between feedback and performance.

For mediation to be present there must be a correlation between the variables in question. Therefore, a Pearsons product moment correlation was used to examine the relationships among the outcomes and mediators and correlations among performance and self-efficacy support the presence and direction of the proposed relationships (Table 6) indicating a potential mediation effect.

Table 6 Pearsons product moment correlations for pre- and post-manipulation self-efficacy and pre-and post-manipulation performance (n = 50, $^{*}p < 0.001$)

	Pre-efficacy	Post-efficacy	Pre-performance	Post-performance
Pre-efficacy				
Post-efficacy	.98*			
Pre-Performance	.49*	.50*		
Post-Performance	.53*	.58*	.94	

The first step in the mediation analysis as proposed by Judd et al. (2001) is to establish that the independent variable (feedback) is significantly related both to the proposed mediator (self-efficacy) and the dependent variable (performance). Specifically, there must be a difference in self-efficacy levels and performance between two measurements (pre- and post-feedback) that are both in the same

direction. This is the case for all conditions as we have demonstrated in sections 5.1 and 5.2 (means and significance levels are shown in Table 4 and Table 5).

The next step is to establish that the proposed mediator (self-efficacy) is significantly related to de dependant variable (performance) at each level of the independent variable (feedback), meaning that there must be a significant relationship between self-efficacy and performance in both pre-manipulation and post-manipulation sessions (Figure 11).

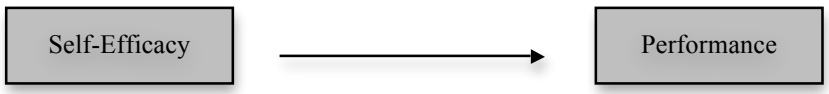

Figure 11 There must be a significant relationship between self-efficacy and performance for both sessions

To prove so, each performance measure is regressed on the corresponding self-efficacy measure, to test for overall manipulation effects in self-efficacy and performance. As predicted, the results in Table 7 show that self-efficacy levels, for both baseline and manipulation measurements, are significantly related to performance for the positive behaviour-based feedback and the outcome-based realistic feedback (marginally significant), with higher self-efficacy levels associated with higher performance.

The final step is to show that pre- and post-feedback self-efficacy differences are significantly associated with performance differences (Figure 12). To do so, the difference of the two performance measures is regressed on the difference in self-efficacy scores. Furthermore, related to hypothesis 2, it might be of interest to test whether the manipulation effect is moderated by self-efficacy. This is done by showing that pre-manipulation and post-manipulation self-efficacy sum is significantly associated with performance differences. The regression coefficient for the sum predictor estimates the difference in the two within-performance slopes, consequently it estimates the degree to which the manipulation effect is moderated by self-efficacy. The larger this coefficient, the larger the manipulation effects with a larger mean self-efficacy score.

Figure 12 To show a mediation effect, self-efficacy differences must be significantly associated with performance differences.

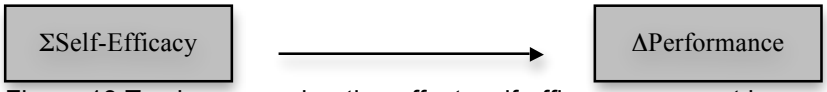

Figure 13 To show a moderation effect, self-efficacy sum must be significantly associated with performance differences.

Regressing the performance difference on the self-efficacy sum and difference results in the regression estimates are shown in Table 7, with self-efficacy difference as a significant predictor of performance differences for both positive behaviour-based feedback as well as realistic outcome-based feedback (marginally significant) indicating mediation of these types of feedback on performance. Self-efficacy sum has been shown to be only marginally significant in the realistic outcome-based feedback condition, suggesting that the effect of realistic outcome-based feedback is moderated by self-efficacy.

In addition, for there to be full mediation, the effect of feedback on performance should be eliminated when self-efficacy is included in the model. According to Judd et al. (2001), this is done by centring the self-efficacy sum variable and regressing it on performance difference. Centring the self-efficacy sum variable estimates the mean manipulation effect as if the difference in self-efficacy was zero. The regression constant indicates the residual manipulation difference, without mediation, which should be smaller than the unmediated treatment difference. For there to be full mediation the residual manipulation difference should be significantly different from zero, which is the case for positive behaviour-based feedback (Table 7).

In conclusion, there is a significant manipulation effect on self-efficacy that serves as a full mediator of the performance difference for positive behaviour-based feedback and as a partial mediator for realistic outcome-based feedback (marginally significant). Besides, there is evidence of a marginally significant manipulation difference in performance with self-efficacy moderating that difference for realistic outcome-based feedback. Participants with initial high self-efficacy receiving realistic outcome-feedback show a larger effect.

Table 7 Regression analyses for self-efficacy and performance - With P_1 and ES_1 as the baseline performance and self-efficacy measures, respectively, and P_2 and ES_2 the manipulation performance and self-efficacy measures, P_D as performance difference, ES_S as the sum of self-efficacy scores and ES_D as self-efficacy difference scores ($^*p < 0.001$).

Type of feedback	Pre- or post manipulation	Constant	Unstandardized coefficients	Standardized coefficient	sig
$P_1 = \delta_{10} + \delta_{11}ES_1$ and $P_2 = \delta_{20} + \delta_{21}ES_2$					
Behaviour positive	Pre	62.95	11.32 ES_1	0.708	0.01
	Post	21.94	15.94 ES_2	0.748	0.005
Behaviour realistic	Pre	197.36	8.33 ES_1	0.400	ns
	Post	147.70	15.67 ES_2	0.493	≤0.10
Outcome postive	Pre	139.2	12.03 ES_1	0.472	≤0.10
	Post	275.63	15.41 ES_2	0.428	ns
Outcome realistic	Pre	249,5	4.15 ES_1	0.477	≤0.10
	Post	218.61	12.21 ES_2	0.482	≤0.10
$P_D = \delta_0 + \delta_1ES_S + \delta_2ES_D$					
Behaviour positive		31.73	0.134 ES_S	0.034	ns
			50.49 ES_D	0.947	<0.001
Behaviour realistic		-41.012	2.57 ES_S	0.389	ns
			48.79 ES_D	0.470	≤0.10
Outcome postive		116.40	1.705 ES_S	0.238	ns
			22.110 ES_D	0.198	ns
Outcome realistic		-87.613	4.16 ES_S	0.472	≤0.10
			35.94 ES_D	0.478	≤0.10
$P_D = \delta_0 + \delta_1ES'_S + \delta_2ES_D$					
Behaviour positive		38.088*	0.134ES'_S	0.034	ns
			50.494ES_D	0.947	<0.001
Behaviour realistic		89.82	2.674ES'_S	0.389	ns
			48.79ES_D	0.470	≤0.10
Outcome postive		218.93	1.71ES'_S	0.238	ns
			22.11ES_D	0.198	ns
Outcome realistic		160.22	4.157ES'_S	0.472	≤0.10
			35.943ES_D	0.478	≤0.10

6. Discussion

The aim of this study was to examine the effect of positive versus realistic feedback in terms of health outcomes, as compared to positive versus realistic feedback about current behaviour, on indoor cycling performance in older adults. Based on the literature the following effects were expected: First, that all four types of feedback (positive behaviour-based; negative behaviour-based; positive outcome-based; negative outcome-based) lead to an increase in performance ($H_{1.1}$). Second, that performance feedback in terms of health outcomes, as compared to performance feedback about current behaviour, lead to a greater increase in physical activity ($H_{1.2}$). Third, that realistic feedback, as compared to only positive performance feedback, lead to a greater increase in performance ($H_{1.3}$). Fourth, an additive effect was expected with negative feedback in terms of health outcomes working the best at improving performance, followed by positive feedback in terms of health outcomes, realistic feedback about current behaviour and positive feedback about current behaviour being the worst at increasing performance. And lastly, it was expected that the effects of feedback on performance were mediated by self-efficacy (H_2).

Confirming the first hypothesis ($H_{1.1}$) all four types of feedback led to an increase in performance. That is, participants stayed longer on the bicycle after receiving feedback, which was the case for all types of feedback. Related to this hypothesis we also found that all four types of feedback led to increase self-efficacy, meaning that after receiving feedback participants had a greater belief they were able to be physically active than before.

In line with the second hypothesis ($H_{1.2}$) outcome-based feedback led to a significant greater change in performance than behaviour-based feedback. That is, results suggested that participants stayed longer on the bicycle when they received feedback in terms of health outcomes as compared to feedback solely about their current behaviour.

Furthermore, results also suggested that realistic feedback did not lead to a greater increase in performance than did positive feedback ($H_{1.3}$). Our hypothesis was based on the fact that participants in the realistic feedback condition would also receive negative feedback and that negative feedback has been shown to have positive effects on behaviour change as compared to giving positive feedback (e.g. Ham & Midden, 2009; Vossen, Ham, & Midden, 2009). In the realistic feedback condition 96% of the participants received negative feedback for an average duration of 70.83

seconds (SD = 29.46) of a mean total time on the bicycle of 567.41 seconds (SD = 231.82). Research by Baumeister et al. (2001) showed that people have selective memory for negative feedback and we tend to better remember positive feedback especially when only a small amount of negative feedback is embedded in generally good feedback, which was also the case in the current research. Furthermore, a moderation effect of self-efficacy shows that participants with initial high self-efficacy receiving realistic outcome-feedback show a larger effect on performance. Research shows that higher self-efficacy leads people to pay less attention to unfavorable information and that when they receive repeated negative performance feedback acceptance of the feedback decreased (Nease et al., 1999). Participants might not have paid attention to the negative feedback or not have remembered the small amount of negative feedback they received, which might be the reason we did not find a difference between positive and realistic feedback, but led both positive as realistic feedback to work equally well.

Partially confirming hypothesis 1.4 ($H_{1.4}$), in which additive effects of outcome-based and negative feedback were expected, results suggested that outcome-based feedback led to a greater increase in performance as compared to behaviour-based feedback. Which implies that, in line with hypothesis 1.4, participants who received feedback in terms of health outcomes stayed longer on the bicycle than participants who received feedback solely about their current behaviour. Furthermore, realistic behaviour-based feedback worked better at increasing participants performance than positive behaviour-based feedback. However, participants receiving positive outcome-based stayed longer on the bicycle than did participants receiving realistic outcome-based feedback, which is the reverse of what was expected.

In support of hypothesis 2 (H_2) positive feedback about current behaviour was fully mediated by self-efficacy, realistic feedback about current behaviour as well as realistic feedback in terms of health outcomes were both partly mediated by self-efficacy (marginally significant). These results, as well as the results confirming hypothesis 1.2, are in line with findings from other research that showed that feedback about behaviour increases self-efficacy and therefore physical activity (Bandura, 1997). Nevertheless, realistic feedback was only marginally significantly mediated by self-efficacy. Therefore, realistic feedback might have led to higher performance, not because it caused participants self-efficacy to increase, but because of other

psychological processes, such as trust in the system, that might play a role in the effect of realistic feedback on performance. Messages coming from credible, trustworthy sources are more likely to be accepted, therefore the positive effect of realistic feedback might also be attributed to the fact that they trust the systems judgement.

The effect of positive feedback in terms of health outcomes was not mediated by self-efficacy, therefore partially rejecting hypothesis 1.4 ($H_{1.4}$). Further analysis revealed that positive outcome expectancies at experiment onset were a better predictor of performance than self-efficacy, accounting for 36% of the variation in performance (For details on the results see Appendix D). This is in contradiction research by, for example, Shannon et al. (1990), who found that not outcome expectancies but rather self-efficacy contributed significantly to explanation of behaviour. Furthermore, we found that outcome expectancies moderated the effect of positive outcome-based feedback (Appendix D), meaning that participants with initial positive outcome expectancies receiving positive outcome-based feedback show greater performance. No such effect was found for the other conditions and outcome expectancies did not change significantly during the experiment. This suggested that when making the positive effects of physical activity on health salient and show people that they are efficacious in physical activity, as suggested by McAuley & Courneya (1993), pre-existing high outcome expectancies are important factors needed for the feedback to work at its best.

6.1 Limitations and future research

In the current research we have found very large effects of all types of feedback on performance. Although we did not find an effect of the amount of physiotherapy sessions participants received between the two measurements (daily, every other day, once a week), this could be explained by the fact that we might have underestimated the large improvements patients make during their time in the rehabilitation centre, especially at the beginning of their admission. Thus, for future research it is suggested to control for such effects and getting insight in the usual progression of patients, by using a control group that does not get feedback during the second session. Future research might also investigate the longitudinal effects of feedback in terms of health outcomes to see whether implementing this form of feedback really leads to a lasting positive change in physical activity.

Self-efficacy theory was chosen as the source of influence on physical activity as research suggests that self-efficacy is one of the most stable predictors of behaviour and has been used extensively in research on health behaviour. However, research also suggests there are many more processes that account for the fact that elderly stop being physically active, such as attitudes toward being active, attitudes toward health or fear of falling. However, as the target group was cognitively and physically weak we chose to limit the duration of the experiment and questionnaires as much as possible and focus on just one of the psychological aspects. Further research could investigate those other processes and in which way those account for the positive effect of negative feedback that have been found.

The experiment leader took the questionnaires orally, since some participants were cognitively impaired and were not able to read or write well. Participants were asked to point out their answer on a 4 point scale printed on A3 size paper. This method worked very well and contributed to the participants understanding of the questions. However, this method is not desirable as people are likely to give socially desirable answers. Results show that quite a part of the participants scored themselves very high on self-efficacy and almost reached the maximum score, which is very unlikely in comparison to other experiments.

In the current research energy generated, in watts, was used as a second performance measure that was used to generate negative feedback. This second performance measure was not included in the analysis as participants goal was cycle as long as possible at a constant speed and that the emphasis was put on cycle duration. However, negative feedback was generated when participants started cycling slower, since the time participants stay on the bicycle has no negative component in it. For the target group it is not an easy task to cycle at constant speed without receiving feedback about it. Consequently, participants who only received positive feedback showed a lot more variation in energy as compared to the group that received realistic feedback as they did not receive feedback about it (See Appendix C for a graph of the mean progress). Also not enough emphasize was put on the fact that they had to cycle at constant speed. Therefore, energy in watts would have been a bad indicator of performance. Future research should carefully consider the options of measuring performance and generating performance feedback and more consistently present the task to participants.

Future research might also investigate other ways of visualizing the feedback as none of the participants in the performance feedback condition, as well as the outcome feedback condition, reported to see the visualization as a metaphor for their health, but named it to be either just an image of a growing flower or it showing their performance. For future research it would be of interest to test whether there is a difference in unconscious processing that accounts for this effect.

This was one of the first studies assessing the effects of feedback on physical activity in terms of future health effects, in specific with cognitively and physically disabled elderly. This study revealed results that suggest that giving feedback on physical activity in terms of health outcomes can increase physical activity. Further research is needed to strengthen these findings and investigate the long term effect of such feedback. This could possibly lead to the design of a device that helps patients at home to increase their physical activity levels without the constant interference of a physiotherapist and therefore become both cognitively and physically stronger.

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8. Appendices

8.1 Appendix A, Self-Efficacy Scale

Self-efficacy was measured with the Exercise Self-Efficacy Scale (ESES) (Kroll, Kehn, Ho, & Groah, 2007). While the ESES was developed to measure self-efficacy for both physical activity and exercise. The ESES contains a single scale consisting of ten items. Responses range from ‘not at all true (1)’ to ‘always true (4)’. Items scores are summed to obtain an overall self-efficacy score for physical activity.

Table 8 ESES items by Kroll et al. (2007).

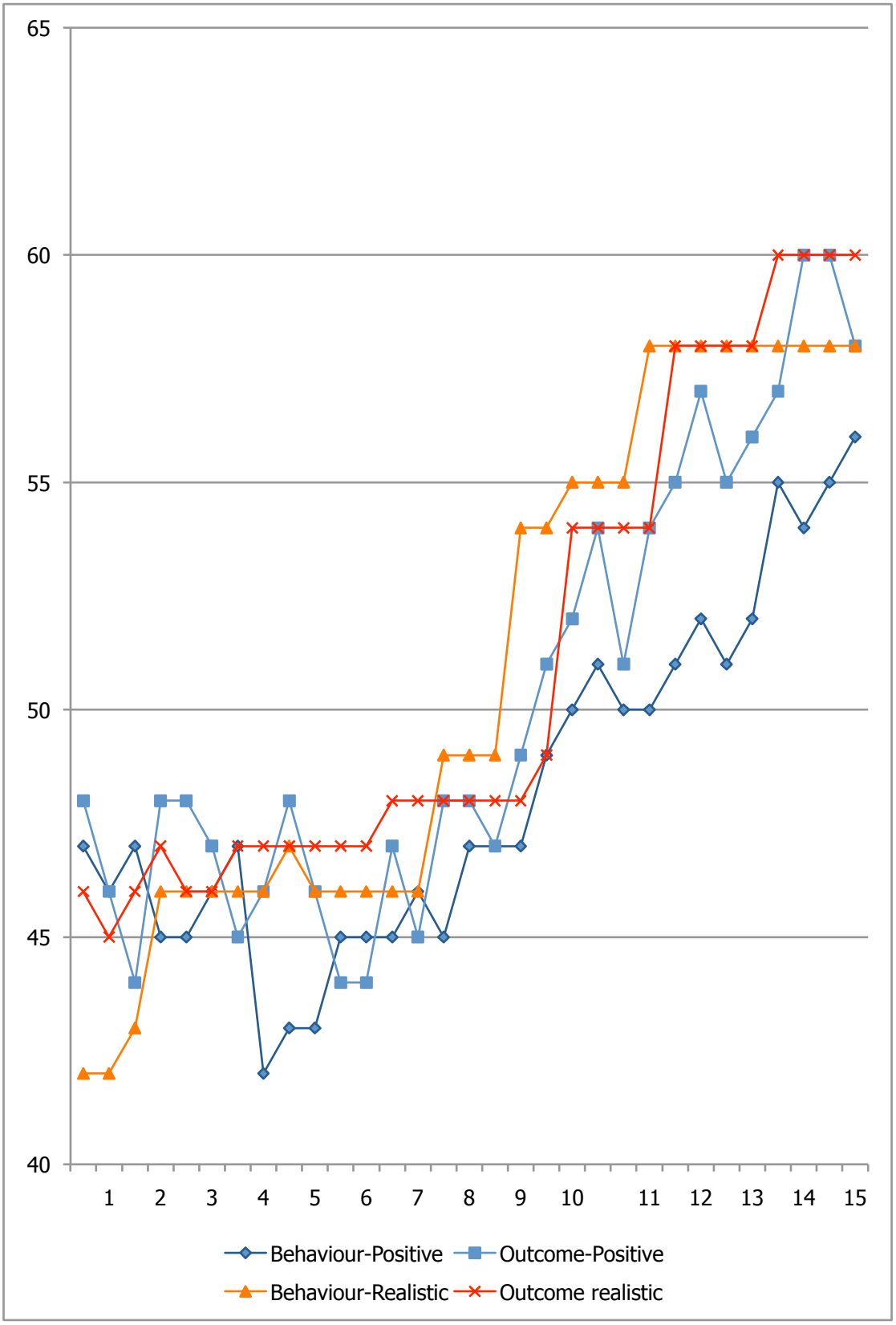
I am confident…
…that I can overcome barriers and challenges with regard to physical activity and exercise if I try hard enough (ES1)
…that I can find means and ways to be physically active and exercise (ES2)
…that I can accomplish my physical activity and exercise goals that I set (ES3)
…that when I am confronted with a barrier to physical activity or exercise I can find several solutions to overcome this barrier (ES4)
…that I can be physically active or exercise even when I am tired (ES5)
…that I can be physically active or exercise even when I am feeling depressed (ES6)
…that I can be physically active or exercise even without the support of my family or …friends(ES7)
…that I can be physically active or exercise without the help of a therapist or trainer (ES8)
…that I can motivate myself to start being physically active or exercising again after I've stopped for a while (ES9)
…that I can be physically active or exercise even if I had no access to a gym, exercise, training, or rehabilitation facility (ES10)

8.2 Appendix B, Self-Efficacy Items (Dutch)

Ik ben er zeker van…

…dat als ik hard genoeg probeer ik de obstakels en uitdagingen met betrekking tot fysieke activiteit of het doen van oefeningen kan overwinnen (ES1)
…dat ik de middelen en manieren kan vinden om fysiek actief te zijn of oefeningen te doen (ES2)
…dat ik de doelen die ik heb gesteld met betrekking tot fysieke activiteit of het doen van oefeningen kan realiseren (ES3)
…dat wanneer ik geconfronteerd word met obstakels die fysieke activiteit of het doen van oefeningen belemmeren ik verschillende oplossingen kan bedenken om deze obstakels te overwinnen (ES4)
…dat ik fysiek actief kan zijn of oefeningen kan doen zelfs als ik moe ben (ES5)
…dat ik fysiek actief kan zijn of oefeningen kan doen zelfs als ik me depressief voel (ES6)
…dat ik fysiek actief kan zijn of oefeningen kan doen zonder de support van mijn familie of vrienden (ES7)
… dat ik fysiek actief kan zijn of oefeningen kan doen zonder de hulp van een therapeut of trainer (ES8)
…dat ik mezelf kan motiveren om weer te beginnen met fysieke activiteiten of het doen van oefeningen nadat ik daar een tijd mee gestopt ben (ES9)
…dat ik fysiek actief kan zijn of mijn oefeningen kan doen, zelfs als ik geen toegang heb tot oefen-, trainings-, revalidatiefaciliteiten of een sportschool (ES10)

8.3 Appendix C, Energy in Watts as Performance Measure



8.4 Appendix D, Assessing the Outcome Expectancies on Performance

Type of feedback	Pre- or post manipulation	Constant	Unstandardized coefficients	Standardized coefficient	sig
$P_1 = \delta_{10} + \delta_{11}OCEX_1$ and $P_2 = \delta_{20} + \delta_{21}OCEX_2$					
Behaviour positive	Pre	62.95	11.32 $OCEX_1$	0.708	0.01
	Post	21.94	15.94 $OCEX_2$	0.748	0.005
Behaviour realistic	Pre	197.36	8.33 $OCEX_1$	0.400	ns
	Post	147.70	15.67 $OCEX_2$	0.493	≤0.10
Outcome postive	Pre	139.2	12.03 $OCEX_1$	0.472	≤0.10
	Post	275.63	15.41 $OCEX_2$	0.428	ns
Outcome realistic	Pre	249,5	4.15 $OCEX_1$	0.477	≤0.10
	Post	218.61	12.21 $OCEX_2$	0.482	≤0.10
$P_D = \delta_0 + \delta_1OCEX_S + \delta_2OCEX_D$					
Behaviour positive		31.73	0.134 $OCEX_S$	0.034	ns
			50.49 $OCEX_D$	0.947	<0.001
Behaviour realistic		-41.012	2.57 $OCEX_S$	0.389	ns
			48.79 $OCEX_D$	0.470	≤0.10
Outcome postive		116.40	1.705 $OCEX_S$	0.238	ns
			22.110 $OCEX_D$	0.198	ns
Outcome realistic		-87.613	4.16 $OCEX_S$	0.472	≤0.10
			35.94 $OCEX_D$	0.478	≤0.10
$P_D = \delta_0 + \delta_1OCEX'_S + \delta_2OCEX_D$					
Behaviour positive		38.088*	0.134$OCEX'_S$	0.034	ns
			50.494$OCEX_D$	0.947	<0.001
Behaviour realistic		89.82	2.674$OCEX'_S$	0.389	ns
			48.79$OCEX_D$	0.470	≤0.10
Outcome postive		218.93	1.71$OCEX'_S$	0.238	ns
			22.11$OCEX_D$	0.198	ns
Outcome realistic		160.22	4.157$OCEX'_S$	0.472	≤0.10
			35.943$OCEX_D$	0.478	≤0.10