Improving current technology based fitness devices through closer alignment to behaviour change literature

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Declaration

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Improving current technology based fitness devices through closer alignment to behaviour change

Abstract

We set out to explore the ways that different individuals get different results when they use the same technology based fitness devices. This suggests that the current approach is successful for some individuals and provides little help to others. Behaviour change literature puts forward a different approach that individual progress through a number of Transtheoretical stages and that different interventions will be more or less effective at different stages of this process. As a result we explored whether closer alignment between the current behaviour change literature and the devices yield more behaviour change. We have found though undertaking a behaviour change preference questionnaire on presentation controlled devices that approaches that are more closely aligned to literature are significantly more effective than devices that follow less of the current literature. In addition that some interfaces are significantly more tailored to specific stages of the Transtheoretical model than others. Based on this discovery we recommend that future designs should follow the behaviour change literature more closely and adapt to the stage that the participant currently is. We believe that as the underlying behaviour change models are successful in multiple domains we believe that these changes to designs will be effective in other behaviour change domains.

Improving current technology based fitness devices through closer alignment to behaviour change literature

Table of Contents

Improving current technology based fitness devices through closer alignment to behaviour change literature

List of Figures

Improving current technology based fitness devices through closer alignment to behaviour change literature

List of Tables

Improving current technology based fitness devices through closer alignment to behaviour change literature

Acknowledgements

Improving current technology based fitness devices through closer alignment to behaviour change literature

1 Introduction

An ever increasing number of people are struggling to undertake enough fitness behaviour in order to get the economic and health benefits associated with it. This has lead to numerous applications and devices that promise to aid individuals in changing their fitness behaviour. However they currently do not explain all the reasons that people provide for not undertaking enough health related physical activity. Behaviour change literature does explain all of these reasons when we consider multiple schools of thought. As a result we believe that closer alignment between devices and the literature will allow individuals to get the support that they need for the stage of behaviour change they are currently in. We will test this idea through exploring how different technology aided fitness device interfaces that conform to different amounts of the behaviour change literature cause different amounts of behaviour change in different people.

1.1 Problem goals

The project aims to provide recommendations for future designs of technology based fitness devices based on proven successful behaviour change principles in order for them to deliver more behaviour change.

1.2 Problem description

Individuals who do not undertake enough physical activity experience worse health and economic welfare (Warburton et al. 2006; Haltiwanger et al. 2013). Scholes and Mindell (2012) have shown that this is still a large problem with only sixty seven percent of males and fifty five percent of females undertake enough cardiovascular endurance training to improve their health related fitness. They have also shown that only thirty four percent of males and only twenty four percent of females undertake enough muscular strength and endurance training to improve their health related fitness. This issue is also most prevalent amongst individuals with lower income, the elderly and those who life in the north of England. The reasons that these individuals do not undertake enough fitness activity has been reported to include not having enough time and not seeing any positive impact of the activity (Sallis et al. 1987; Markland & Tobin 2009). However these issues have not been addressed by current devices but they have been explained by behaviour change theories (Glanz et al. 2008). As a result we believe if current devices followed these behaviour change principles more closely then they may be more successful. However it is identified by Cowan et al (2012) that these existing devices at best only account for forty percent of behaviour change models. As a result we feel there is space for improvement.

1.3 Motivation

This is an important as not undertaking enough fitness activity has been shown to worsen an individuals health. This includes an include increased risk of diabetes, increased chance of getting cancer and increased chance of heart disease (Warburton et al. 2006; Carnethon et al. 2003; Kim et al. 2000; Eckel & Krauss 1998). The increased risk of these illnesses and diseases leads individuals who are not undertaking enough physical activity to be three times more likely to die due to this. In addition to the heath complications individuals who do not undertake enough physical activity experience worse economic welfare than individuals who do (Haltiwanger et al. 2013). If the devices are more effective then these issues can be avoided, in a cheaper way than traditional labour intensive behaviour change innovations, as individuals will be undertaking enough activity to mitigate these issues.

Improving current technology based fitness devices through closer alignment to behaviour change literature

1.4   Contribution

Should we be able to improve technology based fitness devices through closer alignment to behaviour change principles then we would be able to improve both the future designs of devices and the behaviour change literature. In addition due to the behaviour change principles being successful in other domains we believe that these improve designs can be transferred in to a wide range of other domains. However this is outside the scope of this paper.

Improving current technology based fitness devices through closer alignment to behaviour change literature

2   Literature review

In this section we will start by identify the current technology based fitness aides exist. These fitness aids exists in two main forms wearable devices and mobile applications. Both of these styles of devices have been shown to be beneficial to some individuals however they fail to solve some of the key reasons that individuals give for not undertaking enough health related fitness activity. As a result we believe that a different approach is needed. We turned to the behaviour change literature in order to try and improve these devices and applications. In order to do so we explored a number of different explanations about how behaviours are formed. We also aim to identify how these different explanations fit together in order to have the fullest understanding of behaviour change and to create a model based on all of them. We have found that different approaches to behaviour change intuitively should be more effective at certain stages of that an individual goes through in order to adopt a new behaviour. We use this model to explain the reasons that individuals have for not undertaking fitness behaviour to demonstrate that it may be more effective at delivering behaviour change. Once we have done this we go on to explore whether the current devices conform to the behaviour change model.

2.1   Technology based Fitness aids

In this section we will look at existing technology based fitness aids to identify how they work. Once we have an understanding of what they are we will evaluate how they explain and help to overcome the reasons people provide for not undertaking fitness behaviour to aim to identify if they fully support all individuals in changing their behaviour.

2.1.1   Current approaches of Technology based Fitness aids

This section we will explore the current technology aids that exist in order to change fitness behaviour. Martin (2014) has shown that these are widely used with six point seven million people currently own one in order to support their fitness activity. This market is also expanding as estimates show that around thirteen million users are expected to use a technology based fitness aid by the end of twenty fifteen.

Technology fitness aids can be divided into two main groups depending on what they need in order to deliver change. The first of these is wearable devices. Wearable devices are currently used by seventy nine percent of those individuals who use technology based fitness aids (Martin 2014). The other is using mobile applications. Mobile applications are less popular with only twenty eight percent of individuals using them (Martin 2014). However this research has shown that seven percent of users are utilising both applications and wearable technology. In the subsequent section we will explore how both of these approaches currently deliver behaviour change starting with wearable devices.

Wearable devices

The first mass market health related fitness aids were pedometers. These devices monitor the number of steps that an individual takes on a given day and gives a visual display of their step count (Bravata et al. 2007). Bravata et al (2007) have explored a verity of literature to identify the strengths and weaknesses of this approach in a wide verity of domains and age groups. These steps can be translated into metabolic equivalence and so can give an understanding of the impact to cardiovascular endurance training that occur (Marshall et al. 2009). This translates to ninety two steps per minute being equivalent to three metabolic equivalent rate in men and ninety one steps per minute for females. However pedometers do not track any of the other aspects of health related fitness. In has

Improving current technology based fitness devices through closer alignment to behaviour change literature

highlighted that pedometers have an engagement problem with an average drop out rate of twenty percent across an eighteen week average study length. This is considerably more than other health related fitness intervention approaches that have a drop out rate of between four and sixteen percent. However this can be explained with other approaches having more guidance, follow up and supervision (Foster et al. 2014). The use of a pedometer has, for the individuals who complete the entire intervention, been seen, across this wide range of studies, to improve cardiovascular activity by an average of two thousand and four steps against each control group. All of the studies showed some improvement overall with the smallest improvement being three hundred and ninety five step improvement and the largest improvement being five thousand and sixty six. However this does not show the full story as in three separate studies a selection of individuals having pedometer intervention undertaking fewer steps than the control groups, as a result this approach does not work for all individuals. Bravata et al (2007) argues with supporting evidence, from numerous sources, that having a goal amount of steps results in greater gains against the control group. In addition to this they show that when the intervention takes place outside of the workplace they are more effective. However they made no claims as to why this intervention improves the individual health related fitness.

More recently smart devices have overtaken pedometers as they can provide more features. This market has been dominated by a small section of devices with the Fitbit, Jawbone and Nike accounting for ninety seven percent of health related fitness wearable technology sales (Dolan 2014). This paper acknowledges that other wearable devices exist however will focus on these commonly used devices (Orr & Abowd 2000; Gupta & Jilla 2011).

All of these devices allow their user to track their own movement and this activity is displayed on the device however rather than using metabolic equivalence they use their own preparatory measurement system and do not publicly disclose how it is calculated. With Nike stating that they looked at the metabolic equivalence scale before creating a "motivational metric" which "compare activity levels on an even playing field" however this means that users can not compare between ecosystems (Nike 2013). However these approaches are not as accurate as a traditional pedometer underestimating by nine percent and being even less accurate when users undertake quicker activity (Delgado n.d.). This also has the problem with not being able to identify whether a given amount of the preparatory compares to the recommended level of activity that is needed for health related fitness. This makes business sense as it locks the user in. However is not helpful for the individual who wants to make a positive change in their life and can be seen as a marked failure. These devices also share the problem that they only measure cardiovascular endurance and so other leave the user unaware of the other aspects of health related fitness that they need to undertake. However Fritz et al (2014) have shown that the users of these devices have an affect on their users through persuasive and reflective approaches (Munson 2012). They first highlight that the users have a strong attachment to the devices and look at them often creating a large awareness of their progress towards a goal. When they find that they are close to their goal they will undertake action in order to reach it. They also find that when they see a low value of their progress they will undertake action to improve it. They also have found that the device can provide evidence to the user that they can undertake activity and can improve the confidence for the users. In addition the users are seeing their fitness activities to only be beneficial if they get credit from the device rather than the benefits to their health undertaking less activity when they forget their devices. Overwhelmingly the strongest benefit of using the devices is that the can compare their activity with others and compete with them. This shows that the community that the user is involved with has a key affect in the impact on the users cardiovascular endurance.

There are also devices that are designed to track in a similar way a users muscular training in order to motivate users to improve their muscular endurance and strength (Anon 2015). However as outlined by Dolan (2014) that these are not purchased by users which may be an example of market failure.

Improving current technology based fitness devices through closer alignment to behaviour change literature

Even if these devices were purchased the user will have to make a choice of which device to wear and thus is monitored as no devices track both types of fitness. The user cannot make the choice to track their flexibility training as no device that monitors this aspect of health related fitness.
One of the challenges outlined in the motivation section is that the elderly are particularly not undertaking fitness activity. The current devices that exist are not tailored to them. (De Bruin et al. 2008) have shown that if they were then they can improve their cardiovascular endurance through monitoring. This research is limited to that specific element of physical activity. Although this is outside the scope of the project concepts that are presented may be of benefit for that future work.

These devices have been explored in order to consider how well they improve users fitness (Munson & Consolvo 2012; Shin et al. 2012; Chen 2014). This shows that they are valid to be explored in this domain. They have been found to have varying levels of success however no study has been found that all users improve or get the majority of users to the recommended level of activity. As a result we feel that a contribution can be made if better approaches to these can be found.

These wearable devices have been found to be no more accurate than applications running on a smart phone (Case et al. 2015). As a result smart phone applications are considered sufficient to track and monitor fitness goals. This paper will now consider the current approaches in fitness aid applications in order to see if these later relate more closely to the behaviour change literature.

Applications

Martin (2014) has shown that the limited number of individuals who use mobile applications to track their health related fitness activities are divided equally into free and paid applications. Although eighty percent of those using free applications intend to purchase a paid version in the near future. Kranz et al (2013) have shown that these applications fall into three main groups GPS tracker applications, workout planning applications and exercise books. GPS trackers provide the user with a way of tracking the route their run takes thus is limited to specific types of cardiovascular endurance training. Workout planning applications allow the users to plan when to work out and what type of training to undertake as a result are able to track and aid in the planning of training for all health related fitness training. Exercise books provide the user with the information about how to work out thus providing them with knowledge they need.

Kranz et al (2013) have highlighted that the users undertaking fewer actions to track activity or access information can improve these apps usability. In addition they highlight that although the support is not up to the level of a personal trainer they represent a high level of instructional quality. They finally identify that the application aids the long term motivation of users particularly when a scoring mechanism is used. They have also explored how a mobile application can be used with physical work out devices. This can be to provide information that is inaccessible such as a balance board tracking the movement of the user or to collect information more accurately when linked into a treadmill. This approach scored highly with the users and improved the accuracy of the information or scores being presented to the users. However these recommendations were made without looking at the behaviour change literature as a result we feel that when the behaviour change models are considered alternative approaches can be recommended which may have a different impact.

Improving current technology based fitness devices through closer alignment to behaviour change literature

2.1.2   How does technology based fitness aids deal with the reasons people do not exercise

In the previous section we have identified the different technology approaches that aim to increase the fitness activity. However we believe they are not fully effective to all individuals at all times. In order to highlight this we have identified the main reasons that individuals do not undertake physical activity (Mullan et al. 1997). We will go on to explore how these current applications and devices explain these reasons.

The first of the groups of reasons is external regulation, this is where the individual does the behaviour as they are being told to do the behaviour. Wearable devices and fitness planning applications both tell the user to do exercise either when they plan it or when the device recognises that the user should preform the activity. However we do not know effective a device can replace the individuals that are described in the reasons. As a result the devices may be seen to be less effective than social norm to describe these issues.

The second of the groups of reasons is introjected regulation. This is where the individual feels guilty when they miss the exercise. Fitness planning applications will remind the user when they miss exercise however it is unknown whether this creates guilt for the user. Our model would require the individual to have the knowledge that the behaviour as a result if guilt does exist then it will likely only exist in individuals in the contemplation stage or later. However Toscos et al (2006) has shown that wearable devices provide a physical representation of the users commitment. This makes us believe that they will feel more guilt and thus better explain this issue.

The third group of reasons people do not undertake exercise is the identified regulation is identified regulation. This is where the individual performs the exercise as they see the benefits of the exercise. However neither wearable devices nor applications describe the benefits of exercise as a result do not help with this group of reasons.

The final group of reasons is intrinsic regulation. This is where the individual preforms the activity due to enjoyment they have for the activity. Wearable devices are the only fitness based technology aids that attempt to improve enjoyment through gamification.

As a result technology based fitness aids can be good in supporting the reasons that people have for not undertaking physical activity depending on their implementation. However they are not perfect in particular they do not aid identified regulation that the behaviour change model can explain. We believe that another approach will improve these devices. In the subsequent section we will look at different behaviour change methods that explain the entire behaviour change process and test to see whether they can explain these reasons people do not exercise.

Improving current technology based fitness devices through closer alignment to behaviour change literature

2.2 Behaviour change

Taylor et al (2006) on behalf of the national institute of clinical excellence, identified a number of approaches that they argue are effective at changing the health behaviour of individuals. The health behaviours that they argue that can be changed included but where not limited to changing diets, promoting exercise, controlling alcohol use and adhering to treatments. As a result these models will be effective in the domain that we are exploring. The models that they identified that would be effective in our domain are the health belief model, the theory of reasoned action, the theory of planned behaviour and Transtheoretical model. Each of these models argues that a change in behaviour is created from a different source. However none have been universally successful as a result we believe that different individuals require different interventions focusing on different aspect to be effective. In order to start creating interventions that would be more effective we will look at how the models can be put together which we believe will create stronger motivation to change. While we where fitting the models together we identified that other models where necessary to be included in order to fill in gaps due to the identified models only focusing on certain parts of the behaviour change process. As a result we also include discussions of reversal theory, social cognitive theory, overview of procrastination model, health action process approach, Fogg belief model, temptation bundling and gamification. We feel that these are acceptable to be included as each has been proved to be effective in the fitness domain (Frey 1993; Fujiyama et al. 2005; Dzewaltowski et al. 1990; Milkman et al. 2014; Fogg 2009; Mayrsohn & Lyons n.d.).

2.2.1 Transtheoretical model

Prochaska in 1977 created the Transtheoretical model or the stage of change model (Prochaska & DiClemente 2005). This model argues that the individual in order to adopt a new behaviour has to progress through a number of stages (Velicer et al. 1998). These stages break down into two main phases an intention phase and an action phase (post planning). The intention phase the individual needs to change their beliefs about the new behaviour to be something that they wish to do and feel are able to do. Individuals in this phase, Cropley et al (2003) argues, have a negative opinion towards exercise believing that it will lead to injury rather than improving health. This phase starts with the precontemplation stage. At this stage the individual has no intention to undertake the new behaviour in the next six months. They do not feel that the behaviour has any benefits or if they do believe the behaviour has benefits they do not outweigh the costs. This is generally due to the individual being under informed about the benefits of the new behaviour.

Once the individual has changed their attitude towards the behaviour they enter the contemplation stage. In this stage the individual has the intention to undertake the new behaviour but not in an immediate future. By delaying the behaviour this stage the individual is particularly prone to procrastination. Individuals in this phase may also have tried and failed to adopt the behaviour previously due to seeing the benefits of the new behaviour. This may have an effect on the individuals willingness to reattempt to adopt the new behaviour and thus may be stuck in the phase for longer. However if the individual changes their beliefs towards the new behaviour and no longer sees the benefits of the new behaviour they will relapse back to the precontemplation stage.

When the individual is over the procrastination and is ready to take immediate action to start the new behaviour they enter the preparation stage. At this stage the individual needs to have all the knowledge about how to do the behaviour along with how they plan to start executing the behaviour. If the individual does not have the knowledge to undertake the new behaviour, experiences another barrier to the immediate adoption of the behaviour or lack a plan to executing the behaviour then the individual is likely to relapse into the contemplation phase as they are not prepared to do immediate

action. Once the individual is fully prepared to adopt the new behaviour they can transit from the intention phase to the action phase (post planning).

In the action phase (post planning) the individual is undertaking the behaviour starting with the action stage. Individuals in this phase, Cropley et al (2003) argues, no longer see the negative issues of exercise instead they view it as only a positive behaviour. During this stage the individuals will be attempting to adopt the new behaviour and may try different approaches in order to identify what works best for themselves. They do the experimentation in to identify how they can adopt the behaviour and resist relapse into earlier stages of the process most commonly the contemplation or preparation stages.

Once the individual has successfully established the behaviour as part of their life they enter the maintenance stage. At this stage the individual is confident in their plan and their ability to continue to undertake the behaviour. The individual will be highly resistant to relapse at this point.
Prochaska and DiClemente (2005) argue that individuals progress through all these stages in order to adopt any behaviour some behaviours progress through all these stages quickly where as other behaviours take longer to be successfully adopted. In order to move between these stages Buckworth et al (2007) argues, an internal or external change needs to occur however the size of the change will differ from person by person depending on their threshold for change. They identified that the sources of internal changes include pressure, enjoyment, interest and choice. They also identified sources of external changes include social competition, appearance and tangible rewards. They found that choice and tangible rewards have the biggest impact on motivating an individual to the later stages of the behaviour change process. However Cropley et al (2003) have shown that individuals in earlier stages of the process focus on the negative potential aspects of undertaking physical activity such as getting injured rather than the positives. As a result different interventions are effective at different stages and so should be tailored to the transitions to the individuals next stage.
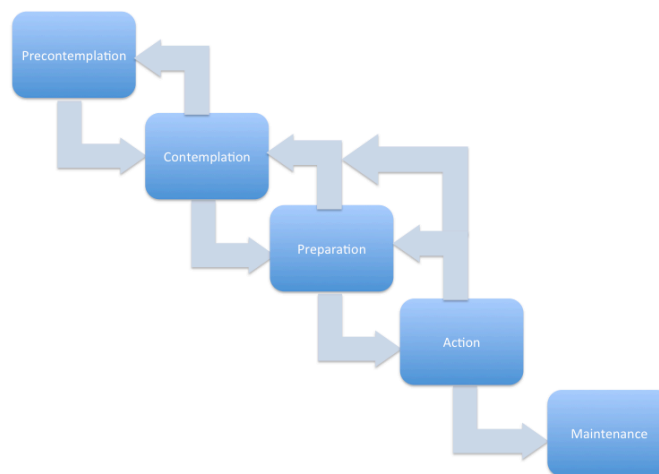
Figure 2-1 - Summary of the Transtheoretical model

Historically the interventions based on the behaviour change literature have considered their success or failure as to whether the individual is undertaking the behaviour. However using the Transtheoretical model we can more precisely identify the stages that an individual goes through in order to adopt a behaviour. Between any of these points different interventions that are inspired by different behaviour change models can be seen as successful. We will now go through each of the stages that an individual goes through in order to identify how different behaviour change models can

aid the transitions. We are doing this based on the models themselves informing these decisions however these models may fit together differently in practice. We will start by looking at the transition between the precontemplation stage to the contemplation stage.

2.2.2 Models that help explain the transition from the Precontemplation stage to contemplation stage

The first transition that the Transtheoretical model focuses on is from the precontemplation stage, where the individual has no intention to undertake any health related fitness activity, to the contemplation stage, where the individual sees the importance of health related fitness activity and has the intention to undertake it but not in the near future. As a result this transition is focusing on getting the individuals to see health related fitness as important. When they see that doing the fitness is important then the individual will create an intention to undertake more health related physical fitness. However they still may lack the ability to perform the behaviour as a result they must progress through the later stages before they adopt the behaviour. There are a number of models that identify different ways that the perceptions of fitness can be changed. The paper will now go on to explore how social cognitive theory, the theory of reasoned action, the theory of planned behaviour and health belief model can be used to change the perception of health related fitness activity.

Social cognitive theory

Holt (1931) in 1931 argued that behaviour change could be explained using social cognitive theory. This theory argues that the adoption of new behaviours is influenced by personal factors, external factors and behavioural factors (Bandura 1998). Bandura (1998) describes personal factors as the individuals beliefs about the new behaviour and whether they are capable to preform the behaviour. External factors are described as the environment that makes the new behaviour easier or more difficult such as the access to gyms or outdoor running spaces. Finally behavioural factors are the individuals observations of others undertaking the new behaviour which changes their personal beliefs or the external factors of doing the activity. As each of these factors changes they change the others and create an overall impression of the new behaviour call an efficacy. However these changes in factors may not always be positive as a result the individuals efficacy can fall as well as increase.
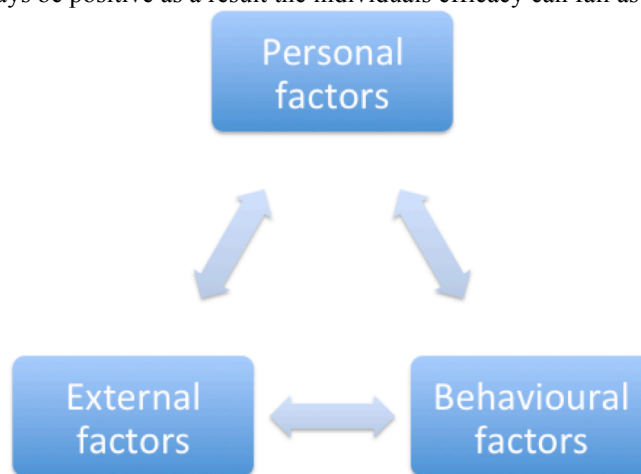
Figure 2-2 - Summary of social cognitive theory

Improving current technology based fitness devices through closer alignment to behaviour change literature

The strongest way to create positive efficacy, Bandura (1998) argues, is through mastery experiences. This is where successful execution of the new behaviour improves the individuals personal factors as they have proven to themselves that they can perform the action. This in turn will improve the efficacy of the new behaviour. However if the individual fails in there attempt to undertake the action then personal factors will fall due to having evidence that they are unable to do the new behaviour. This will result in the efficacy of the new behaviour falling which if large enough may make the individual to relapse into earlier stages of the process. As this intervention requires the individual to undertake the new behaviour it is most suited to transitions between the preparation stage, action stage and maintenance stages (See Figure 2-3).

The next way that Bandura (1998) argues affects the individuals efficacy is through vicarious experiences. This is where the individual see the benefits people similar to themselves are getting from the new behaviour. This will change the individual personal factors through observing behavioural factors. This is due to making the individual feel that they are more capable to perform the action and that they will get the same benefits that the individual they are observing is gaining. However the individual may feel that the individual is different to himself or herself, as a result will feel less able to adopt the new behaviour. This approach is most effective when the benefits that they are individual cares about are observed in vicarious experience (Jehn et al. 1997). The vicarious experiences focusing on observing that others are gaining benefits from the new behaviour will be effective in aiding the transition from the precontemplation stage to the contemplation stage. The vicarious experiences that help the individual to see that they are capable of undertaking the new behaviour will be effective from the contemplation stage to the preparation stage (See Figure 2-3).

The third way that Bandura (1998) argues that efficacy is affected through social persuasion. This is where others help the individual realise that the new behaviour is beneficial and that they have the ability to do the new behaviour through the persuasion of others. This also changes the individuals personal factors though a change in the behavioural factors that they observe. However they may also experience social persuasion to not undertake the behaviour or to undertake conflicting behaviours. As a result the personal factors may be reduced and the behaviour being seen less efficacy. This like vicarious experiences provides aid to individuals transitioning from the precontemplation stage to the contemplation stage of changing attitudes. In addition to aiding individuals from the contemplation stage to the preparation stage through making the individual more confident in their ability to perform the activity (See Figure 2-3).

The final personal factor that Bandura (1998) argues that affects how efficacy is perceived by the individual is their somatic and emotional states. These exist solely as personal factors. If the individual is feeling stressed or in pain while doing the new behaviour then their efficacy is likely to fall and relapse is likely. However if they are feeling stronger as a result of the behaviour then their efficacy is likely to rise. The challenge that health related fitness in particular has with this regard is initially undertaking exercise initially has pain and fatigue that will lower the individuals efficacy prior to it getting raised by the latter effects. In addition to this the mood that the individual has will also play an effect in raising or lowering the efficacy of a new behaviour. As this revolves around the individual undertaking the activity it is most effective between the preparation stage, action stage and the maintenance stage (See Figure 2-3).

Holt (1931) describes that the perceived social norms of the behaviour also affect the efficacy of the behaviour. When the individual observes lots of other people are doing the behaviour they also will adopt the behaviour to fit in. This is an example of the behavioural factor being so strong it will start a change in the behaviour without needing the individual to change his or her own personal beliefs. This is an intervention that may get the individual to move from the precontemplation phase to the preparation phase (planning phase).

Improving current technology based fitness devices through closer alignment to behaviour change literature
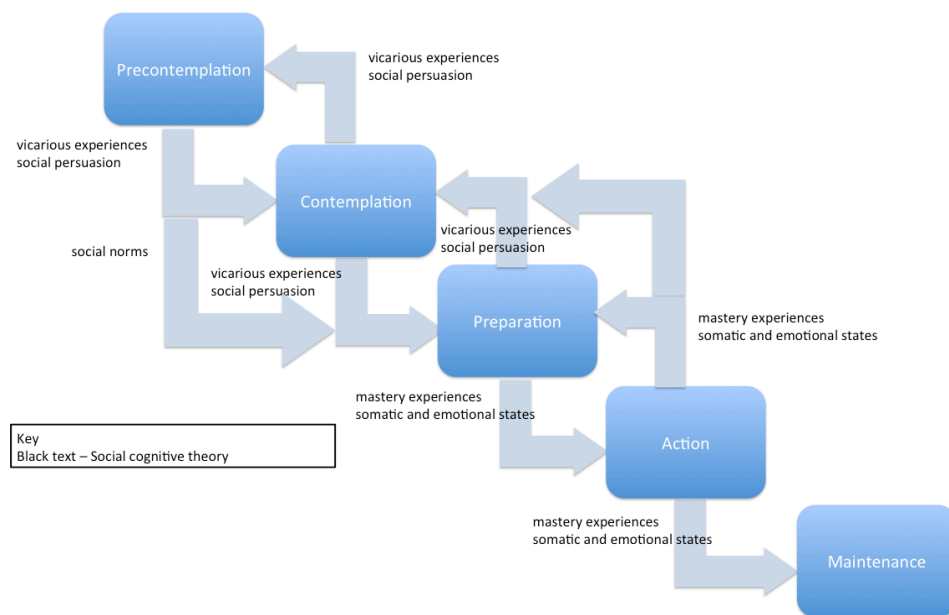
Figure 2-3 - How the aspects of social cognitive theory fits into the Transtheoretical model

Social cognitive theory has indicated a number of interventions that are effective in changing the personal factors of an individual. The theory of reasoned action and the theory of planed behaviour have additional aspects that are important to changing the personal factors in a way that encourages the adoption of the new behaviour.

Theory of reasoned action

The theory of reasoned action was created by Fishbein and Ajzen in 1975 (Fishbein, M., Ajzen 1975). This model argues that an intention to do the new behaviour is formed by two social cognitive theory personal factors. The first personal factor is the individual attitude towards the behaviour (Ajzen 1985). The individuals attitude toward the new behaviour is described as how favourably the individual evaluates the new behaviour to be. Social cognitive theory has demonstrated that attitudes can be changed using vicarious experiences and social persuasion. The theory of reasoned action expands on this through Kelman (1958) identifying three approaches that have been shown to change attitudes with various levels of success. The first of these attitude changing approaches is through compliance. Compliance, Kelman (1958) argues, is when an individual changes their attitude in order to gain a reward rather than from the belief that an activity is beneficial. However when compliance is used to change is only observable when the individual I directly supervised. The next attitude changing approach is through identification. This is when an individual undertakes behaviour due to relationships they do with one another. However this approach is only observable when the relationship is maintained. This identifies that relapses could occur due to a change in the relationship that initiated the change in attitude. The final and most long lasting attitude change approach is through internalization. This is where the change in attitude is due to the individuals changing their internal perception of the activity so they now wish to undertake the activity for themselves.

The other personal factor is the individuals belief of how social norm the new behaviour (Ajzen 1985). Social norm of the new behaviour has also been identified in social cognitive theory.
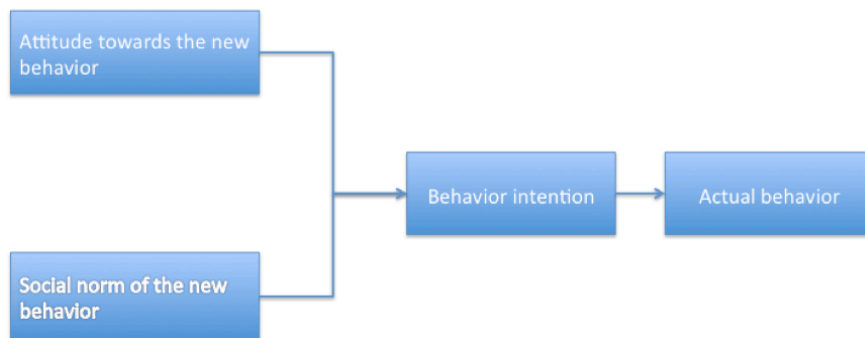
Figure 2-4 - Summary of the theory of reasoned action

These two factors, Dillard and Pfau (2002) argue, are required in different levels of strength depending on the individual and the behaviour being adopted. However they state that this leads to an intention being created as a result we believe that this model is most effective between the precontemplation and the contemplation stages of the Transtheoretical model. The model goes on to show that this intention will be adopted without any further intervention once the intention is created. This depending on the new behaviour being changed may occur however the Transtheoretical model shows that adopting a new behaviour is vastly different to forming an intention to undertaking the new behaviour. As a result other models that focus on progressing individuals from the contemplation stage to the maintenance stage can be used to aid the adoption of the new behaviour (See Section 2.2.3).
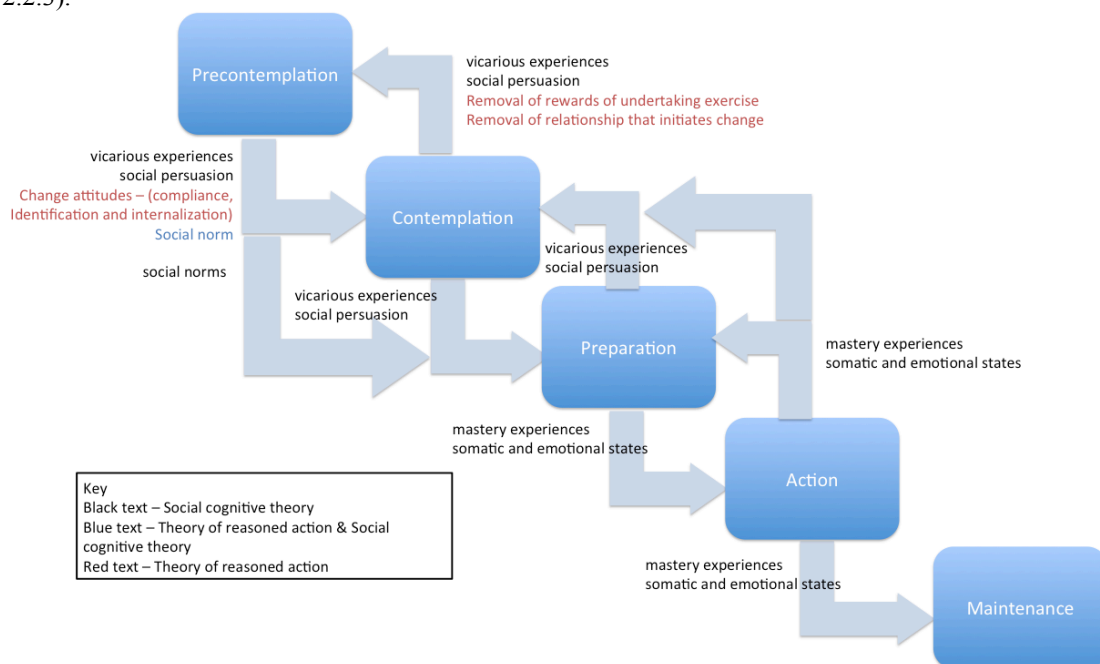
Figure 2-5 - How the Theory of reasoned action fits into our model of behaviour change

Improving current technology based fitness devices through closer alignment to behaviour change literature

The theory of reason action was later expanded in 1985 by Ajzen (1985) into the theory of planned behaviour that introduced another personal factor that they argue will aid in the creation of intention of the new behaviour. We will now explore the theory of planned behaviour.

Theory of planned behaviour

The theory of planned behaviour as described in the theory of reasoned action uses both personal factors of changing the individuals attitude towards a new behaviour and the social norm of the new behaviour in order to create interventions. The theory of planned behaviour goes on to include another personal factor, the behavioural control that an individual feels that they have to undertake the new behaviour (Netemeyer et al. 1991).
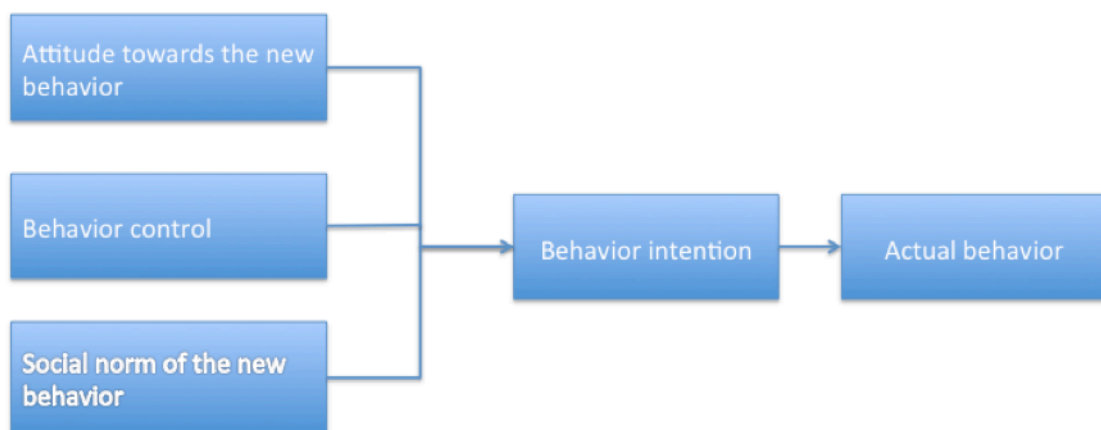
Figure 2-6 - Summary of the theory of planned behaviour

The perceived behavioural control can be maximised through making an individual more confident in their ability to preform the new behaviour. This can be created through the use of vicarious and mastery experiences as identified in our analysis of the social cognitive theory. When behavioural control is considered with subjective norms it mimics the Locus of control identified by Rotter (1966). The perceived behavioural control is representative of how internal factors effect how much control the individual has over a given behaviour. The subjective norms, on the other hand, are representative of how external factors affect how in control an individual is over a given behaviour. If this principle holds true then the external factors individuals feel powerless to change them.

The theory of reasoned action and the theory of planned behaviour have been shown to have shown mixed results in the fitness domain (Blue 1995). However Blue (1995) have shown that theory of planned behaviour is a better identification of behaviour change than the theory of reasoned action as the majority of the behaviour change can be attributed to the control aspect introduced in the model. They have also shown that social norms are a lot more likely to make an impact on the effectiveness of the intervention rather than the attitude towards the new behaviour. However Dzewaltowski et al (1990) argues that the social cognitive theory is more likely to lead to a change in behaviour across a four week period. This, we believe, is due to the social cognitive theory being able to be applied with individuals in more stages of the Transtheoretical behaviour change model.

Improving current technology based fitness devices through closer alignment to behaviour change literature
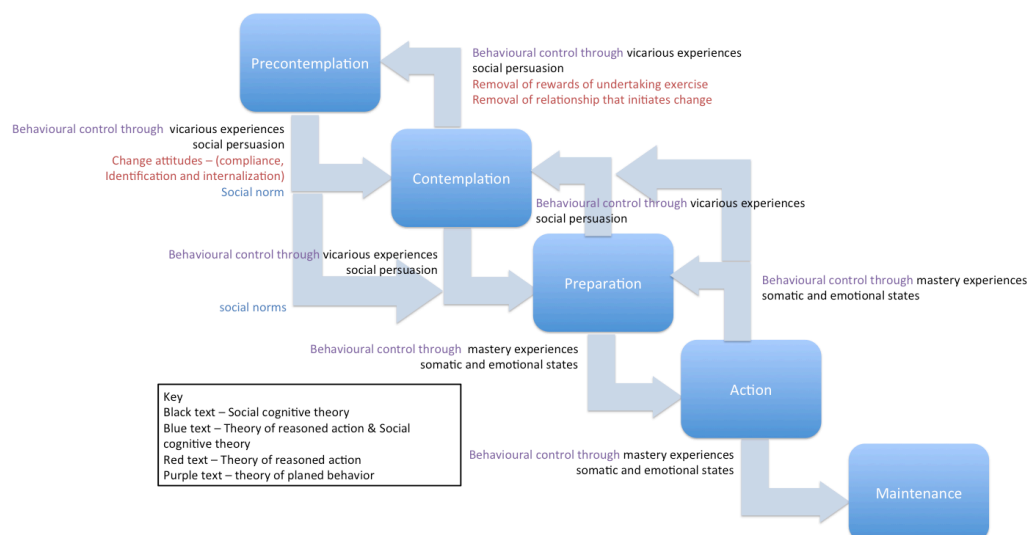
Figure 2-7 - How the theory of planned behaviour fits into the Transtheoretical model

The attitude towards a new behaviour can be further explained by the health belief model, which we will go on to explore in the next section.

Health belief model

The health belief model created in 1966 by Rosenstock (1966). This model overall describes behaviours as being generated by beliefs and motivations which change over time based on the decisions made by the individual (Finfgeld et al. 2003). The model describes a number of elements that they argue are important for an individuals attitude towards the new behaviour to be improved to encourage an intention to be formed. These include how severe the individual perceives the consequences of not doing the new behaviour are, how susceptible they feel to the negative consequences and what they perceive the benefits of adopting the new behaviour are (Carpenter 2010).

The first of these is how susceptible the individual feels they are to a negative outcome should they undertake the activity. In fitness terms, ceteris paribus, if the individual feels that they are susceptible to the negative outcomes of not exercising then they are likely to exercise. The second of these is how severe they perceive the outcomes to be. In fitness terms, ceteris paribus, if they feel that not exercising would lead to more server consequences then they are more likely to undertake positive fitness activities. As explained in section 1.3 there are strong health and economic issues of not undertaking enough physical activity. This results that the issue is due to the individuals perception rather than the real problems of not undertaking the behaviour. The final of these perceptions is whether the target behaviour, in this case fitness activities, will provide strong benefits which they do as they counteract the health and economic issues.

The health belief model also gives an observation of a factor that affects the theory of planned behaviour behavioural control. This factor is how the individual perceives the barriers to adopting the new behaviour are. In the fitness domain Schutzer and Graves (2004) have shown the barriers to adopting the behaviour are the health of the individual, the environments the user lives in, knowledge about how to work out and the amount of activity individuals have done in their youth.

Improving current technology based fitness devices through closer alignment to behaviour change literature

The model concludes by identifying that an individuals willingness to undertake the behaviour can be improved through receiving a cue to action. These cues to action can come from outside influences such as from the media or internal influences such as body image and the stronger they are, ceteris paribus, the more likely the individual is to undertake a given behaviour. However the individual must already have the intention to undertake the behaviour in order to be successful. This results in it existing between the contemplation and preparation and action stages of the Transtheoretical model.
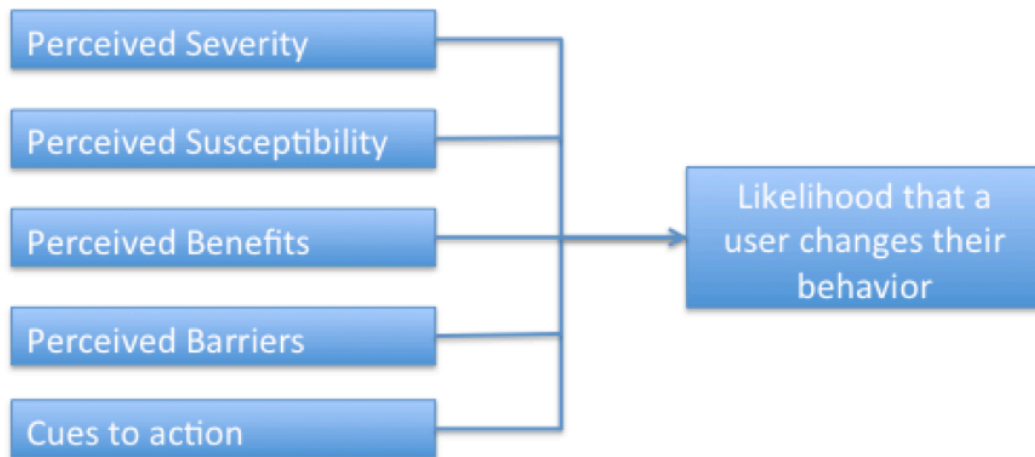
Figure 2-8 - Summary of the health belief model

The approach has been seen as a highly effective approach to getting individuals to undertake more physical activity with studies resulting in between eleven percent and eighty seven percent more activity depending on the intervention approach (Mirotznik et al. 1995). This is across a wide range of ages, gender and education levels. However the drop out can be seen as quite high at fifty percent. This O'Connell et al (1985) argues, can be explained by the model itself as when the intervention fails to improve the individuals fitness immediately they feel more out of control to undertake the activity and so will drop out of the intervention.

Figure 2-9 - How the health belief model fits into the Transtheoretical model

Improving current technology based fitness devices through closer alignment to behaviour change literature

In this section we have explored how different models change how you think about a new behaviour in order to create an intention to adopt the new behaviour. However once this intention is created further intervention is needed in order for the behaviour to actually be adopted and maintained. We have already identified a few elements that that aid the later stages of the Transtheoretical model. We will now explore how the individual gets from having the intention to undertake the new behaviour to being ready to try the new behaviour. This represents the individual moving from the contemplation stage to the preparation stage.

2.2.3   Models that help explain the transition from the Contemplation stage to preparation stage

Once the individual is in the contemplation stage they have the intention to undertake the new behaviour however they are not able to undertake immediate action to undertake the new behaviour. As a result the individual needs to move into the preparation stage. We have already identified a number of elements such as the theory of planed behaviour behavioural control to overcome perceived barriers, social cognitive theory social persuasion and the health belief models cues to action. In addition to this we are going on to explore a number of other models that aim to overcome procrastination in order for the individual to be ready to start undertaking the behaviour. We will look at Health action process approach and the overview of the causes of procrastination model.

Overview of the causes of procrastination model

Procee et al (2013) have shown that procrastination towards a behaviour that an individual has an intention to preform is effected by task factors and personality factors. Task factors can be improved, and thus the individual can be encouraged to start the behaviour, through making the behaviour easier to start, remove the delay to starting the behaviour and to make the task more appealing than the other tasks that the individual needs to preform. To encourage the behaviour to be started we can use the Kelman (1958) methods to provide a incentive to preform the action. However when we consider this with the Transtheoretical model the individual when they are in the contemplation stage will already have the desire to undertake the behaviour. The next task factor that can change procrastination is making the activity easier to start. In fitness this can be achieved through having the individual undertaking easier exercises such as walking before doing the activities that are harder such as running. The final task factor, Procee et al (2013) agues, is to make the activity more appealing than the other activities in their life. The other activity that the individual has to do is outside the scope of this project as different people have lots of different tasks they need to do. However we can make the task more appealing. Toscos et al (2006) has shown that individuals see the task more appealing when the device is more appealing.

The personality factors differ from individual to individual depending on their personal fear of failure and their susceptibility to procrastination. The fear of failure can be reduced through seeing other people succeed through vicarious experiences. The susceptibility to procrastination, Procee et al (2013) argues, depends on the individuals sensation seeking, impulsiveness, contentiousness and self esteem. In addition to this we have identified the reversal theory that identifies that people will adopt behaviours when they are in certain metamorphic states (Smith & Apter 1975). In particular individuals who are in conforming, mastery or telic states will be more likely to overcome procrastination more easily (Finfgeld et al. 2003). Reversal theory also shows that a number of the interventions can be more effective to individuals in certain metamorphic states than in others. For example individuals in alloic metamorphic states will be more susceptible to social norm interventions and individuals in conforming and telic metamorphic states will be more susceptible to goal and rule orientated interventions such as those based on the theory of planed behaviour or cues to action.

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Improving current technology based fitness devices through closer alignment to behaviour change literature
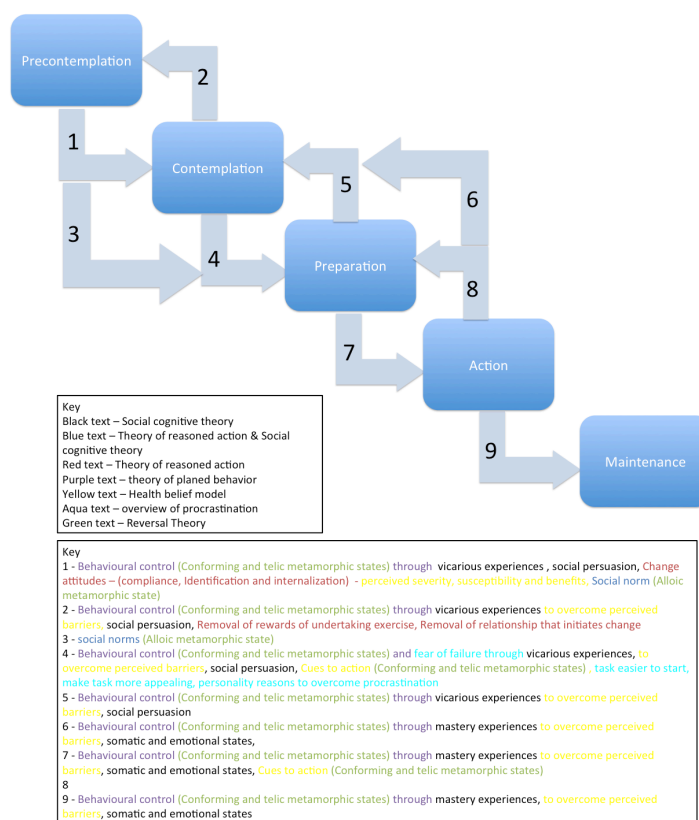
Figure 2-10 - How the causes of Procrastination fit into the Transtheoretical model

Health action process approach

The health action process approach has a different approach indicating that intentions can overcome procrastination and become behaviour through planning (Schwarzer & Renner 2000; Schwarzer & Luszczynska 2008). This model details those two types of planning need to occur action planning and coping planning. Action planning is the planning in order to identify how and when the intention can be performed. The how aspect of action planning intuitively is described in a similar way as the task related parts of the causes of procrastination model. The second way of planning is coping planning this is how the individual anticipates the barriers which is similar to the perceived barriers aspect of the health belief model. However this model builds upon this through explaining that plans of how to overcome the barriers need to be created to overcome the procrastination.

In order for the plans to be most effective, Milne et al (1991) allong with Oettingen & Gollwitzer (2007) argue that a number of aspects that must be present in the plan. These are when they include a time frame (no matter how distant or proximal the time frame is), have a specific outcome and have a goal framework. Where a goal framework is either to learn something new in this case to start running or a performance goal to do more running or to achieve a time for a given distance. The plans need to be simple and possible given the skills of the individual. However in the fitness domain these skills will change over time as a result the plans that the individuals have must evolve over time. Finally the plans are most effective when the individual has strong commitment to the plan and receive frequent feedback.

Improving current technology based fitness devices through closer alignment to behaviour change literature

Key
Black text – Social cognitive theory
Blue text – Theory of reasoned action & Social cognitive theory
Red text – Theory of reasoned action
Purple text – theory of planed behavior
Yellow text – Health belief model
Aqua text – overview of procrastination
Green text – Reversal Theory
Brown text – health action process approach

Key
1 - Behavioural control (Conforming and telic metamorphic states) through vicarious experiences , social persuasion, Change attitudes – (compliance, Identification and internalization) - perceived severity, susceptibility and benefits, Social norm (Alloic metamorphic state)
2 - Behavioural control (Conforming and telic metamorphic states) through vicarious experiences to overcome perceived barriers, social persuasion, Removal of rewards of undertaking exercise, Removal of relationship that initiates change
3 - social norms (Alloic metamorphic state)
4 - Behavioural control (Conforming and telic metamorphic states) and fear of failure through vicarious experiences to overcome perceived barriers (coping planning) , social persuasion, Cues to action (Conforming and telic metamorphic states) , Action planning (task easier to start, make task more appealing) , personality reasons to overcome procrastination
5 - Behavioural control (Conforming and telic metamorphic states) through vicarious experiences to overcome perceived barriers (coping planning), social persuasion
6 - Behavioural control (Conforming and telic metamorphic states) through mastery experiences to overcome perceived barriers (coping planning), somatic and emotional states,
7 - Behavioural control (Conforming and telic metamorphic states) through mastery experiences to overcome perceived barriers (coping planning), somatic and emotional states, Cues to action (Conforming and telic metamorphic states)
8
9 - Behavioural control (Conforming and telic metamorphic states) through mastery experiences, to overcome perceived barriers (coping planning), somatic and emotional states

Figure 2-11 - How the health action process approach fits into the Transtheoretical model

2.2.4   Models that help explain the transition from the Preparation stage to action stage

Once we have overcome the procrastination the individual is ready to undergo immediate adoption of the behaviour as they are in the preparation stage. However they have yet to undertake any activity. Through the model we are developing to understand all the factors of behaviour change we have identified a number of aspects that are important for the fist time they undertake the activity. These include the mastery experience that they get when they first try the activity and cue to start the action. In addition to this we have identified Fogg behavioural model that identifies the aspects that an individual needs in order to process in order to perform the action.

Improving current technology based fitness devices through closer alignment to behaviour change literature

Fogg behavioural model

In order for the individuals to start undertaking the activity the Fogg behavioural model shows that they must be motivated, have a trigger and have the ability to undertake the behaviour (Fogg 2009). The motivation should already have been established as the individual progresses through the previous stages. However this model details that different sides of certain motivators motivate different individuals. These motivators are pain/pleasure, hope/fear and social acceptance/rejection. We believe that the side of the motivators that the individual is on is related to the metamorphic state that they are in as described in the reversal theory. However we could find no evidence to support this belief.

This model goes on to identify that the individual requires a trigger this is similar to the cue to action as described in the health belief model. However this model provides more details about the types of trigger that can be effective. These are a spark, a facilitator or a signal.

The model concludes by explaining that the individual must have the ability to perform the activity. They require the time, money, physical effort, social deviance and brain capacity to preform the activity. If the individual has all of these then they will be able to perform the activity for the first time and thus enter the action stage. This is in addition to the barriers that Schutzer and Graves (2004) have indicated in section 2.2.2.
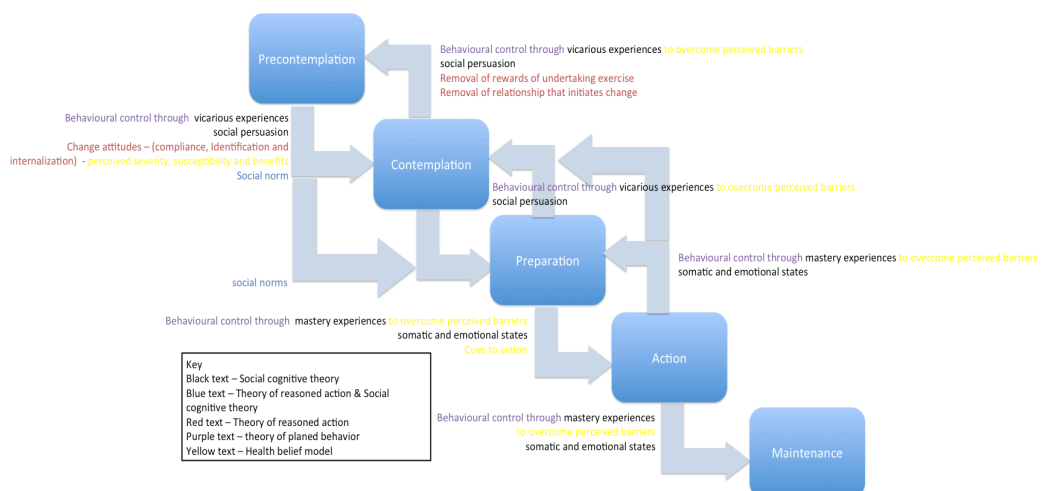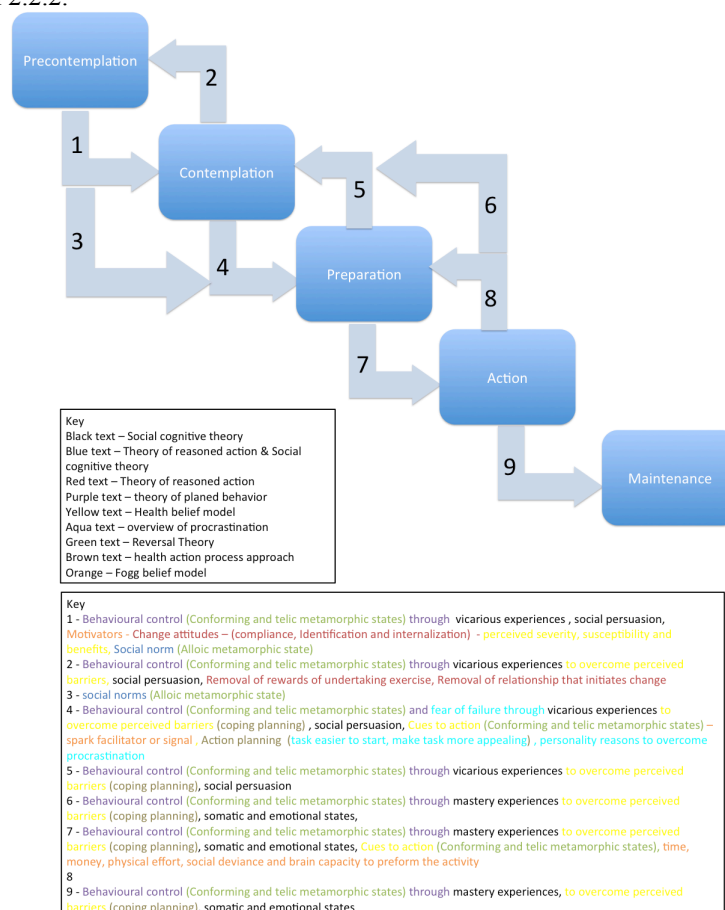

Figure 2-12 - How the Fogg belief model fits into the Transtheoretical model

Improving current technology based fitness devices through closer alignment to behaviour change literature

2.2.5   Models that help explain the transition from the Action stage to maintenance stage

Once the individual starts undertaking the behaviour we must take steps in order to keep the individual engaged with the behaviour in order to avoid them stop preforming the activity. The model that we have been creating up to this point has identified that mastery experiences will aid in the continued performing of the behaviour. In addition to this we have identified other approaches that have been seen to be effective to encourage an individual to continue to perform the behaviour. One such approach is to increase the engagement to behaviour is through temptation bundling (Milkman et al. 2014). This is where the participant associates something they want to do in this case listening to audio books with the behaviour that they wish to adopt in this case fitness. They then restrict the access to what they want to do to when they are doing the behaviour. This allows the behaviour to be continued as the individual continues to want to get the temptation and if they no longer want the temptation then it can be changed. The final approach that we consider is that gamification has been shown to improve the engagement in undertaking fitness activity (Mayrsohn & Lyons n.d.).
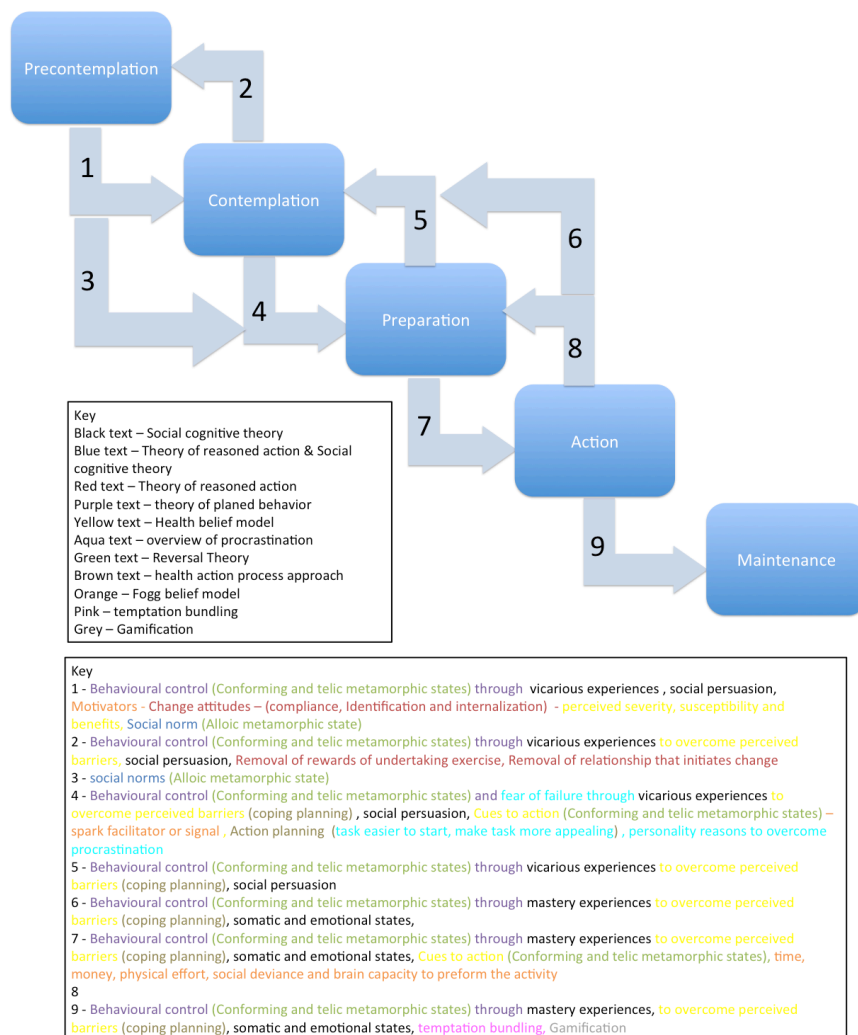
Figure 2-13 - How gamification and temptation bundling we believe fits into the Transtheoretical model

Improving current technology based fitness devices through closer alignment to behaviour change literature

2.2.6   How our model explains identified reasons that individuals give for not undertaking enough health related physical activity

Mullan et al (1997) have identified a number of reasons that individuals do not undertake enough fitness activity. Each of these reasons is an example of the behaviour change approaches outlined in the previous sections. We will now aim to identify how each of these reasons fits into our understanding of how behaviour change. The first group of reasons identified are classified as external regulation. This is when other people pressure the individual into making a change. Our model due to social persuasion can explain this as the individual is changing their beliefs due to what others are saying. Our model overcomes this once the individual is in the preparation stage.

The second group of reasons is identified regulation this is where the individual undertakes the behaviour for their own benefits. This can be addressed in our model by the perceived benefits aspect of the health belief model. This is also considered an early reason occurring between the precontemplation and contemplation stages.

The third group of reasons is intrinsic regulation. This is where the individual undertakes the behaviour due to enjoying the behaviour. Our model explains this firstly the task aversiveness aspect of the overview of procrastination and through temptation bundling.

Finally, Mullan et al (1997) has shown introjected regulation is a reason given to not undertaking fitness activity. This is when the individual feels guilty when they fail to perform the behaviour. This is explained in our model as the perceived susceptibility and severity of not undertaking the behaviour.

This shows that through evaluating the different models that aim to explain behaviour change we can explain the main reasons that individuals give to not preforming the activity. This gives us some confidence that our model is sufficient to evaluate behaviour change in technology based fitness aids.

2.2.7   Summary of behaviour change

In this section we have identified a selection of the behaviour change models that exist and identified what stage of the behaviour change process they can be most effective using the Transtheoretical model. We believe that these models may be more useful during a specific stage or phase of the process and through combining many different models we gain a fuller understanding of how behaviours can be changed. This paper acknowledges that others exist however are considered out of scope for this project. We went on to use this model in order to identify how it can explain the reasons that people state for not undertaking enough physical activity. We will use this model to look at the existing fitness aids to identify how they deliver behaviour change currently, whether they can be used to overcome the identified reasons for not working out and whether they conform to our combined model of how behaviour change is created.
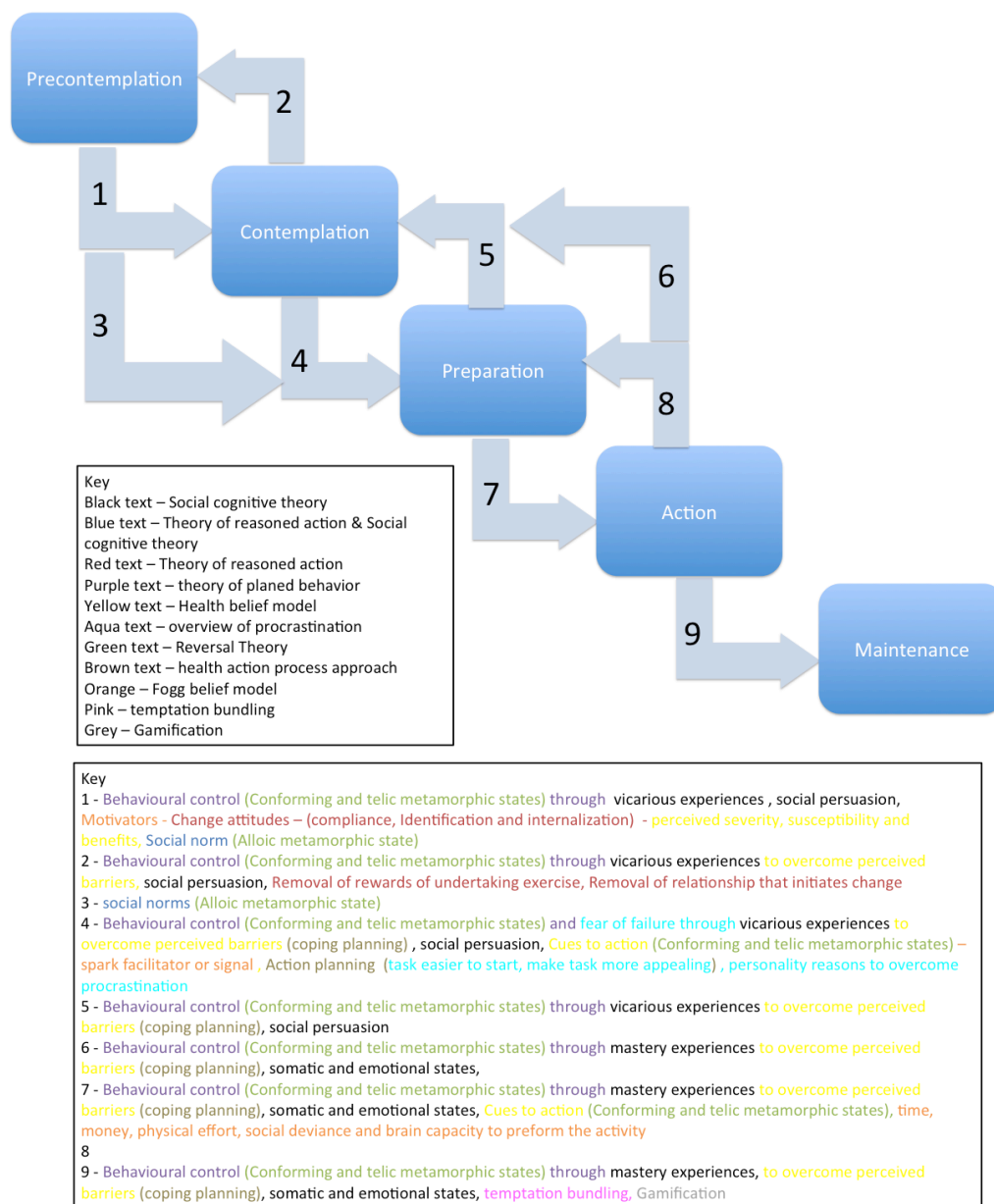
Figure 2-14 - How we believe the different behaviour change models fit around the Transtheoretical model

Improving current technology based fitness devices through closer alignment to behaviour change literature

## 2.3 Empirical analysis showing how current devices conform and do not conform to the behaviour change models

As indicated in the previous section the current technology based fitness aids do not fully explain the reasons people do not preform exercise however our understanding of behaviour change literature does. This provides evidence that behaviour change literature will allow technical devices to be improved. In order to identify the improvements can be made we first should evaluate the gaps between the devices and behaviour change literature. Cowan et al (2012) has shown that current technology based fitness aids do not fully conform to the behaviour change literature. However their study focused on a large number of mobile applications our analysis looks at wearable devices in addition to these. In addition the analysis that they preformed was only to assign percentages and scores to the applications however they do not show the aspects of the model that they conform to and do not conform to. As well as this their analysis does not look at the behaviour change models in combination with one another. Finally the study only explores a number of the models that we have identified however they exclude the causes of procrastination model, health action process model, Fogg behavioural model and reversal theory. In light of these limitations we expand on their analysis. Our findings are summarised in Figure 2-15 and our discussion on how each fitness aid conforms to each behaviour model can be found in the subsequent sections. Starting with the Transtheoretical model.

			Wearable devices				Applications		
			Pedometer	Fitbit	Jawbone	Nike	Gps trackers	Workout planning	Exercise books
Health belief model		Perceived susceptible to negative outcomes							
		Perceived severity of negative outcomes							
		Perception of the benefits							
		Barrier to starting							
		Cues to action							
Theory of reasoned action	Attitude towards the new behavior	Compliance							
		Identification							
		Internalization							
	Social norm of the new behavior								
Theory of planned behavior	Attitude towards the new behavior								
	Social norm of the new behavior								
	Perceived control over the behavior								
Reversal Theory		Means - Ends	Telic	Telic	Telic	Telic	Para telic	Para telic	Para telic
		Rules	Conforming	Conforming	Conforming	Conforming	Negativistic	Conforming	Negativistic
		Transactions	Mastery	Both	Both	Both	Sympathy	Mastery	Mastery
		Relationships	Alloic	Alloic	Alloic	Alloic	Autic	Autic	Autic
Trans Theoretical model		Precontemplation							
		Contemplation							
		Preparation							
		Action							
		Maintenance							
Social cognitive theory		Personal factors							
		Behavioral factors							
		External factors							
causes of procrastination model		Task Related							
		Personality Related							
Health action process approach		Action planning							
		Coping planning							
Fogg behavioral model		Ability							
		Trigger							
		Motivation							

Key	Close alignment to theory		Some alignment to theory		no alignment to theory	

Figure 2-15 - How we believe the current styles of technology based fitness devices conform to behaviour change literature

Improving current technology based fitness devices through closer alignment to behaviour change literature

2.3.1   Transtheoretical model

The devices and applications predominantly provide benefit for the later stages of the Transtheoretical model as they require the user to undertake fitness activity to be useful. The devices aim as the user undertakes more activity their strength of affects become grater as the sunk costs increase as a result they are targeting users to move from the action to the maintenance phase. As a result they provide the most benefit in the maintenance phase. Gps tracking applications also aid the user in undertaking activity and encourage them to continue through competition as a result it is also effective in the action and maintenance phases. However they provide more support during the action and less to encourage them to continue to undertake the activity. Exercise book applications only provide support to the user during the exercise however they do not motivate them to undertake the activity or provide motivation to continue doing the activity. As a result this application can only partially aid a user in the action phase (post planning). Workout planning applications provide the most benefit to the user according to the user as it allows the user to create an accountable plan that will encourage the user to transition from the preparation to the action phase (post planning). Once they start undertaking the physical activity the application can support the user to find time to do more activity. Thus the application can aid in the maintenance phase also.

2.3.2   Health belief model

In the health belief model all the devices make the user feel susceptible to some negative outcomes. The negative outcome is not allowing their score to increase and thus fail to miss their goal. The goal is important to them and as a result this creates an intrinsic negative emotional outcome. In addition the leader boards may lead to a negative social outcomes (Fritz et al. 2014; Oettingen & Gollwitzer 2007). However these approaches do not highlight the risk of the health and economic effects of not working out the users themselves do highlight this as an approach that causes them to use the devices and so can be seen to effectively meet this aspect of the model. Gps tracking applications and exercise book applications do not highlight the negative outcomes of not working out however work out planning applications often provide the information about the importance of health as they are trying to motivate through being informative (West et al. 2012).

The health belief model goes on to explore how severe the user perceives the negative outcomes to be the devices do not perceive strong negative outcomes. However the user perception of the number on their device with more or less importance as a result they will experience more or less severe outcomes to not working out. In addition the Jawbone device does not have a display on the device as a result it is a lot harder to see the outcome of the score not increasing and thus the user is further detached from the outcome. However as they remove the link to the health implications, due to not being able to translate their preparatory scores into recommendations, they are providing less sever impact than the domain could deliver. The gps tracker and exercise books applications due to not presenting any negative outcomes to the user they rely on the users own knowledge about the benefits of undertaking physical activity as a result do not do anything to highlight the problems and encourage the behaviour to be undertaken. Work out planning applications often highlights the medical implications as a result the outcomes are perceived as more severe.

The wearable devices also provide the user with a consistent perception of the benefits through the counter being increases. However this mechanism does not provide any indication of the health or economic benefits again due to the preparatory scoring mechanism as a result it cannot be seen to fully meet the model in this domain. The gps tracking applications and exercise book applications do not prove any information about the benefits using the system. The workout planning applications often do inform the user that the impact of not working out leads to health issues however they do not

show the improvement that the individual is making to reduce these as a result it also does not meet this part of the model.

The health belief model also shows that the users can be motivated to undertake an activity if the barriers to undertaking it are reduced. The wearable technologies primarily introduce a barrier to their use through the cost to acquire them however due to the evidence that individuals are prepared to pay this cost and are buying the devices this paper will ignore this limitation. The barriers to changing fitness behaviour started with the health of the individual none of the current applications can improve their users health as a result can not be seen to remove this barrier. However the Fitbit and GPS trackers can monitor the users heart beat as a result can highlight to the user when their exercise is becoming a risk during a work out. The environment the user lives in is also considered a barrier however the wearable devices monitor the users behaviour at all times in all environments which allows activity to be undertaken in a wider range of locations thus removing this barrier. In addition exercise book applications have been designed to provide work out activities that provide benefit to the user in various locations and so also reduce this barrier. The knowledge about how to work out is only addressed by the exercise book applications as these provide information about how to preform the actions that provide you benefits. The final barrier that was identified in this paper was the amount of activity an individual has done in their youth and no intervention will be able to change the past to overcome this barrier. Overall none of the applications and devices can be seen when fully remove all the identified barriers to undertaking fitness activity.

The final part of the health belief model is cues to action. All of the devices give the user a physical device that reminds them of their commitment to undertake the activity as a result can be considered a permanent cue to action. In addition to this the smart devices, Nike, Jawbone and Fitbit, all can provide move indicators this is where the device will vibrate until you move in order to encourage you to undertake more activity. This shows that these devices provide strong cues to action. The applications on the other hand often have their own call to action using the notification however these are easy to ignore and so have less of an impact to the user. As a result these will be considered a partial solution.

2.3.3   Theory of reasoned action

All of the wearable devices provide the user with a score which while increasing which acts as a reward to the user. This approach provides the incentive through an idea called gamification (Deterding & Dixon 2011). This idea is further extended though the Nike and Fitbit devices giving the user achievements that acts as another reward. Gps tracking applications also have aspects of gamification depending on the application design such as being fictionally chased of through needing to collect materials (Zuckerman & Gal-Oz 2014; Mayrsohn & Lyons n.d.). These virtual rewards are more important to the individual than the actual rewards of working out of increased health. The virtual rewards can be considered a intrinsic reward as it's a score based mechanism however extrinsic rewards have been seen to be more motivating to change users behaviour (Buckworth et al. 2007; Pink 2011). In addition to this the rewards are given out at a consistent basis for clear reasons, one Nike fuel is always one Nike fuel, however literature has also suggests that when the rewards criteria is changing and less consistent the user will be more motivated to undertake different positive behaviour to try and find the next reward (Guzzo 1979; Bishop et al. 1978; Steinberg & Parks 1979). Wearable devices can also create an incentive to change as they are shown to be checking up on the user this results in the supervision benefit that Foster et al (2014) shows ensures that the user continues to undertake the behaviour. However this approach can indicate that the change is only temporary as when the supervision is removed the individual stops the intended behaviour and returns to their original actions (Foster et al. 2014). Exercise book applications also often provide virtual rewards as the user is rewarded with stars depending on their performance in the activity. The smart wearable

Improving current technology based fitness devices through closer alignment to behaviour change literature

technology along with gps tracking applications also provides the user with identification incentives due their use of competition (Chen & Pu 2014). However the other applications and the pedometer do not have social integration and thus do not use this part of the literature to create change. In addition none of the studied technology aids provide encouragement to undertake activity for yourself however exercise books will be most effective when the user wants to preform activity as it a information about how to work out as a support activity.

The majority of the devices do not provide information that physical activity is socially normal and thus does not aid the user to change their behaviour in this model. The Nike and Fitbit ecosystem will allow you to add friends so if you know others that undertake the behaviour then it will provide some evidence that it is normal and beneficial to do so. However if these friends that you add do not consistently undertake activity on the application you will believe that the social norm is to own the device and not undertake the activity thus a cobra effect is created (Egelman et al. 2013).These devices effectiveness really rely on the community that the device exists in (Fritz et al. 2014).

2.3.4   Theory of planed behaviour

The first two aspects of this model of the attitude towards the behaviour and the social normative of the behaviour have been discussed in the previous section. This section will therefore focus on the final aspect of this model, the perceived control over the behaviour. The devices have a clear association between the amount of effort you put in is directly associated to how quickly your number on the device increases. As a result the user feels in control of the behaviour and can undertake the activity. Gps tracking applications only work after the fact and so the behaviour triggers the app to work as a result the user is in control but the application does not support the control. This is also a problem with the exercise book application that relies on the user initiating the activity and supporting them through it. The workout planning applications on the other hand support the user being in control much better but direct their training when shortcomings occur.

2.3.5   Reversal theory

None of the devices or applications provides mechanisms to tailor their support to the individuals metamotivational states. However they do lend themselves to helping the users when they are in one of the states. As a result this analysis will be directed to identify which state the application of device is likely to be effective in. All the wearable devices provide the user with a goal that they work towards as a result they are support changing behaviour when the user is in a telic state. Where as the applications do not provide the user with a goal so the will be effective when a user is in a paratelic state. This means that the new behaviour that the user needs to be fun however Thompson (2008) have shown that individuals do not find fitness activities enjoyable especially when they are compared with other activities in their modern life. One approach that has been seen to improve users opinions that undertaking physical activity is through temptation bundling. Milkman et al (2014) have shown that through making the activity more entertaining through restricting access to entertainment to when the user is undertaking physical activity the user experiences short term enjoyment from the media and long term enjoyment due to the reduction of guilt from not working out. This approach has been seen to be highly effective with fifty one percent more gym visits than the non intervened control group.

The model also goes on to explore the rules metamotivational state for the wearable devices the rule can be seen, as the user should always achieve their goal. This mechanism relies on virtual rewards and social rewards when the user achieves their goals rather than punishing users when they fail to meet them. As a result the user will be lead to believe after they first fail to meet a goal it is not a requirement to meet the goal everyday. However prior to this point users have indicated the rewards

are enough to make them follow the rule (Fritz et al. 2014). As a result these devices work most effectively when the user is in a conforming state. Workout planning applications also have a target activity relying on the rewards to motivate the user to undertake the activity. However these applications rewards have been seen to have less user attachment and thus motivate them less. Gps tracking applications and exercise book applications do not make rules for the users to follow they instead aid the process of working out. This approach is more affective when the user is in the negativistic state.

The next part of the model explores the transactions metamotivational state. This mimics the attitude towards the behaviour being generated through compliance for such methods were the individual is due to their own performance or due to their relationship with others. The pedometer, workout planning application and exercise books all act in isolation and so are targeted at users who are in a mastery state. Gps trackers on the other hand get the majority of their motivation is through the competition that the user has with others as a result are more effective when the user is in a sympathy state. The Nike, Jawbone and Fitbit all provide incentives to the user through their scoring mechanism and though relationships through their competition aspects of the designs. As a result can be seen to work for both states.

Finally the relationship metamotivational state is addressed by the wearable devices being an external influence to encourage the user to conduct the new behaviour and so is most effective, according to this model, when the user is in the alloic state. The applications on the other hand are driven by the user and so are effective when the user is in an autic state.

2.3.6 Social cognitive theory

The only application or device that provides information about how to work out is the exercise book application, as a result this is the only method to create behaviour change through personal factors as part of the social cognitive theory. However none of this information about how to work out or the benefits comes from observing others behaviours as a result none of the identified devices or applications align loosely to the behaviour change aspect of this model. The external influences that this paper identified started with is the others responses to the activity being undertaken. None of the applications or devices prove information of the benefits or social norm of the activity in this way. In addition to this the paper identified how accessible the new behaviour is the devices make working out more accessible as it tracks activity in all circumstances. In addition exercise books provide information to make the behaviour more accessible. As a result these technology aids partially support behaviour change through external factors.

2.3.7 Causes of procrastination model

The only aspect of this model that the devices currently aid is exercise books. These applications allow the task to be performed more easily as it provides the individual with the information to make the task easier to start. This is done primarily through the task being broken down into beginner, intermediate and expert activities. However this is only for one type of activity, which may not be the type of activity best suited to the individual.

2.3.8 Health action process approach

The health action process model coping planning can be aided through exercise books. This is done through the application providing the user with the knowledge that overcomes this barrier to adopting the behaviour. However this or other applications and devices do not help the other identified barriers to the behaviour. In addition to this workout planning applications can be seen to help the user perform action planning. This is due to these applications aiding the individual planning when to do different fitness activities.

Improving current technology based fitness devices through closer alignment to behaviour change literature

2.3.9 Fogg behavioural model

The Fogg behavioural model ability factor can be improved through exercise books as they inform the user how to undertake these fitness activities. We have also found that a number of devices such as Nike plus, Fitbit and jawbone aid behaviour change according to this model through providing triggers to undertake activity. This will remind the individual to undertake the activity that they should do and also be a physical reminder of their commitment to fitness activity. In addition we find that these devices also provide motivation to the individual through gamification and social competition with other users.

2.4 Summery of theoretical research undertaken

In this section we started by exploring the current technology based fitness devices that exist. We found that two main forms of technology based fitness devices exist wearable devices and applications however neither fully supports the reasons people do not exercise. As a result we believe they can be improved through a different approach. The approach we decided to explore was behaviour change methods that have been seen to change fitness devices. We did this by using the Transtheoretical model to describe the stages that an individual goes through in order to change their behaviour. We then went through each of these transitions between stages trying to identify based on other models elements that we believe will be most helpful at each stage. This combined model is able to describe all of the reasons people do not exercise. As a result we believe it is a better approach than the approach taken by technology based fitness devices. In order to test the current devices and applications we first must identify which models they are most compliant with. We have found that different approaches to these devices and applications conform to different amounts of the behaviour change literature.

Improving current technology based fitness devices through closer alignment to behaviour change literature

3   Empirical experiment exploring how different level of conformity with behaviour change literature effects the amount of behaviour change experienced

In the previous section we identified that different technology based fitness devices conform different amounts to the identified behaviour change literature. We want to understand the impact that the amount of conformity to this literature has on the behaviour change experienced by the user. As a result we want to compare two interfaces that conform to different amounts to the behaviour change literature. In order to identify interfaces that conform more or less to the behaviour change literature we will evaluate nine different interfaces (see Figure 3-1). These interfaces were selected due to being the most popular examples of wearable devices and applications. The first three interfaces are examples of wearable devices followed by two gps tracking applications, two exercise books and two workout planning applications. We selected interfaces one and interface eight. We believe that interface one is an example of a number of elements of behaviour change such as gamification, mastery experiences, proof that the user is overcoming barriers, cue to action and has plans. Where as interface eight solely aids the user to keep track of when to do fitness activity. As a result we feel that interface one conforms to more behaviour change literature then interface eight. Thus these are the interfaces that we will use in order to provide evidence that more conformity to behaviour change literature will result in the interface delivering more behaviour change. In the subsequent sections we will report on this study undertaken to explore this in the American psychological association format. In addition to this we aim to highlight the aspects that Foster et al (2014) argues are important in a study surrounding fitness interventions.
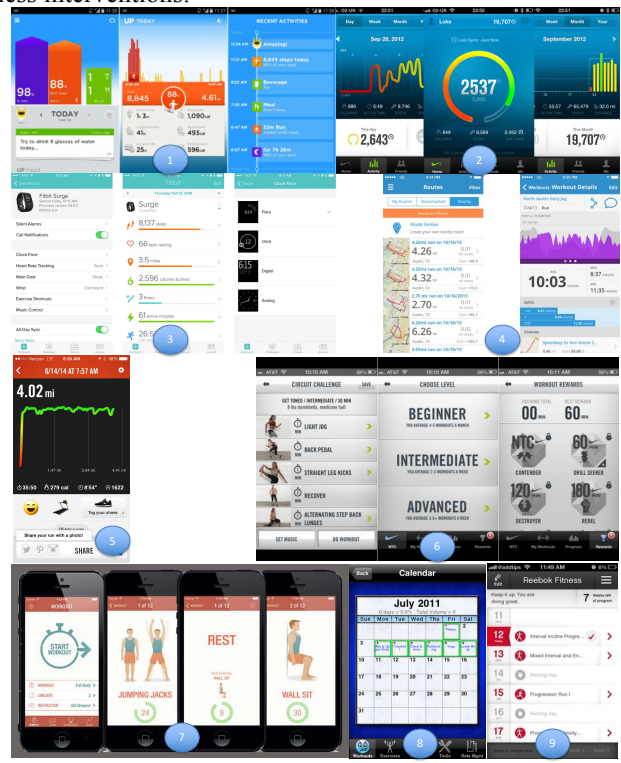
Figure 3-1 - showing the interfaces we looked at to identify interfaces which conform and do not conform to behaviour change literature (Phandroid 2014; Trustedreviews 2012; Imore 2015; Bestofmicro 2013; pinkpolishandrunningshoes 2014; Gawker n.d.; Trendspotters 2014; kinja 2011; Addictivetips 2013)

Improving current technology based fitness devices through closer alignment to behaviour change literature

3.1 Introduction

In this study we had two different approaches to determine how much behaviour change is experienced. The first of these is to provide the interfaces to participants in a longitudinal study however due to behaviour change potentially taking a long time to change and the limitations on time for this project we felt that this would not be possible. Instead we elected to take the second approach to evaluate the interfaces for behaviour change through a questionnaire. This approach has been used previously to evaluate interfaces, assess behaviour change preferences and to explore fitness behaviour (Tullis & Stetson 2004; Dunn et al. 1999; Godin & Shephard 1985). As a result we shall use the questionnaire to evaluate these interfaces. However in order to use the interfaces we must make sure that they are presented in a fair way. Staggers and Kobus (2000) have shown that different presentations of graphical user interfaces get different levels of satisfaction, errors and response time. As a result we believe that this may also apply to the behaviour change that the participants get from the interfaces. Particularly as interface one has three parts of the display presented and interface eight had one. Hilbert and Redmiles (2000) have shown that we can translate the interface into a standard approach in order to extract the differences in information from both of the displays and present them in the same way. This will identify that the changes in the behaviour are due to the underlying information that is presented rather than the way it is presented.

3.1.1 Aims

In this study we aim to identify whether different interfaces, which provide different information, can be seen to be create more or less behaviour change in their users both overall and at the stages of behaviour change as described in the Transtheoretical model.

3.1.2 Operational hypothesises

H1 - We hypothesise that participants will score interface one significantly more highly than interface three overall and for each element of behaviour change.

Rational: We believe that this will occur due to interface one complying to the behaviour change literature across multiple stages. As a result participants in all stages will get the information that they require. Participants in the preparation phase (and the stages that make up it) will get a vicarious experience of seeing some one else preforming the behaviour successfully and thus will reduce their perceived barriers of undertaking the activity. In the action stage we believe that the individual will gain a benefit from the monitoring information that it provides, this will act as a mastery experience and the individual feels more able to continue to do the activity and that their plan is working Interface eight on the other hand does not have these instead it relies on providing a cue to action to specific tasks at certain times. This may have some effect for participants in the preparation stage to overcome procrastination however particularly participants in the action phase will want to follow the plan that they know works for them rather than what an interface suggests.

H2 - We hypothesise that interface one participants in the action stage (post planning phase) will score the interface significantly more highly than participants in the preparation stage (planning phase).

Rational: We believe that interface one is more tailored to individuals in the action stage. This is due to the interface requiring information to be entered through activity undertaken in order to be affective. As a result we believe that this leads to more reliability for the interface. In addition this interface does not talk about the benefits of undertaking activity directly instead it relies on the individual being able to translate the information. We believe that participants will have stronger skills

Improving current technology based fitness devices through closer alignment to behaviour change literature

to do this than participants in the preparation phase. Finally we believe that this is also getting some of the elements of gamification due to the interfacing creating a competition with your past self.

H3 - We hypothesise that interface eight will be scored significantly more highly by participants in the preparation phase (planning phase) than participants in the action phase (post planning phase).

Rational: We believe that this will occur due to interface eight telling the participant what to do and thus acting as a cue to action according to the health belief model or a trigger according to the Fogg Behavioural model. The literature on these indicate that that cause the individual to start preforming the behaviour however do not provide any help once the behaviour is adopted.

3.2 Method

In this section we will identify the process that we went through for this study.

3.2.1 Design

The overall design aims to see the effect that the stage of the Transtheoretical model that a participant is in effects the amount of behavior change they experience from the information distilled from interface one and eight that they view as seen in Table 3-1 and Table 3-2.

Table 3-1 - Table showing the study divided by phase

Iv = Stage the participant is in the Transtheoretical model	
Preparation phase (planning phase)	Action phase (post planning)
Group A (84 people)	Group B (39 different people)
Dv = the responses to statements about participants knowledge, attitudes, intentions and behaviour	Dv = the responses to statements about participants knowledge, attitudes, intentions and behaviour

Table 3-2 - Table showing how the study is divided by stage

Iv = Stage the participant is in the Transtheoretical model				
Precontemplation group	Contemplation group	Preparation group	Action group	Maintenance group
Group A (20 people)	Group B (48 different people)	Group C (16 different people)	Group D (22 different people)	Group E (17 different people)
Dv = the responses to statements about participants knowledge, attitudes, intentions and behaviour				

Independent variable

The independent variable is the stage of the Transtheoretical model that the participant is in. This gives us five groups, precontemplation group, contemplation group, preparation group, action group and the maintenance group. In addition to this the five groups can also be grouped by phase were the precontemplation group, contemplation group and preparation group are in the preparation phase (planning phase). Where as the action phase (post planning) is made up of the action group and maintenance group. During the results we will only compare like levels of abstraction either at the stage or the phase level.

Improving current technology based fitness devices through closer alignment to behaviour change literature

Group classification

Individuals were post sorted into groups strictly based on their response to questions based on the readiness to change questionnaire (Budd & Rollnick 1996). Heather et al (1993) have shown that this approach is valid in assessing drinking behaviours as it is also a health related behaviour change. This research identifies four statements that they argue accurately defines whether an individual is in the precontemplation, contemplation or action stages of the Transtheoretical model when an individual is aiming to change their drinking behaviours. In order to do make the questions a better fit for our purpose we translated these questions to remove the link to drinking and focused on fitness activity. In addition we added statements that we felt would be able to identify the other stages of the model. The participants would then be asked how much they agree to these statements using a Likert scale in the same way Budd and Rollnick (1996) undertook their classifications (Edwards & Kenney 1946). However there have been a number of identified issues with using a Likert scale. The first of these issues has been identified by Lee et al (2002) is that different cultures will respond differently when asked to rate the same issue on a Likert scale. We will aim to control this through the service that we use primarily having American members however some participants may come from other nationalities. We will report the data with and without these differences. The second issue is identified by Wakita et al (2012) that having different lengths of scale or different distances between the point of the scale will change the responses provided. This is controlled through this and all other Likert scales used having a five point scale with the same distance between all points. However as the initial research used these scales and got favourable groupings we also followed it. These can be found in Table 3-3. This left us with four questions for each stage of the Transtheoretical model. The participants answer how much they agree or disagree with the statement about each stage. They then are allocated to the group that they show the most affinity to. This is calculated by the largest average for the group of four questions where strongly agree scores 5 points and strongly disagree scores 1 point. Where participants highest averages are the same the participant is grouped to the earlier of the similar values. In addition to this we ask the individual two questions to see if they have experienced negative relapse and two questions to identify individuals that have experienced positive relapse (See Table 3-3).

Improving current technology based fitness devices through closer alignment to behaviour change literature

Table 3-3 - Table showing the questions to asses behaviour stage

Question asked	Stage the question refers to
I don't think exercise is important	Precontemplation
I don't want to exercise more than I currently am	Precontemplation
Exercising more would have no benefit for me	Precontemplation
It is a waste of time thinking about exercise	Precontemplation
Sometimes I think I should be exercising more	Contemplation
I don't think I do enough exercise	Contemplation
My lack of physical activity is a problem for me	Contemplation
I am at the stage in my life that I need to undertake more physical activity	Contemplation
I have just signed up to undertake more fitness activity	Preparation
I have just signed up to a gym	Preparation
In my immediate future I will be undertaking more exercise	Preparation
I am soon going to start exercising more	Preparation
I am currently changing my fitness behaviours	Action
I am doing something to improve my fitness	Action
I have been trying to undertake more exercise activity than I used to	Action
I have recently changed my fitness habits	Action
I have been a member of a sports team for over a season	Maintenance
I work out every day for as long as I can remember	Maintenance
I am satisfied that I consistently do enough physical activity	Maintenance
I have been undertaking fitness activity for over three mounts	Maintenance
I have in the past relapsed in my attempts to undertake more fitness behaviour	Relapse
I have been trying to undertake more exercise however I find it hard to	Relapse
I often try new ways to improve my fitness	Good relapse
I often change my fitness beliefs	Good relapse

Conditions

We have to conditions which were the two interfaces that we adapted using the principles presented by Hilbert and Redmiles (2000). This will allow us to control the presentation of each of the displays so that the observed change in behaviour is due to the information that is presented rather than the way it is presented. The process starts with selecting the information in each of the displays that we wanted to include. This can be seen as the coloured boxes that overlay the interfaces in Figure 3-2 and Figure 3-3. From this we abstract the information so that it is independent from the interface and recode it in to a text based interface. We decided to control the number of text statements, presenting only seven statements to the participants. These statements can be seen as the text below each of the interfaces in Figure 3-2 and Figure 3-3. These statements without the graphical user interfaces was presented to the participants in the study in order to assess the behaviour change that occurs.

Improving current technology based fitness devices through closer alignment to behaviour change literature
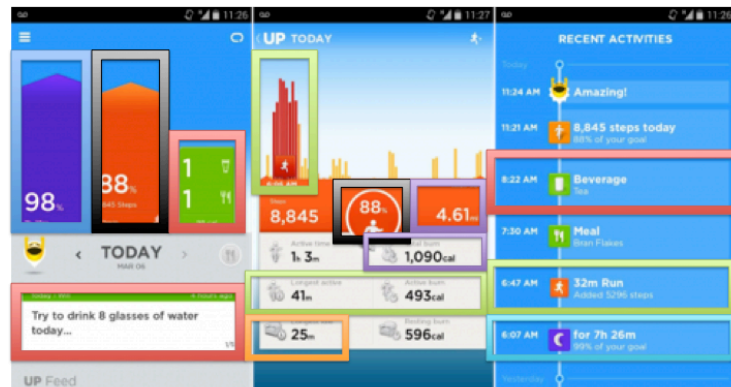
Blue - You have done 98% of the number of steps you did last Wednesday
Black - You have done 88% of your daily goal number of steps
Red - Today your goal was to drink 8 glasses of water, You currently have drunk one
Green - The majority of steps you have done today have come from your morning 3.2 mile run at 6:47 AM lasting 41 minutes and burning 493 calories
Purple - Today you have travelled 4.61 miles and burnt 1090 calories
Aqua - Last night you slept for 7 hours and 26 minutes
Orange - The longest time you spent idle today is 25 minutes

Figure 3-2 - Showing how the statements from interface one appear in the application

Blue - On Friday you have a Plates class
Black - Next Monday you have planned to go to the gym to undertake Abs and upper body training
Red - Next Tuesday you have planed to go to the gym to run on the treadmill
Green - Next Wednesday you have planned to go to the gym to undertake chest and arm body training
Purple - Next Thursday you have a kickboxing class
Aqua - Next Friday you have a yoga class
Orange - Next Saturday you have planned to go to the gym to undertake lower body training

Figure 3-3 - Showing how the statements from interface eight appear in the application

Improving current technology based fitness devices through closer alignment to behaviour change literature

Dependent variable

The dependent variable is assessment criteria set out to explore individuals preferences towards the elements of behaviour change. This identifies that a behaviour change intervention can be seen as effective if it results in an improvement in the participants knowledge, attitudes, intentions and behaviour. This is done through assessing the participants response to number of statements each focusing on identifying the users knowledge, attitude, intention and behaviour when they see the text based interfaces. In addition to this several of the behaviour change models and observations we have evaluated identify these elements as being important to changing behaviour (See Section 2.2).

Table 3-4 - Table showing how we assessed behaviour change

Question asked	Behaviour change aspect	Aspect about
How well does this interface explain the benefits of adopting fitness behaviours?	Knowledge	About benefits of fitness
How easy is it to see the amount of activity that you are doing from this interface?	Knowledge	About your progress
How well does this interface show you the benefits that you are getting from the exercise you are currently doing?	Knowledge	About the benefits you are getting
How well does this interface show you your progress against your planned behaviour?	Knowledge	About your plan
To what extent does this interface provide you with information about how to better plan your fitness activity?	Knowledge	how to plan
To what extent does this interface provide you with information about how to do more fitness activity?	Attitude	perceived barriers
To what extent does this interface provide you with information about your current fitness behaviours?	Attitude	behavioural control of current activity
To what extent does this interface provide you with information about other fitness behaviour?	Attitude	towards other activates
To what extent does the interface convince you to undertake more fitness activity?	Attitude	to do more of the same activity
To what extent does the interface convince you to plan more or less fitness activity?	Attitude	to plan to do more activity
To what extent does this interface change your attitude towards the benefits of fitness?	Attitude	toward fitness
Given regular access to this interface how likely are you to maintain your current approach to getting fit?	Intention	to do the same amount of activity
Given regular access to this interface how likely are you to do more of your current approach to getting fit?	Intention	to do more of the same activity
Given regular access to this interface how likely are you to try a different approach to getting fit?	Intention	to try different fitness activity
Given regular access to this interface would it make it easier to undertake your current fitness approach?	Behaviour	ease of current approach
Given regular access to this interface would it make it easier to undertake a different fitness approach?	Behaviour	ease of new approach

Improving current technology based fitness devices through closer alignment to behaviour change literature

Counterbalance and controls

Controlling for Socio economic factors

In the section 2.2 of this project highlighted that individuals that are younger, male, undertake more work and did activity in their youth are likely to undertake physical activity. In addition section 2.2 shows that the environment that an individual resides is also a limiting factor over the amount of physical activity that they tend to do. In addition to this our results use the Likert scale to group participants and assess the individuals responses to the interfaces. Lee et al (2002) have shown that individuals with different nationality, age and education provide different responses even when they are representing the same level of belief. As a result we aim to have participants who reside in the same country and due to the membership of the website being predominantly American we will use that group. However we also want to see if different nationality has an effect on the behaviour change preferences expressed. As a result we will analyse the results to see if the nationality has an effect.

Controlling for past experiences

We ask the user to identify what common technology based fitness aids they have used. This is to ensure that our encoding of the interfaces overcomes any pre existing feelings towards them that may affect our results. In order to ensure that this has not occurred we will analyse the results of participants with and without past experiences.

Controlling for personal fitness values

We ask questions to identify the values that the individuals have with regards to fitness. We did this through having two positive counts and two negative statements for each value that participants were asked to rank using a Likert scale (see the table below). The average would be calculated from positive statements where strongly agreeing scored five points to strongly disagreeing scoring one point and negative statement scoring five points when strongly disagreeing to one point when strongly agreeing. However we also want to see if different values have an effect on the behaviour change preferences expressed. As a result we will analyse the results to see if the nationality has an effect.

Improving current technology based fitness devices through closer alignment to behaviour change literature

Table 3-5 - Table showing the questions assessing values of participants

Statement	Positive or negative direction	Value assessed
I do activities that I think will improve my health	Positive	Health
I often make plans to improve my health	Positive	Health
I often cancel planed activities that would improve my health	Negative	Health
I don't care about improving my health	Negative	Health
I do things that I find challenging	Positive	Challenge
I often make plans that I think will challenge myself	Positive	Challenge
I often cancel planed activities if I feel they are too challenging	Negative	Challenge
I only do things that I know I can do	Negative	Challenge
I often make plans that I think will improve my economic outlook	Positive	Economic
I do activities that improve my economic welfare	Positive	Economic
I don't care about improving my economic outlook	Negative	Economic
I often cancel planned activities that would improve my economic outlook	Negative	Economic
I often make plans to do activities with others	Positive	Social
I do activities because other people are doing them	Positive	Social
I prefer to do activities independently of what others are doing	Negative	Social
I often cancel plans when doing activities with others	Negative	Social

Ensuring the information was provided was accurate

Meade and Craig (2012) argues that online questionnaires of the length that we are asking about, when the study is done in an uncontrolled online setting and when less social contact is involved causes individuals to randomly answer questions. In order to mitigate against this issues we have two controls the first is to ask participants to respond in a certain way to a question, for example to strongly agree to this response (Fink 2002). Although some participants may randomly select the correct response a section of the participants who are randomly clicking through will be identified and thus the results can be reported with and without these participants included. The second control measure that we can use in order to have participants that are paying attention is to limit our questionnaire to participants who have used the platform successfully for other questionnaires. As a result we only allowed users who have successfully completed over one hundred other academic studies with a success rate of over ninety five percent could participate in the study. This also leads to participants taking more care over their responses, as they want to maintain their reputation on the service. This aims to mitigate some of the traditional problems online studies face.

Ordering of questions

Inside of the sections and inside of a particular interface the question order is shuffled using the inbuilt Google forms algorithm. This aims to reduce the order effects of filling in one question before another. However the method of that Google uses to shuffle these questions is unknown as a result it the amount that order effects are mitigated against.

Improving current technology based fitness devices through closer alignment to behaviour change literature

Counterbalance

This is done through half the participants being shown each interface first. And then they are asked the stage, value and socioeconomic questions before seeing the interface that they have not yet seen. This allows both of the interfaces to have the same benefits of being seen first or second as a result fairer comparisons can be made.

3.2.2   Participants

The target population is Americans with a verity of ages and genders. Ross et al (2010) and Buhrmester et al (2011) have shown that Mechanical Turk recruiting results in a significantly more reflective of the population than college based or other online questionnaires. The Mechanical Turk demographics at the most recent information is forty percent under thirty and sixty percent female (Ross et al. 2010). We have collected our data from a volunteer sampling as the individuals have the decision of whether to do our study rather than other ones on the Mechanical Turk website. However once a job exists on the Mechanical Turk it is presented more prominently to users more different in age and gender to the participants that have currently undertaken your study (Paolacci et al. 2010). In addition we have used convenience sampling in order to have the largest data set possible.

3.2.3   Materials

The study was designed in order to be easy to participate in as a result the participants only require a computer with Internet access to participate. They must also have a Mechanical Turk account with ninety five percent accepted jobs across over one hundred jobs. The participants may use any web browser, as we believe it will not affect the results.

3.2.4   Procedure

In order to test the hypothesis we devised an online questionnaire. This questionnaire was published on the Mechanical Turk online platform. Buhrmester et al (2011) have shown that using this platform results in data more reflective of the populous than on collage studies or other online studies. In addition they have found that the data collected on Mechanical Turk is as least as reliable as other methods of data collection. Two separate Mechanical Turk jobs were created limited each to sixty responses where qualifications were required so to stop a user from filling in both jobs. Each of these Mechanical Turk jobs was linked to two different Google form so that sixty people were presented with each text based interface first. Once the participant finished the questionnaire on Google forms they are presented with a unique code that they can enter on the Mechanical Turk job page to receive payment, which in this case was twenty five cents. The amount of compensation, Buhrmester et al (2011) argues makes no difference to the quality of responses being provided.

3.2.5   Ethical Considerations

Their were two main ethical considerations in this study, the first of these is that the participants were well informed about the study before accepting the job and before answering any questions. Prior to accepting the job we present the prospective participant with a brief description that explains that the study is about fitness behaviour and values. This seeds what the study is about and that some participants who do not like fitness would not undertake the study that may affect the results. However we feel it is more important for the participant to be informed and agree than the effect that this may cause to the participant pool. Once the individual accepts the job and accesses the Google form we get explicit consent to use the data for this paper and other work that originates from it. We also tell them not to talk to anyone else about the study, as we are unsure the extent Mechanical Turk

participants talk to one another and we do not want this affecting the results. However the user can remove this consent at any time without penalty. This information is stored anonymously against a time stamp with no link to the personal information or to the participants Mechanical Turk account. This allows the semi sensitive information such as the age and gender to be protected. However age is also grouped which allows participants to answer more honestly as they know the information is protected.

The second ethical concern is the payment that is received. Firstly the payment that is paid irrespective of the user completing the Google form or permission granted for the results to be used. If they do not consent for their data to be collected then we direct them immediately to the code to receive payment on the Mechanical Turk website. The amount that is provided is a compromise between the price that are displayed for similar jobs and the cost for the number of participants that we require. However when we look at the time that it takes to do the questionnaire after the whole study has been run we find that the wage per hour is actually lower than the minimum wage at between one dollar twenty nine to one dollar thirty nine per hour according to the statistics Mechanical Turk provides. This is something that we would hope to improve in follow up studies. Fortunately Ross et al (2010) shows that twelve percent of American participants and thirty one percent of Indian participants sometimes or always require the money from Mechanical Turk to meet the individuals basic needs. As a result only a subsection of our participants will be affected by our miscalculation over the compensation amount to provide.

Improving current technology based fitness devices through closer alignment to behaviour change literature

3.3 Results

In this section we discuss the responses that participants provided. The raw data along with the T tests preformed can be found at http://www.thomaswnorton.com/university-dissertation.html.

3.3.1 Control variables

Table 3-6 - Table showing the breakdown of participants

		Count of all participants	Percentage of all participants	Count of participants paying attention	Percentage of participants paying attention
Gender	Male	64	52.03%	42	50.60%
	Female	59	47.97%	41	49.40%
Active in youth	Yes	111	90.24%	72	86.75%
	No	12	9.76%	11	13.25%
Nationality	United States	67	54.47%	53	63.86%
	India	56	45.53%	30	36.14%
Age when finished education	14 or under	0	0.00%	0	0.00%
	15	5	4.07%	0	0.00%
	16	9	7.32%	3	3.61%
	17	5	4.07%	4	4.82%
	18	23	18.70%	11	13.25%
	19 or older	81	65.85%	65	78.31%
Has a plan	Yes	104	84.55%	69	83.13%
	No	19	15.45%	14	16.87%
Has Relapsed	> 3	74	60.16%	52	62.65%
	<= 3	49	39.84%	31	37.35%
Previous experience	Gym Buddy	24	19.51%	13	15.66%
	Jawbone	1	0.81%	1	1.20%
	Both	3	2.44%	0	0.00%
	Neither	95	77.24%	69	83.13%

The participants in the study were majority Male (52.03%, 64 of 123 participants) however the Early phase (52.38%, 44 of 84 participants), contemplation stage (54.17%, 26 of 48 participants), preparation stage (56.25%, 9 of 16 participants), not active in their youth (91.67%, 11 of 12 participants), fifteen to seventeen age when left school (15 - 80.00%, 4 of 5 participants 16 - 55.56%, 5 of 9 participants, 17 - 80.00%, 4 of 5 participants), past experience of the jawbone (Interface 1 - 100.00%, 1 of 1 participants), past experience of both interfaces (66.67%, 2 of 3 participants), not having a plan (57.89%, 11 of 19 participants) and not relapsing (51.35%, 38 of 74 participants) were majority female (As seen in Appendix A). The majority of participants also considered themselves to have been active in their youth (90.24%, 111 of 123 participants), which to a greater and lesser extent is present in all the groupings of participants as seen in appendix A. The majority of participants in our study also reside in the United States (54.47%, 67 of 123 participants) however a number of groups the majority of participants resided in India. The groups that more people resided in India were early phase (52.38%, 44 of 84 participants), precontemplation stage (80.00%, 16 of 20 participants), preparation stage (75.00%, 12 of 18 participants), maintenance stage (58.82%, 10 of 17 participants), economic value (60.00%, 12 of 20 participants), male (51.56%, 33 of 64 participants), active in the youth (50.45%, 56 of 111 participants), fifteen when left school (100.00%, 5 of 5 participants), sixteen when left school (66.67%, 6 of 9 participants), previous experience of the gym buddy (interface 8) application (58.33%, 14 of 24 participants) and past experience of both interfaces (66.67%, 2 of 3

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participants) (As seen in Appendix A). We also found that the majority of participants left school when they were nineteen or older (65.85%, 81 of 123 participants) this was also seen in all groups except the participants who had past experience of both interfaces (0.00%, 0 of 3 participants) (As seen in Appendix A). The majority of participants had a plan (84.55%, 104 of 123 participants), which was reflected, in all of the groups (As seen in Appendix A). We also found the participants in the study have not experienced relapse (score less than three 60.16%, 74 of 123 participants) this was reflected in all groups except participants in the maintenance stage (47.06%, 8 of 17 participants), social value group (45.45%, 5 of 11 participants) and left school at the age of fifteen (0.00%, 0 of 5 participants) (As seen in Appendix A). Finally the majority of participants did not have any previous experience of the two interfaces (77.24%, 95 of 123 participants). This was also the case in all groups with the exception of participants in the preparation phase (planning phase) (37.50%, 6 of 16 participants) were the majority of participants had past experience of the Gym Buddy (Interface 8) interface (62.50%, 10 of 16 participants) (As seen in Appendix A).

3.3.2 Dependent Variable

In this section we firstly report our results about how we grouped participants. Once we have group these participants we will report how each group responds to each interface.

How we grouped participants

Table 3-7 - Table showing how we grouped participants

	Number of stages the participant could have been				
	One	Two	Three	Four	Five
number of participants	87	24	7	4	1
precontemplation stage	5	8	3	3	1
contemplation stage	35	9	3	1	0
preperation stage	9	6	1	0	0
action stage	21	1	0	0	0
maintenance stage	17	0	0	0	0

We have found that 87 of the participants were grouped into the stage that they scored most highly. However 36 participants responded to two or more stages equally as a result these participants were grouped into the first of these groups. The full grouping of the responses that lead to these groupings can be found in Appendix A.

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Overall level
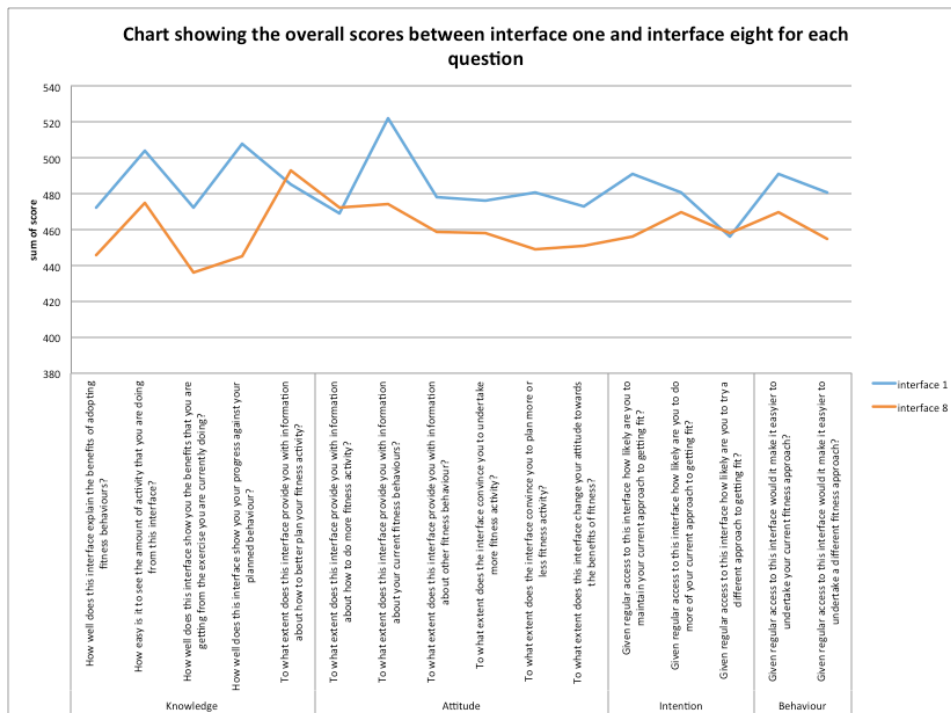
Figure 3-4 - Chart showing the overall scores for both interfaces

When we apply an Anderson-Darling normality test we find that interface one is normal with a confidence of 15.92% and a confidence of 53.04% for interface eight. We then applied a paired T test to test for significant differences in the responses to the questions. We have found that participants overall score interface one (M = 483.75, SD = 16.46) significantly more highly than interface eight (M = 460.44, SD = 14.38); T = 5.05, P val = 0.0001, CI 13.46 – 33.16. This provides support for H1. When we look at the elements of behaviour change we have found that interface one (M = 483.17, SD = 19.47) scores significantly more highly than interface eight (M = 460.50, SD = 10.45) for attitude questions; T = 3.29, P val = 0.0217, CI 4.96 – 40.37. This also provides support for H1. However for knowledge, intention and behaviour questions a paired T test has shown that there are no significant differences between the two interfaces. This provides no evidence for H1.

Table 3-8 - Table showing the sum of overall scores for both interfaces

		interface 1	interface 8
Knowledge	How well does this interface explain the benefits of adopting fitness behaviours?	472	446
	How easy is it to see the amount of activity that you are doing from this interface?	504	475
	How well does this interface show you the benefits that you are getting from the exercise you are currently doing?	472	436
	How well does this interface show you your progress against your planned behaviour?	508	445
	To what extent does this interface provide you with information about how to better plan your fitness activity?	485	493
Attitude	To what extent does this interface provide you with information about how to do more fitness activity?	469	472
	To what extent does this interface provide you with information about your current fitness behaviours?	522	474
	To what extent does this interface provide you with information about other fitness behaviour?	478	459
	To what extent does the interface convince you to undertake more fitness activity?	476	458
	To what extent does the interface convince you to plan more or less fitness activity?	481	449
	To what extent does this interface change your attitude towards the benefits of fitness?	473	451
Intention	Given regular access to this interface how likely are you to maintain your current approach to getting fit?	491	456
	Given regular access to this interface how likely are you to do more of your current approach to getting fit?	481	470
	Given regular access to this interface how likely are you to try a different approach to getting fit?	456	458
Behaviour	Given regular access to this interface would it make it easyier to undertake your current fitness approach?	491	470
	Given regular access to this interface would it make it easyier to undertake a different fitness approach?	481	455

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Phase level

Preparation phase (planning phase)
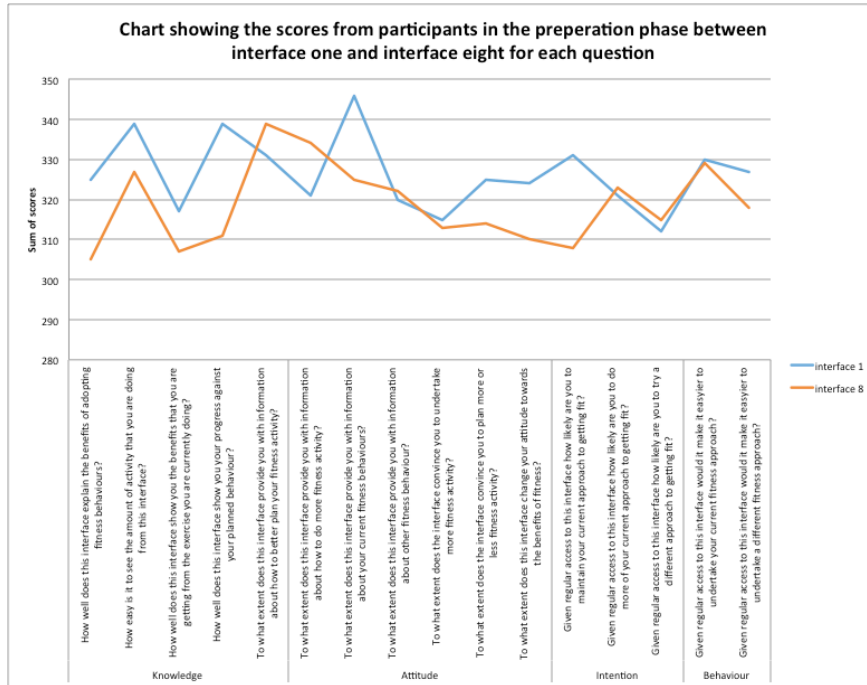
Figure 3-5 - Chart showing how participants in the preparation score the interfaces

When we apply an Anderson-Darling normality test we find that interface one is normal with a confidence of 66.43% and a confidence of 60.83% for interface eight. We then applied a paired T test to test for significant differences in the responses to the questions. When we look at participants in the preparation phase (planning phase) they score interface one (M = 326.44, SD = 9.28) significantly more highly than interface eight (M = 318.75, SD = 10.11); T = 7.69, P val = 0.0203, CI 1.37 – 14.00. Thus providing support for H1. However we observe no support for H1 for any of the other elements of behaviour change.

Table 3-9 - Table showing how participants in the preparation phase (planning phase) score the interfaces

		interface 1	interface 8
Knowledge	How well does this interface explain the benefits of adopting fitness behaviours?	325	305
	How easy is it to see the amount of activity that you are doing from this interface?	339	327
	How well does this interface show you the benefits that you are getting from the exercise you are currently doing?	317	307
	How well does this interface show you your progress against your planned behaviour?	339	311
	To what extent does this interface provide you with information about how to better plan your fitness activity?	331	339
Attitude	To what extent does this interface provide you with information about how to do more fitness activity?	321	334
	To what extent does this interface provide you with information about your current fitness behaviours?	346	325
	To what extent does this interface provide you with information about other fitness behaviour?	320	322
	To what extent does the interface convince you to undertake more fitness activity?	315	313
	To what extent does the interface convince you to plan more or less fitness activity?	325	314
	To what extent does this interface change your attitude towards the benefits of fitness?	324	310
Intention	Given regular access to this interface how likely are you to maintain your current approach to getting fit?	331	308
	Given regular access to this interface how likely are you to do more of your current approach to getting fit?	321	323
	Given regular access to this interface how likely are you to try a different approach to getting fit?	312	315
Behaviour	Given regular access to this interface would it make it easyier to undertake your current fitness approach?	330	329
	Given regular access to this interface would it make it easyier to undertake a different fitness approach?	327	318

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Action phase (post planning)

Figure 3-6 - Chart showing how participants in the action phase (post planning) score the interfaces

When we apply an Anderson-Darling normality test we find that interface one is normal with a confidence of 78.48% and a confidence of 88.50% for interface eight. When we consider participants in the action phase (post planning) a T test has show that they also score interface one (M = 158.31, SD = 8.39) significantly more highly than interface eight (M = 141.69, SD = 6.58); T = 6.58, P val = 0.0001, CI 10.56 – 20.69. This provides evidence for H1. When we consider the elements of behaviour change participants in the action phase (post planning) score interface one (M = 158.00, SD = 10.18) significantly more highly for attitude than interface eight (M = 140.83, SD = 5.31); T = 17.17, P val = 0.0021, CI 9.56 – 24.78. However for knowledge, intention and behaviour questions a paired T test has shown that there are no significant differences between the two interfaces and thus no support for H1.

Table 3-10 - showing the sum of scores for the action phase (post planning) participants

		interface 1	interface 8
Knowledge	How well does this interface explain the benefits of adopting fitness behaviours?	147	141
	How easy is it to see the amount of activity that you are doing from this interface?	165	148
	How well does this interface show you the benefits that you are getting from the exercise you are currently doing?	155	129
	How well does this interface show you your progress against your planned behaviour?	169	134
	To what extent does this interface provide you with information about how to better plan your fitness activity?	154	154
Attitude	To what extent does this interface provide you with information about how to do more fitness activity?	148	138
	To what extent does this interface provide you with information about your current fitness behaviours?	176	149
	To what extent does this interface provide you with information about other fitness behaviour?	158	137
	To what extent does the interface convince you to undertake more fitness activity?	161	145
	To what extent does the interface convince you to plan more or less fitness activity?	156	135
	To what extent does this interface change your attitude towards the benefits of fitness?	149	141
Intention	Given regular access to this interface how likely are you to maintain your current approach to getting fit?	160	148
	Given regular access to this interface how likely are you to do more of your current approach to getting fit?	160	147
	Given regular access to this interface how likely are you to try a different approach to getting fit?	144	143
Behaviour	Given regular access to this interface would it make it easyier to undertake your current fitness approach?	161	141
	Given regular access to this interface would it make it easyier to undertake a different fitness approach?	154	137

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Comparison between two phases

Interface one
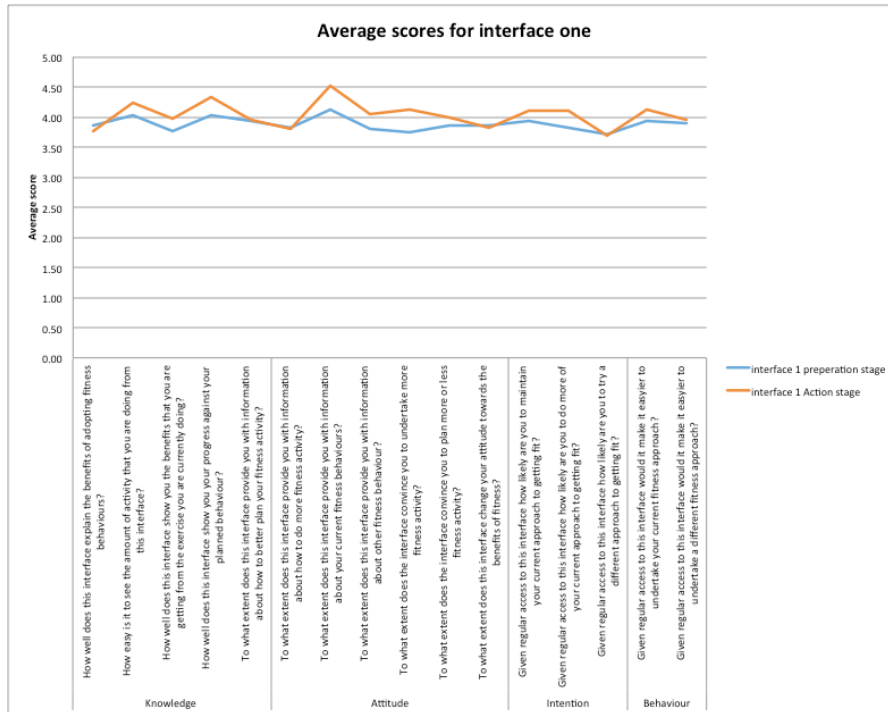
Figure 3-7 - Showing the average score for interface one at the phase level

A Paired T test has shown that participants in the action phase (post planning) (M = 4.03, SD = 0.21) score the interface significantly more highly than participants in the preparation phase (planning phase) (M = 3.88, SD = 0.11); T = 3.83, P val = 0.0016, CI 0.23 – 0.06. This provides support for H2. However we have found no evidence for H2 in any of the constituent elements of behaviour change.

Table 3-11 - showing how participants in the preparation and action phase (post planning) score interface one

		interface 1	
		preperation stage	Action stage
Knowledge	How well does this interface explain the benefits of adopting fitness behaviours?	3.87	3.77
	How easy is it to see the amount of activity that you are doing from this interface?	4.04	4.23
	How well does this interface show you the benefits that you are getting from the exercise you are currently doing?	3.77	3.97
	How well does this interface show you your progress against your planned behaviour?	4.04	4.33
	To what extent does this interface provide you with information about how to better plan your fitness activity?	3.94	3.95
Attitude	To what extent does this interface provide you with information about how to do more fitness activity?	3.82	3.79
	To what extent does this interface provide you with information about your current fitness behaviours?	4.12	4.51
	To what extent does this interface provide you with information about other fitness behaviour?	3.81	4.05
	To what extent does the interface convince you to undertake more fitness activity?	3.75	4.13
	To what extent does the interface convince you to plan more or less fitness activity?	3.87	4.00
	To what extent does this interface change your attitude towards the benefits of fitness?	3.86	3.82
Intention	Given regular access to this interface how likely are you to maintain your current approach to getting fit?	3.94	4.10
	Given regular access to this interface how likely are you to do more of your current approach to getting fit?	3.82	4.10
	Given regular access to this interface how likely are you to try a different approach to getting fit?	3.71	3.69
Behaviour	Given regular access to this interface would it make it easyier to undertake your current fitness approach?	3.93	4.13
	Given regular access to this interface would it make it easyier to undertake a different fitness approach?	3.89	3.95

45

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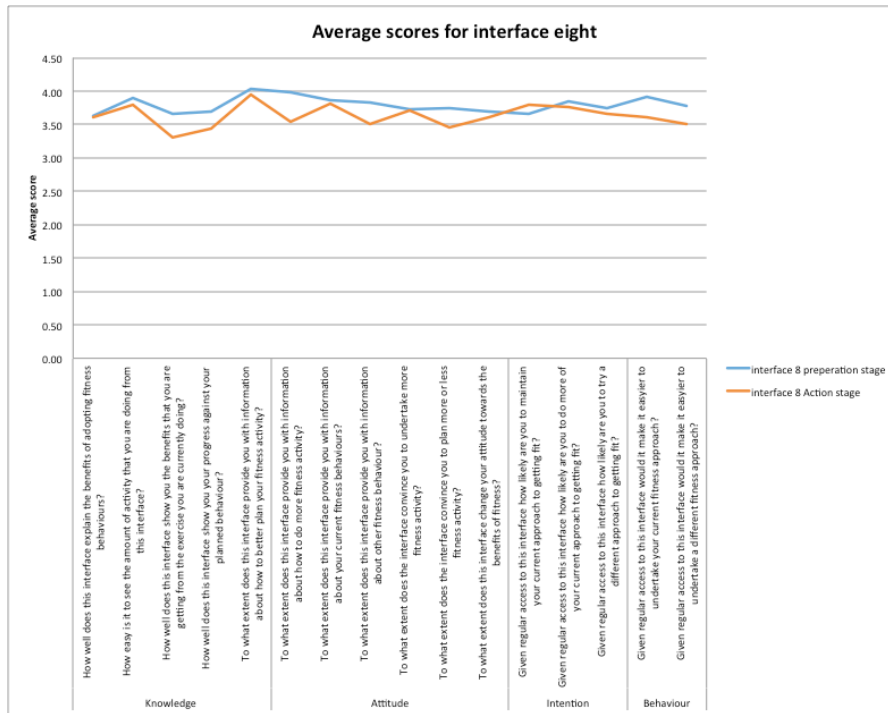
Interface eight

Figure 3-8 - showing the average scores for interface eight

When we consider interface eight a T test shows that participants in the preparation stage (M = 3.80, SD = 0.12) score the interface significantly more highly than participants in the action stage (M = 3.63, SD = 0.17); T = 4.18, P val = 0.0008, CI 0.08 – 0.24. This provides support for H3. At the attitude (M = 3.81, SD = 0.11) and behaviour (M = 3.86, SD = 0.09) levels the participants in the preparation stage score the interface significantly more highly than participants in the action stage (M = 3.61, SD = 0.14 and M = 3.57, SD = 0.08); T = 2.72, P val = 0.0416, CI 0.01 – 0.38 and T = 29.00, P val = 0.0219, CI 0.16 – 0.42. This provides further support for H3. However this is no support for H3 for the knowledge or intention elements of behaviour change.

Table 3-12 - showing how participants score interface eight by phase

		interface 8	
		preperation stage	Action stage
Knowledge	How well does this interface explain the benefits of adopting fitness behaviours?	3.63	3.62
	How easy is it to see the amount of activity that you are doing from this interface?	3.89	3.79
	How well does this interface show you the benefits that you are getting from the exercise you are currently doing?	3.65	3.31
	How well does this interface show you your progress against your planned behaviour?	3.70	3.44
	To what extent does this interface provide you with information about how to better plan your fitness activity?	4.04	3.95
Attitude	To what extent does this interface provide you with information about how to do more fitness activity?	3.98	3.54
	To what extent does this interface provide you with information about your current fitness behaviours?	3.87	3.82
	To what extent does this interface provide you with information about other fitness behaviour?	3.83	3.51
	To what extent does the interface convince you to undertake more fitness activity?	3.73	3.72
	To what extent does the interface convince you to plan more or less fitness activity?	3.74	3.46
	To what extent does this interface change your attitude towards the benefits of fitness?	3.69	3.62
Intention	Given regular access to this interface how likely are you to maintain your current approach to getting fit?	3.67	3.79
	Given regular access to this interface how likely are you to do more of your current approach to getting fit?	3.85	3.77
	Given regular access to this interface how likely are you to try a different approach to getting fit?	3.75	3.67
Behaviour	Given regular access to this interface would it make it easyier to undertake your current fitness approach?	3.92	3.62
	Given regular access to this interface would it make it easyier to undertake a different fitness approach?	3.79	3.51

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Stage level

Precontemplation stage

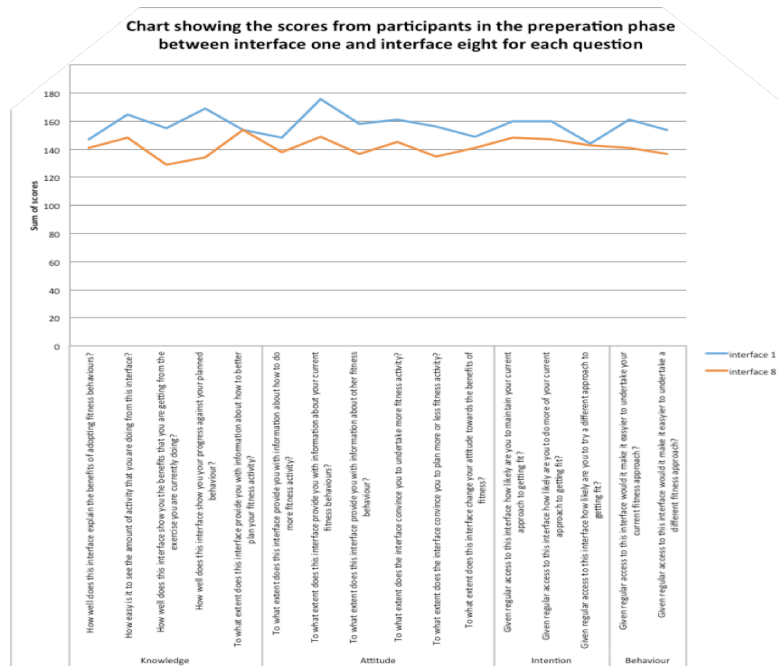Figure 3-9 - chart showing how participants in the precontemplation stage score the interfaces

When we apply an Anderson-Darling normality test we find that interface one is normal with a confidence of 84.09% and a confidence of 21.53% for interface eight. A T Test has shown that participants in the precontemplation stage neither interface significantly differently either overall or for any element of behaviour change. Thus providing no support for H1.

Table 3-13 - Table showing the scores for both interfaces from participants in the precontemplation stage

		interface 1	interface 8
Knowledge	How well does this interface explain the benefits of adopting fitness behaviours?	86	84
	How easy is it to see the amount of activity that you are doing from this interface?	81	86
	How well does this interface show you the benefits that you are getting from the exercise you are currently doing?	76	83
	How well does this interface show you your progress against your planned behaviour?	81	80
	To what extent does this interface provide you with information about how to better plan your fitness activity?	80	81
Attitude	To what extent does this interface provide you with information about how to do more fitness activity?	80	80
	To what extent does this interface provide you with information about your current fitness behaviours?	86	80
	To what extent does this interface provide you with information about other fitness behaviour?	83	83
	To what extent does the interface convince you to undertake more fitness activity?	75	76
	To what extent does the interface convince you to plan more or less fitness activity?	83	74
	To what extent does this interface change your attitude towards the benefits of fitness?	78	79
Intention	Given regular access to this interface how likely are you to maintain your current approach to getting fit?	79	76
	Given regular access to this interface how likely are you to do more of your current approach to getting fit?	74	81
	Given regular access to this interface how likely are you to try a different approach to getting fit?	78	81
Behaviour	Given regular access to this interface would it make it easyier to undertake your current fitness approach?	76	83
	Given regular access to this interface would it make it easyier to undertake a different fitness approach?	84	81

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Contemplation stage

Figure 3-10 - showing how participants in the contemplation score the interfaces

When we apply an Anderson-Darling normality test we find that interface one is normal with a confidence of 40.94% and a confidence of 38.32% for interface eight. When we consider participants in the contemplation stage a T test has show that they also score interface one (M = 180.94, SD = 8.31) significantly more highly than interface eight (M = 171.25, SD = 9.31); T = 3.99, P val = 0.0012, CI 4.51 – 14.87. Thus providing support for H1. When we consider the elements of behaviour change participants score interface one (M = 181.80, SD = 9.83) significantly more highly for knowledge than interface eight (M = 167.00, SD = 15.00); T = 3.20, P val = 0.0330, CI 1.94 – 27.66. This provides further support for H1. However no evidence has been found across the attitude, intention and behaviour questions to support H1.

Table 3-14 - showing how participants in the contemplation stage score the interfaces

		interface 1	interface 8
Knowledge	How well does this interface explain the benefits of adopting fitness behaviours?	171	152
	How easy is it to see the amount of activity that you are doing from this interface?	193	176
	How well does this interface show you the benefits that you are getting from the exercise you are currently doing?	172	155
	How well does this interface show you your progress against your planned behaviour?	188	164
	To what extent does this interface provide you with information about how to better plan your fitness activity?	185	188
Attitude	To what extent does this interface provide you with information about how to do more fitness activity?	172	180
	To what extent does this interface provide you with information about your current fitness behaviours?	194	175
	To what extent does this interface provide you with information about other fitness behaviour?	173	174
	To what extent does the interface convince you to undertake more fitness activity?	178	173
	To what extent does the interface convince you to plan more or less fitness activity?	179	172
	To what extent does this interface change your attitude towards the benefits of fitness?	187	165
Intention	Given regular access to this interface how likely are you to maintain your current approach to getting fit?	184	168
	Given regular access to this interface how likely are you to do more of your current approach to getting fit?	178	175
	Given regular access to this interface how likely are you to try a different approach to getting fit?	169	166
Behaviour	Given regular access to this interface would it make it easyier to undertake your current fitness approach?	192	181
	Given regular access to this interface would it make it easyier to undertake a different fitness approach?	180	176

48

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Preparation stage

Figure 3-11 - showing the sum of scores from participants in the preparation stage

When we apply an Anderson-Darling normality test we find that interface one is normal with a confidence of 45.16% and a confidence of 72.20% for interface eight. A T Test has shown that participants in the preparation stage score neither interface significantly differently either overall or for any element of behaviour change thus providing no evidence for H1.

Table 3-15 - Showing the sum of scores from participants in the preparation stage

		interface 1	interface 8
Knowledge	How well does this interface explain the benefits of adopting fitness behaviours?	68	69
	How easy is it to see the amount of activity that you are doing from this interface?	65	65
	How well does this interface show you the benefits that you are getting from the exercise you are currently doing?	69	69
	How well does this interface show you your progress against your planned behaviour?	70	67
	To what extent does this interface provide you with information about how to better plan your fitness activity?	66	70
Attitude	To what extent does this interface provide you with information about how to do more fitness activity?	69	74
	To what extent does this interface provide you with information about your current fitness behaviours?	66	70
	To what extent does this interface provide you with information about other fitness behaviour?	64	65
	To what extent does the interface convince you to undertake more fitness activity?	62	64
	To what extent does the interface convince you to plan more or less fitness activity?	63	68
	To what extent does this interface change your attitude towards the benefits of fitness?	59	66
Intention	Given regular access to this interface how likely are you to maintain your current approach to getting fit?	68	64
	Given regular access to this interface how likely are you to do more of your current approach to getting fit?	69	67
	Given regular access to this interface how likely are you to try a different approach to getting fit?	65	68
Behaviour	Given regular access to this interface would it make it easyier to undertake your current fitness approach?	62	65
	Given regular access to this interface would it make it easyier to undertake a different fitness approach?	63	61

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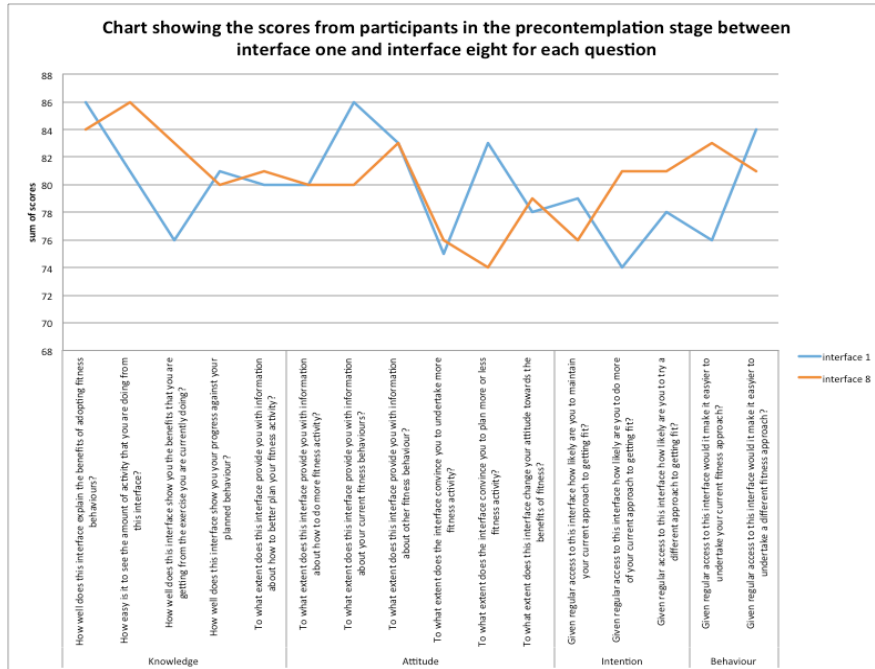
Action stage
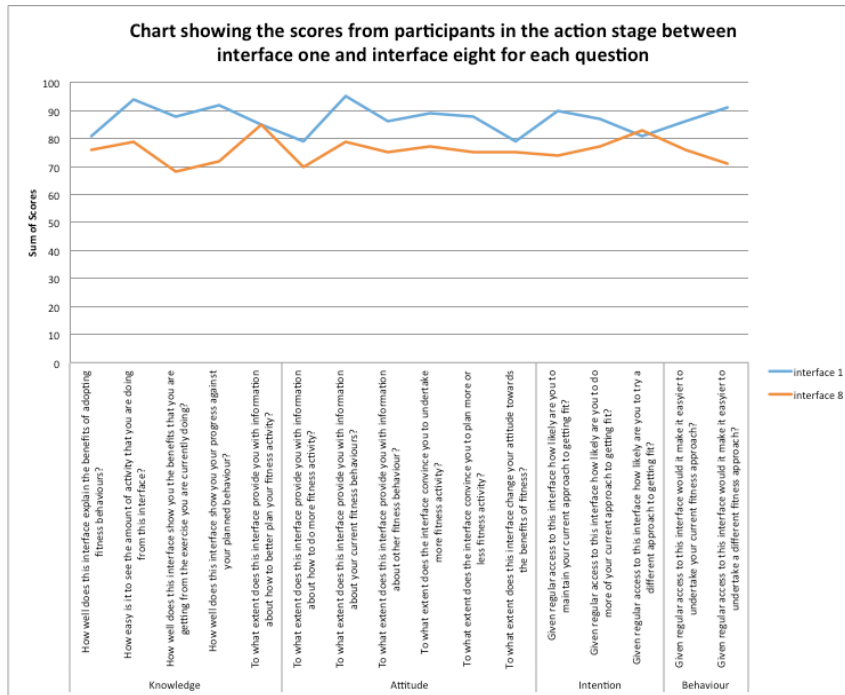
Figure 3-12 - showing the sum of scores from participants in the action stage

When we apply an Anderson-Darling normality test we find that interface one is normal with a confidence of 63.84% and a confidence of 61.25% for interface eight. When we consider participants in the action stage a T test has show that they also score interface one (M = 86.94, SD = 5.00) significantly more highly than interface eight (M = 75.75, SD = 4.45); T = 6.58, P val = 0.0001, CI 7.56 – 14.81. This provides support for H1. When we consider the elements of behaviour change participants score interface one (M = 88.00, SD = 5.24) significantly more highly for knowledge than interface eight (M = 76.00, SD = 6.52); T = 2.95, P val = 0.0418, CI 0.72 – 23.28. In addition to this we also observe that participants score interface one (M = 86.00, SD = 6.20) significantly more highly for attitude than interface eight (M = 75.17, SD = 2.99); T = 6.52, P val = 0.0013, CI 6.56 – 15.10. However we do not observe any evidence to support H1 for the other elements of behaviour change.

Table 3-16 - Showing the sum of scores from participants in the action stage

		interface 1	interface 8
Knowledge	How well does this interface explain the benefits of adopting fitness behaviours?	81	76
	How easy is it to see the amount of activity that you are doing from this interface?	94	79
	How well does this interface show you the benefits that you are getting from the exercise you are currently doing?	88	68
	How well does this interface show you your progress against your planned behaviour?	92	72
	To what extent does this interface provide you with information about how to better plan your fitness activity?	85	85
Attitude	To what extent does this interface provide you with information about how to do more fitness activity?	79	70
	To what extent does this interface provide you with information about your current fitness behaviours?	95	79
	To what extent does this interface provide you with information about other fitness behaviour?	86	75
	To what extent does the interface convince you to undertake more fitness activity?	89	77
	To what extent does the interface convince you to plan more or less fitness activity?	88	75
	To what extent does this interface change your attitude towards the benefits of fitness?	79	75
Intention	Given regular access to this interface how likely are you to maintain your current approach to getting fit?	90	74
	Given regular access to this interface how likely are you to do more of your current approach to getting fit?	87	77
	Given regular access to this interface how likely are you to try a different approach to getting fit?	81	83
Behaviour	Given regular access to this interface would it make it easyier to undertake your current fitness approach?	86	76
	Given regular access to this interface would it make it easyier to undertake a different fitness approach?	91	71

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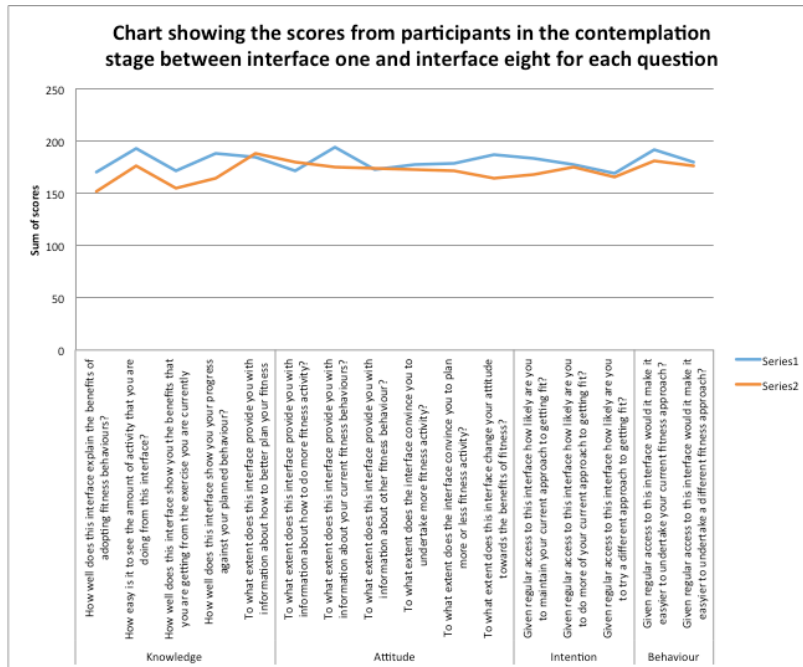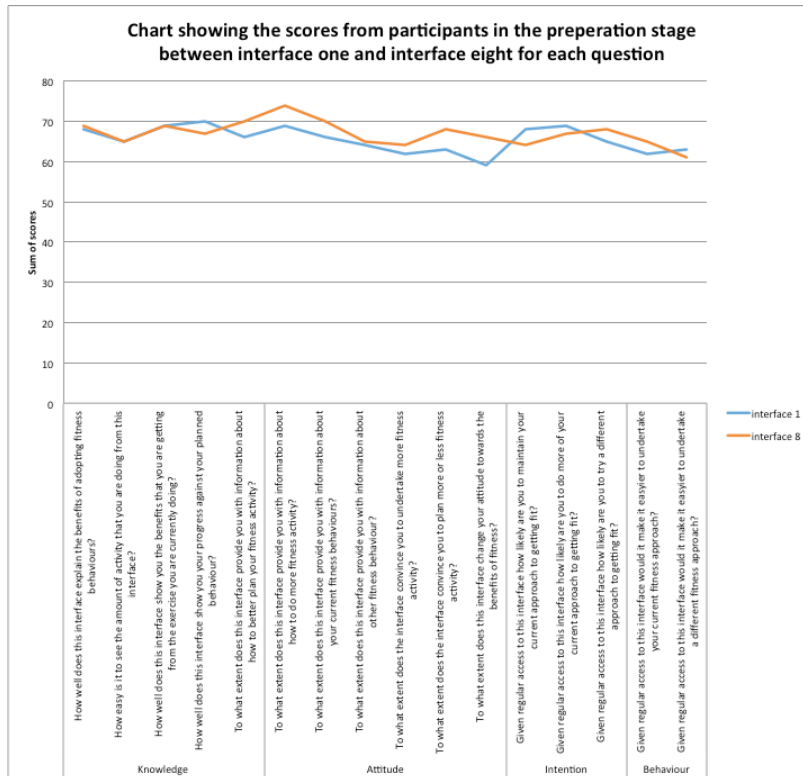
Maintenance stage
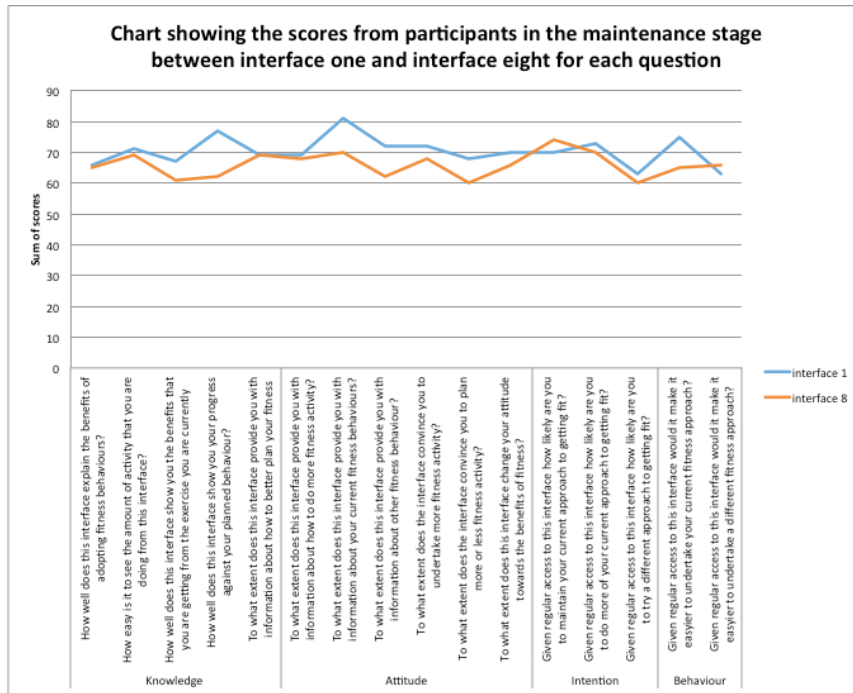
Figure 3-13 - Showing the sum of scores from participants in the maintenance stage

When we apply an Anderson-Darling normality test we find that interface one is normal with a confidence of 82.39% and a confidence of 46.62% for interface eight. When we consider participants in the maintenance stage a T test provides evidence for H1 as participants also score interface one (M = 70.38, SD = 4.76) significantly more highly than interface eight (M = 65.94, SD = 4.11); T = 3.39, P val = 0.0041, CI 1.65 – 7.23. When we consider the elements of behaviour change participants score interface one (M = 72.00, SD = 4.69) significantly more highly for attitude than interface eight (M = 65.67, SD = 3.88); T = 3.94, P val = 0.0109, CI 2.21 – 10.46. However no evidence for H1 have been found across the knowledge, intention and behaviour questions.

Table 3-17 - showing the sum of scores for both interferences from participants in the maintenance stage

		interface 1	interface 8
Knowledge	How well does this interface explain the benefits of adopting fitness behaviours?	66	65
	How easy is it to see the amount of activity that you are doing from this interface?	71	69
	How well does this interface show you the benefits that you are getting from the exercise you are currently doing?	67	61
	How well does this interface show you your progress against your planned behaviour?	77	62
	To what extent does this interface provide you with information about how to better plan your fitness activity?	69	69
Attitude	To what extent does this interface provide you with information about how to do more fitness activity?	69	68
	To what extent does this interface provide you with information about your current fitness behaviours?	81	70
	To what extent does this interface provide you with information about other fitness behaviour?	72	62
	To what extent does the interface convince you to undertake more fitness activity?	72	68
	To what extent does the interface convince you to plan more or less fitness activity?	68	60
	To what extent does this interface change your attitude towards the benefits of fitness?	70	66
Intention	Given regular access to this interface how likely are you to maintain your current approach to getting fit?	70	74
	Given regular access to this interface how likely are you to do more of your current approach to getting fit?	73	70
	Given regular access to this interface how likely are you to try a different approach to getting fit?	63	60
Behaviour	Given regular access to this interface would it make it easier to undertake your current fitness approach?	75	65
	Given regular access to this interface would it make it easier to undertake a different fitness approach?	63	66

Improving current technology based fitness devices through closer alignment to behaviour change literature

Comparison between stages

Interface one

Table 3-18 - Anova test showing the participants in different stages average score for interface one

Anova: Single Factor						
SUMMARY						
Groups	Count	Sum	Average	Variance		
precontemplation	16.00	64.00	4.00	0.04		
contemplation	16.00	60.30	3.77	0.03		
preparation	16.00	65.52	4.10	0.04		
action	16.00	63.22	3.95	0.05		
maintenance	16.00	66.25	4.14	0.08		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1.35	4.00	0.34	7.20	0.00	2.49
Within Groups	3.51	75.00	0.05			
Total	4.86	79.00				

The diagram above shows that when an Anova test is preformed we have found significant differences between the scores provided by participants in different stages. In order to identify which stages are most different we applied paired T tests to compare the scores that are provided by participants in different stages as seen in the table below. When the score is coloured in yellow the stage on the left is scored more highly. As a result a T test has found that precontemplation stage participants score this interface more highly than participants in the contemplation stage. This diagram also shows in green when the top stages score the interface more highly. As a result T tests have shown that participants in the preparation, action and maintenance stage score the interface more highly than participants in the contemplation stage. This provides some support to H2. In addition participants in the maintenance stage score the interface more highly than participants in the action stage. This shows that the interface is most tailored to participants in the contemplation stage. However we have not observed significant differences between participants in other stages.

Table 3-19 - Showing which stage participants in different stages score interface one based on a Paired T test across all questions

		Interface one				
		precontemplation	contemplation	preparation	action	maintenance
Interface one	precontemplation			0.0019	N/S	N/S	N/S
	contemplation				0.0005	0.0018	0.0001
	preparation					N/S	N/S
	action						0.0113
	maintenance						

Improving current technology based fitness devices through closer alignment to behaviour change literature

Interface eight

Table 3-20 - Anova test showing the participants in different stages average score for interface eight

Anova: Single Factor						
SUMMARY						
Groups	Count	Sum	Average	Variance		
precontemplation	16.00	64.40	4.03	0.02		
contemplation	16.00	57.11	3.57	0.04		
preparation	16.00	67.01	4.19	0.04		
action	16.00	55.07	3.44	0.04		
maintenance	16.00	62.06	3.88	0.06		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	6.19	4.00	1.55	38.83	0.00	2.49
Within Groups	2.99	75.00	0.04			
Total	9.18	79.00				

The diagram above shows that when an Anova test is preformed we have found significant differences between the scores provided by participants in different stages. In order to identify which stages are most different we applied paired T tests to compare the scores that are provided by participants in different stages as seen in the table below. These T test have shown that participants in the preparation stage answer the behaviour stage questions higher than participants in any other stage. This provides support towards H3 and that we can refine the tailoring to a specific stage rather than to a phase. Participants in the action phase (post planning) however score the interface lower than participants in any other stages. This also provides evidence for H3.

Table 3-21 - showing how participants in different stages score interface eight based on a Paired T test across all questions

		Interface eight				
		precontemplation	contemplation	preparation	action	maintenance
Interface eight	precontemplation		0.001	0.0179	0.0001	N/S
	contemplation			0.0001	0.0345	0.0001
	preparation				0.0001	0.0015
	action					0.0001
	maintenance					

3.4   Discussion

In this section we start by explore the practicalities of the study. Where we identify the challenges that we experienced when grouping the participants and highlight various ways that we feel that the study could have been improved. We go on to discuss our results for each hypothesises in turn. This section concludes by highlighting other results that we found while undertaking the study.

Improving current technology based fitness devices through closer alignment to behaviour change literature

3.4.1 Practicality of the study

In our study we found it very easy to recruit participants that we required. However we have found evidence that up to forty of the participants did not pay as much attention as they filled in the study, as they did not answer the test questions as directed. The results that we analysed are based on the whole sample population as we have no evidence that these participants affect any one of the groupings more than any other. In addition all bar nineteen participants took the time to write a plan as a result we feel this provides evidence that participants were in fact paying attention.

One of the main challenges that we encountered after running the study was how to group individuals into one particular group. In section 3.2.1 we detailed the strict algorithm that we were going to apply in order to determine the groups of individuals. We found that a large number of participants had similar values for a number of stages and thus we sorted into the first of these. This results in the earlier stages or values having more of the participants that have characteristics of later stages or strong secondary values that may affect the results. If this study were to be repeated we would introduce two new safeguards against this. The first of these it to introduce more questions that assess each particular stage and introduce negative and positive statements. This was not done initially as we were following the method of selection set out by Budd and Rollnick (1996). We believe that introducing more questions will allow the averages to be more different in the same way that more results allows smaller differences to be acceptable. We also believe that introducing negative questions will provide more differences, as the similarity was greater in the stage classification than that in the value classification that used negative questions. However this may also be due to people fitting into one value more easily than one stage of the Transtheoretical model. The challenge that introducing these additional questions poses is to find questions that allows individuals to be placed into one group rather than another. We have found, and will report in the subsequent sections, that elements that describe a particular stage in literature is not true when we look at the responses that they provide such as not having a plan in the precontemplation phase. The second approach to deal with classifying participants that show characteristics of more than one phase is to add them to different groups so that impact of these participants is the same across all the groups rather than disproportionally effecting participants in the earlier stages and values.

In addition to grouping into stages (and the phases that they also are a part of) and values we needed to group participants based on whether they had a plan. The challenge that this posed is what level of detail could be considered a plan. We firstly considered anyone who left the answer blank to not have a plan and participants that gave long statements about losing weight or exercise more to have a plan. The difficulty presented itself we participants that just responded yes to the question. We decided to take this as a misunderstanding that rather than being asked what their plan was they believed that they were being asked whether they had a plan as a result we considered that these individuals also to have a plan. In addition to the difficulty surrounding plans we realised in collating the results that the question to determine whether a participant had been active in their youth to have an obvious issue. This is due to it being a yes or no question we believe that participants who did the same amount of activity may answer the question differently from one another. In addition it does not allow us to see the participants who ran every day in their youth to those who walked to school one day a week that still consider that as being active. As a result if the study was repeated we believe it would be better to ask exactly what activity they undertook in their youth.

The categorisation of gender, nationality, age they finished education, and whether they had used the interfaces previously on the other hand did not cause any issues.

Another challenge that we found was trying to identify the reasons why our findings occur. As a result our discussion follows existing literature than presents any alternative explanation. One way that this could be improved is by asking the participants why they answered the way that they did. This would

primarily be able to present alternative arguments as to why the results were observed. However it would also provide us with more explanation over how the existing model operate both on there own and when the models work in combination.

The final challenge that we experienced through doing the experiment in this way is to calculate what an acceptable compensation would be for the participants prior to the study being run as previously indicated. However in addition to this we had participants enter the wrong Mechanical Turk code as a result they did not complete the job and thus other participants were recruited. This accounts for why we had one hundred and twenty three participants rather than one hundred and twenty that we asked for. This resulted in interface one being seen first one additional time than interface eight. However it is impossible to know which result is this additional data point, as the participants are not linked to their Mechanical Turk accounts in any way.

3.4.2   Reviewing Hypothesises

In this section we will discuss each of hypothesises we had prior to undertaking the study in turn for the population that we observed. We go on to identify whether our results support or refute these hypotheses and try to explain why these results occur.

H1 - We hypothesize that participants will score interface one significantly more highly than interface three overall and for each element of behavior change.

Our results have shown a significant preference for interface over interface eight for all groupings except participants in the precontemplation and preparation stages. This was expected as interface one conforms to more behaviour change literature particularly as this information we feel would be most benefit to individuals in the action stage, maintenance stage and action stage as it preforms feedback on the individuals plan. Interface one also provides most benefit to individuals in the contemplation stage and the preparation phase (planning phase) overall. We believe that this is linked to the new understanding that all stages process a plan and thus can receive feedback on it. As the interface describes this information in terms of what you have done rather than the benefits that it provides you with individuals in the precontemplation stage will gain less benefit from it. However participants in the preparation stage also have this knowledge but do not score the interface more highly as a result there must be another reason for this change. We believe that individuals in the preparation stage need a cue to perform the action immediately as a result monitoring provides limited benefit. Where as individuals in the contemplation individuals are trying to overcome procrastination. In order to do this our model has highlighted action planning can be effective this would make us expect interface eight to be more effective, however it is not. Interface one provides vicarious experience that shows that another person has overcome the barriers to fitness activity and are preforming the behaviour. As a result we believe that this hints to us that vicarious experiences are better for overcoming procrastination than action planning for the interfaces studied. We also believe that these scores would be further increased if the participants felt that the interface was coming from a friend or family as they would experience stronger social norm effects and make the vicarious experience stronger.

When we consider the elements of behaviour we have seen that interface one is preferred over interface eight in the overall, action phase (post planning), action stage and maintenance stage groupings. As a result monitoring information strengthens participants in the later stages attitude towards the behaviour. As a result this should strengthen the individuals resistance to relapse. We have also found that participants in the contemplation and action stages gain more knowledge from the interface. This is unexpected as neither interface provides information about the benefits of fitness. However interface one provides you with feedback on your activity relative to a fitness goal as a result we believe that this is why the interface is providing an improvement in knowledge. However this is

not present in all stages. We believe that the maintenance stage participants do not get this change of knowledge as they already have this knowledge where as participants in the precontemplation stage do not understand the information that is presented as a result will not get the improvement to knowledge. The participants in the preparation stage who do not score interface one more highly than interface eight we believe is due to them requiring knowledge about how to do the fitness activity rather than the amount of activity that they can do. We have also found that no groups of participants gain significantly more intention or behaviour elements of behaviour change from one interface to another. We believe that this is due to these elements requiring more persistent exposure to the interface in order for the individual to change them.

H2 - We hypothesise that interface one participants in the action stage (post planning phase) will score the interface significantly more highly than participants in the preparation stage (planning phase).

When we consider interface one we find that participants in the action stage score the interface more highly than participants in the preparation stage. We believe that this shows that the interface is more tailored to participants in the later stages. This is due to the interface requiring more knowledge to translate the information in the display from the number of steps or activity that they do to the benefits of doing the activity. We also believe that this is due to the interface requiring the user to be undertaking the activity before information is being displayed. However when we look at the constituent elements of behaviour change we find that the individuals in the action stage do not score the interface more highly than individuals in the preparation stage. As a result the interface is preferred due to all elements of behaviour change rather than one element delivering the differences.

We have identified that interface one scores most poorly for participants in the contemplation stage an element of the preparation phase. This is due to the interface not aiding overcoming procrastination very well. As a result we believe that this narrows down the situations that are not successful however we have not found any further precision on the stage that this interface is more successful in.

H3 - We hypothesise that interface eight will be scored significantly more highly by participants in the preparation phase (planning phase) than participants in the action phase (post planning phase).

When we consider interface eight we find the opposite where participants in the preparation phase (planning phase) score the interface significantly more highly than participants in the action phase (post planning). In particular we find significant improvement for the attitude and behaviour elements of behaviour change questions. Both of these we believe is due to participants in the earlier stages requiring cues to action to preform the activity where as in the later stages the participants undertake the behaviour more autonomously. As the interface tells you what to do people in the earlier phases will follow it where as participants in the later stages will repel against it relying on their own mastery experiences and knowledge above what an interface tells them to do. However the participants in the preparation phase (planning phase) do not score the interface more highly for knowledge as a result we believe that this shows that they do not understand why they should be undertaking the activity and as a result when the interface is removed the behaviour will stop.

We have also found that interface eight is not very good for participants in the action stage, an element of the action phase. This we believe provides more precision to the situations that this interface is not successful in. We believe that this is due to people in the action stage trying to resist relapse and to assess how well their plan is preforming. This interface does not support either of these requirements. However participants in the preparation stage (an element of the preparation phase) score the interface more highly than participants in any other stage. As a result we believe that this provides more precision to the situations that this interface is more successful. We believe that this is

due to these participants being ready to undertake immediate action and the plans that this interface displays details the activities that they can do in that time scale. Participants in the contemplation stage will see these plans as unachievable as the interface does not improve procrastination that they suffer with. Where as participants in the precontemplation phase will not care about these plans. However our findings have found that participants in the precontemplation score the interface more highly than participants in the contemplation score. We believe that this will be due to individuals in the precontemplation stage gaining more knowledge from the interface about what activities are good to preform however we do not have the evidence to support these claims.

3.4.3   Additional findings

We have found that there appears to be more males in the later stages of the Transtheoretical model. This mimics our theoretical research showing that males do more physical activity and thus should be more in the action and maintenance stage (Scholes & Mindell, 2012). We believe that this is due to males and females responding to differently to cues to exercise, perceived benefits of exercise and barriers to exercise differently. Our results also have shown that individuals with the most education, having left education after the age of nineteen, the make up more of the action phase (post planning) than the preparation phase (planning phase). As a result our findings support that individuals with more education are in the later stages and phases of the Transtheoretical model. We believe that this is may be due to individuals who leave school earlier less able to view the social norm of their peer group and not getting the soft skills about how to plan thus make progressing to the maintenance phase less likely.

We have also found that the majority of participants in all stages and phases of fitness behaviour change report that they feel they were active in their youth. Our theoretical research had highlighted that this is a barrier to undertaking physical activity in later life however our findings do not support this. Our results also do not support that environment as a barrier to activity due to the United States and Indian participants fitting into similar numbers in each stage of the Transtheoretical model. Our findings also do not support that individuals in the precontemplation will not have a fitness plan or goal.

There are a number of possible reasons for this. The first of these reasons is that people in the precontemplation phase actually do have a plan and so should be more carefully described. This would cause our findings to be in conflict with the vast literature on the subject as a result we believe this not to be the true reason. The second reason is that we have not accurately found the precontemplation people from the questions that we are asking. This we also believe is unlikely as the other stages also have the trend for having a plan. The third possible reason we present is that participants when asked if they have a plan cause them to create a plan. This is interesting as this may be an easy solution to progress individuals from the precontemplation stage to the contemplation stage as individuals have the knowledge that the behaviour is good but lack the intention that is created when a plan is made. The final possible reason that we present to explain why participants have a plan in the precontemplation stage is that the participants that we recruited in the precontemplation have relapsed from later stages and the plan they had when they were in those later stages persists. This is backed up by 55.00% of precontemplation participants answering on the agree side for past relapse.

In order to explore the reasons why individuals in the precontemplation stage we should also consider the plans that each group is making. In section 2.2, we identified a number of reasons that plans are successful. A couple of these can be seen in the responses that participants gave. The responses provided by precontemplation participants were not very specific indicating they would like to do more exercise or would like the outcomes of the exercise without any of the activity that leads to it. In addition the precontemplation participants goals lack any time frame for their achievement. The goals

from the other participants are more specific about the amount of a given activity that they wish to undertake indicating exact amounts of weight loss or number of work outs undertaken. This allows the plans to be monitored and feedback to be provided. However they still do not have a time frame associated to their goals. As a result we can further aid the behaviour change of individuals to include these elements to their plans and give more visibility to the individuals progress. When the plans themselves are considered we can more clearly see that the plans that precontemplation stage are less effective than those of later stages. As a result we believe this provides more support that the reason that majority of individuals are in the precontemplation stage with a plan is due to relapsing from the later stages and have become disillusioned with exercise. This also is supported through the majority of participants in the precontemplation stage being active in their youth that shows they were at some point in the action stage.

The implication of this is that we have identified that planning is an important part of the model and the designs no matter which stage they try to help can ask for a plan and help the user to refine this plan as they progress. Once the plan is know the application can identify the best way to achieve the goal in the time scale that is attributed to it. However we do not know what happens to an individual behaviour change once they achieve the goal. This will be particularly prevalent in the maintenance stage, as they will be making the most progress towards the goal. As a result one approach to understand what happens when a goal is met is to follow up with the maintenance individuals after a period to identify whether they have reached their goal and if they have met their goal what there new goal is, if they have one. However this may be difficult to identify the individuals in this phase to follow up with.

The final interesting result is that participants in the maintenance stage still show signs that they are relapsing. As a result we now believe that the maintenance stage is more complex through rather than resisting relapse the participants can still recover from relapse more quickly and easily so that it does not cause the behaviour to be changed.

3.5   Summary

In this section we have detailed our approach to explore how participants are grouped according to behaviour change principles and how they receive different levels of behaviour change from the same and different interfaces. We have found that the participants can be grouped into different stages and phases of the Transtheoretical model and the characteristics that these stages process can be explained by combining different models and observations about behaviour change. However we have discovered elements that the model does not fully explain such as participants in the precontemplation phase still having a plan to do the fitness activity when the description of the model says that this should not occur. We have also found that interfaces are prefered for aiding behaviour change in participants relative to one another and that these interfaces can also be more effective to one stage or phase relative to another. However we have also found some issues with our study and these have been detailed along with how we would address them in order to improve the study if we undertake the study again.

Improving current technology based fitness devices through closer alignment to behaviour change literature

4   Implications for future designs

Based on interface one following the behaviour change literature and scoring higher than interface eight we believe that this shows that interface eight can be improved through delivering more monitoring information to their users. This could be done through showing the participants their past successful activates they have undertaken. In addition the interface could provide feedback about how much of the current day activities they have done, for example on upper body work out that the individual has done all of today push ups however they have not done any of their bench dips. Also interface one could provide better service to individuals in the preparation phase (planning phase) through telling them what to do and when to do it. We also have observed that interface one conforms to more behaviour change literature and thus we believe that this may be true for other interfaces. However more interfaces should be checked prior to this finding being followed. If this holds true across more interfaces we believe that we would be able to create new interfaces that aim to deliver more behaviour change through following more of the literature. Neither of the interfaces used in the study aim to increase the perceived social norm of the behaviour as they focus on the individual. However this is present in other displays such as the leader boards on the Fitbit and Nike plus wearable devices. These displays currently require the individual to be performing the activity before they deliver any benefit this could be expanded so that it provides more relative social norm cues at the earlier stages of the process. When the individual first uses the device their score is lowest amongst their friends thus making relapse from the action back to the contemplation stages more likely due to feeling that their activity yield no rewards. In addition the current implementation of these social norm cues rely on competition on a limited metrics normally number of steps taken or Nike fuel. However other positive behaviours such as swimming or yoga the devices fail to track effectively as a result they are weakening the social norm of these fitness activities. If these are the best form of activity for you then these devices and applications are harming rather than helping the behaviour change.

In addition to this the interfaces could include coping planning supported tailored to the plan that the participants have. Exercise books provide coping support to overcome deficiencies in knowledge for certain exercise. However these current devices are deficient in two main ways firstly they do not provide knowledge support to other fitness activity such as yoga positions that the participant plans to do in order to get healthier. In addition the current devices do not provide the other forms of coping planning that are necessary for successful adoption of behaviours such as having the time or money to undertake the exercise. However additional research should be undertaken before following this suggestion.

The other approach that we believe that our study shows is that different individuals require different support at different stages. As a result we feel that an interface that alters its approach as the individual progresses through these stages we believe would be effective. This could be achieved through the device using the questions that establish stage in order to inform what information and support is given at any time. This way the individual receives the information and tools that are most suited to progressing them to their next stage. This can also take more parameters into account such as the type of activity that the individual plans to do in order to provide better action and coping planning.

In order to expand on this work we first recommend that more research be undertaken in order to better group participants into one specific group or whether the theory needs to see individuals as being in multiple of these stages and what the impact of this would be to the other models.

We also recommend that a longitudinal study be performed to ensure that the preferences expressed in

our study reflect the behaviours that would occur should the interface be used more regularly. We believe that this will identify whether behaviour change needs or values change over time that a one off study does not provide us with. This could be done through exposing the text based information to participants every day or to monitor their use of the applications themselves. As behaviour change is complex with any part of the interface creating the change in behaviour we believe the text based approach will be more able to assess each part of the literature in turn to identify which stage it is most effective for without confounding effects when the approaches are used in combination in the applications directly. This also has the added benefit of being able to test ideas that are presented in literature but not currently used in practice.

We would also expand on this work through testing other aspects of the behaviour change literature such as social norm of the behaviour to identify, which is the most effective information or combination of information at each transition between stages. Particularly as we believe the same information presented in a way that the participant believes that it is coming from a trusted source will deliver stronger results.

We also would like to further explore some of the discrepancy that we had identified between the behaviour change literature and our results for example we observed that plans were present in participants in the precontemplation stage or relapse being seen in participants in the maintenance stage. We would like to identify the reasons that these discrepancies exist in order to better understand behaviour change.

In addition to this we would also like to expand our research in order to test the devices based on mitigating the negative aspects of not undertaking enough exercise rather than against behaviour change. This is due to the ultimate aim of these devices is to ensure that the individual is becoming more healthy rather than to adopt the behaviour. As individuals adopt the behaviour they may do it in a way that rather than improving their own health may be doing too much activity or the wrong type of activity.

Finally we would also like to test this approach across other behaviour change domains. We believe that as the underlying models have been effective in multiple domains the supporting information that these interfaces provide will also be able to be transferred across domains. As a result the devices that monitor other behaviours such as energy usage or to stop smoking could also be explained by progressing towards the behaviour being adopted. This approach could help tailor the support they provide to the immediate needs of the individual.

5 Conclusion

Behaviour change is a complicated process with different individuals requiring different interventions at different times to be effective. We have found that this is due to individuals passing through a number of Transtheoretical stages prior to the new behaviour being adopted. We have shown that the transitions between these stages different interfaces will be more or less helpful. We believe that this is due to these interfaces providing the information that the individual needs at that particular stage. The information that we believe will be most effective at any stage was informed by the behaviour change literature. However we have not looked at all the different information that the literature suggests will be effective. As a result we believe that the current devices can be improved by providing the right information for the stage the individual is currently in. This will make it more likely that the individual progresses to the next Transtheoretical stage where they are closer to adopting the behaviour but will then require different support and information. This will mean that the support the device provides will then have to change. Should the interface be more successful then the behaviour will be more easily adopted and the negative impact of not exercising be mitigated. However the link between devices and negative impact of not undertaking fitness has not been explored in this project.

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Improving current technology based fitness devices through closer alignment to behaviour change literature

Appendix A

Socio Economic

Gender

		Gender			
		all values		Paying attention	
		Male	Female	Male	Female
All		64	59	42	41
Phase	Early	40	44	21	29
	Late	24	15	21	12
Stage	Precontemplation	11	9	4	3
	contemplation	22	26	13	21
	Preperation	7	9	4	5
	Action	13	9	11	8
	Maintence	11	6	10	4
value	health	39	38	27	27
	challenge	9	6	4	4
	economic	10	10	8	2
	social	6	5	3	2
active in youth	Yes	63	48	42	30
	No	1	11	0	11
nationality	United States	31	36	23	30
	India	33	23	19	11
age left school	14 or under	0	0	0	0
	15	1	4	0	0
	16	4	5	1	2
	17	1	4	0	4
	18	12	11	5	6
	19 or older	46	35	36	29
Previous experience	Gym Buddy	14	10	7	6
	Jawbone	0	1	0	1
	Both	1	2	0	0
	Neither	49	46	35	34
Has a plan	Yes	56	48	37	32
	No	8	11	5	9
Has relapsed	> 3	36	38	23	29
	<=3	28	21	19	12

Improving current technology based fitness devices through closer alignment to behaviour change literature

		Gender			
		all values		Paying attention	
		Male	Female	Male	Female
All		52.03%	47.97%	50.60%	49.40%
Phase	Early	47.62%	52.38%	42.00%	58.00%
	Late	61.54%	38.46%	63.64%	36.36%
Stage	Precontemplation	55.00%	45.00%	57.14%	42.86%
	contemplation	45.83%	54.17%	38.24%	61.76%
	Preperation	43.75%	56.25%	44.44%	55.56%
	Action	59.09%	40.91%	57.89%	42.11%
	Maintence	64.71%	35.29%	71.43%	28.57%
value	health	50.65%	49.35%	50.00%	50.00%
	challenge	60.00%	40.00%	50.00%	50.00%
	economic	50.00%	50.00%	80.00%	20.00%
	social	54.55%	45.45%	60.00%	40.00%
active in youth	Yes	56.76%	43.24%	58.33%	41.67%
	No	8.33%	91.67%	0.00%	100.00%
nationality	United States	46.27%	53.73%	43.40%	56.60%
	India	58.93%	41.07%	63.33%	36.67%
age left school	14 or under	0.00%	0.00%	0.00%	0.00%
	15	20.00%	80.00%	0.00%	0.00%
	16	44.44%	55.56%	33.33%	66.67%
	17	20.00%	80.00%	0.00%	100.00%
	18	52.17%	47.83%	45.45%	54.55%
	19 or older	56.79%	43.21%	55.38%	44.62%
Previous experience	Gym Buddy	58.33%	41.67%	53.85%	46.15%
	Jawbone	0.00%	100.00%	0.00%	100.00%
	Both	33.33%	66.67%	0.00%	0.00%
	Neither	51.58%	48.42%	50.72%	49.28%
Has a plan	Yes	53.85%	46.15%	53.62%	46.38%
	No	42.11%	57.89%	35.71%	64.29%
Has relapsed	> 3	48.65%	51.35%	44.23%	55.77%
	<=3	57.14%	42.86%	61.29%	38.71%

Improving current technology based fitness devices through closer alignment to behaviour change
literature

Active in youth

		Active in youth			
		all values		Paying attention	
		Yes	No	Yes	No
All		111	12	72	11
Phase	Early	77	7	43	7
	Late	34	5	29	4
Stage	Precontemplation	20	0	7	0
	contemplation	41	7	27	7
	Preperation	16	0	9	0
	Action	18	4	15	4
	Maintence	16	1	14	0
value	health	69	8	46	8
	challenge	13	2	7	1
	economic	18	2	14	0
	social	11	0	5	0
Gender	Male	63	1	42	0
	Female	48	11	30	11
nationality	United States	55	12	42	11
	India	56	0	30	0
age left school	14 or under	0	0	0	0
	15	5	0	0	0
	16	8	1	2	1
	17	4	1	3	1
	18	20	3	9	2
	19 or older	74	7	58	7
Previous experience	Gym Buddy	24	0	13	0
	Jawbone	1	0	1	0
	Both	2	1	0	0
	Neither	84	11	58	11
Has a plan	Yes	94	10	60	9
	No	17	2	12	2
Has relapsed	> 3	66	8	44	8
	<=3	45	4	28	3

Improving current technology based fitness devices through closer alignment to behaviour change literature

		Active in youth			
		all values		Paying attention	
		Yes	No	Yes	No
All		90.24%	9.76%	86.75%	13.25%
Phase	Early	91.67%	8.33%	86.00%	14.00%
	Late	87.18%	12.82%	87.88%	12.12%
Stage	Precontemplation	100.00%	0.00%	100.00%	0.00%
	contemplation	85.42%	14.58%	79.41%	20.59%
	Preperation	100.00%	0.00%	100.00%	0.00%
	Action	81.82%	18.18%	78.95%	21.05%
	Maintence	94.12%	5.88%	100.00%	0.00%
value	health	89.61%	10.39%	85.19%	14.81%
	challenge	86.67%	13.33%	87.50%	12.50%
	economic	90.00%	10.00%	100.00%	0.00%
	social	100.00%	0.00%	100.00%	0.00%
Gender	Male	98.44%	1.56%	100.00%	0.00%
	Female	81.36%	18.64%	73.17%	26.83%
nationality	United States	82.09%	17.91%	79.25%	20.75%
	India	100.00%	0.00%	100.00%	0.00%
age left school	14 or under	0.00%	0.00%	0.00%	0.00%
	15	100.00%	0.00%	0.00%	0.00%
	16	88.89%	11.11%	66.67%	33.33%
	17	80.00%	20.00%	75.00%	25.00%
	18	86.96%	13.04%	81.82%	18.18%
	19 or older	91.36%	8.64%	89.23%	10.77%
Previous experience	Gym Buddy	100.00%	0.00%	100.00%	0.00%
	Jawbone	100.00%	0.00%	100.00%	0.00%
	Both	66.67%	33.33%	0.00%	0.00%
	Neither	88.42%	11.58%	84.06%	15.94%
Has a plan	Yes	90.38%	9.62%	86.96%	13.04%
	No	89.47%	10.53%	85.71%	14.29%
Has relapsed	> 3	89.19%	10.81%	84.62%	15.38%
	<=3	91.84%	8.16%	90.32%	9.68%

Improving current technology based fitness devices through closer alignment to behaviour change literature

Nationality

		Nationality			
		all values		Paying attention	
		United States	India	United States	India
All		67	56	53	30
Phase	Early	40	44	30	20
	Late	27	12	23	10
Stage	Precontemplation	4	16	2	5
	contemplation	32	16	26	8
	Preperation	4	12	2	7
	Action	20	2	17	2
	Maintence	7	10	6	8
value	health	45	32	37	17
	challenge	8	7	5	3
	economic	8	12	8	2
	social	6	5	3	2
Gender	Male	31	33	23	19
	Female	36	23	30	11
active in youth	Yes	55	56	42	30
	No	12	0	11	0
age left school	14 or under	0	0	0	0
	15	0	5	0	0
	16	3	6	1	2
	17	3	2	3	1
	18	17	6	10	1
	19 or older	44	37	39	26
Previous experience	Gym Buddy	10	14	6	7
	Jawbone	1	0	1	0
	Both	1	2	0	0
	Neither	55	40	46	23
Has a plan	Yes	54	50	43	26
	No	13	6	10	4
Has relapsed	> 3	41	33	34	18
	<=3	26	23	19	12

Improving current technology based fitness devices through closer alignment to behaviour change literature

		Nationality			
		all values		Paying attention	
		United States	India	United States	India
All		54.47%	45.53%	63.86%	36.14%
Phase	Early	47.62%	52.38%	60.00%	40.00%
	Late	69.23%	30.77%	69.70%	30.30%
Stage	Precontemplation	20.00%	80.00%	28.57%	71.43%
	contemplation	66.67%	33.33%	76.47%	23.53%
	Preperation	25.00%	75.00%	22.22%	77.78%
	Action	90.91%	9.09%	89.47%	10.53%
	Maintence	41.18%	58.82%	42.86%	57.14%
value	health	58.44%	41.56%	68.52%	31.48%
	challenge	53.33%	46.67%	62.50%	37.50%
	economic	40.00%	60.00%	80.00%	20.00%
	social	54.55%	45.45%	60.00%	40.00%
Gender	Male	48.44%	51.56%	54.76%	45.24%
	Female	61.02%	38.98%	73.17%	26.83%
active in youth	Yes	49.55%	50.45%	58.33%	41.67%
	No	100.00%	0.00%	100.00%	0.00%
age left school	14 or under	0.00%	0.00%	0.00%	0.00%
	15	0.00%	100.00%	0.00%	0.00%
	16	33.33%	66.67%	33.33%	66.67%
	17	60.00%	40.00%	75.00%	25.00%
	18	73.91%	26.09%	90.91%	9.09%
	19 or older	54.32%	45.68%	60.00%	40.00%
Previous experience	Gym Buddy	41.67%	58.33%	46.15%	53.85%
	Jawbone	100.00%	0.00%	100.00%	0.00%
	Both	33.33%	66.67%	0.00%	0.00%
	Neither	57.89%	42.11%	66.67%	33.33%
Has a plan	Yes	51.92%	48.08%	62.32%	37.68%
	No	68.42%	31.58%	71.43%	28.57%
Has relapsed	> 3	55.41%	44.59%	65.38%	34.62%
	<=3	53.06%	46.94%	61.29%	38.71%

Age when finished education

		Age when finished education										
		all values						Paying attention				
		14 or under	15	16	17	18	19 or older	14 or under	15	16	17	18	19 or older
All		0	5	9	5	23	81	0	0	3	4	11	65
Phase	Early	0	4	7	3	12	58	0	0	2	2	4	42
	Late	0	1	2	2	11	23	0	0	1	2	7	23
Stage	Precontemplation	0	1	3	1	5	10	0	0	0	0	1	6
	contemplation	0	1	3	2	5	37	0	0	1	2	3	28
	Preperation	0	2	1	0	2	11	0	0	1	0	0	8
	Action	0	0	0	1	9	12	0	0	0	1	6	12
	Maintence	0	1	2	1	2	11	0	0	1	1	1	11
value	health	0	3	1	3	14	56	0	0	1	2	7	44
	challenge	0	1	3	1	2	8	0	0	0	1	1	6
	economic	0	0	3	1	5	11	0	0	0	0	0	5
	social	0	1	2	0	2	6	0	0	0	0	0	5
Gender	Male	0	1	4	1	12	46	0	0	1	0	5	36
	Female	0	4	5	4	11	35	0	0	2	4	6	29
active in youth	Yes	0	5	8	4	20	74	0	0	2	3	9	58
	No	0	0	1	1	3	7	0	0	1	1	2	7
nationality	United States	0	0	3	3	17	44	0	0	1	3	10	39
	India	0	5	6	2	6	37	0	0	2	1	1	26
Previous experience	Gym Buddy	0	0	2	1	5	16	0	0	0	1	2	10
	Jawbone	0	0	0	0	0	1	0	0	0	0	0	1
	Both	0	0	1	0	2	0	0	0	0	0	0	0
	Neither	0	5	6	4	16	64	0	0	3	3	9	54
Has a plan	Yes	0	5	9	4	19	67	0	0	3	3	8	55
	No	0	0	0	1	4	14	0	0	0	1	3	10
Has relapsed	> 3	0	0	7	3	17	47	0	0	3	2	9	38
	<=3	0	5	2	2	6	34	0	0	0	2	2	27

		Age when finished education										
		all values						Paying attention				
		14 or under	15	16	17	18	19 or older	14 or under	15	16	17	18	19 or older
All		0.00%	4.07%	7.32%	4.07%	18.70%	65.85%	0.00%	0.00%	3.61%	4.82%	13.25%	78.31%
Phase	Early	0.00%	4.76%	8.33%	3.57%	14.29%	69.05%	0.00%	0.00%	4.00%	4.00%	8.00%	84.00%
	Late	0.00%	2.56%	5.13%	5.13%	28.21%	58.97%	0.00%	0.00%	3.03%	6.06%	21.21%	69.70%
Stage	Precontemplation	0.00%	5.00%	15.00%	5.00%	25.00%	50.00%	0.00%	0.00%	0.00%	0.00%	14.29%	85.71%
	contemplation	0.00%	2.08%	6.25%	4.17%	10.42%	77.08%	0.00%	0.00%	2.94%	5.88%	8.82%	82.35%
	Preperation	0.00%	12.50%	6.25%	0.00%	12.50%	68.75%	0.00%	0.00%	11.11%	0.00%	0.00%	88.89%
	Action	0.00%	0.00%	0.00%	4.55%	40.91%	54.55%	0.00%	0.00%	0.00%	5.26%	31.58%	63.16%
	Maintence	0.00%	5.88%	11.76%	5.88%	11.76%	64.71%	0.00%	0.00%	7.14%	7.14%	7.14%	78.57%
value	health	0.00%	3.90%	1.30%	3.90%	18.18%	72.73%	0.00%	0.00%	1.85%	3.70%	12.96%	81.48%
	challenge	0.00%	6.67%	20.00%	6.67%	13.33%	53.33%	0.00%	0.00%	0.00%	12.50%	12.50%	75.00%
	economic	0.00%	0.00%	15.00%	5.00%	25.00%	55.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
	social	0.00%	9.09%	18.18%	0.00%	18.18%	54.55%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
Gender	Male	0.00%	1.56%	6.25%	1.56%	18.75%	71.88%	0.00%	0.00%	2.38%	0.00%	11.90%	85.71%
	Female	0.00%	6.78%	8.47%	6.78%	18.64%	59.32%	0.00%	0.00%	4.88%	9.76%	14.63%	70.73%
active in youth	Yes	0.00%	4.50%	7.21%	3.60%	18.02%	66.67%	0.00%	0.00%	2.78%	4.17%	12.50%	80.56%
	No	0.00%	0.00%	8.33%	8.33%	25.00%	58.33%	0.00%	0.00%	9.09%	9.09%	18.18%	63.64%
nationality	United States	0.00%	0.00%	4.48%	4.48%	25.37%	65.67%	0.00%	0.00%	1.89%	5.66%	18.87%	73.58%
	India	0.00%	8.93%	10.71%	3.57%	10.71%	66.07%	0.00%	0.00%	6.67%	3.33%	3.33%	86.67%
Previous experience	Gym Buddy	0.00%	0.00%	8.33%	4.17%	20.83%	66.67%	0.00%	0.00%	0.00%	7.69%	15.38%	76.92%
	Jawbone	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
	Both	0.00%	0.00%	33.33%	0.00%	66.67%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Neither	0.00%	5.26%	6.32%	4.21%	16.84%	67.37%	0.00%	0.00%	4.35%	4.35%	13.04%	78.26%
Has a plan	Yes	0.00%	4.81%	8.65%	3.85%	18.27%	64.42%	0.00%	0.00%	4.35%	4.35%	11.59%	79.71%
	No	0.00%	0.00%	0.00%	5.26%	21.05%	73.68%	0.00%	0.00%	0.00%	7.14%	21.43%	71.43%
Has relapsed	> 3	0.00%	0.00%	9.46%	4.05%	22.97%	63.51%	0.00%	0.00%	5.77%	3.85%	17.31%	73.08%
	<=3	0.00%	10.20%	4.08%	4.08%	12.24%	69.39%	0.00%	0.00%	0.00%	6.45%	6.45%	87.10%

Has a plan

		Has a plan			
		all values		Paying attention	
		Yes	No	Yes	No
All		104	19	69	14
Phase	Early	70	14	40	10
	Late	34	5	29	4
Stage	Precontemplation	18	2	5	2
	contemplation	39	9	28	6
	Preperation	13	3	7	2
	Action	18	4	16	3
	Maintence	16	1	13	1
value	health	67	10	47	7
	challenge	14	1	8	0
	economic	14	6	10	1
	social	9	2	4	1
Gender	Male	56	8	37	5
	Female	48	11	32	9
active in youth	Yes	94	17	60	12
	No	10	2	9	2
age left school	14 or under	0	0	0	0
	15	5	0	0	0
	16	9	0	3	0
	17	4	1	3	1
	18	19	4	8	3
	19 or older	67	14	55	10
Previous experience	Gym Buddy	20	4	9	4
	Jawbone	1	0	1	0
	Both	3	0	0	0
	Neither	80	15	59	10
nationality	United States	54	13	43	10
	India	50	6	26	4
Has relapsed	> 3	63	11	42	10
	<=3	41	8	27	4

Improving current technology based fitness devices through closer alignment to behaviour change literature

		Has a plan			
		all values		Paying attention	
		Yes	No	Yes	No
All		84.55%	15.45%	83.13%	16.87%
Phase	Early	83.33%	16.67%	80.00%	20.00%
	Late	87.18%	12.82%	87.88%	12.12%
Stage	Precontemplation	90.00%	10.00%	71.43%	28.57%
	contemplation	81.25%	18.75%	82.35%	17.65%
	Preperation	81.25%	18.75%	77.78%	22.22%
	Action	81.82%	18.18%	84.21%	15.79%
	Maintence	94.12%	5.88%	92.86%	7.14%
value	health	87.01%	12.99%	87.04%	12.96%
	challenge	93.33%	6.67%	100.00%	0.00%
	economic	70.00%	30.00%	90.91%	9.09%
	social	81.82%	18.18%	80.00%	20.00%
Gender	Male	87.50%	12.50%	88.10%	11.90%
	Female	81.36%	18.64%	78.05%	21.95%
active in youth	Yes	84.68%	15.32%	83.33%	16.67%
	No	83.33%	16.67%	81.82%	18.18%
age left school	14 or under	0.00%	0.00%	0.00%	0.00%
	15	100.00%	0.00%	0.00%	0.00%
	16	100.00%	0.00%	100.00%	0.00%
	17	80.00%	20.00%	75.00%	25.00%
	18	82.61%	17.39%	72.73%	27.27%
	19 or older	82.72%	17.28%	84.62%	15.38%
Previous experience	Gym Buddy	83.33%	16.67%	69.23%	30.77%
	Jawbone	100.00%	0.00%	100.00%	0.00%
	Both	100.00%	0.00%	0.00%	0.00%
	Neither	84.21%	15.79%	85.51%	14.49%
nationality	United States	80.60%	19.40%	81.13%	18.87%
	India	89.29%	10.71%	86.67%	13.33%
Has relapsed	> 3	85.14%	14.86%	80.77%	19.23%
	<=3	83.67%	16.33%	87.10%	12.90%

Has Relapsed

		Has Relapsed			
		all values		Paying attention	
		> 3	<= 3	> 3	<= 3
All		74	49	52	31
Phase	Early	53	31	34	16
	Late	21	18	18	15
Stage	Precontemplation	11	9	3	4
	contemplation	34	14	27	7
	Preperation	8	8	4	5
	Action	13	9	11	8
	Maintence	8	9	7	7
value	health	43	34	31	23
	challenge	10	5	6	2
	economic	16	4	13	3
	social	5	6	2	3
Gender	Male	36	28	23	19
	Female	38	21	29	12
active in youth	Yes	66	45	44	28
	No	8	4	8	3
age left school	14 or under	0	0	0	0
	15	0	5	0	0
	16	7	2	3	0
	17	3	2	2	2
	18	17	6	9	2
	19 or older	47	34	38	27
Previous experience	Gym Buddy	15	9	8	5
	Jawbone	1	0	1	0
	Both	2	1	0	0
	Neither	56	39	43	26
Has a plan	Yes	63	41	42	27
	No	11	8	10	4
nationality	United States	41	26	34	19
	India	33	23	18	12

Improving current technology based fitness devices through closer alignment to behaviour change literature

		Has Relapsed			
		all values		Paying attention	
		> 3	<= 3	> 3	<= 3
All		60.16%	39.84%	62.65%	37.35%
Phase	Early	63.10%	36.90%	68.00%	32.00%
	Late	53.85%	46.15%	54.55%	45.45%
Stage	Precontemplation	55.00%	45.00%	42.86%	57.14%
	contemplation	70.83%	29.17%	79.41%	20.59%
	Preperation	50.00%	50.00%	44.44%	55.56%
	Action	59.09%	40.91%	57.89%	42.11%
	Maintence	47.06%	52.94%	50.00%	50.00%
value	health	55.84%	44.16%	57.41%	42.59%
	challenge	66.67%	33.33%	75.00%	25.00%
	economic	80.00%	20.00%	81.25%	18.75%
	social	45.45%	54.55%	40.00%	60.00%
Gender	Male	56.25%	43.75%	54.76%	45.24%
	Female	64.41%	35.59%	70.73%	29.27%
active in youth	Yes	59.46%	40.54%	61.11%	38.89%
	No	66.67%	33.33%	72.73%	27.27%
age left school	14 or under	0.00%	0.00%	0.00%	0.00%
	15	0.00%	100.00%	0.00%	0.00%
	16	77.78%	22.22%	100.00%	0.00%
	17	60.00%	40.00%	50.00%	50.00%
	18	73.91%	26.09%	81.82%	18.18%
	19 or older	58.02%	41.98%	58.46%	41.54%
Previous experience	Gym Buddy	62.50%	37.50%	61.54%	38.46%
	Jawbone	100.00%	0.00%	100.00%	0.00%
	Both	66.67%	33.33%	0.00%	0.00%
	Neither	58.95%	41.05%	62.32%	37.68%
Has a plan	Yes	60.58%	39.42%	60.87%	39.13%
	No	57.89%	42.11%	71.43%	28.57%
nationality	United States	61.19%	38.81%	64.15%	35.85%
	India	58.93%	41.07%	60.00%	40.00%

Previous experience

		Previous experience							
		all values				Paying attention			
		Gym Buddy	Jawbone	Both	Neither	Gym Buddy	Jawbone	Both	Neither
	All	24	1	3	95	13	1	0	69
Phase	Early	20	1	1	62	10	1	0	39
	Late	4	0	2	33	3	0	0	30
Stage	Precontemplation	5	0	1	14	0	0	0	7
	contemplation	5	1	0	42	4	1	0	29
	Preperation	10	0	0	6	6	0	0	3
	Action	2	0	0	20	1	0	0	18
	Maintence	2	0	2	13	2	0	0	12
value	health	14	1	1	61	8	1	0	45
	challenge	3	0	2	10	2	0	0	6
	economic	4	0	0	16	2	0	0	4
	social	3	0	0	8	1	0	0	4
Gender	Male	14	0	1	49	7	0	0	35
	Female	10	1	2	46	6	1	0	34
active in youth	Yes	24	1	2	84	13	1	0	58
	No	0	0	1	11	0	0	0	11
age left school	14 or under	0	0	0	0	0	0	0	0
	15	0	0	0	5	0	0	0	0
	16	2	0	1	6	0	0	0	3
	17	1	0	0	4	1	0	0	3
	18	5	0	2	16	2	0	0	9
	19 or older	16	1	0	64	10	1	0	54
Has a plan	Yes	20	1	3	80	9	1	0	59
	No	4	0	0	15	4	0	0	10
nationality	United States	10	1	1	55	6	1	0	46
	India	14	0	2	40	7	0	0	23
Has relapsed	> 3	15	1	2	56	8	1	0	43
	<=3	9	0	1	39	5	0	0	26

Improving current technology based fitness devices through closer alignment to behaviour change literature

		Previous experience							
		all values				Paying attention			
		Gym Buddy	Jawbone	Both	Neither	Gym Buddy	Jawbone	Both	Neither
	All	19.51%	0.81%	2.44%	77.24%	15.66%	1.20%	0.00%	83.13%
Phase	Early	23.81%	1.19%	1.19%	73.81%	20.00%	2.00%	0.00%	78.00%
	Late	10.26%	0.00%	5.13%	84.62%	9.09%	0.00%	0.00%	90.91%
Stage	Precontemplation	25.00%	0.00%	5.00%	70.00%	0.00%	0.00%	0.00%	100.00%
	contemplation	10.42%	2.08%	0.00%	87.50%	11.76%	2.94%	0.00%	85.29%
	Preperation	62.50%	0.00%	0.00%	37.50%	66.67%	0.00%	0.00%	33.33%
	Action	9.09%	0.00%	0.00%	90.91%	5.26%	0.00%	0.00%	94.74%
	Maintence	11.76%	0.00%	11.76%	76.47%	14.29%	0.00%	0.00%	85.71%
value	health	18.18%	1.30%	1.30%	79.22%	14.81%	1.85%	0.00%	83.33%
	challenge	20.00%	0.00%	13.33%	66.67%	25.00%	0.00%	0.00%	75.00%
	economic	20.00%	0.00%	0.00%	80.00%	33.33%	0.00%	0.00%	66.67%
	social	27.27%	0.00%	0.00%	72.73%	20.00%	0.00%	0.00%	80.00%
Gender	Male	21.88%	0.00%	1.56%	76.56%	16.67%	0.00%	0.00%	83.33%
	Female	16.95%	1.69%	3.39%	77.97%	14.63%	2.44%	0.00%	82.93%
active in youth	Yes	21.62%	0.90%	1.80%	75.68%	18.06%	1.39%	0.00%	80.56%
	No	0.00%	0.00%	8.33%	91.67%	0.00%	0.00%	0.00%	100.00%
age left school	14 or under	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	15	0.00%	0.00%	0.00%	100.00%	0.00%	0.00%	0.00%	0.00%
	16	22.22%	0.00%	11.11%	66.67%	0.00%	0.00%	0.00%	100.00%
	17	20.00%	0.00%	0.00%	80.00%	25.00%	0.00%	0.00%	75.00%
	18	21.74%	0.00%	8.70%	69.57%	18.18%	0.00%	0.00%	81.82%
	19 or older	19.75%	1.23%	0.00%	79.01%	15.38%	1.54%	0.00%	83.08%
Has a plan	Yes	19.23%	0.96%	2.88%	76.92%	13.04%	1.45%	0.00%	85.51%
	No	21.05%	0.00%	0.00%	78.95%	28.57%	0.00%	0.00%	71.43%
nationality	United States	14.93%	1.49%	1.49%	82.09%	11.32%	1.89%	0.00%	86.79%
	India	25.00%	0.00%	3.57%	71.43%	23.33%	0.00%	0.00%	76.67%
Has relapsed	> 3	20.27%	1.35%	2.70%	75.68%	15.38%	1.92%	0.00%	82.69%
	<=3	18.37%	0.00%	2.04%	79.59%	16.13%	0.00%	0.00%	83.87%

Improving current technology based fitness devices through closer alignment to behaviour change literature

Dependent variables

How we grouped participants

Precontemplation

Precontemplation	contemplation	Preperation	Action	Maintence	Group	Relapse
4	3.5	3.75	3.25	3.25	1	3.5
3.25	3	3.25	3.25	3.25	1	3
2.25	2	2.25	2	1.5	1	1.5
5	4	4.5	4	3.75	1	4.5
4.75	4.75	4.75	4.5	4	1	4
3	3	2	3	3	1	2
5	5	5	4.5	4.75	1	4
5	5	5	5	5	1	5
3.75	3	2.75	3.25	3.75	1	3.5
3.25	2.5	2.25	2.75	2.75	1	3
3	2.75	2.75	2.5	2.5	1	2.5
4.5	4.5	4.5	4.5	4.25	1	5
3	1	1	1.75	2.75	1	1
3	3	2.25	2	1.75	1	2
4.25	3.5	4.25	4	3.75	1	3.5
3.25	3.25	3	3	2.75	1	3
4.5	4.25	4.5	4.25	4.5	1	4.5
5	4.75	5	4.25	4.75	1	4.5
4.5	4.25	4.5	4.25	4.25	1	5
3.25	2	3.25	2.25	2.25	1	2

contemplation

Precontemplation	contemplation	Preperation	Action	Maintence	Group	Relapse
3.25	4	3.75	2.75	3.5	2	3.5
1	4.75	2.25	3.5	2.5	2	4.5
2.25	4	3.25	3.5	2.5	2	3
2	3.5	2.5	3	3.5	2	3
2	4	3	4	2.25	2	4
2	3	2.25	1.75	2.5	2	1.5
2	4	2.75	3.5	3.75	2	4.5
2.25	3.5	2.5	3	3	2	2.5
2.75	3.5	1.5	2	2.5	2	4
4	4.75	4	4	4.25	2	3.5
2.75	4.75	4	2.25	2	2	3.5
1.25	4	3.25	4	3.5	2	4
3.25	4.25	3.75	3.5	3.5	2	5
2	3.75	2.25	2.5	1.75	2	4.5
2	4	4	4	2	2	4.5
2.25	4	2.5	2.75	2	2	4
2.5	3.5	3	3	2.5	2	3
1.75	4.25	2.5	2.5	2	2	4.5
2	4.75	1.75	2.25	1	2	4.5
1.75	5	3.75	4.25	2.25	2	5
2.5	3.5	3	3	2.75	2	3.5
3.25	3.75	3.75	3.5	3.75	2	4
1	4.5	2.25	2.75	1.5	2	4
1	5	4	3.75	1.75	2	4.5
3	3.5	2.75	3	3.25	2	3
2.25	3.5	2.75	2.75	2.75	2	3.5
1.75	3.75	2.25	3	1.5	2	3.5
1.25	4.5	4.25	4	3.5	2	4
2	4	2.5	2.75	2	2	4
3.5	3.75	3.25	3.25	3.75	2	3.5
1.25	4.5	3.5	3.25	2.25	2	3
1.5	4.75	3	4.5	1.75	2	3.5
1.75	4.5	2.5	4.5	3	2	4.5
2.5	4	4	4	4	2	4
3	3.5	3	2.75	3	2	3
1	4.75	2.75	4	1.5	2	4
3.5	3.75	3.25	2.75	3.75	2	3
1	4.25	3.25	3.25	3.25	2	3.5
2.5	3	2.75	3	3	2	3
2	3.5	3	3.25	2	2	2
1.75	4.5	4.5	4.25	3	2	4
3	3.5	2.5	2.75	3	2	3
1.5	4.5	2	3.75	1.25	2	3
2.25	4	2.5	3.25	3	2	3.5
2	3.75	2.75	3.5	2.5	2	4
1.5	4	2.75	2.75	2.5	2	4
1.75	2.5	2.5	1.5	2.25	2	2

preparation

Precontemplation	contemplation	Preperation	Action	Maintence	Group	Relapse
4.5	4	4.75	4	4.75	3	4.5
3	3.5	4.25	3.75	3.75	3	4
3.5	3.75	4	3.25	3.25	3	3
2.5	2.75	4	3	3.75	3	4
3	3	3.5	3.25	3	3	3
1.75	2	2.5	1.75	1.5	3	2.5
4.5	4.5	4.75	4.5	4.25	3	3.5
2.25	3	4.5	4.5	4.5	3	3
2.75	2.25	2.5	2	2.5	3	2
4.25	3.75	4.75	4.75	4	3	4
2.75	3.25	3.5	2.5	3.25	3	3
3.25	3.5	4	3.5	4	3	3
2	3	4.25	4.25	3.5	3	4
2	2.5	5	4.5	4	3	3
2.5	3.5	2.75	3.75	2.5	3	4
1.75	2.5	2.5	2.25	2.25	3	1.5
2	3	5	5	3.5	3	5

action

Precontemplation	contemplation	Preperation	Action	Maintence	Group	Relapse
3	2.5	2.5	3.25	2.75	4	2.5
2	2.75	2.5	3.25	2.25	4	3.5
1.5	2.25	3.75	4.75	4.75	4	2
2	2.75	2.5	3	1.75	4	3
1.75	1	1	2	4.25	4	1.5
1.25	3.25	2.75	4.25	3.5	4	4.5
1.75	3.25	2.25	3.5	1.75	4	3.5
2.75	2.75	3	1.5	4	3
1.25	4	3	4.25	2.5	4	4.5
1.5	3.25	3.25	4	3.25	4	3.5
3	3.5	3.25	3.75	3.25	4	3
2.5	3.5	2.75	3.75	2.5	4	4
1.75	3.75	3.5	4	2.25	4	4
2	3	3.25	4	2.5	4	3
2.75	4	3	4.25	4	4	4
2.5	2.5	3	3.5	3	4	2
1.25	4	3.5	4.25	2.5	4	4.5
4.75	4.75	4.75	5	4.5	4	4.5
1.5	3.75	2.75	4	2.25	4	4
1	3.25	3.25	4	3.25	4	3

maintenance

Precontemplation	contemplation	Preperation	Action	Maintence	Group	Relapse
4.5	4.75	4.5	4.75	5	5	4
1.75	2.5	2.75	2.25	3.25	5	2.5
1.75	2.5	3	2.75	4	5	3
1.75	1	1	2	4.25	5	1.5
2.5	3	3.75	3.25	4	5	4
2.75	3	3.75	3.75	4	5	4
2	1.75	2	1.5	4.25	5	2
3	3.25	3.25	3	3.75	5	4
2	1.75	1.75	2.25	2.5	5	2.5
3.25	4	3.75	3.75	4.5	5	3.5
2	1.75	3	3	4	5	3
4.5	4	4.75	4.25	5	5	5
3.5	2.25	4	4.5	5	5	3.5
2	1.75	1.75	2.25	2.5	5	2.5
2	3	3.5	3	4	5	3
2.5	3.5	3.5	3.5	4	5	3.5