Habituation and Dishabituation of Physical Activity

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ABSTRACT

Three experiments with single subject research designs were conducted to see whether habituation occurred as human participants completed physical activity. Experiment 1 had an arrangement where participant's rates of stationary cycling were recorded throughout 20 minute sessions. Instead of habituation, stationary cycling rates increased over time, likely to be due to a rule that controlled behaviour derived from previous reinforced responding in the same setting as the experimental context. Experiment 2 was arranged similarly to Experiment 1 with an added concurrent task to disrupt the behaviour chain causing the rule-governed behaviour seen in Experiment 1. Despite this concurrent task, rates of stationary cycling again increased due to rule-governed behaviour. Experiment 3 had stationary cycling rates associated with a salient reinforcer that could lose its effectiveness to reinforce over time and thus habituate. Instead, Experiment 3 resulted in stable rates of stationary cycling consistent with task adherence, a rule-governed behaviour. With the failure of habituation to predict the results of this study, they are instead discussed from the more applicable perspective of motivating operations.

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EXPERIMENT 1

Physical activity is one modifiable aspect of life that, if increased, can have positive results on health. Defined as movements of the body, physical activity can include many different types of activities. These range from normal living activities such as housework or walking the dog, to structured intentional activities such as strength training, sporting/group activities, or attending a gymnasium (Ministry of Health [MOH], 2003). Physical activity is beneficial to health and overall mortality because it reduces the incidence of many diseases linked to excessive sedentary behaviour. These diseases include; coronary heart disease, hypertension, obesity, type two diabetes, osteoporosis, and cancers of the colon and breast (American College of Sports Medicine [ACSM], 2009).

The guidelines for how much physical activity individuals require differs between health authorities. New Zealand's Ministry of Health recommends that children 5 to 18 years old should get 60 minutes of moderate to vigorous physical activity per day and adults should get 30 minutes of moderate intensity physical activity on most days of the week (MOH, 2003). The New Zealand Health Survey 2006/2007 found, at that time, that the prevalence of people meeting these physical activity recommendations was 50.5% of over 17,000 respondents, with this percentage declining as age increased (MOH, 2008). This finding shows there is a need for effective interventions designed to increase physical activity levels in order to reduce the incidence of diseases caused by excessive sedentary behaviour.

To decrease the prevalence of sedentary behaviour, a diverse body of literature from a variety of theoretical perspectives has developed. This literature includes research showing the utility of intervention procedures, some of which have involved altering dimensions of an activity such as its type, intensity, the session durations, and/or the session frequencies (World Health Organisation [WHO], 2010). Other beneficial intervention procedures have involved altering the environment in which physical activity is completed.

Interventions that increase physical activity

There has been a considerable amount of research on the effectiveness of behaviour change interventions designed to increase the amount of physical activity completed by individuals. To consolidate the results of the research in this area, Conn, Hafdahl, and Mehr (2011) conducted a meta-analysis focused on the effect interventions had on the levels of physical activity completed by healthy adults. This meta-analysis concluded that, in general, the use of interventions designed to increase physical activity led to a modest increase in the amounts completed. A second finding was that when Conn et al. (2011) divided interventions into groups of those that came from a cognitive approach and those that came from a behavioural approach, it was found that the use of behavioural interventions led to higher gains in physical activity compared with those from a cognitive approach. Although this meta-analysis did not establish which intervention was the most effective, it does indicate that the implementation of behavioural interventions can increase the amounts of physical activity completed by an individual.

Behavioural interventions designed to increase physical activity are useful regardless of whether they are implemented singularly, or as components of an intervention package. Although it is difficult to assess the effectiveness of singular interventions within packages because they are usually all introduced at one time, the following combinations are examples of intervention packages that have been shown to successfully increase physical activity amounts:

- A behavioural contract and positive reinforcement (Kau & Fischer, 1974).

- A behavioural contract, self-recording, self-set goals, and reinforcement (Wysocki, Hall, Iwata & Riordan, 1979).
- Self-recording, goal-setting, self-reinforcement, and stimulus control (Keefe & Blumenthal, 1980).
- Feedback from a pedometer, goal-setting, and daily contact with the researcher (Normand, 2008).
- Self-recording and positive reinforcement (Maki, Rudrud, Schulz & Rapp, 2008).

While the introduction of these intervention packages did increase physical activity, further conclusions regarding the effectiveness of the interventions included in these packages could only have been made had these components been introduced in isolation from the others, or had their introductions been staggered across time. Despite this, one observation can be made; each of the intervention packages utilised within these studies included a component of positive reinforcement, suggesting its inclusion contributed to the observed increases in physical activity.

Further evidence for the effectiveness of adding positive reinforcement to a context to increase physical activity is provided by research utilising reinforcement as a singular intervention. Within this research, different reinforcers have been implemented, including several studies that have used social reinforcers such as praise or encouragement to increase physical activity. For example, Thompson and Born (1999) found that when the instructor of a group exercise session began to encourage those not participating to do so, increases in the overall time participants spent completing the activities was increased. In other research, praise was shown by McNair, Depledge, Brettkelly, and Stanley (1996) to increase the force of a biceps brachii muscle contraction by on average 5% compared with baseline measures. Similarly, Andreacci et al. (2002) increased the performance of participants by providing praise as they ran as fast as they could for as long as they could on a treadmill. During the trials where participants were praised frequently, significant increases were seen in the recorded cardiovascular and metabolic markers of exertion as well as participant's perceived effort, confirming that as an intervention, the addition of praise can increase physical activity.

The addition of positive reinforcement in an arrangement where tangible items were provided within a token economy has also been shown to significantly increase the amounts of physical activity completed by an individual. In an early example, Libb and Clements (1969) increased the overall rates of stationary cycling completed by three of four participants by adding tangible reinforcement to the context delivered within a token economy. Here, a variable ratio (VR) schedule of reinforcement was calculated for each participant using their baseline rates so five marbles could be earned per session that were later exchangeable for tangible items. Similarly, De Luca and Holborn (1992) increased the rates and durations of stationary cycling by adding a VR schedule of reinforcement to the context that required participants to stationary cycle at rates 15% higher than they had during baseline sessions. Not only this, but with a changing criterions design, De Luca and Holborn's (1992) experiment showed that when the stationary cycling rates that were required for reinforcement were increased by a further 15%, and then 30% above the initial VR schedules requirements, participants increased their responding accordingly. This latter finding suggests that reinforcement schedules can be thinned so fewer reinforcers are required to maintain high rates of responding.

More recently, research has shown that the addition of another type of schedule of reinforcement, a fixed ratio (FR) schedule, can increase the rates and durations of a physical activity. Cohen, Paradis, and LeMura (2007) compared the amounts of stationary cycling by participants during a baseline condition with three experimental conditions. These experimental conditions included stationary cycling during a FR 40 schedule where a counter showed the amount of money earned during the session, another where each participants favourite music was played in the background, and a third that included both the FR schedule and the music. It was found that all of the experimental conditions had significantly higher average rates of stationary cycling, and the two conditions that included the FR schedule also had significantly increased durations of stationary cycling. Additionally, it was found that the condition with both the FR schedule and the music did not result in significantly higher rates of stationary cycling compared with the FR schedule alone suggesting that in this context money was a more powerful reinforcer than music.

In conclusion, of the large amount of literature focused on increasing levels of physical activity, interventions from a behavioural approach appear to be the most effective. One behavioural intervention, positive reinforcement, has been shown to increase the amounts of physical activity completed by an individual regardless of whether it is utilised alone or as part of an intervention package. As a singular intervention, positive reinforcement as either encouragement or praise has been shown to increase physical activity by increasing levels of participation, effort, and the force of a muscle contraction. Also, the addition of positive reinforcement as tangible items provided within VR and FR scheduled token economies has been shown to increase both the rates and durations of physical activity. Two further findings of this research include that when the amount of physical activity required to receive tangible reinforcers was increased, so too was performance, and, a participant's preferred music playing in the background appears to be a less powerful reinforcer than money.

Within the reviewed research on intervention procedures that increase physical activity, aside from the use of positive reinforcement, there are few consistencies due to the variety of participants, contexts, and methodologies used. A further issue with this area of research is that all of the methodologies utilised involved measuring the amount of an activity completed during each session and comparing it with amounts completed during other sessions as opposed to measuring the within session patterns of responding. This means there is a gap in this literature that shows how rates of physical activity change within sessions. It is possible that during sessions the rates of activity diminish over time, thus contributing to the problem of individuals not getting enough physical activity to avoid the health consequences of excessive sedentary behaviour. One area, behaviour analysis, can contribute literature showing not only how patterns of responding develop within session, but also the ways these patterns could be modified.

Habituation

Habituation occurs when conditions remain consistent during responding without the introduction of an independent variable. Described in early habituation literature as "response decrement as a result of repeated stimulation" (Harris, 1943, p.385), these patterns predict that the frequency or magnitude of responses will decrease as time continues if the context remains unchanged (Rankin et al., 2009). McSweeney and Swindell (1999) have argued that in light of the research on operant habituation, decreases in responding are caused by reinforcers losing their value over time.

In one of the earliest pieces of literature showing that habituation occurs during operant conditioning, McSweeney and Roll (1993) reviewed studies that measured the response patterns that occurred within sessions. They took only the data from the control conditions in each of these studies, ensuring that no independent variables had been introduced, and that the environmental conditions remained stable. After comparing the data from conditions meeting these criteria, the authors found that patterns were not only consistent across experimental contexts, but that they were also comparable to what had been previously described in the classical conditioning literature as habituation. In this review, McSweeney and Roll (1993) observed these patterns of habituation across different species, schedules, and responses, as well as during positive reinforcement, punishment, and avoidance experimental designs. Three patterns of habituation have since been identified; an increase in responding followed by a decrease, an increase with levels stabilising at the peak they reach, and a gradual decrease over time (McSweeney & Murphy, 2009).

Literature has highlighted distinct features of the experimental context that influence the development of habituation patterns. Although the earlier, classical conditioning literature has reported a number of habituation characteristics (Thompson & Spencer, 1966), to date, only some of these have been reported to apply to operant conditioning contexts (McSweeney & Murphy, 2009; Rankin et al, 2009). The characteristics pertaining to operant habituation not only alter the within session patterns of responding momentarily, but also have implications for the comparison of habituation patterns across sessions. Thus, these characteristics are important considerations during both the design of habituation experiments and the analysis of any subsequent results.

The first characteristic of habituation reported to occur in operant contexts is that the frequency of reinforcer delivery alters the speed at which habituation occurs. McSweeney (1992) reported this characteristic in rats' rates of responding during several different variable interval (VI) schedules of reinforcement ranging from VI 15 s to VI 240 s. The resulting patterns of responding varied systematically depending on the frequency of reinforcement. The schedules providing lower frequencies of reinforcement had slower decreases in responding. As the frequency of reinforcer delivery increased, so did the speed at which response rates decreased. In other words, lower frequencies of reinforcement led to slower habituation compared with higher frequencies of the same reinforcer.

A second characteristic of operant habituation is that response rate decreases are influenced by stimulus intensity. For example, Melville, Rue, Rybiski, and Weatherly (1997*)* compared the response rate decreases that rats had during conditions that differed in the proportion of sucrose delivered as reinforcement. The resulting patterns of responding showed that those containing the lowest proportions of sucrose had faster decreases in responding. As the proportion of sucrose increased, response rate decreases became slower. In other words, the schedules providing more intense reinforcers produced faster patterns of habituation compared with the schedules providing lower intensity reinforcers.

Another characteristic of operant habituation is that within session patterns of responding are relatively specific to the context. Stimulus specificity is demonstrated when, if a feature of a context where habituation has occurred is changed, and this change is significantly different, then with this change will come a response rate increase as habituation commences to the new context. For example, Aoyama and McSweeney (2001) increased the wheel running rates of rats by changing the surface on which they ran. Here, one group of rats ran two halves of a session in a wire mesh wheel. The other group ran the first half of their session in the wire mesh wheel, and the second half in a wheel with its floor covered entirely in tape. The resulting response patterns showed that while both groups had similar average running rates during the first half of sessions, those running in the tape-covered wheels during the second half had higher average running rates compared with those who spent this time in the wire mesh wheel. This shows that wheel-running rates were specific to the surface of the running wheel. When this stimulus was changed, increased rates of responding occurred as habituation began to the new context.

Long-term habituation is the fourth characteristic of operant habituation. Here, as the number of occasions habituation to a particular stimulus increase, so too does the speed of habituation. For example, Epstein, Carr, Cavanaugh, Puluch, and Bouton (2011) recorded the response rates humans had during a computer task rewarded with points. The number of points earned by participants determined the amount of a food they received at the end of each session. Over five days of the same food being presented, participant's response rates during each subsequent session decreased more rapidly with a corresponding reduction in the amount of food they consumed. In other words, as the occasions of daily habituation increased, the speed of habituation decreased with a corresponding reduction in the amount of reinforcers delivered.

The fifth characteristic of operant habituation is spontaneous recovery. Here, if stimuli that were previously habituated to are absent for a period, when reintroduced, the corresponding response rates will be higher compared with just prior to its absence. For example, Aoyama and McSweeney (2001) demonstrated the spontaneous recovery of rat's running rates after a period without access to a wheel. Here, rats ran on a wheel each day for 19 days, with the final, 20th session, separated from the earlier ones by a period of either 24 or 48 hours. When the two groups running rates during the final session were compared, it was found that rats with one day of wheel running deprivation had steeper decreases in responding compared with the rats deprived of running for two days. In other words, the greater the length of time between wheel-running sessions, the greater the spontaneous recovery of responding when access was restored.

The sixth characteristic of habituation that applies to operant conditioning contexts is dishabituation. Dishabituation will be covered in more detail in the following section due to its relevance to the current study. Dishabituation is important because of its ability to help distinguish habituation from other potential causes of response rate decreases by boosting levels of responding during habituation. If human physical activity has within session patterns of responding consistent with habituation, then dishabituation could be a feasible method of increasing the amounts of physical activity completed during sessions as well as confirming the decreases are the result of habituation. Also, due to its dependence on dishabituation, the following section will also contain a description of the seventh characteristic of habituation, habituation to a dishabituator.

Dishabituation

During an observed pattern of habituation, the brief presentation of a stimulus that is strong, novel, or extra may alter responding by increasing it to earlier levels once the original stimulus is reinstated (McSweeney & Murphy, 2009). For example, Murphy, McSweeney, Kowal, McDonald, and Wiediger (2006) measured the effect of a tone presented to rats as habituation occurred to reinforcers comprised of ethanol and water. Immediately after the tone, rates of responding for the ethanol reinforcer increased to levels seen earlier in the session, showing the tone acted as a dishabituator. This increase in responding to the original stimulus following the introduction of a different stimulus is *dishabituation*.

The experiment by Murphy et al. (2006) involving the dishabituation of rats' responding for ethanol reinforcers was repeated a number of times. These authors then compared the response rate increases resulting from dishabituation across sessions, finding that during the first five occasions of dishabituation, higher increases occurred compared with those observed during subsequent occasions of dishabituation. This shows that with repeated presentations of a dishabituator, a reduction in the response rate increase that results from dishabituation will occur. This characteristic of habituation; the habituation of dishabituators, is consistent with a characteristic of the habituation seen during classical conditioning (Thompson & Spencer, 1966) and is thus the seventh characteristic of habituation to be shown to also occur in operant conditioning contexts.

A demonstration of dishabituation is important if one wants to attribute within session decreases in responding to habituation. If, by introducing a dishabituator, the corresponding response rates increase, then other explanations for the response rate decreases such as fatigue or satiation are unlikely to be the cause. This is because the increases seen during dishabituation are inconsistent with the irreversible decreases that might be attributed to response-based explanations such as fatigue or satiation (Aoyama & McSweeney, 2001). For example, if fatigue were causing response rate decreases rather than habituation, then the introduction of a different stimulus would not be expected to increase the rates of responding because it would not remove or decrease its cause.

Habituation, confirmed as such with dishabituation, has been observed during a variety of animal studies including those involving physical activity. For example, Aoyama and McSweeney (2001) found that there were within session decreases in the recorded rates of running when rats were left to run freely in a wheel for 30 minutes. When this decrease occurred, a dishabituator was introduced, consisting of either a brake or a light, turned on and off each second for five seconds. It was found that immediately after the dishabituators were introduced, a significant increase in running was seen. This not only confirmed that habituation was the cause of the decreases in within session wheel running as opposed to fatigue, but also that the amount of wheel running completed by the rats during these sessions could be increased by dishabituation.

Later, Belke and McLaughlin (2005) conducted an experiment where rats responded by pressing a lever that was rewarded with a period of wheel running on a fixed interval (FI) 30 s schedule. They included the same dishabituators as Aoyama and McSweeney (2001) with an additional condition testing whether a tone played could dishabituate responding. All dishabituators were introduced 25 seconds into the 45 second reinforcement and lasted a total of five seconds. The brake, houselight, and tone dishabituators all led to an immediate decrease in wheel running that was later argued to be a fear or startle response. After this decrease, responding recovered to significantly higher levels than the baseline condition. The immediate decline in running was absent from Aoyama and McSweeney's (2001) results. Belke and McLaughlin (2005) argued this was because while they produced data every five seconds, Aoyama and McSweeney (2001) had recorded data every three minutes, making Belke and McLaughlin’s (2005) study more sensitive to changes in responding.

These studies show that as rats ran on wheels their rates decreased consistent with habituation patterns (Aoyama & McSweeney, 2001; Belke & McLaughlin, 2005). During the reductions in wheel rate running, dishabituation not only confirmed these decreases were habituation, but also increased the total amount of running completed by rats during these sessions. The finding that rat wheel-running results in habituation is likely to extend to other physical activities. Depending on whether human behaviour habituates, it is possible such reductions will also occur during physical activities that could be increased with the introduction of a dishabituator.

Human habituation

Human studies demonstrating habituation and dishabituation are limited to contexts where participants have responded to the sensory properties of food and taste stimuli. In this literature, unconditioned responses such as salivation and facial muscle twitches have been shown to habituate (Epstein & Paluch, 1997; Epstein, Rodefer, Wisniewski & Caggiula, 1992) as well as the operant response of button pressing during a computer task (for example, Epstein et al., 2003). To discount other explanations for the decreases in response rates, habituation is usually confirmed as the cause with either stimulus specificity or dishabituation (Epstein et al., 1992).

Much of the human habituation literature in recent years has focused on operant responding. In these studies, the methodology has usually involved measuring button presses during a computer task rewarded with points during a schedule of reinforcement. Here, as points were earned, food was delivered to participants that they then consumed. During the stimulus specificity and dishabituation trials, it was the food stimulus that was changed rather than any aspect of the point delivery. The earliest evidence that human habituation occurs during operant responding was provided by Myers Ernst and Epstein (2002). Here, participants completed a computer task that was rewarded with points on a VR 32 schedule, with each point earned followed by the delivery of food. The within session response patterns that resulted from this arrangement were consistent with habituation, and confirmed as such when a novel food stimulus was introduced during a trial that resulted in dishabituation.

Not only did Myers Ernst and Epstein's (2002) experiment result in patterns of responding consistent with habituation, but they also found that habituation was disrupted when the food stimulus was varied across trials. Here, those receiving the same food stimulus during each trial had much steeper decreases in their response rates compared with those receiving a variety of stimuli during this time. This is consistent not only with the earlier research showing that human salivation habituates to stimuli (Epstein, Paluch & Coleman, 1996), but also the disruption to habituation patterns found when varying stimuli were presented during animal operant responding (McSweeney & Murphy, 2009).

Many studies since have provided further evidence that habituation occurs during human operant responding. In several studies habituation has been found to occur in the responding of children as they complete a computer task similar to the one described earlier (Epstein et al., 2003; Temple et al., 2006). A later study by Epstein et al. (2008) found that children who were overweight had slower habituation during the computer task compared with their non-overweight counterparts. This finding extended Epstein, Paluch, and Coleman's (1996) earlier study where overweight adults' salivation had slower habituation in response to food stimuli compared with those who were not overweight.

Although much of the operant research to date has replicated findings originally seen in human habituation studies where unconditioned responses were observed, there are two studies that have contributed new information to the habituation literature. The first was that the habituation of salivation in response to food presentations could be dishabituated with a trial of video-game playing, a non-food stimulus (Epstein et al, 1992). This finding was later extended in research by Temple, Giacomelli, Kent, Roemmich, and Epstein (2007) who showed that another non-food stimulus, television viewing, could dishabituate human computer task responding that was reinforced by the presentation of food stimuli. Here, during the dishabituation trial, participants either viewed television, received a novel food stimulus, or waited during this time. A comparison of the increases in responding after the dishabituators were introduced indicated that viewing television dishabituated responding as much as the novel food stimulus, with both of these response rate increases being significantly higher than the condition that did not include a dishabituator. This means that television viewing, a non-food stimulus, can effectively dishabituate food stimuli to the same degree as a novel food stimulus.

In a second study, Temple et al. (2007) wanted to observe how disruptive watching television would be to the habituation of a food stimulus. Here children sat and ate their favourite snack as they either sat quietly during the session, watched a continuous television show, or watched a short segment of television that was repeated within each trial. The results showed that watching television led to the greatest amount of food consumed compared with the other conditions. The group who watched the repeated segment ate less than those watching continuous television, while those sitting quietly consumed the least showing that television viewing is a stimulus that disrupts habituation to food stimuli.

These reviewed studies show that habituation patterns occur during human operant responding to food or taste stimuli. Added to this is the observation that these patterns can be dishabituated not just with food stimuli, but also other classes of stimuli including television viewing and video game playing.

If habituation occurs during both human responding to food stimuli and animal responding to many different stimuli (McSweeney & Roll, 1993), then it follows that humans may also habituate to other stimulus classes. With previous animal studies such as Belke and McLaughlin's (2005) demonstrating that habituation patterns occur as rats complete a physical activity, perhaps such patterns also occur during human physical activity. If this is the case, then as humans habituate during human physical activity, the addition of a dishabituator to the context could lead to an immediate increase in the rates of that activity. This would contribute to the overall amount of activity completed during sessions, thereby reducing the impact of health problems associated with insufficient physical activity.

Summary

Recent research has shown that people in New Zealand do not get the recommended amounts of physical activity needed to prevent illnesses associated with excessive sedentary behaviour. Many interventions have been designed to address this with research showing that interventions that include positive reinforcement can increase physical activity levels compared with baseline measures. Although there are many studies showing the utility of such interventions, there remains a gap in research describing how rates of activity change within session when conditions remain consistent.

One area of behaviour analysis has focused on patterns of responding that occur within session, identifying three common patterns collectively known as habituation. Habituation has many characteristics including dishabituation; an increase in response rates with the brief introduction of a different stimulus before the original stimulus is reintroduced. By demonstrating dishabituation during decreases in responding, habituation is confirmed as the cause as opposed to other response-based explanations.

Patterns of habituation and dishabituation have been observed during animal studies, including those observing physical activity. This suggests within session physical activity can habituate and be dishabituated. Human studies have shown that habituation and its dishabituation occur during sessions of responding to food and taste stimuli. With habituation patterns occurring not only for animals during physical activity, but also during human responding to food stimuli, it follows that humans may also generate patterns of responding during physical activities that are consistent with habituation. If this is the case, the addition of a dishabituator to the context that results in an increase in responding will not only confirm that habituation occurs during such activities, but will also increase the rates of physical activity during that session. If dishabituation can increase rates of physical activity, then health benefits associated with a reduction in excessive sedentary behaviour will be gained as a result.

The current study

This study has two aims, with the second dependent on the outcome of the first. The first is to observe human physical activity to see whether within session rates decrease consistent with habituation. If decreases in physical activity rates are observed, the second aim is to test whether they can be dishabituated. If dishabituation occurs, the increase in rates of responding will confirm habituation as the cause of any decrease in response rates seen. In addition to this, dishabituation will increase the overall amount of physical activity completed by adding to both its intensity as well as its duration. Dishabituation will also differentiate habituation patterns from decreases caused by response related phenomena such as fatigue or satiation (Aoyama & McSweeney, 2001; McSweeney & Murphy, 2009).

To dishabituate a physical activity, it must first be shown that the behaviour has within session patterns of responding consistent with habituation. Therefore, the aim of Experiment 1 is to observe participants as they complete a physical activity, with the hypothesis that patterns of responding will occur that are consistent with habituation.

Research design

Like other research on habituation (for example, Aoyama & McSweeney, 2001), the research design for the current experiment will be single subject. This will eliminate individual fitness levels as a variable as well as allowing for each within session pattern of responding to be observed in isolation.

Earlier it was shown that when within session data collection is more frequent, measures are more sensitive to patterns of responding that would otherwise remain undetected (Belke & McLaughlin, 2005). Considering this, the current experiment will record data every 10 seconds in order to be frequent enough to capture the patterns that occur.

Stationary cycling will be the physical activity observed during this study. This activity is ideal because it can be performed at low intensities, thus avoiding the risk of cardiac issues that could occur in sedentary participants or those who exercise infrequently (ACSM, 2009). In addition, by setting the stationary cycle at a low intensity, responding can be at higher rates while minimising the fatigue that is likely to accumulate over time (ACSM, 2009). Responses will be measured in Revolutions per Minute (RPMs) to combine both the magnitude and the speed of pedalling. This means habituation will be recorded regardless of whether it occurs as a reduction in response magnitude or as a decrease in the rates of pedalling.

Finally, both because the development of habituation has been shown to be independent of sessions length (McSweeney, 1992; McSweeney, Roll & Cannon, 1994), and because there are no fitness requirements for individuals to participate in this study, sessions will last the minimum amount of time needed for health benefits, 20 minutes (ACSM, 2009).

Method

Participants

An advertisement (see Appendix A) was placed on the customer service counter at a local exclusively female gym. This advertisement specified that those who were over the age of 16 and medically fit to exercise were invited to take part in a study on exercise behaviour. Those interested could leave their contact details on the accompanying sign-up sheet and/or take a copy of the information sheet (Appendix B).

Participants were six female gymnasium staff/members who gave informed consent. Their ages ranged from 28 to 51 with an average age of 40.

Apparatus

Data collection was conducted in the gymnasium where advertising took place.

A Life Fitness 9500HR stationary cycle was moved to a private room. The computer display on this cycle showed, from left to right; time elapsed, heart rate, RPMs, and the wattage generated. The heart rate shown on this screen is usually taken from sensors located on the stationary cycle handles. Should participants remove their hands from the handle grips during experimental sessions, the heart rate data would cease until between 10 and 30 seconds after hands were placed back on the sensors (Life Fitness, 1997). To ensure continuous heart rate measures were taken throughout each session, tape was placed over these sensors to prevent the generation of heart rate measures from the hands. Instead, participants were asked to wear a heart rate monitor around their chest that measured their heart rate in Beats per Minute (BPMs), and transmitted these readings in place of the heart rates generated by the stationary cycle. The display on the stationary cycle was removed from the stand and turned 180 degrees facing away from participants out of their view.

A smartphone with Android Version 2.3 and a free application called A HIIT Interval Timer was downloaded from the android market (https://market.android.com). This application has been designed so exercises of varying times can be performed in a sequence with alarms signalling when it is time to start, stop, or change. This standardises the sequence and time of each phase within a session without needing to make adjustments. For this experiment, there was an alarm programmed to sound at the beginning of the session, and another once 20 minutes had passed to signal the end of the session.

A Samsung ST65 camera with high definition movie recording capabilities was used to capture data shown on the stationary cycle display during the session.

A brief questionnaire (Appendix C) was designed with content taken from the *Physical Activity Readiness Form* (ACSM, 2009). These questions have been designed to screen participants for medical problems that may make physical activity unsafe.

Procedure

After explaining to participants what the experiment would require, they were asked to fill in the participant details form (Appendix C), which included the questions designed to screen for health problems that could make physical activity unsafe. If participants answered 'yes' to any of the health screening questions, it was considered unsafe for them to participate in the experiment and they were thanked for their time. Those who answered 'no' to all questions could then fill in the consent form (Appendix D).

Participants were shown how to wear the heart monitor, and left to put it on. Then, the seat on the stationary cycle was adjusted for participant’s height, and they then sat and began cycling as the researcher programmed the cycle to the fourth level of difficulty. Participants were asked to continue cycling at their own pace until either the final alarm, or they felt unable to continue due to fatigue or discomfort.

During each session, the researcher sat behind the stationary cycle out of the participants view and only spoke during the session if the participant did not respond to an alarm after 10 seconds.

Data Collection

Data collection was video capture of the stationary cycle computer display. The measurements of interest were the RPM and BPM values recorded throughout the session. Participants were not directly filmed, only the performance measures they generated. Later, the footage was played back and the RPM and BPM values were written into data sheets. This data was collected at the end of each 10 second interval throughout the footage of experimental sessions. Because alarms were used during experimental sessions to signal the beginning and end of each experimental session, these alarms sounding in the background of the recorded footage were used as points of reference marking the beginning and end of data collection.

Data Analysis

Using the data captured on video, the RPM and BPM values were recorded every ten seconds. Each participant's data during minutes 2 and 3 was compared with data during minutes 19 and 20 with a Wilcoxon sign-rank test. Heart rates taken at the same time intervals as the RPM data were also compared with a Wilcoxon sign-rank test. To assess the correlation between the cycling rate data and heart rate data, a Pearson's product-moment correlation coefficient was calculated. Graphs were also used for a visual display of data.

The University of Waikato Psychology Research and Ethics Committee approved this study and the experiments it consists of.

Results

Participants were instructed to stationary cycle until the end of the session, signalled by the sound of an alarm. All participants cycled for the required 20 minutes and did not stop during this time.

Figure 1 shows P01-P06's rates of stationary cycling measured in RPMs throughout sessions. Each of the graphs in Figure 1 has an x-axis representing the time during sessions in consecutive minutes, and a y-axis representing the speed of stationary cycling in RPMs. Throughout these sessions, the rates of stationary cycling were measured every ten seconds and are represented in the graphs by the solid, dark data line. The straight dashed line passing through the performance data is its line of best fit using linear regression. The shaded grey squares in each graph represent the samples of data used in the statistical analysis described later in this section. The data plotted and the trend lines of Figure 1 show that three participants, P01, P02, and P03 had gradual, constant increases in their cycling rates throughout their sessions. One participant, P04, had a decrease in RPMs during the first nine minutes of their session and then their rates began to increase over time similar to the other participant's data patterns. The frequent peaks and dips in RPM values seen in the graphs of P05 and P06 show that, compared with the other participants in this experiment, these two participants had a greater amount variation in their cycling rates during their sessions.

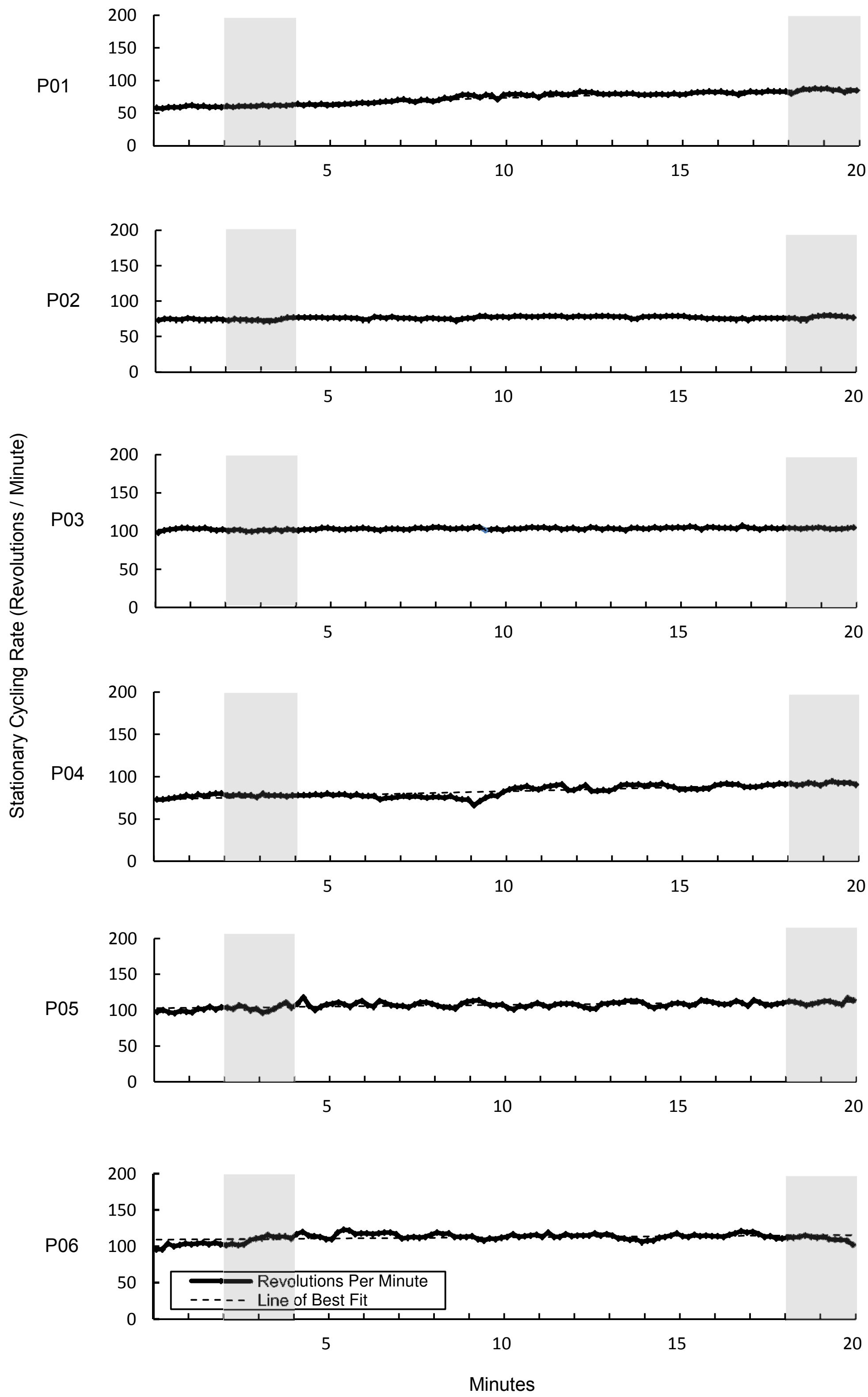

Figure 1. Experiment 1's RPM data. The data points represent stationary cycling data measured in RPMs during sessions. The dashed line passing through each data set is the RPM data's line of best fit.

Figure 2 depicts P01-P06's heart rate data recorded during the same stationary cycling sessions as the RPM data. Here, the x-axis represents time in consecutive minutes throughout each session, and the y-axis represents the heart rates measured in BPMs. The solid, dark data lines in each graph represent the heart rates measured in BPMs recorded every 10 seconds during the same time intervals at which the RPMs were measured. The straight, dashed line passing through the heart rate data is its line of best fit using linear regression, and again, the shaded squares in each graph show where the samples of data used in the statistical analysis described later have been drawn from. Both the data points and the trend lines within Figure 2 show that all participants had heart rates that increased over time. The graph depicting P03's heart rates during their session has several peaks and dips during the initial four minutes before levelling out with a slight increase, similar to that of the other participants' trends.

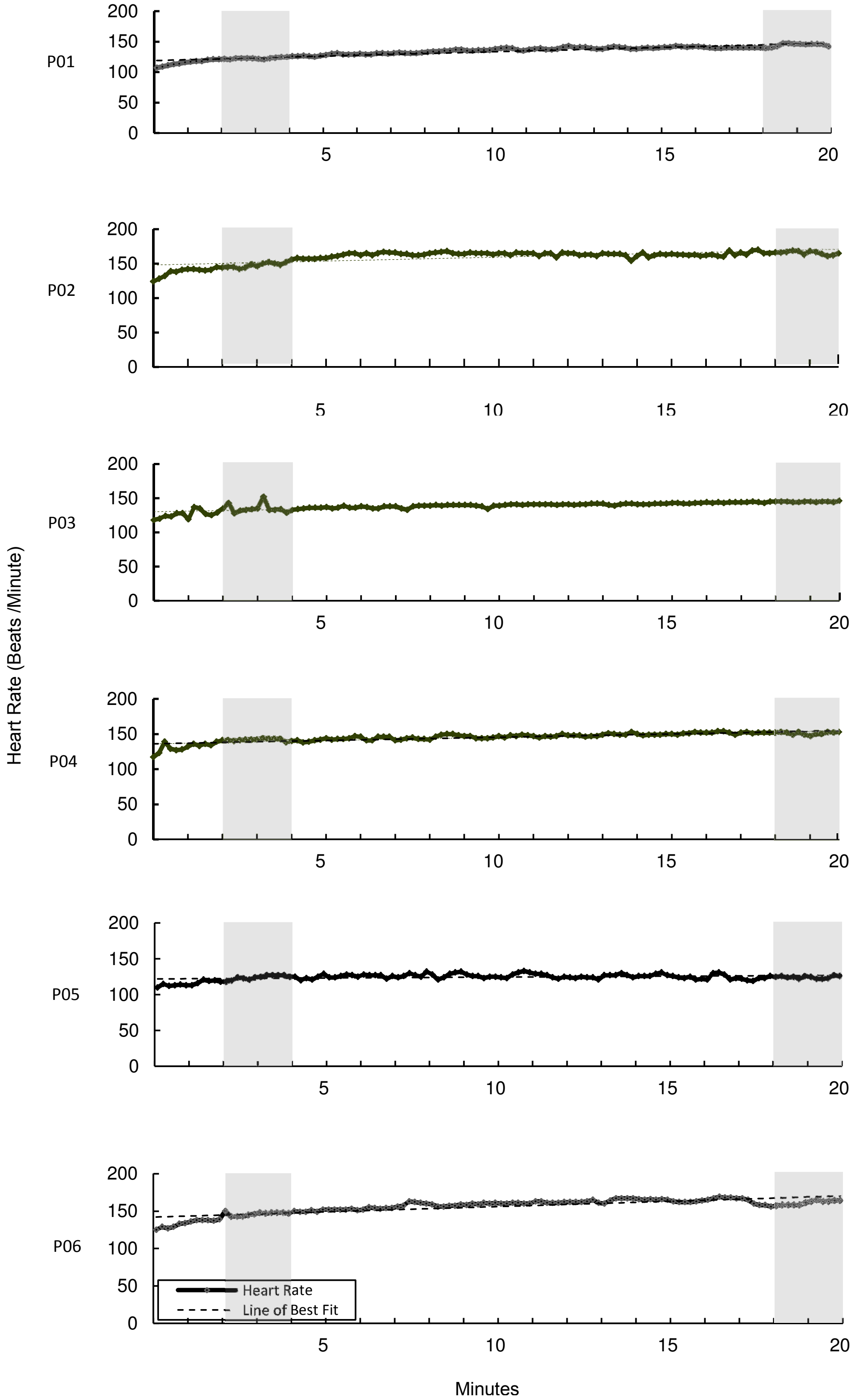

Figure 2. Experiment 1's heart rate data measured in BPM recorded during stationary cycling. The dashed line passing through these represents the heart rate data's line of best fit.

Table 1 shows each participants intercept and slope of their RPM data's line of best fit, and the amount of variance this line accounts for. In this table, it can be seen that all participants had positive slopes with varying intercepts. This table also shows that the variance explained by P02, P03, P05, and P06's lines of best fit did not represent their data well. P01 had a line that fit their data well and P04's was a moderately good fit. This data has a range of .807, indicating there was a large amount of variation amongst participants in terms of how well their data was represented by their line of best fit.

Table 1: Experiment 1's RPM data slopes, intercepts, and the amount of variance accounted for using regression analysis.

Participant	Intercept	Slope	R^2
P01	58	.250	.914
P02	75	.260	.210
P03	102	.021	.268
P04	73	.160	.690
P05	122	.037	.323
P06	109	.050	.107

To get a better estimate of the change that occurred across sessions, each participant's RPM data was divided into 10 segments, with each containing 2 minutes of data. The second segment, containing minutes 2 and 3, was compared with the data in the tenth segment containing the data from minutes 19 and 20 using a Wilcoxon sign-rank test. Table 2 shows the results of each comparison and the level at which each is significant. In this table, it can be seen that all participants except P03 had increases in their rates of stationary cycling between the second segment and the tenth that were significant with an alpha of .05.

Table 2. Experiment 1's RPM data medians, results of the Wilcoxon sign-rank, and levels of significance.

Participant	Second Median	Tenth Median	*Z*	*p*
P01	61	85.5	-3.07	.002*
P02	74	78	-2.67	.008*
P03	111	112	-0.67	.504
P04	101.5	104	-2.96	.003*
P05	78	92.5	-3.07	.002*
P06	103	111.5	-3.07	.002*

* $p < .05$

Table 3 shows the intercepts and slopes of the lines fitted to each participant's heart rate data, and the amount of variance these lines account for. Each participants slope is positive, indicating that they all increased their rates of cycling over time. There were moderate to high amounts of data represented by the lines of best fit for all participants except P05's whose line was not a good fit for their data. The lines of best fit had a range of 0.78, a relatively large spread across the possible values this measure could have indicating that this experiment's heart rate data was not well described by this method of analysis.

Table 3. Experiment 1's heart rate data slopes, intercepts, and the amount of variance accounted for using regression analysis.

Participant	Intercept	Slope	R^2
P01	119	.240	.869
P02	136	.157	.708
P03	130	.139	.664
P04	112	.130	.746
P05	103	.075	.094
P06	148	.193	.511

In order to get a better account of the changes that occurred during each participant's session, their heart rate data was analysed using the same methods as the RPM data. Here, each heart rate data set was divided into 10 segments with each containing 2 minutes of data. As with the RPM data, the second segment of heart rate data containing minutes 2 and 3 was compared with the tenth segment containing the heart rate data during minutes 19 and 20 using a Wilcoxon sign-rank test. Table 4 shows the results of each participant's test along with the significance level of that result. Table 4 shows that all participants had an increase in their heart rates between the second and tenth segments of their sessions that were significant with an alpha of .05.

Table 4. Experiment 1's heart rate data medians, Wilcoxon sign-rank test results, and levels of significance.

Participant	Second Median	Tenth Median	*p*
P01	123	145.5	-3.08
P02	142	152	-3.06
P03	147	166	-3.06
P04	133.5	145	-2.90
P05	115	125.5	-3.10
P06	103	111.5	-3.07

* $p < .05$

Table 5 shows the level of association between each participant's complete RPM and heart rate data sets using a Pearson's product-moment correlation coefficient. These results show that participants had moderate to high positive correlations ranging from .329 to .946 that were all significant with an alpha of .05.

Table 5. Experiment 1 Pearson's product-moment correlation coefficient values and the levels of significance for RPM and heart rate data sets.

Participant	*df*	*r*	*p*
P01	118	.946	< .001*
P02	118	.329	< .001*
P03	118	.492	< .001*
P04	118	.672	< .001*
P05	118	.462	< .001*
P06	118	.700	< .001*

* $p < .05$

Discussion

The aim of this experiment was to observe participants as they stationary cycled to see if patterns of habituation occurred. After measuring the cycling rates of six participants during 20 minute sessions, it was found that overall their rates of cycling increased. This led to an increase in heart rates over time, and moderate to high positive correlations between cycling rates and heart rates.

Habituation is considered to have occurred when, under stable conditions, one of three patterns of responding is observed that can be dishabituated. These patterns include; a gradual decrease in responding, an increase to a point where response rates become stable, or an increase in response rates followed by a decrease (McSweeney & Roll, 1993). One or more of these patterns were expected to occur during responding in the current experiment, but instead, rates of cycling increased over time.

Patterns of responding consistent with habituation were expected to occur during the current experiment because there have been a number of animal studies that have demonstrated that habituation occurs during physical activity. For example, Aoyama and McSweeney (2001) found that, consistent with one of the patterns of habituation described earlier, as rats ran on wheels their within session rates of responding decreased. Aoyama and McSweeney (2001) confirmed that the reduction in wheel running was habituation by demonstrating that this decrease could be reversed by adding a dishabituating tone to the context. The finding that physical activity by rats can habituate, along with other studies showing that humans can habituate to food stimuli (for example, Temple et al., 2007) led to the hypothesis of the current experiment that human physical activity would have within session patterns of responding consistent with habituation.

A possible reason why decreases in responding were not seen during this experiment is that there were inadvertent reinforcers or punishers in the experimental design. Within the current experiment, it was assumed that there were no reinforcers present in the context that might influence rates of responding. Instead, the increases in stationary cycling rates over time found in the present experiment were similar to the increases in stationary cycling reported by De Luca and Holborn (1992) after they added positive reinforcement to the context. Although De Luca and Holborn (1992) compared separate conditions, their control and experimental conditions are analogous to the current study's comparison of the second segment with the tenth segment of each session. If De Luca and Holborn's (1992) addition of a reinforcer to the context led to an increase in response rates compared with baseline measures, then it is likely the increases in responding seen during the current experiment are also the result of a reinforcer present in the context.

Further support for the presence of a reinforcer in the current experiment's context comes from the increased heart rates during stationary cycling. The increase in heart rates during physical activity suggests there is fatigue or exertion caused by the activity. Fatigue accumulates over time either as a result of performing a low intensity activity for a long period of time, or a high intensity activity over a short period of time (Kraemer, Fleck & Deschenes, 2012). This means that in the present experiment cycling rates increased despite the accumulation of fatigue, indicating a reinforcer was present in the environment that was preferred over the avoidance of fatigue. As a punisher, if fatigue were the prevailing factor, a decrease in response rates would have occurred rather the increases that were found in the current experiment.

It is therefore likely that reinforcers available to participants during their cycling sessions led to the increased cycling rates over time. These reinforcers may have come from several different sources. One potential source is a process called sensitization. Sensitization patterns are increases in response rates or magnitudes over time before a peak is reached and habituation begins (McSweeney & Murphy, 2009). This increase in responding has been attributed to an organism becoming sensitized to reinforcer properties, making stimuli more effective at reinforcing the associated behaviour (McSweeney & Murphy, 2009).

Patterns of sensitization could explain the increases seen in cycling rates during the current experiment. Peak levels of responding may not have been reached during sessions due to the frequency of the reinforcement provided within session. Previous research has shown that when reinforcers are delivered less frequently, the peak levels of responding that are reached are lower and occur later in the session compared with higher frequencies of reinforcer delivery (McSweeney & Hinson, 1992; McSweeney, Roll & Weatherly, 1994). If the increases in stationary cycling rates were due to sensitization, then increasing the session's duration would allow habituation to occur.

A more likely explanation for the increases in stationary cycling rates during the current experiment is that participants responded although reinforcers were available in the current experiment's context due to previous reinforced responding in the same setting. This can occur when a rule controls behaviour rather than the immediate contingencies of a context. A rule is a statement that specifies a relationship between responding and reinforcement that, when present, signals that a reinforcer or punisher is available (Skinner, 1969, pp. 148-149). An example of a rule is the statement *stretching before a workout will prevent injuries.* This rule specifies that the behaviour of stretching before a workout will be reinforced with the avoidance of the pain of an injury. When rules control behaviour this is *rule-governed behaviour*, and when such behaviour occurs, a history of responding, along with information in the immediate context determines behaviour rather than the contingencies of the immediate context (Skinner, 1969).

Research supports rule-governed behaviour as an explanation for schedule insensitivity by showing that histories of responding can determine later responding. For example, Weiner (1969) recorded the responding of participants during a differential reinforcement of low rate (DRL) schedule, followed by responding during three FI schedules. When the response patterns during these schedules were compared, it was found that the responding during the later FI schedules was at the low rates seen during the earlier DRL schedule rather than the high rates that would have maximised reinforcer delivery. Consistent with Skinners (1969) account of rule-governed behaviour, these findings show that behaviour was determined by earlier responding in similar contexts rather than the immediate schedule in effect.

Similar to the participants involved in Weiner’s (1969) research, those involved in the current experiment had histories of reinforced responding in the same setting as the current experiment. This is because the current experiment's participant recruitment occurred in the same gymnasium as this experiment. This means that those participating were either staff or clients of this gymnasium with histories of completing physical activity in this experiment’s setting. Those who belong to gymnasiums usually do so to increase their performance levels, with the achievement of these goals providing reinforcement. In addition, the staff and clients in the gymnasium would encourage those who exercise, meaning social reinforcement associated with performance was likely to have occurred in this context prior to this experiment. Therefore, it is likely that participants of the current experiment had previous reinforced responding in the gymnasium this experiment was set in, leading to a rule that high rates of responding would be reinforced and response patterns during the current experiment consistent with this rule.

Another possible contributor to the rule-governed behaviour observed in the current experiment is that parts of the experimental context may have hinted at the response dimension being measured during sessions of stationary cycling. For example, Stokes and Balsam (2003) showed that when they gave hints to participants to focus on a particular dimension of responses, variability in that response dimension decreased during subsequent responding compared with the control condition where no hint was given. This finding suggests that hints can influence the aspect of responding to which they refer.

During the present experiment, participants may have received an inadvertent hint that the results would be based on stationary cycling rates. This is because during the participant recruitment phase of this experiment, an information sheet (Appendix B) was made available to prospective participants that specified that it was the rates of stationary cycling that were of interest. The specification of the measurement of interest in the present study is similar to the hints provided to the participants in Stokes and Balsam's (2003) instructions regarding response dimensions. This means that in the present experiment it is possible that the information sheet hinted to participants that their rate of stationary cycling was the measurement of interest. The hint in itself, or perhaps combined with previous reinforcement for high rates of physical activity, could have resulted in a rule specifying that high rates of stationary cycling would lead to reinforcement.

If the high rates of stationary cycling that occurred in the current experiment are the result of rules present in the context, then this responding was not sensitive to the immediate contingencies. In order for habituation to occur, participants need to be sensitive to the immediate schedule so responding reflects the loss in reinforcer effectiveness that is thought to be the cause of habituation (McSweeney & Murphy, 2009). Instead, it is likely that the responding in the current experiment was rule-governed behaviour caused by a history of responding in the current experimental context, possibly in combination with a hint that it was the rate of stationary cycling that was the measurement of interest. Therefore, in order to have seen habituation patterns in the current experiment's context, rule-governed behaviour needed to be removed or experimentally controlled in order for schedule sensitivity to occur.

One might expect that during the current experiment, the researcher's presence in the room as participant's stationary cycled might influence the within session patterns of responding. However, there is no evidence in the literature on rule-governed behaviour to suggest that this is the case. This is supported by the results of research involving the comparison of response patterns by participants during a rule-governed behaviour when a researcher has been present with those occurring when the researcher was absent. For example, Vaughan (1985) found that error rates during the rule-governed behaviour caused by instructed responding were similar regardless of whether the researcher was absent from the context or sitting next to participants. In general, rule-governed behaviour is considered to be consistent across both time and settings; no study so far has reported that a researcher's presence has caused a change in rule-governed behaviour.

In summary, the increases seen during the current experiment are not consistent with patterns of habituation. Instead, the increasing rates of stationary cycling are likely to have been caused by participants self-generating a rule that high rates of responding would lead to reinforcement. Research has shown that when participants have a history of responding in a context, they bring past patterns of responding into later similar situations. In the current experiment, participants were likely to have had a history of exercising in this experimental context, during which, reinforcers were likely to have been provided for high levels of performance. This history, possibly combined with a hint in the environment that the measurements of interest were the rates of stationary cycling, may have resulted in the increasing rates of responding observed in the current experiment. Therefore, in order to have seen patterns of responding consistent with habituation, rule-governed behaviour needed to be experimentally controlled to prevent it from influencing within session response patterns.

EXPERIMENT 2

Operant literature shows that the patterns of responding animals have during schedules of reinforcement are systematic and specific to the type of schedule in effect (Ferster & Skinner, 1957; Morgan, 2010). Human responding is less predictable because response patterns are dependent on more than just the immediate context. This is evident in the results of Experiment 1 of the current study where it was predicted that responding would decrease over time consistent with habituation patterns. Instead, within session increases in response rates were found during Experiment 1, argued to be caused by participants following self-generated rules derived from earlier experiences where high response rates were reinforced.

Rule-governed behaviour

One source of control over human behaviour other than immediate contingencies can be rules that are either self-generated or from external sources. As discussed in Experiment 1 of the current study, Skinner (1969) described rules as verbal discriminative stimuli that specify a relationship between a behaviour and a reinforcer or punisher (pp. 148-149). For example, the driving rule *stop at the red light or you will crash* specifies that the behaviour of stopping a car at a red light will avoid the punishing consequence of a collision with another car and thus reinforce stopping at the red light. When rules control behaviour, this is termed *rule-governed behaviour* (Skinner, 1969, p.146). Rule-governed behaviour has been further defined by Zettle and Hayes (1982) as "behaviour in contact with two sets of contingencies, one of which includes a verbal antecedent" (p.78). The emphasis Skinner (1969) placed on verbal stimuli in his description of rules, as well as Zettle and Hayes' (1969) emphasis on verbal antecedents in their definition of rule-governed behaviour highlight the role verbal behaviour has in the formulation of rules and the behaviour they control. If verbal behaviour has a role in rule-governed behaviour, then in order for a human's behaviour to be controlled by a rule, that individual needs to have verbal abilities.

Support for the explanation that rule-governed behaviour causes an insensitivity to an immediate schedules contingencies is provided by research showing this schedule insensitivity only occurs when humans have verbal skills. For example, Weiner (1969) has shown that human participants with different histories of responding had later responding that was consistent with the earlier reinforced responding rather than an immediate schedule's contingencies. For instance, three participants in this study first responded during a FR 40 schedule with the high rates needed to maximise reinforcer delivery. When these participants responded during a subsequent DRL 20 s schedule, this was again at high rates rather than the low rates required for reinforcement. Weiner (1969) had similar findings in another group who initially responded at the low rates of responding needed for reinforcement during a DRL 20 s schedule. These patterns were later brought into FI schedule responding where high rates would have led to greater reinforcement, further demonstrating that response patterns were at least in part determined by earlier experiences in similar situations.

Weiner's (1969) research showing that participants bring past response patterns into later, similar contexts as opposed to responding with schedule sensitivity involved participants who had verbal skills. Later research supports this as rule-governed behaviour by showing that those without verbal skills tend to respond during schedules of reinforcement in ways that can be predicted by animal responding during schedules of reinforcement. Lowe, Beasty, and Bentall (1983) demonstrated this by observing the response patterns of two preverbal children during several different FI schedules. The resulting response patterns resembled those seen during animal studies (for example, Ferster & Skinner, 1957) including accelerating rates of responding until reinforcement followed by a post-reinforcement pause. Not only this, but these patterns were sensitive to the changing FI schedule values in that both the rates of responding and the post reinforcement pauses proportionally changed as the schedule values lengthened.

Lowe and colleagues (1983) findings were further extended by the results of Bentall, Lowe, and Beasty's (1985) research directly comparing the response patterns generated by differently aged children as they responded during FI schedules. Not only were their results consistent with earlier studies where preverbal children were sensitive to the immediate contingencies and verbal children were not, but those with verbal skills who responded at low rates also reported using verbal behaviours to help pass the time between schedule intervals. The finding that participants used verbal behaviours to regulate responding further supports the importance verbal behaviour has in the generation of rule-governed behaviour.

The research showing that non-verbal human participants respond with schedule sensitivity (Bentall et al., 1985; Lowe et al., 1983) is consistent with Skinner’s (1969) account of rule-governed behaviour. This is likely to be because the preverbal participants did not have the verbal skills required to form rules that link previous experiences of reinforced responding with later, similar contexts. Like Weiner’s (1969) findings, the participants involved in Experiment 1 of the current study had verbal abilities and therefore the verbal skills required to formulate rules.

If verbal human responding can be determined by past responding in similar contexts, then past experiences could also influence verbal human responding in contexts where habituation would be predicted to occur. Because animal studies such as Belke and McLaughlin's (2005) have shown that rats habituate during physical activities, those participating in the current studies Experiment 1 were also predicted to have rates of responding consistent with habituation during physical activity. However, in light of the literature focused on verbal human responding and rule-governed behaviour, habituation would only occur if verbal human responding were sensitive to the immediate context rather than being determined by past responding in similar situations. In other words, participants in Experiment 1 of this study needed to be sensitive to the immediate changes in the effectiveness of a reinforcer to reinforce; the theorised cause of habituation (McSweeney & Murphy, 2009).

If the responding that occurred during Experiment 1 of the present study was insensitive to the immediate contingencies due to rule-governed behaviour, then like most complex, operant human behaviour, this rule-governed behaviour was the result of a behaviour chain. *Behaviour chains* are antecedents, behaviours, and reinforcers or punishers that are linked so each consequence serves as an antecedent for a new behaviour chain (Skinner, 1953). With the formulation of rules requiring an individual to have verbal skills, these verbal behaviours are likely to be components of the behavioural chains causing rule-governed behaviour.

Because rule-governed behaviour is in part determined by histories of responding, some components of the behaviour chain they consist of exist in the past (Dew, 1962). Should sensitivity to an immediate contingency be required instead of rule-governed behaviour, because components of this behaviour chain may exist in the past, it may not be possible to remove some of its components to eliminate its influence. However, there may be a way to reduce its effect. Dew (1962) argued in early research that the disruption of a behaviour chain could reduce the influence of its earlier components on responding. One possible method for achieving this could be the addition of a task to the context that is completed concurrent with responding.

Concurrent tasks

The response patterns of verbal humans have been shown to more closely approximate those seen during animal studies when participants also have a concurrent task to complete. Laties and Weiss (1963) found this by measuring the response patterns generated by participants during two conditions. The control condition involved participants responding during a FI schedule, and the experimental condition involved participants responding to the FI schedule while concurrently completing a subtraction task. As participants responded during the FI schedule, the resulting response patterns had long post-reinforcement pauses that were replaced towards the end of each interval with rapid responding. The condition with the added subtraction task had generally more irregular responding throughout intervals with shorter post-reinforcement pauses. Based on these results, Laties and Weiss (1963) argued that during the control conditions, the end of each interval was anticipated with the use of verbal behaviour. The addition of the subtraction task disrupted this behaviour chain leading to patterns that more closely resembled those seen during animal studies where responding usually occurs throughout intervals.

Latis and Weiss (1963) have shown that adding a concurrent task to the context can disrupt behaviour chains containing verbal components enough that responding more closely approximates the response patterns seen during animal studies where schedule sensitivity occurs. By implication, the addition of a concurrent task to other contexts that involve behaviour chains with verbal components may disrupt these enough that schedule sensitivity can occur. If a chain of behaviour that included verbal components led to rule-governed behaviour during Experiment 1 of the current study, the addition of a concurrent task to this context may disrupt this rule-governed behaviour enough to allow habituation patterns to occur during stationary cycling. Experiment 2 of the present study will test this by having participants answer general knowledge questions as they stationary cycle in the same experimental design and setting as Experiment 1 of this study. It is hypothesised that this experiment will result in stationary cycling rates that decrease over time consistent with habituation patterns.

Method

Participants

Both Experiment's 1 and 2 of the present study had participants recruited at the same time, with the final five who signed up taking part in Experiment 2. These participants were all female gymnasium staff/members with ages ranging from 37 to 56 with an average age of 45.

Procedures

Experiment 2 was identical to Experiment 1 in terms of how participants were recruited, the setting, and the experimental design, with the current experiment taking place after the completion of Experiment 1. The instructions and procedure all remained the same as Experiment 1 except for the concurrent task where participants would be asked general knowledge questions. Once the instructions detailed in Experiment 1 were explained to participants, they were told that they would be asked general knowledge questions as they cycled, and were asked to answer these as best as they could.

The researcher stood to the front right of the stationary cycle, out of the camera's view. From the beginning of the session, signalled by the first alarm, the researcher began asking the prepared general knowledge questions (Appendix E) to participants, and continued to do so until the final alarm sounded. Each participant was asked the same selection of questions, in the same order, at a steady speed. These were read from the researcher's clipboard which was kept tilted, out of the participants view. Once a question was answered, the researcher either ticked or crossed the column alongside the question depicting whether it was answered correctly or incorrectly. 'Correct' answers were defined as the answer given by participants that matched the meaning of the answer the researcher had; the exact wording did not matter. The answers marked

‘Incorrect’ included those that did not match the meaning of the answer the researcher had, those indicated to be unknown, and those where there was a five second delay before the question was answered. If the participant asked for a question to be clarified, that question was repeated as written, with no further information given. Although participants were not told during sessions which questions they got correct they were given both the percentage they got correct, and the opportunity to read the question and answer sheet once the session had ended.

Apparatus

All of the apparatus used in this experiment were identical to those described during Experiment 1, except for the general knowledge questions. These were questions taken from the website http://www.pub-quiz.net, with the New Zealand content taken from http://www.clevedonschool.co.nz and http://homepages.paradise.net.nz/nzealand/quiz.html. The questions taken from the latter site were originally in the form of multiple choice. These were rewritten so their format was short questions/answers and distributed throughout the other general knowledge questions for consistency.

Data collection and analysis

The data collection and analysis methods were identical to those used during Experiment 1 of this study.

The University of Waikato Psychology Research and Ethics Committee approved this study and the experiments it consists of.

Results

During Experiment 2 participants were instructed to stationary cycle until an alarm sounded after 20 minutes. All participants cycled until this time without pausing or stopping. As participants were cycling, the researcher asked them general knowledge questions at a steady pace.

Figure 3 shows the RPM data generated during each participant's session of stationary cycling. As with the previous experiment, in these graphs the x-axis represents time in consecutive minutes during experimental sessions, and the y-axis represents the RPMs. The solid data line in each graph represents the performance rates measured in RPMs that were recorded at ten second intervals throughout each session. The dashed line passing through this is the data's line of best fit calculated using linear regression. The shaded squares highlight where the samples of data were drawn from for the statistical analysis described later in this section. Within Figure 3 it can be seen that all participants maintained generally consistent rates of cycling throughout their sessions. Four of the five participants had slight increases in RPM values over time, while one, P11, had a slight decrease.

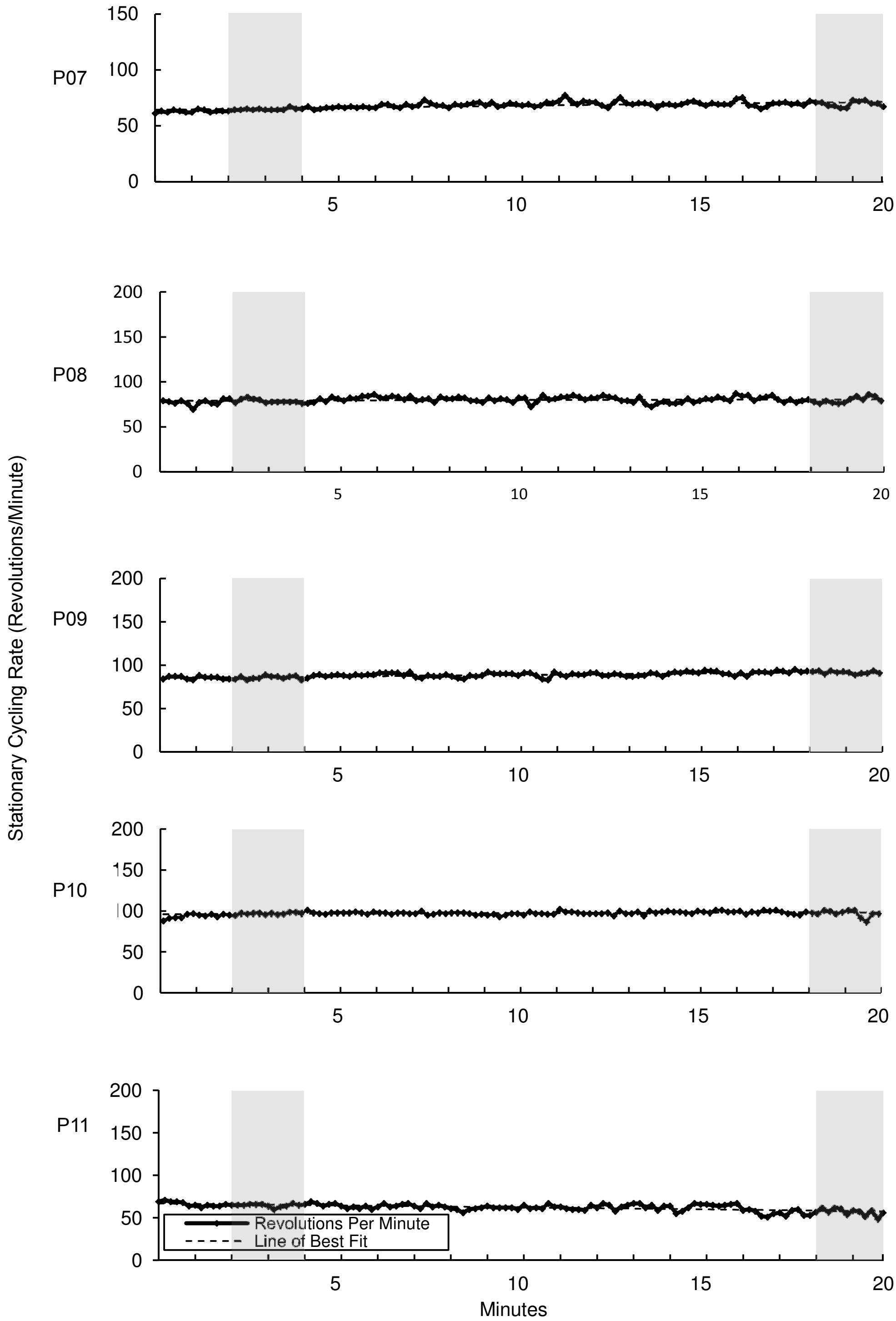

Figure 3. Experiment 2 RPM data. The data points represent the rates of stationary cycling measured in RPMs during 20 minute sessions. The dashed line passing through each RPM data set is its line of best fit.

Figure 4 shows P07-P11's heart data recorded while they stationary cycled. Again, the x-axis represents the time in consecutive minutes during each participants experimental session, and the y-axis represents the heart rate in BPMs. The solid data line represents the heart rates measured in BPMs, recorded every ten seconds during the same time intervals as the performance data. Passing through each participant's heart rate data is a dashed line representing that heart rate data's line of best fit using linear regression. Again, the shaded squares represent the data used for a statistical comparison describe later in this results section. From both the data and lines of best fit, it can be seen that each participant's heart rate had a consistent, gradual increase over time.

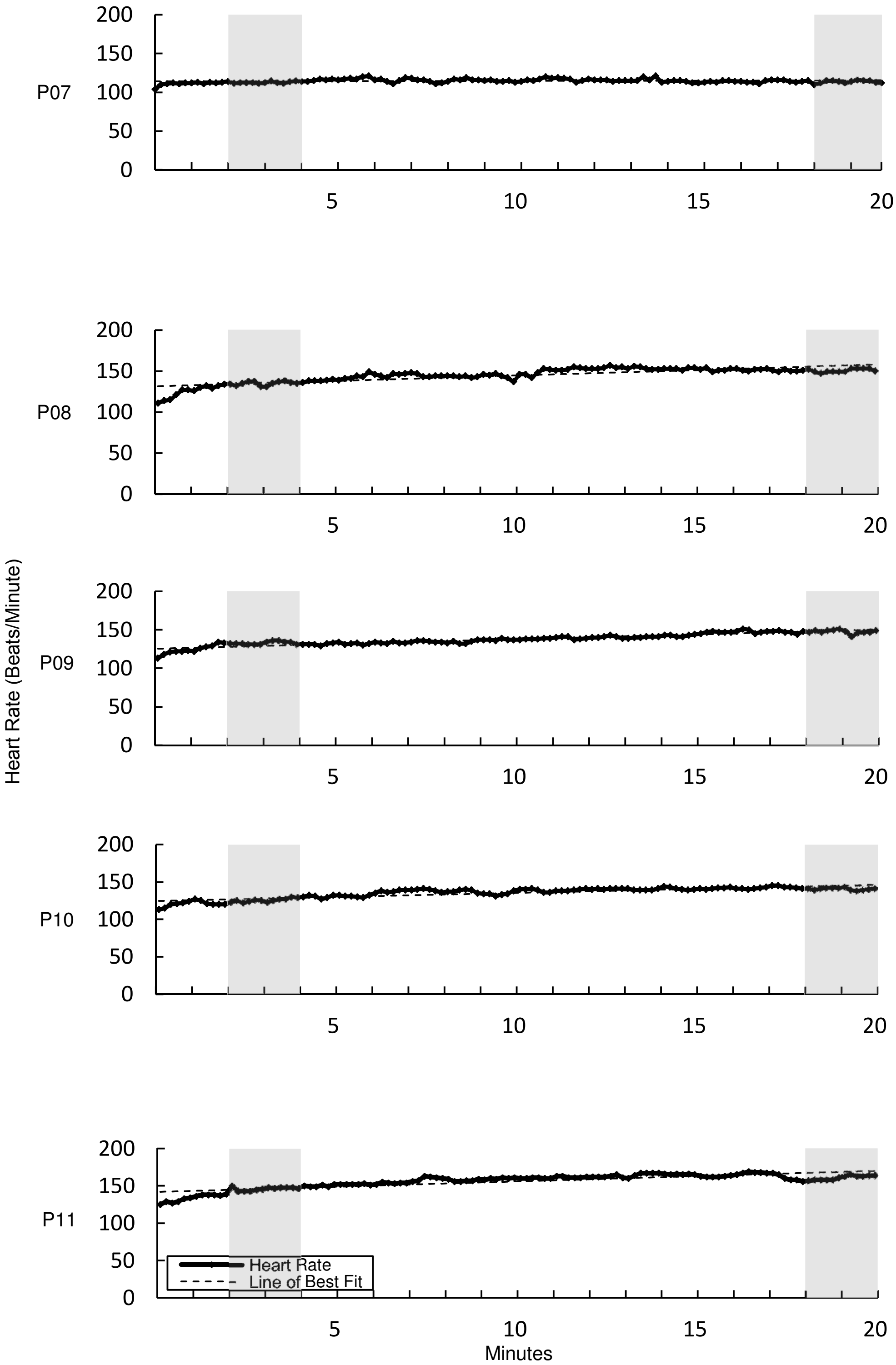

Figure 4. Experiment 2 heart rate data. The data points represent the heart rate measured in Beats per Minute. The dashed line passing through this is the data's line of best fit.

Each participant had a line of best fit calculated for their RPM data. Table 6 shows the intercepts and slopes of these lines, along with the amount of variance each accounted for. Four participants; P07, P08, P09, and P10, had positive slopes indicating that these participants had cycling rates that increased over time. One participant, P11, had a negative slope, showing that there was a decrease in cycling rates during their

Table 6. Experiment 2's RPM data slopes, intercepts, and the amount of variance accounted for using regression analysis.

Participant	Intercept	Slope	R^2
P07	64	.061	.470
P08	79	.014	.024
P09	85	.059	.506
P10	96	.023	.108
P11	67	-.761	.383

session. The variance accounted for by each of these lines was low to moderate, demonstrating that these lines were not a good fit for the data.

Because of the low amount of variance accounted for by the lines of best fit, the RPM data was assessed in the same manner as the results of Experiment 1. Each participant's data was divided into ten segments. The second consecutive segment containing the RPM data from minutes 2 and 3 was compared with the tenth consecutive segment containing the RPM data from minutes 19 and 20. This comparison was made using a

Wilcoxon sign-rank test. Table 7 shows the medians of each participant's second and tenth segments of data, the results of the Wilcoxon sign-rank tests, and the levels at which they were significant. From this table it can be seen that P07 and P09 had an increase in RPM values over time that were significant with an alpha of .05. Two participants, P08 and P10, had non-significant increases in RPM values, and one participant, P11, had a significant decrease over time.

Table 7. Experiment 2's RPM data medians, Wilcoxon sign-rank results, and levels of significance.

Participant	Second Median	Tenth Median	*Z*	*p*
P07	64	70	-3.06	.002*
P08	78	79	-0.62	.532
P09	86	92	-3.07	.002*
P10	97.5	98.5	-0.79	.431
P11	65	57.5	-3.07	.002*

* $p < .05$

Like the RPM data, each participant's heart rate data had a line of best fit calculated. Table 8 shows the slope and intercept of each participant's trend line along with the amount of variance it accounted for. Here, it can be seen that all participants had lines of best fit that increased over time. Two participants, P09 and P10, had lines that were a good fit with their data. One participant, P07, did not have a line of best fit that represented their data well. The amount of variance accounted for had a large range of .846.

Table 8. Experiment 2's heart rate data slopes, intercepts, and the amount of variance accounted for using linear regression.

Participant	Intercept	Slope	R^2
P07	113	.010	.019
P08	131	.222	.686
P09	125	.204	.865
P10	124	.181	.735
P11	142	.233	.683

Due to the heart rate data having a large range, the changes over time were instead assessed with the same method as the RPM data. Each participant's heart rate data was divided into ten segments, and again, the second segment was compared with the tenth using a Wilcoxon sign-rank test. Table 9 shows the medians of each participant's second and tenth segments of data, the results of the Wilcoxon sign-rank test, and each results level of significance. In this table, with an alpha of .05, it can be seen that the results of the Wilcoxon sign-rank test were significant for P08, P09, and P11's data and non-significant for P07 and P10's. Those with significant changes in their heart rate were in the direction of an increase.

Table 9. Experiment 2's heart rate data medians, Wilcoxon sign-rank test results, and levels of significance.

Participant	Second Median	Tenth Median	*Z*	*p*
P07	113	114	-0.67	.503
P08	135	149.5	-3.09	< .001*
P09	132	147.5	-3.06	.002*
P10	97.5	98.5	-0.79	.431
P11	147	162	-3.13	.002*

* $p < .05$

Table 10 shows the association between each participant's complete RPM and heart rate data sets recorded throughout sessions, calculated with a Pearson's product-moment correlation coefficient. These results show four participants, P07, P08, P09, and P10, had moderate, positive correlations that were significant with an alpha of .05. One participant, P11, had a significant moderate negative correlation.

Table 10. Experiment 2 Pearson's product-moment correlation coefficient values and the levels of significance for RPM and heart rate data sets.

Participant	*df*	*R*	*p*
P07	118	.370	< .001*
P08	118	.307	< .001*
P09	118	.670	< .001*
P10	118	.470	< .001*
P11	118	-.492	< .001*

* $p < .05$

Discussion

Experiment 2 measured participants rates of stationary cycling as they cycled while answering general knowledge questions. The hypothesis was that as participants stationary cycled, decreases in cycling rates would occur consistent with habituation patterns. Instead, this experiment resulted in two of the five participants having significant increases in RPM values over time and one having a significant decrease. Along with these changes in cycling rates over time, three participants had significantly increased heart rates. A final finding was that four participants had moderate, positive correlations between their RPM data and their heart rate data, while one had a moderate negative correlation.

These results indicate that the majority of those who took part in the current experiment did not have changes in their stationary cycling rates consistent with the previously described patterns of habituation. If patterns consistent with habituation had occurred, rates of cycling would either have decreased over time, increased then decreased, or increased to a point where rates became stable (McSweeney & Murphy, 2009). Only one participant in the present experiment had decreases in their stationary cycling rates consistent with a habituation pattern, however, this is unlikely to be its cause. The reductions in this participant’s cycling speeds are more likely to be the result of fatigue growing throughout the session. This is because, as discussed in Experiment 1 of this study, increasing heart rates such as those accompanying this participant’s performance data indicate that fatigue was accumulating (Kraemer et al., 2012), making this the most likely cause of the reduction in cycling rates during this time.

Within the present experiment, two participants had significant increases in their rates of stationary cycling. These increases are consistent with the response patterns found during Experiment 1 of the present study, argued to be the result of a rule controlling behaviour. This means that in the present experiment, although a concurrent task was placed in the context to disrupt the behaviour chains that led to this rule-governed behaviour, it is likely that unintended rules still prevented habituation. This was either because a rule specifying that participants needed to stationary cycle at high rates for reinforcement was not completely removed as an influence on responding, or because rule-governed behaviour was not the cause of the increases seen during Experiment 1.

One source of reinforcement not discussed in Experiment 1 that may have contributed to the increases seen in the present experiment is attention. Previous studies within behaviour analysis have shown that, similar to praise and encouragement, attention can act as a reinforcer maintaining behaviours associated with its delivery (for example, Kodak, Northup & Kelley, 2007). In the current experiment, as participants were asked general knowledge questions, attention would have been provided by the researcher that may have reinforced stationary cycling.

Regardless of the source, it appears that inadvertent reinforcers in the context cannot be prevented from determining stationary cycling patterns. Perhaps instead, a more salient reinforcer needs to be placed into the context that is contingent with stationary cycling rates. If a salient reinforcer controls stationary cycling rates, then perhaps the reinforcer controlling behaviour will lose its effectiveness to reinforce over the course of the session consistent with the proposed cause of habituation (McSweeney & Murphy, 2009). An arrangement such as this may result in patterns of responding consistent with habituation.

EXPERIMENT 3

McSweeney and Murphy (2009) have argued that habituation occurs because a reinforcer in the context loses its effectiveness to reinforce over time. This explanation for habituation implies that there is a reinforcer or rule present in the context associated with responding. Although Experiments 1 and 2 of the current study tested the hypothesis that habituation would occur during stationary cycling, no reinforcer was provided contingent on this response and this may be the reason habituation was not seen.

Reinforcers have been present in previous studies demonstrating habituation (McSweeney & Roll, 1993; Murphy, McSweeney, Smith & McComas, 2003) including those observing habituation during a physical activity. For example, Belke and McLaughlin (2005) showed that animals would respond during schedules of reinforcement for access to wheel running, a physical activity. In these contexts, physical activity acted as a reinforcer that maintained responding. This contrasts the experimental designs of Experiments 1 and 2 of the present study where no reinforcer was arranged and any reinforcer that maintained responding was unintended.

To make the current study's context more consistent with previous studies demonstrating habituation, a reinforcer needs to be placed into the experimental arrangement associated with stationary cycling. With a reinforcer in the context that can lose its reinforcing value over time, the associated stationary cycling rates will decrease consistent with habituation patterns.

One possible source of reinforcement is feedback. Feedback has been shown in many previous studies to act as a reinforcer. For example, in a facility that housed intellectually disabled children, Panyan, Boozer, and Morris (1970) implemented feedback forms. Here, as residents were taught self-care skills by staff using operant training techniques, staff also filled in forms that recorded each resident's daily progress learning the skills. It was found that with the introduction of the feedback forms there were large increases in the daily use of the operant training methods. Not only does this indicate that the feedback forms reinforced staff using the operant techniques to teach skills, but that the form's reinforcing value was greater than the staff observing the changes in the behaviour of residents alone (Panyan et al., 1970).

With feedback shown to act as an effective reinforcer that can increase task performance, it would be ideal to add to the current experiment's context. If participants were given a stationary cycling task associated with feedback, then over time the feedback might lose its reinforcing value leading to a reduction in stationary cycling rates consistent with habituation. The current study will contain a task where, as participants stationary cycle, the screen in front of them will change colour depending on the speed at which they cycle. Participants will be asked to cycle at a speed that maintains a particular colour on this screen. The hypothesis of this experiment is that rates of stationary cycling will occur that are consistent with habituation.

Method

Participants

Advertisements were placed on the community noticeboard at BP Horsham Downs (Appendix F) and the University of Waikato (Appendix G). As with the previous experiments in this study, these advertisements asked those who were over 16 and medically fit if they were interested in participating in a study on exercise behaviour, and included contact details for further enquires. Those who enquired about the experiment were provided with an information sheet (Appendix H & Appendix I). If individuals remained interested after reading the information sheets, a time was arranged for data collection.

Participants included three females and three males who gave informed consent with ages ranging from 22 to 37 and an average age of 30.

Apparatus

Data collection was conducted in a private room at the University of Waikato where participants responded by stationary cycling. An Elite PL-3008 stationary cycle was used in this experiment, with its display blocked from the view of participants, and set to the second level of resistance.

A smaller screen was placed over the top of the stationary cycle computer in clear view of participants. This touch screen was used to assign a participant number to the data collected, establish a set point, and then to begin the experiment. The set point was the target duration for each pedal rotation measured in milliseconds that would keep the screen light blue. When rotations were slower than the target speed the screen remained green. Rotations faster than the target speed led to a dark blue screen. The apparatus transmitted data to a computer located in the same room. This computer recorded the following information in columns from left to right; subject, set point, time, r, g, b, trot, and delta. Finally, a stopwatch was used to time the sessions with the final alarm sounding after 20 minutes had passed.

Procedure

This experiment took place after the completion of Experiments 1 and 2 of the current study. As with the previous experiments in this study, after explaining to participants what the experiment would require and answering any questions, participants filled in the participant details form (Appendix C). If participants answered 'yes' to any of the health screening questions, it was deemed unsafe for them to participate in the experiment and they were thanked for their time. Those who answered 'no' to all questions were asked to fill in the consent form (Appendix J) and then began the experiment. Participants were asked to adjust the stationary cycle seat to a height comfortable for them. Once they were seated, they were given the instructions to cycle at a speed that would maintain a light blue screen, and to continue either to do so until they heard an alarm signalling the end of the session or they felt unable to continue due to fatigue or discomfort. During each session, the researcher sat behind the stationary cycle out of view of the participant.

Data Collection

Data collection consisted of computer recorded performance rates during sessions of stationary cycling. The measurements of interest were the time as the session continued, and the time each pedal rotation took to complete its revolution.

Data Analysis

Data analysis consisted of both a visual inspection of the graphs generated using the data collected and the use of a Wilcoxon sign-rank test to establish whether significant changes in pedal rotation times occurred during sessions. To assess the degree of any significant changes across time, Cohen's *d* will be calculated.

The University of Waikato Psychology Research and Ethics Committee approved this study and the experiments it consists of.

Results

During Experiment 3, participants were given the task of stationary cycling at a rate that would keep the screen in front of them light blue. Sessions lasted a maximum of 20 minutes, and although all participants cycled for this long, due to issues with the equipment, some of the data generated during these sessions was not recorded. The missing data included the first eight minutes of P12's data and the final four minutes of P13's. All of the other participants had the full 20 minutes of their data captured for analysis. During each session, the times of all pedal rotations made were recorded in milliseconds, as was the target rotation time needed to keep the screen light blue. Both the data recorded and the target rotation times were then converted into RPMs, and the target rotation rate was subtracted from the RPM data leaving the rates of cycling relative to the target rate.

Figure 5 depicts each participant's data relative to the target rate throughout their session. The x-axis of each graph is time in consecutive minutes. The y-axis represents the speed of cycling in RPMs with zero on this axis the target rotation rate. The grey data points depict the rate of each pedal rotation throughout each session of stationary cycling. The dashed line passing through this data is the mean rate of that participant's session, and the solid line represents the data's logarithmic trend line. The two shaded areas in each participants graph indicate where the data for the statistical analysis described later in this section has been drawn from.

In Figure 5 it can be seen that both P12 and P17 maintained generally consistent speeds though out their sessions, remaining near their average speeds of 25 and 34 RPMs above the target rotation rate respectively. Figure 5 shows that the rates of cycling increased during the

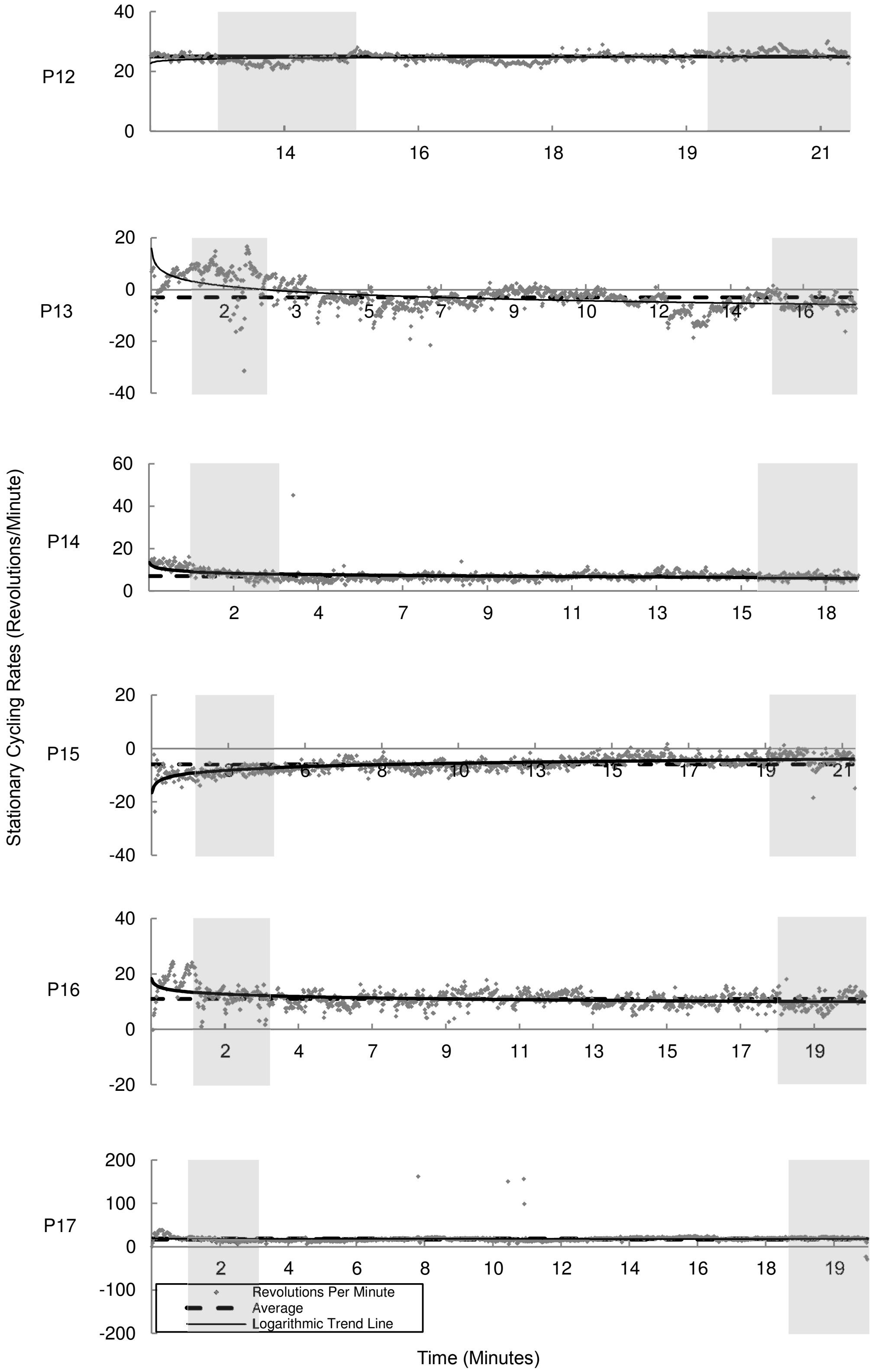

Figure 5. Experiment 3 stationary cycling rates of P12-P17. The grey data points represent the RPMs throughout sessions relative to the target rate of cycling, zero, on the y-axis. The dashed line passing though the data points is the data's average speed, and the solid line is the data's logarithmic trend line.

first minute of P13's session. This was followed by a decrease that levelled out near this participant's session average of 3 RPMs below the target rate, with these rates kept consistent for the remainder of their session. The graph of P14's data shows that after a small drop in their rates of cycling during the first minute, rates remained near the average of 10 RPMs above the target speed. The first half of P15's session had rates below their average speed of -6 RPMs*.* As time continued these rates gradually increased, passing through the mean to approach the target at the end of the session. The graph depicting P16's stationary cycling rates shows there was an initial increase during the first minute, followed by a decrease during the second. Stationary cycling rates then stabilised near their average of 11 RPMs above the target rate. Finally, three participants; P13, P15, and P16, appear to have generally more scatter in their rates of cycling compared with the relatively consistent rates kept by the other participants.

Figure 6 is a graph displaying boxplots of each participant's stationary cycling data. In this graph, the x-axis represents the participant number, the y-axis is the rate of cycling in RPMs, and again, zero represents the target rate of cycling. Each participant's boxplot has a box showing where the median of the data is located, as well as the first and third quartiles. The two whiskers extending from each box show where the maximum and minimum values of that participant's data set lie. Although means are not depicted in these boxplots, only one participant, P17, had a mean that differed from their median. In this participant's case, their mean rotation rate was 16 RPMs and their median rotation rate was 18 RPMs. Within Figure 6 it can be seen that the medians vary, ranging from -3 to 25. It can also be seen in Figure 6 that two participants, P12 and P16, have symmetrical boxplots, P13 and P14 have negatively skewed boxplots, and P15 and P17's boxplots are positively skewed.

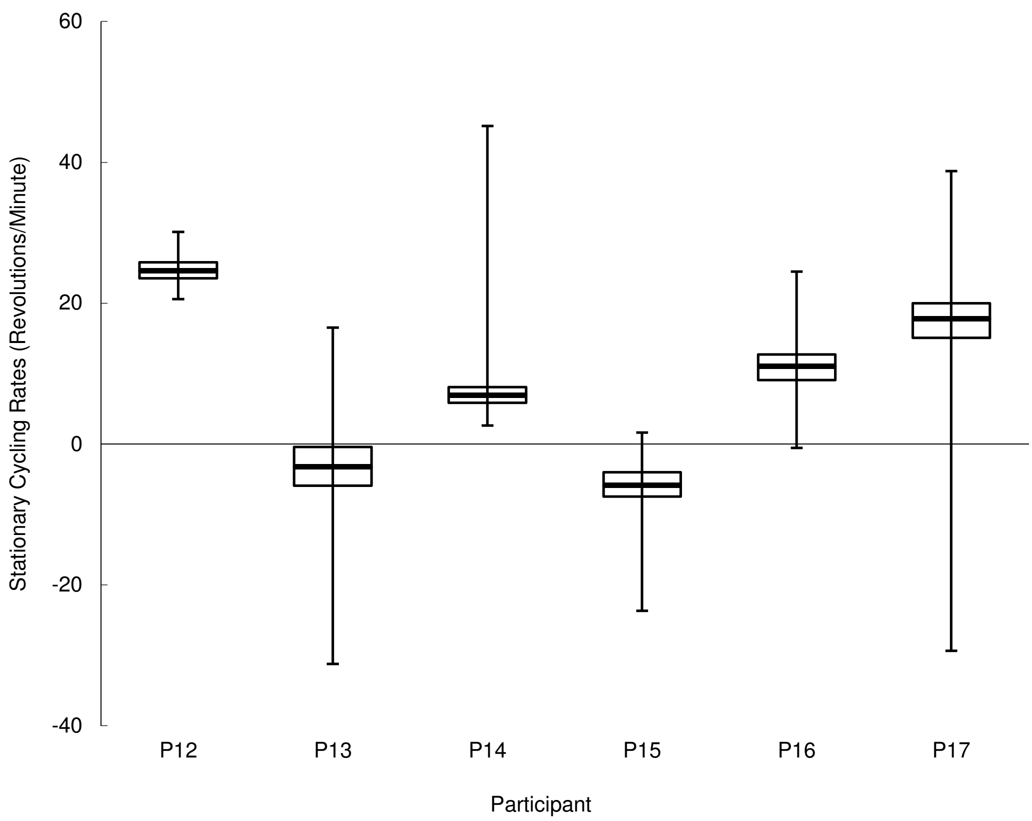

Figure 6. Boxplots of Experiment 3's RPM data showing the minimum, first quartile, median, third quartile, and maximum of each participant's data.

To assess whether there were any significant changes in the rates of stationary cycling over time, each participant's data had two sets of RPM values drawn from it and compared using a Wilcoxon sign-rank test. The first data set containing the data between the 50th rotation and the 149th (inclusive), was compared to a second data set, containing the data from the final 100 rotations of the session. Figure 5 depicts where these data sets were drawn from as shaded areas of each participant's graph. Table 11 shows the median RPM value in each data set, the results of each Wilcoxon sign-rank test used to compare this data, and levels of significance. Within this table, it can be seen that with an alpha of .05, all participants had significant changes in the rates of cycling between their first data set and the last. Although all participants had significant changes in their rates of cycling, these were not all in the same direction. Three participants, P12, P15, and P17, had significant increases throughout their sessions while the others, P13, P14, and P16, all had significant decreases.

Table 11. Experiment 3 RPM data showing medians of each data set compared, results of the Wilcoxon sign-rank test, and levels of significance.

Participant	First Median	Second Median	*Z*	*p*
12	24	26	-8.16	<.001*
13	7	-6	-8.01	<.001*
14	8	7	-5.09	<.001*
15	-8	-3	-7.95	<.001*
16	12	10	-4.27	<.001*
17	16	20	-6.30	<.001*

* $p < .05$

To assess the degree of change in the rates of stationary cycling during each participant's session, Cohen's *d* was calculated with the means of the data sets described earlier and pooled standard deviations. Table 12 shows the data used for these calculations including the mean of each data set, each participant's pooled standard deviation, and the effect size calculated using these values. The effect sizes in Table 12 show that all those involved in this experiment had either moderate or large changes in their rates of stationary cycling. Here, large increases in stationary cycling rates occurred during P12 and P15's session, while P17's increase was moderate. Of those having a reduction in their rates of cycling during sessions, the decreases of both P13 and P16's were large and P14's moderate.

Table 12. Experiment 3 means of each participant's two data sets, pooled standard deviations, and effect sizes.

Participant	First Mean	Second Mean	Pooled *SD*	*d*
12	23	26	1.24	-2.42
13	6	-6	5.23	2.29
14	8	7	1.49	0.67
15	-9	-4	2.29	-2.19
16	13	10	3.68	0.82
17	16	19	4.83	-0.62

Discussion

The aim of this experiment was to observe within session stationary cycling patterns as participants were reinforced with feedback. The hypothesis was that over time rates of cycling would decrease consistent with habituation patterns. Of the six participants involved in this experiment, three had modest increases in their rates of cycling over time, two of which were large and one moderate. There were also three participants in this experiment with modestly decreasing rates of cycling during their sessions, again two of these were large and one moderate. These results indicate that habituation was not observed during the present experiment.

Three participants had decreases in their rates of cycling that have a superficial resemblance to the patterns described as habituation. As previously mentioned, habituation includes three patterns of responding over time; a decrease, an increase followed by a decrease, and increasing rates to a point where they stabilize (McSweeney & Murphy, 2009). In the case of the current experiment, although three participants had patterns similar to those described as habituation, they are not. This is because during habituation, given that the sessions are long enough, the decreases seen can continue to decline until they approximate an absolute zero; in other words, responding slows down to the point where it can cease altogether (Rankin et al., 2009). This did not happen in the current experiment, instead, the decreases over time only declined until they reached the target rate, and remained at this speed for the rest of the session rather than continuing to decrease.

An alternative, more likely explanation for the results of the current experiment is that participants were following the instructions of the researcher. Given that participants were instructed to cycle at the rate indicated by the feedback, it is not surprising that while the initial rates of cycling were variable until the correct feedback was found, rates generally approximated the target rate thereby ensuring reinforcement.

The finding that participants remained near the target speed for most of their session's duration is likely to be because in order to establish feedback as a reinforcer in this experiment, instructions were given to participants before they began stationary cycling. These instructions specified the relationship between the feedback reinforcer and the cycling rates required to reach it. Skinner (1966) has previously argued that instructions explicitly stating the relationship between responding and reinforcement can modify response patterns. With such instructions, the resulting response patterns generated are determined not by schedule sensitivity, but instead by the relationship specified in the instructions given. This is because participants are likely to have histories where adhering to instructions resulted in reinforcement, with this pattern of task adherence brought into later, similar circumstances.

This was the case in the present experiment where participants were given the instruction to maintain the speed of cycling signalled as correct by the feedback. Because participants in the current study are likely to have histories where adhering to instructions have led to reinforcement, then, as with the previous two experiments of this study, this history of responding is likely to have been brought into the current experimental context via rules, and is thus rule-governed behaviour. This means that rule-governed behaviour once again may have caused participants to be insensitive to the immediate contingencies of the experimental context. Without schedule sensitivity, habituation cannot occur.

The possibility that rule-governed behaviour caused the responding in the current experiment is consistent the results of the previous two experiments in this study. With Experiment 3 attempting to control rule-governed behaviour, it could be argued that its presence influencing results yet again is a methodological flaw of the current experiment. However, it remains unclear how one would set up an experiment involving human participants without giving some sort of instructions.

In summary, the results of Experiment 3 of the present study did not result in habituation patterns during a human physical activity. This is likely to be due to the instructions given at the outset of participant's sessions of responding. With rule-governed behaviour occurring, schedule sensitivity was reduced thereby preventing habituation patterns that may have occurred as reinforcer effectiveness decreased over time. Thus, in order to observe habituation during a human physical activity like stationary cycling, a methodology that removes the rules controlling responding is required.

GENERAL DISCUSSION

The results of each of the experiments in the current study found that changes in rates of stationary cycling across time were modest and not systematic. Behaviour was persistent, indicating a reinforcer was present and maintaining responding without any loss in its effectiveness. Each experiment ended with a discussion arguing that the findings were likely to be caused by rule-governed behaviour, linking previously reinforced behaviour from similar, earlier circumstances to the experimental contexts of the present study.

Despite the attempts to remove or manage the rules controlling behaviour, patterns of habituation did not result from these changes. Looking back at the human habituation literature, particularly in operant responding contexts, only a handful of studies actually support the proposition that habituation occurs with humans (7 human studies compared with more than 20 animal studies), and is even further limited in that they all used food as reinforcement unlike the current study which involved no consumable consequences. This dependency on food reinforcers leaves open concerns satiation might have a role in causing their result rather than habituation.

Given the above, it could be argued that there are no substantial demonstrations of habituation that did not depend on food reinforcers. It is therefore perhaps not surprising that efforts to demonstrate habituation during human physical activity have not been successful. There is however an alternative theoretical approach that could have predicted the results of the current study. *Motivating operations* (MOs) were reintroduced to the area of applied behaviour analysis by Jack Michael (1983, 1988, 1993) who added further to this concept. MOs are defined as environmental variables that momentarily alter the value of reinforcers and/or the rates of behaviour related to obtaining such reinforcers

(Michael, 1993). As such, an organism's state of deprivation or satiation with regards to an associated reinforcer is central to the concept of MOs. For example if an individual were to be water deprived, this would not only increase the value of water as a reinforcer, but this state would make behaviours associated with its acquisition more likely to occur, such as turning on a tap.

Michael (1983) added further to the concept of MOs by subdividing them according to the type of learning they involve. The example of water deprivation is considered an *unconditioned motivating operation (UMO)* because water is an environmental variable that does not need to be learned in order to function as a MO (Michael, 2007). Other examples of UMOs include food, activity, sex, oxygen, sleep, temperature change, and painful stimuli (Michael, 1988, 2007).

Michael's (1983) other subcategory of MO's is *conditioned motivating operations (CMOs).* These are associated through learning and reinforcement with a UMO, but can be linked to another CMO that is linked to a UMO. One common example of a widely used CMO is money. On its own, money does not hold much intrinsic value. But, if an individual were thirsty for example, any money that individual had would increase in value as a means of accessing water (assuming there was a store nearby selling it). Not only this, but because money is associated with a multitude of reinforcers through repeated associations, it can in itself become a reinforcer. Because of this, when there is a deprivation of reinforcers that have been available with money, its value increases, thereby increasing behaviours associated with money acquisition such as work, job seeking, gambling and so forth.

Given the nature of MOs, it would be reasonable to argue that the cycling rates during sessions were steady because the reinforcing value of cycling has been held consistent by the constant presence of the MO. The experiments in the current study had a methodology that involved the researcher remaining in the room during sessions of stationary cycling. The presence of the researcher during these sessions may have acted as a social reinforcer by providing a constant source of attention, that is, the researcher was a MO for cycling at a consistent rate. In this case, as long as stationary cycling continued, participants were not in a state of deprivation with regards to attention; once responding ceased, so too did the reinforcement that was preventing this deprivation.

From the perspective of MOs, attention is considered a CMO in human infants that is associated with abolishing UMOs such as food and comfort (Michael, 2000). When a caregiver continues to provide necessities to an infant, not only does attention become a reinforcer in itself through its association with other reinforcers, but the situations where it acts as such become more generalised. As adults, the deprivation of attention may have led participants to become involved in the current study, suggesting this MO was also likely to be in effect during the current experiment's sessions. This explains not only how the researcher's presence maintained the stationary cycling in the current experiment, but may also explain why social reinforcers increased physical activity in the research reviewed during Experiment 1 of this study (Andreacci et al., 2002; McNair et al., 1996; Thompson & Born, 1999).

Similar to the role MO's may have had in the rates of behaviour found in the current study, a previous study has shown that attention acted as a MO that maintained the challenging behaviour of a participant with developmental disabilities. After O'Reilly, Edrisinha, Sigafoos, Lancioni, and Andrews (2006) had identified that attention was a valued reinforcer to a participant, they then measured this participants challenging behaviour during two conditions. Both conditions involved attention provided on a FR 1 schedule contingent with challenging behaviour. These conditions differed in that one involved the participant receiving attention for 15 minutes prior to the session, while the other had attention restricted during this time. It was found that when attention was provided prior to sessions, challenging behaviour occurred less frequently than when attention was restricted. Here, the deprivation of attention acted as a MO by both increasing attention's value as a reinforcer during sessions, and increasing the behaviour associated with its acquisition.

With the previous research showing that physical activity is increased with social reinforcers (Andreaci et al., 2002; McNair et al., 1996; Thompson & Born, 1999), the attention inherent in these reinforcers are shown to be valued during the completion of physical activity. This demonstration that not only is attention a valued reinforcer, but it can increase behaviour associated with it (O'Reilly et al., 2006), supports the possibility that attention acted as a CMO that maintained stationary cycling in the current study. From this perspective, the rates of stationary cycling would be expected to remain consistent to ensure the reinforcer in the context continued to be available.

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APPENDIX A


WANTED
RESEARCH PARTICIPANTS
IF YOU ARE
-OVER 16 YEARS OLD
-MEDICALLY FIT TO EXERCISE
-HAVE AN HOUR OF TIME
YOU ARE INVITED TO PARTICIPATE IN A RESEARCH PROJECT LOOKING AT EXERCISE AND MOTIVATION. IF YOU ARE INTERESTED, PLEASE LEAVE YOUR CONTACT DETAILS ON THE SIGN-UP SHEET. ALTERNATIVELY YOU CAN TEXT 027 617 8904 OR EMAIL MEDELZA@HOTMAIL.COM FOR MORE DETAILS.

APPENDIX B

PARTICIPANT INFORMATION SHEET

Researcher: Demelza Crawford, School of Psychology, University of Waikato
Supervisor: James McEwan

I am a student studying towards a Masters of Applied Psychology at the University of Waikato. As part of this degree, I am required to conduct a piece of original research, which, in this case, is entitled Habituation and Dishabituation of an Exercise Behaviour. This means observing the usual measurements of a person exercising and looking at some patterns of change. Clients over 16 and in good health are invited to take part in this research which will be conducted at the Contours Northcity gym, who have kindly lent me use of their equipment and space.

What will be involved?

The whole session will last approximately 30 minutes and consists of:

- briefing, consent, putting on the heart monitor
- cycling on a stationary cycle
- debriefing

You will be asked to wear a heart rate monitor. The stationary cycle computer display will be faced out of view, and a camera will be set up to capture the information on the display. This information is what will be used for analysis and results. A debriefing will follow this to check everything went well.

The session will be conducted one-on-one. Please wear/bring loose fitting clothing comfortable for working out in.

You have the right to refuse to answer any particular question/s. You are also free to withdraw from this research at any time, and this includes withdrawal of any information you have provided up until the data collection is finished. If you have any questions feel free to ask, contact details are provided below. If you indicate on the Participant Details form, or ask at a later time, a summary of the findings based on your data, and/or the finished research will be provided through your preferred contact method as soon as they are available.

Confidentiality and anonymity.

Any personal information will be securely held, will not be publicly available or appear in any publications or disseminations, and will be destroyed at the completion of the study. This includes any identifiable information and footage. The data will only be viewed by the researcher and their supervisor if needed. The estimated finishing time of this research is July 2012, and after this time electronic copies of the research will be available through the University of Waikato Library and/or the psychology department.

This research project has been approved by the Human Research Ethics Committee of the Faculty of Arts and Social Sciences. If you have any questions about the ethical conduct of this research, you can write to:

Secretary of the Committee, Faculty of Arts and Social Sciences, Te Kura Kete Aronui, University of Waikato, Te Whare Wananga o Waikato, Private Bag 3105, Hamilton 3240.
Or,
Email fass-ethics@waikato.ac.nz,.

Researcher: Demelza Crawford
Email: medelza@hotmail.com
Phone/Text 027 6178904

APPENDIX C

PARTICIPANT DETAILS

Name: ____

Age: _____ **Phone Number** ______________ **Email** ______________

Address: ____

____

Would you like to receive a summary of your results regarding this research? **Yes/No**

Would you like to receive a copy of the completed research? **Yes/No**

Please read the following questions carefully and circling the answer most appropriate to you:

1. Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor? **Yes/No**
2. Do you feel pain in your chest when you do physical activity? **Yes/No**
3. In the past month, have you had chest pain when you were not doing physical activity? **Yes/No**
4. Do you lose your balance because of dizziness or do you ever lose consciousness? **Yes/No**
5. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity? **Yes/No**
6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition? **Yes/No**
7. Do you know of any other reason why you should not do physical activity? If so please explain______________________________________

APPENDIX D

Consent Form

Ψ School of Psychology

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

PARTICIPANT'S COPY

Research Project: Habituation and dishabituation of an exercise behaviour

Name of Researcher: Demelza Crawford

Name of Supervisor (if applicable): James McEwan

I have received an information sheet about this research project or the researcher has explained the study to me. I have had the chance to ask any questions and discuss my participation with other people. Any questions have been answered to my satisfaction.

I agree to participate in this research project and I understand that I may withdraw at any time. If I have any concerns about this project, I may contact the convenor of the Research and Ethics Committee (Dr Lewis Bizo, phone: 838 4466 ext.6402, or 856 0095 e-mail lbizo@waikato.ac.nz)

Participant's Name:____________________Signature:_______________Date:______

Consent Form

Ψ School of Psychology

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

RESEARCHER'S COPY

Research Project: Habituation and dishabituation of an exercise behaviour

Name of Researcher: Demelza Crawford

Name of Supervisor (if applicable): James McEwan

I have received an information sheet about this research project or the researcher has explained the study to me. I have had the chance to ask any questions and discuss my participation with other people. Any questions have been answered to my satisfaction.

I agree to participate in this research project and I understand that I may withdraw at any time. If I have any concerns about this project, I may contact the convenor of the Research and Ethics Committee.

Participant's Name: ____________________Signature:______________ Date:______

Admin_com/psychology forms/consent form

APPENDIX E

General Knowledge Questions.

What colour do you get if you mix blue and yellow paint? Green □
What was the name of the frog in the Muppet Show? Kermit □
What is the only bird from which leather can be obtained? Ostrich □
The Devil is usually associated with which piece of garden equipment? Pitchfork □
Which story begins "all children except one grow up"? Peter Pan □
The oil of which spice is traditionally used for the cure of toothache? Cloves □
Which soft green egg-shaped fruit comes from New Zealand? Kiwi fruit □
What is the world's most southerly capital city? Wellington, New Zealand □
How many strings has a Ukulele? Four □
Which planet is called both the morning and evening star? Venus □
What is the minimum age that you may legally purchase fireworks in New Zealand? Eighteen □
What is the tallest existing mammal? Giraffe □
What is the main ingredient of risotto? Rice □
Which of the seven dwarfs has the longest name? Bashful □
What was Al Capone arrested for? Tax Evasion □
Which country is the largest producer of cheese? USA □
Which city is also known as 'The Big Apple'? New York □
What colour are kowhai flowers? Yellow □
In which month is Anzac Day? April □
What is the name of our national Rugby Team? All Blacks □
What is the name of the small island at the bottom of New Zealand? Stewart Island □
Grapes are used as a base for most wines but what is used as the basis of tequila? Cactus □
Which group had a top 10-album chart success with 'What's the story, morning glory'? Oasis □
In which galaxy is the Earth? Milky Way □
What is the currency of Japan? Yen □
How many Von Trapp children were there in the Sound of Music? Seven □
Which manufacturer produced the first production line car? Ford □
What is the American name for the English postcode? Zip code □
What was Radar's surname in MASH? O'Reilly □
How many degrees in a right angle? 90 degrees □
Who wrote the novel Dracula? Bram Stoker □
New Zealand bases itself on which Treaty? The Treaty of Waitangi □
Which branch of medicine concerns itself with the production of artificial limbs? Prosthetics □
Which expensive vinegar is aged in wooden barrels? Balsamic □
Which chess piece can move only diagonally? Bishop □
Which country produced 70 percent of the world's olive oil? Greece □
What is a freshwater lobster called? A crayfish □
Skeletor was whose arch enemy? He man □
How many milligrams make a gram? 1000 □
In the famous Nintendo games what is the name or Mario's brother? Luigi □
What colour were the magic shoes worn by Dorothy in The Wizard of Oz? Red □
What playing card symbolises death? Ace of spades □
What do Gorillas do when they get nervous? Beat their chests □
What European country consumes the most wine per capita? Italy □
What's inside corn that makes it pop? Water □
In which city is the Sky Tower? Auckland □
What's Mongolia's famous desert? Gobi □

What was constructed to separate England from Scotland? Hadrian's Wall ☐
If you were born on Christmas Day, which star sign would you be? Capricorn ☐
Which two colours form the flag of Switzerland? Red and White ☐
What was the 1st brand of instant coffee? Nescafé ☐
Which plasticine duo has won 6 Oscars? Wallace & Gromit ☐
Which birds are collectively known as Gaggles? Geese ☐
How many stars does the New Zealand flag have? Four ☐
What's a black leopard called? A Panther ☐
What chess outcome results when a player has no legal move? Stalemate ☐
Which sign of the Zodiac does the archer represent? Sagittarius ☐
What are the three colours on the New Zealand flag? Red, Blue, White ☐
What type of creature is Garfield? Cat ☐
Does tennis service begin in the left or the right court? Right ☐
What are the three primary colours? Red, Blue and Yellow ☐
How many holes are there in a ten pin bowling ball? Three ☐
What is the Maori word for tattoo? Moko ☐
What are the six murder weapons used in a game of "Cluedo"?
Candlestick, Dagger, Lead Piping, Rope, Revolver and Spanner ☐
What does Aotearoa mean? Land of the long white cloud ☐
Who has the most teeth, Mammals or Reptiles? Mammals ☐
What gas do all fuels need in order to burn? Oxygen ☐
Through which organ do fish get oxygen? Gills ☐
In the movies who plays the role of Harry Potter? Daniel Radcliff ☐
What is a baby seal called? A pup ☐
What is the furthest planet from the sun? Pluto ☐
Which nuts are used to make Pesto sauce? Pine nuts ☐
What is the capitol of Germany? Berlin ☐
Name the highest mountain in New Zealand. Mt Cook ☐
What is the name of the second book in the Lord of the Rings? The Two Towers ☐
What is the collective noun for a group of crows? A Murder ☐
What is butterfly larvae more commonly known as? Caterpillar ☐
How is the number 14 written in Roman numerals? XIV ☐
Where would you wear an epaulette? Shoulder ☐
In the children's nursery rhyme, who joined the butcher and the baker? Candlestick Maker ☐
Where would a 'troglodyte' live, in a cave, up a tree or underwater? In a cave ☐
True or False: Most Eskimoes have fridges? True (to keep their food from freezing) ☐
In the human body, what are you born with 23 pairs of? Chromosomes ☐
Ma is the Maori word for what colour? White ☐
Which European country is the worlds most visited country? France ☐
Which Sea is the warmest: Red Sea, Dead Sea or the Mediterranean Sea? Red Sea ☐
Who played the lead male role in the film 'Edward Scissorhands'? Johnny Depp ☐
What is Scooby Doo`s favourite food? Scooby Snacks ☐
What became the tallest building in the world when it opened in 1931?
The Empire State Building ☐
Which New Zealand town is famous for L&P? Paeroa ☐
Which sign of the Zodiac is represented by the goat? Capricorn ☐
In fairy tales, what was the name of the little man who could turn straw into gold?
Rumplestiltskin ☐
What are 'clogs' traditionally made from? Wood ☐
What is the bird on the five dollar note? Yellow eyed penguin/hoiho ☐

Multiple choice: What item of food inspired the idea for the computer game pac man Pizza, Watermelon or Cake? Pizza ☐
Which is the only mammal capable of sustained flight? Bat ☐
Who is the Greek god of the Sea? Poseidon ☐
What is prepared in a tannery? Leather ☐
Who played Indiana Jones in the movies? Harrison Ford ☐
In food, what is Chowder? Soup ☐
What is Fred Flintstone's wife called? Wilma ☐
Which saint's day is March 17th? Saint Patrick ☐
What does a Gieger counter measure? Radioactivity ☐
What is the only fruit that grows its seeds on the outside? The strawberry ☐
What was the first capital of New Zealand called? Russell or Kororareka ☐
How many faces does the clock in Big Ben's Tower have? Four ☐
In the animated film Fantasia who played the part of the sorcerer's apprentice? Mickey Mouse ☐
In physics what does UV stand for? Ultra Violet ☐
Which superhero's wife was played by Terri Hatcher in the TV series? Superman ☐
Which element has the chemical symbol Zn? Zinc ☐
What is the only common metal that is liquid at room temperature? Mercury ☐
With which band did Ozzy Osbourne come to fame? Black Sabbath ☐
The Anaconda snake is native to which continent? South America ☐
Which of the following planets is the biggest: Earth, Uranus or Mars? Uranus ☐
What magazine did Hugh Hefner found? Playboy ☐
What word links a group of whales with a group of peas? Pod ☐
Which element has the Atomic number 1? Hydrogen ☐
What is the bird on the one dollar coin? Kiwi ☐
In which country is Marrakech? Morocco ☐
The Caspian Sea isn't a sea at all, what is it? A lake ☐
Which of the green energies is aeolian energy? Wind Power ☐
Which paper size is 210mm x 297mm? A4 ☐
The song "I'll be there for you" is the theme to what TV show? Friends ☐
Who cut off the tails of the three blind mice? The Farmer's Wife ☐
What is a baby rabbit called? Kit or Kitten ☐
How many legs does an insect have? Six ☐
On which Mediterranean island was the Mafia founded? Sicily ☐
Which drug is named after the Greek god of dreams? Morphine ☐
What type of acid is used in car batteries? Sulphuric ☐
What is carnophobia the fear of? Meat ☐
What two groups was this Treaty between? The Maori and the British ☐
When was this Treaty signed? 1840 ☐
Which news mogul owns British Sky Broadcasting? Rupart Murdoch ☐
What constellation features on New Zealand's flag? The Southern Cross ☐
What is the correct term of addressing the the Pope? Your Holiness ☐
Robin Williams dressed in drag for which 1993 film? Mrs Doubtfire ☐
What is the staple food of one third of the world's population? Rice ☐
Who created the Muppets? Jim Henson ☐
Was St Trinnians a school for boys or for girls? Girls ☐
What is a dried grape called? Sultana/raisin ☐
The majority of the land area of Africa lies in which hemisphere? Northern ☐
According to the saying what is "paved with good intentions"? The road to hell ☐

How many Godfather films have been made? Three ☐
What was civil rights leader Martin Luther King's profession? Minister ☐
What does the vertebral column protect? The spinal cord ☐
True or False: The Earth and the Moon are the same age? True ☐
What travels by conduction, convection and radiation? Heat ☐
In golf, how long may you look for a ball before it is declared lost? 5 minutes ☐
What farmyard animal is used to search for Truffles? Pig ☐
Can Polar Bears jump? Yes, up to 6 feet off the ground! ☐
Name the Greenpeace vessel sunk by French spies in Auckland in 1985? The Rainbow Warrior ☐
What is the usual colour of an aircraft's Black Box? Orange ☐
Which toy was originally a Filipino jungle weapon? The yo-yo ☐
Which 1970's supergroup recorded "Stairway to Heaven"? Led Zeppelin ☐
How many Carats is pure gold? Twenty Four ☐
Which came first, Art Deco or Art Nouveaux? Art Nouveaux ☐
What is the process known as whereby plants make food using light? Photosynthesis ☐
The leaf from which tree is on the Canadian national flag? Maple ☐
What is Marsh Gas more commonly known as? Methane ☐
Who is the current Prime Minister of New Zealand? John Key ☐
Which is the worlds most popular brand of cigarettes? Marlboro ☐
What do you do with a 'Won Ton'? Eat it ☐
What is the 1st book of the Bible? Genesis ☐
What is the name of the cooking technique where vegetables are cut into narrow fine sticks? Julienne ☐
How many faces are carved into Mount Rushmore? Four ☐
Who fired the arrow that struck Achilles in his heel? Paris ☐
Which New Zealander was the first person to climb Mount Everest? Sir Edmund Hillary ☐
Which type of animal were Lady and the Tramp? Dogs ☐
In which sport do competitors use a mallet? Croquet ☐
Which major disaster happened in London in 1666? Great Fire ☐
Which famous sportsman "Floats like a butterfly, stings like a bee"? Mohammed Ali ☐
Which scientific word relates to the structure of the human body? Anatomy ☐
In the 'Rocky' films, what was Rocky's surname? Balboa ☐
True or false, Electric eels actually produce electricity? True ☐
What is the term given to the appearance of wounds or scars corresponding to those of the crucified Christ on a human's body? Stigmata ☐
What was Yogi bears best friends name? Boo Boo ☐
Molten rock above the earth's surface is called lava. What is it called under the earth's surface ? Magma ☐
What name is given to an inert substance administered in place of an active drug? Placebo ☐
In 1986 the world's worst nuclear disaster happened where? Chernobyl ☐

TOTAL: ____________________ PERCENTAGE CORRECT: ____________________

APPENDIX F


WANTED
Research Participants
If you are
-Over 16
-Medically fit to exercise
You are invited to participate in a research project looking at exercise and motivation
If you are interested
Email medelza@hotmail.com
Call/Text 027 617 8904
medelza@hotmail.com 027 617 8904
medelza@hotmail.com 027 617 8904
medelza@hotmail.com 027 617 8904
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medelza@hotmail.com 027 617 8904
medelza@hotmail.com 027 617 8904

APPENDIX G


WANTED
Research Participants
If you are
-Over 16 years old
-Medically fit to exercise
You are invited to participate in a research project looking at exercise and motivation. Students enrolled in PSYC 102 and/or PSYC 103 can recieve a one percent course credit for participation, although all students are encouraged to take part.
If you are interested
Email Medelza@hotmail.com
OR call/text 027 617 8904
medelza@hotmail.com
027 617 8904
medelza@hotmail.com
027 617 8904
medelza@hotmail.com
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027 617 8904

APPENDIX H

PARTICIPANT INFORMATION SHEET

Researcher Demelza Crawford (School of Psychology, University of Waikato)
Supervisor James McEwan

I am a student studying towards a Masters of Applied Psychology at the University of Waikato. As part of this degree, I am required to conduct a piece of original research, which in this case is called 'Habituation and Dishabituation of an Exercise Behaviour'. This involves asking for participants to stationary cycle, the cycling rates will be measured as they occur so the patterns can be related to other similar research. Those over 16 and in good health are invited to take part in this research which will be conducted at the University of Waikato.

What will be involved?

The experiment will be held at the University of Waikato. The whole session will last approximately 30 minutes. The session will involve up to 20 minutes of stationary cycling, depending on individual ability. The session will be conducted one-on-one. Please wear loose fitting clothing comfortable to exercise in.

You have the right to refuse to answer any question/s. You are also free to withdraw from this research at any time, for any reason, and this includes withdrawal of any information you have provided. If you have any questions feel free to ask, contact details are provided below. If you indicate on the Participant Details form, or ask at a later time, a summary of the findings based on your data, and/or the finished research will be provided to you as they are available.

This research project has been approved by the Research ethics Committee of the University of Waikato's School of Psychology. If you have any questions about the ethical conduct of this research, you can contact the convener of the committee: Dr Nicola Starky via E-mail nstarkey@waikato.ac.nz or phone 838 4466 ext.6472

Confidentiality and Anonymity

Any personal information will be securely held, will not be publicly available nor appear in any publications or disseminations, and will be destroyed at the completion of the study. This includes any identifiable information. The data will only be viewed by the researcher and their supervisor if needed. The estimated finishing time of this research is December 2012, after this time electronic copies of the research will be available through the University of Waikato Library and/or the psychology department.

Researcher: Demelza Crawford
Email: medelza@hotmail.com
Phone/Text 027 617 8904

APPENDIX I

PARTICIPANT INFORMATION SHEET

Researcher Demelza Crawford (School of Psychology, University of Waikato)
Supervisor James McEwan

I am a student studying towards a Masters of Applied Psychology at the University of Waikato. As part of this degree, I am required to conduct a piece of original research, which in this case is called 'Habituation and Dishabituation of an Exercise Behaviour'. This involves asking for participants to stationary cycle, the cycling rates will be measured as they occur so the patterns can be related to other similar research. Those over 16 and in good health are invited to take part in this research which will be conducted at the University of Waikato. Students enrolled in PSYC 102 or PSYC 103 will receive a 1% course credit for participating, although all students are encouraged to participate.

What will be involved?

The experiment will be held at the University of Waikato. The whole session will last approximately 30 minutes. The session will involve up to 20 minutes of stationary cycling depending on individual ability. The session will be conducted one-on-one. Please wear loose fitting clothing comfortable to exercise in.

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Researcher: Demelza Crawford
Email: medelza@hotmail.com
Phone/Text 027 617 8904

APPENDIX J

Consent Form

Ψ School of Psychology

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

PARTICIPANT'S COPY

Research Project: Habituation and Dishabituation of an Exercise Behaviour

Name of Researcher: Demelza Crawford

Name of Supervisor: James McEwan

I have received an information sheet about this research project or the researcher has explained the study to me. I have had the chance to ask any questions and discuss my participation with other people. Any questions have been answered to my satisfaction.

I agree to participate in this research project and I understand that I may withdraw at any time. If I have any concerns about this project, I may contact the convenor of the Research and Ethics Committee (Dr Nicola Starkey, phone: 838 4466 ext.6472, e-mail nstarkey@waikato.ac.nz)

Participant's Name:____________________Signature:_______________Date:______

Consent Form

Ψ School of Psychology

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

RESEARCHER'S COPY

Research Project: Habituation and Dishabituation of an Exercise Behaviour

Name of Researcher: Demelza Crawford

Name of Supervisor: James McEwan

I have received an information sheet about this research project or the researcher has explained the study to me. I have had the chance to ask any questions and discuss my participation with other people. Any questions have been answered to my satisfaction.

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Participant's Name: ____________________Signature:_______________ Date:______

Admin_com/psychology forms/consent form