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Exploring End User Experience: How Can We Achieve Lifelong Engagement With Physical Activity Tracking Devices?

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Health and Wellness

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ABSTRACT

Activity tracking devices provide biofeedback information and encourage people to be active, however, their long-term usage has been problematic. This study explored the theory of reinforcement techniques and the theory of self- determination to enhance long-term usage of activity tracking devices.

A sample of 43 people was surveyed to examine their experience with activity tracking devices. A multi-regression analysis demonstrated significant results(R square=71.6% Sig level=0.012 N=43). The result indicates how individuals with different orientations likely to perceive the supportiveness of their devices and how likely they were to continue using or stop using their devices. Conclusion: understanding the principles of reinforcement techniques and the perceive supportiveness concept of self-determination theory provide insight into the strategies that instigate and maintain long-term usage of the activity tracking devices

Key terms: Activity tracking device, Stimulus Response and Self Determination theory Habit formation and Lifelong engagement

STATEMENT OF PROBLEM

Activity trackers are increasingly used in the fitness industry. Currently most wearable devices track peoples' steps, count calories expenditure and sleeping patterns (Green, 2015). An estimated 19 million activity tracking devices entered the market in 2014. It is projected to reach 1.6 billion in 2016(Doug, 2015 & Endeavour Partners, 2015). Different categories of activity trackers have emerged in the market. Key categories include heart rate monitors, GPS watches, pedometers and integrated activity trackers. The popular smart wearable devices include Fitbits, Jawbone, Nike fuel bands, Garmin devices, Tom-tom runners, Samsung galaxy gear, Pebble, and Apple watch. Some of these trackers are multifunctional such as monitoring sleep, calories burnt, step count, floor climbs, and route tracking whilst some seem to have limited capabilities. These activities tracking devices are providing exciting opportunities for individuals who are interested in optimizing their health. The auto-device biofeedback and inter-device biofeedback can serve an important source of behavioral change (Dontje, de Groot, Lengton, Van der and Krijen, 2015; Klein, 2015). However, little is known about the consumers' lifelong engagement with these devices.

The role of physical activities in combating most of the chronic diseases such as diabetes, stroke, cancer, and metabolic syndrome have been established (Dontje et al, 2015; WHO, 2008). Physical inactivity has been identified as the fourth leading risk factor for global mortality causing an estimated 3.2 million deaths (WHO, 2008). The wearable activity trackers seem to provide positive direction for encouraging people to

be physically active. However, a study conducted by Endeavor Partners indicates that one-third of wearable fitness device users ceased using them after six months usage (2015). Another study carried out by health care investment fund, Rock Health, estimated that only half of the 20 million Fitbits registered members are currently actively using them in 2015 (Rock Health, 2015).

Step count is an important way of measuring the amount of activities an individual engages daily. The accuracy of the step counts in some popular fitness wearable device and smartphones has been established (Dontje de Groot, Lengton Schsns and Krijenen, 2015 & Stackpool, Porcari, Mikat, Gillette and Foster, 2015; Diaz et al, 2015). These studies however also saw a wide variation in terms of measuring the total amount of calories burned during activities. The prerequisite for social comparison is inter-device data reliability or intra -device data reliability (Dontje et al, 2015). The long-term engagement with activity tracking devices may involves commitment and device reliability. As this study is reviewing related literature other investigators are currently arguing that activity tracking devices are facilitators to behavior change not a driver. Alternative measures of increasing users' commitment must be sought. Moreover, collaborative effort between academia and industries has been suggested to extend health promotion to the 'hard to reach population' (Gibbons, 2011). A study of gaps between activity tracking devices technology and evidence based theoretical perspectives is proposed.

Introjection of wearable devices across the populace and sustaining lifelong usage of these devices involves a complex behavioral process and elements. The overall lifestyle compatibility, adoptability, quality/robustness, and user experience have been mentioned as critical ingredient to enhance long term usage (Endeavor Partners, 2015). However, per critical evidence based protocol more research is needed. Furthermore, short/low utilization rate and the intra-device discrepancy in measuring the activities calories burned, one question still remains "how do we motivate and sustain individuals to engage in long-term usage of these activity tracking devices?" Evidence based research is proposed to explore consumers real experience and their perspective on sustaining long-term engagement with this activity trackers.

LITERATURE REVIEW

RELEVANT PAST RESEARCH AND THEORIES

Research in the area of fitness activities trackers is scarce in the rapidly developing health and fitness industry. The role of wearable activity tracking devices in measuring and assessing physical activity and energy expenditure has been unquestionable (Andre and Wolf, 2015). Activity tracking device has a huge potential as a motivational tool for physical activities and for monitoring activity adherence by experts independently (Bertram, Patterson, Parker, Marcus and Morey, 2015: Andre & Wolf, 2007). Yet the long-term utilization of the activity tracking devices as part of a strategy to prevent sedentary behaviors have been problematic.

Significant evidence demonstrates that most people exercise regularly because of lifelong wellness reasons rather than immediate health problems by (Segar, Updegraff, Zikmund-Fisher, Richardson, 2011; Chen and Li., 2014; Costello ,Kafchinski and Sullivan, 2011). Integrating activity tracking device as life- long motivational tool can be an important ingredient to global campaign against physical inactivity. Yet, technology and consumer consulting firm, Endeavor Partners (2015) revealed that about half of the people who acquired these wearable tracking devices ceased to use them after six months of usages. Some wearable devices manufacturers and employers resort to incentive based reinforcement strategies to sustain the usage of these devices (Norman, Kevin, Helternes, Heck and Osmick, 2015). Evidence is also growing that material incentive strategies undermine intrinsic motivation which is closely linked to long-term engagement in physical activities (Moller Buscemi, McFadden, Hecker and Spring, 2014, Amoura, 2015; Segar, Updegraff, Zikmund-Fisherand, Richardson, 2012, Gardner & Lally, 2013). Furthermore, research into the field of health and fitness promotion has immensely dealt with the role of intrinsic and extrinsic motivation, however, little or no research exist in the area of lifelong engagement with activities tracking devices.

Social Platform engagement may be an important motivational tool for physical activity. Data generated by activity tracking device user can be used to compare with once social network group. (Dontje et al., 2015, Diaz, Krupka, Chang, Peacock, Ma, Goldsmith and Schwartz, 2015; Lee, Drake and Williamson, 2015). However, intra-devices data inconsistencies especially calories count and step count can undermine this

important feature. Another important constraint to the development of the social platform is biodata accessibility. Lee et al. (2015) indicated the logistical constraint in which school environment with restricted firewall can undermine the uploading of bio data from the activity tracking devices. Apart from logistic constraints, privacy and confidentiality issues raise skepticism about the sharing of biodata. Although, the social platform of activity tracking devices is still developing its long-term impact on activity tracking is huge and can undermine their utilization.

Routine usage of an activity tracking device may also increase its positive impact physically and psychologically. To this effect, habit has been mentioned as an important element for long-term engagement with activity trackers (Endeavor Partners, 2015). However, evidence still is limited in the development of long term utilization strategies. One may also ask what about amotivated client with limited social connection? More research is needed to explore the possible linkage between activity tracking device users' habit formation and the underlying theoretical perspective.

Theoretical Framework

Several theories that underlie health promotion interventions, one of which is the health behavior model. However, this theory falls short of linking healthy initiative to long-term sustainability. The socio-ecological approach also indicates that individual health and behavior is influenced by multiple sociocultural forces or factors directly or indirectly but fails to link the intervention strategies to long term behavior change sustainability (McKenzie, Neiger and Thackeray, 2013). Continuum theories also fell

short in their intervention strategies as human behavior is 'factored into single equation' thus ignoring individuals' differences (McKenzie et al., 2013 p.g. 168). Hence, this study acknowledges that the acquisition of long-term healthy behavior is influenced by a series of cognitive-behavioral and environmental process which is coupled with the individual differences thus warrant two theoretical models in a scale-liked continuum operational manner. See appendix G. The integrated model of behaviorist reinforcement theory of motivation of Thorndike, (1898) and Hull, (1945) involves brain biology analysis of the ganglion cell as cited in Yin and Kowlton, (2006) study and Self-Determination Theory (Ray and Deci, 1987, Ray and Deci, 2013) will be reviewed. Embedded in these theories is the intrinsic and extrinsic motivational strategies that can instigate and maintain physical activities.

Reinforcement Theory of Motivation

Reinforcement Theory provides extrinsic material incentives that are powerful tools for motivating and sustaining behavior change. This theoretical framework is critical to individuals who largely influenced by an external locus of control (Rotter, 1950's). These people see healthy lifestyle behaviors as impersonal and out of control. Thus, the Reinforcement Theory of Motivation views individual behavior as a function of its consequences can provide best motivational strategies to this group. It is based on the "law of effect", i.e., individual's behavior with positive consequences tends to be repeated and vise visa. This theory is associated with Thorndike (1898) and has been reviewed in recent times by series of studies as an integrated model of the behavioral

assay and neurobiological analysis as cited in Yin and Kowlton, (2006). Yin and Kowlton evaluated basal ganglia in the human brain which precipitate Stimuli and Response(S-R instrumentation) into habitual and goal-directed behaviors (physical activities for long-term engagement). The basic conceptual framework of the behavioral analysis of goal-directed actions and stimulus-driven habits integrated has been reviewed in recent findings on the anatomy and physiology of the basal ganglia. A set of nuclei that have long been known to control voluntary behavior may be useful to wearable tracking devices programmers and consumers. The premises of their findings revealed that voluntary behaviors like physical exercise can be instigated and sustained in two major ways, habit and goal driven through Stimuli-Response process. Norman, Kevin, Helternes, Heck and Osmick (2015) highlighted that long-term behavioral change may be achieved through short term incentive reinforcement design. Habit formation according to them is a behavioral pattern develop through stimuli-response(S-R) process which can maintain long-term behavioral response (e.g. Physical activities) after the behavior is acquired through overtraining, and this process is premeditated the ganglion cell in the brain. Since, the long-term engagement is a major challenge in the wearable fitness devices industry it is prudent to integrate this concept into wearable devices programming.

To produce behavioral pattern, a goal driven motivational strategies needs a short term relay between behavior response and stimulus, until the behavior becomes a habit. This is particularly important to wearable activity tracking device developers since they have been challenged to developed programs that are meaningful to

behaviors and habits or otherwise value based driven activity tracking device (Green, 2015). Thus the integration of this behavioral –neurobiology into wearable programming may present valuable opportunity.

Self-Determination Theory

The used of material incentives in healthy lifestyle intervention has been criticized as it suppressed long term engagement and autonomy (Moller et al., 2014; Segar et al., 2015). The theory of Self of Determination (SDT) may provide alternative motivational strategies for the wearable technology industry. SDT posits human beings have basic psychological needs for internalizing and self-propelling to grow in a healthy way. Thus providing autonomy–supportive environment enhance our natural or intrinsic tendencies to behave in effective and healthy ways (Ray and Deci, 1987). The SDT view the basic psychological needs as a universal feature of a human. Human beings psychologically yearn for competence, autonomy and social love and support (relatedness) thus emphasis on intrinsic motivation (Vansteenkiste and Sheldon., 2006). Thus, wearables technology needs to provide the real-time supportive environment for users. However, wearable tracking devices companies frequently resort to pointing base motivational strategies (Norman et al, 2015). However, this form of motivation may not apply to individuals who seek to optimize their health intrinsically, although Norman et al buttress their points that for individual to achieve their long-term goals incentives may help the individual to achieve their short term goal in the first place. Also, the long-term sustainability of this form of motivational strategies is also

questionable as the cost will grow exponentially and individuals relapse to a sedentary lifestyle (Segar, 2015). Thus, this theory introduces three types of human orientation; autonomy, competence, and relatedness; to explain individual motivational needs.

The need for competency proposes that human beings actively seek for propensity to grow and develop and to adapt to the complex and changing environment (Deci and Ryan, 2000). However, amotivation and sense of environmental unfriendliness can lead to less utilization or optimization of healthy opportunities (Vansteenkiste et al, 2006; Patrick & Williams, 2012). Limited wearable aesthetic design, user unfriendliness and lack of choices can undermine their utilization. In short, maximally supporting the immediate environment may push or support inherent tendency of mastering the skills of being physical active.

The need for autonomy assesses the extent to which individual personally endorsed healthy behavior (Teixeira, Carraca Marklind, Silva and Ryan, 2015). Nurturing and fulfilling individual's' need for autonomy (e.g. by providing choice) to further enhance their thriving and optimal functioning should be critical to technology developers. Hence, from the wearable tracking devices perspective, technology designers should understand that client choose to use activity tracking device because it is personally valued. For instance, Armoura et al. (2015) reported that individuals who were involved fitness program in an autonomy-support context reported higher satisfaction of the needs for autonomy and competence. Feedback is one of the ways of promoting autonomous behavior but may depend on context. For example, a study

conducted earlier on to examine how Fitbit SMS Text-Messaging Prompts to increase physical activity in overweight and obese adults produced insignificant results highlighting the shortfall of current motivational strategies use in Fibit activity tracking device (Julie et al, 2015)

Relatedness is the universal want to interact and share experience with social our environment (Vansteenkitse et al, 2006). Our social environment is an important source for developing relatedness. The social component is essentially important to overall health. Some of the current activity tracking devices are limited with social platform although they may help individuals to reach the long term goals (Endeavour Partners, 2015). Giving the fact that "human beings are social animals," those socially limited devices are likely to be perceived as not helpfully. This review, therefore, expands the view of the theory that people are likely to perceive these devices as a part of their environment and expect supportiveness from them.

SUMMARY OF LITERATURE

The theory of self-determination explored three individual orientations: autonomy, autonomous and relatedness, that are likely to perceive their wearable tracking devices either supportive or not. Integrating these theoretical construct in exploring the end user experience can provide a useful insight into strategies that enhance long-term engagement. The integrated behavioral-neurobiology reinforcement theory was adopted to explain two important motivational strategies: habituation and goal driven variable reinforcement techniques to sustain the long-term engagement.

This theory demonstrates in practically how to care for the three orientation individuals discussed in self-determination theory. Find the in Appendix

RESEARCH QUESTION

Based on the review of the literature, the following research question is proposed: Can Self-Determination motivational approach and Variable reinforcement techniques enhance long-term usage of tracking devices? The following hypotheses will be evaluated:

Hypothesis 1: Self-determination motivational techniques increase long-term engagement with activity tracking device.

Hypothesis 2: Variable reinforcement leads to continuous exercise behaviors.

Hypothesis 3: Shaping reinforcement leads to continuous exercise behaviors

RESEARCH METHODOLOGY

THEORETICAL FRAMEWORK

The integrated behavioral-neurobiology reinforcement and self-determination theory have been explored in existing literature. However, little have been done in the area of integrating these theories with activity tracking devices to sustain long-term behavioral engagement. Theoretical constructs such as reinforcement, autonomy, relatedness and competence that underpin the long term commitment in the exercise investigated**.** A survey is used to explore the motivational factors that can influence the long-term usage of activities tracking devices. This method is used due to its ability to

reach the wider population. It is flexible (can use quantitative and qualitative methods) and less expensive as well.

PARTICIPANTS

The study was interested in studying the Clement Recreational Center users on the Otterbein University campus. It has approximately 500 users including students, staff, and faculty and community members. The goal was to achieve a sample size of 100 individuals who utilized an activity tracking device to take part in the research. To achieve the purpose of this study, we limited the study population to Otterbein University recreational center users where potential activity-tracking device users were likely to be found.

INSTRUMENT

The Perceived Environmental Supportiveness Scale (PESS) developed by Markland and Tobin (2010) was adopted after permission was granted from Markland, Uk. This measure has been adopted in assessing need support in other contexts, including exercise classes and need support provided by sports coaches (Edmunds, Ntoumanis & Duda, 2007). The current study adopted the instrument in the context of activity tracking devices providing supportive environment to sustain long-term engagement in exercise activities or usage. The instrument, PESS, was designed to assess explicitly the three dimensions of support (autonomy support, structure, and involvement) and comprises 15 items with five items assessing each of the three dimensions. Confirmatory factor analyzes of the three-factor model showed to fit better

than a single factor model. However, reporters indicated that the original instrument may lack discriminant validity due to a highly inter-item correlation. However, Markland and Tobin (2010) found that a principle components analysis yielded a single factor with loadings ranging from .64 to .93 and an internal consistency coefficient for all 15 items of .97. The current research introduced eight new items into the scale. Each item is expressed in continuum from 0 to 7 ("Strongly disagree" to "Strongly agreed" where 4 is "Neutral"). Pilot testing was conducted with both graduate and undergraduate students to establish the content validity. The construct validity was also established through focus group discussion. The editing was done, and the final instrument was used in the study. The instrument used for the study can be found in Appendix A

DELIMITATIONS

The Likert scale instrument was adopted for this study because of its universal method of collecting data. Respondents are often given a spectrum of space to express their view, and they are not forced to express their views. It is an easy and quick method of carrying quantitative research.

LIMITATION

Most psychological variables like motivation are a multidimensional continuum. However, the major limitation of this instrument is its assumption of unidimensional approach (LaMarca, 2011). Respondents are given a certain amount of choices implying that each choice space is equidistant to each other when reality they

are not. The second limitation which is of importance to this study is the participant's' tendency of automatically avoiding extremes answers rather than providing their real answers.

DATA COLLECTION

Approval from the university Institutional Review Board was granted and the management of the Clement recreational center also granted permission to collect the data. The study used non probabilistic convenience sampling technique due to time constraints and the accessible of participants as recommended (lavrkas, 2008 & Howlett, 2014). We directly invited the recreational center users to take part in the research anytime any of them come into the Center from October 2015 to November 2015. We stood at the main entrance to the Clement Recreational Center in the University where it would be easy to invite the many users that passed by to take part in the research. We recruited activity tracking devices users until we reach saturation (both active and passive users). The potential participant was asked whether he/she uses or used a tracking device. Those who said 'yes' were asked if they could spend 10-15 minutes to answer a questionnaire. Participants were asked to read the informed consent portion of the questionnaires before proceeding. After answering the questionnaires, participants were asked to fill a paper to be entered for 25 dollar gift card drawing.

STATISTICAL ANALYSIS

After the data collection; inconsistency, errors, and omission from the data were adjusted using Microsoft-Excel Software. Responses were weighted by taken the total number of respondents divided by estimated total population. A Statistical Package for Social Science (SPSS) software IBM, 2015 version was used to analyze the data. Demographic data was grouped into frequencies while Likert scale data were coded into composite scores as recommended (Boone and Boone, 2012). Inter -item (Pearson) correlation and multi-regression analysis was conducted to predict future usage and current motivational orientation. Analyzed data was then transferred into Microsoft-words for presentation and discussion. Pictorial graphics was used to represent analysis for easy understanding and interpretation.

LIMITATIONS

Research on the long-term utilization of activity tracking devices are scarce and perhaps possible theoretical approach or perspective from other research that could have added more information or thoughts to this study might not have been fully covered. Time constraints could not allowed this study to use qualitative research approach to explore the end user experience, although qualitative research is known for its rich content in exploring the lived experience of people. The use of convenient sampling techniques also undermines our ability to generalize our study.

ETHICAL CONSIDERATIONS

The ethical standard for conducting this study was duly considered. The study received approval from Otterbein University Institutional Research Board. Ethical guidelines of the University research guideline and protocols were strictly followed. The research participants was given informed consent prior to collection the data. The objectivity of the methodological process was meticulously pursued. The confidentiality of respondents and collected data was guaranteed. Carefulness, openness, and respect for intellectual property and responsible publication and monitoring were considered from the beginning of this study to its end. To the researcher's best of knowledge, all ethical consideration was properly and meticulously followed.

RESULTS

DEMOGRAPHICS

Participants. In total 43 people (Male –14/43 and Female –29/43) with an average age of 22.7 completed the survey. Current college students pursuing associate and bachelor degrees comprises of 9.3 % (4) and 53.5 %(23) respectively. Whiles 11.6% (5/43) are Masters/ PhD. Holders and 25.6 %(11/43) are currently in high school. See Appendix B for full breakdown.

Activity tracking brands and Weekly Usage rate. Almost half of the activity tracking devices (46%) were Garmin devices including Garmin 220 and Garmin 420 while 42% of the participants were using Fitbit brand (15 participants) and 12% (5%

and 7%) of the participants used Apple watches or mobile application activity tracking devices respectively . We further looked at the activity tracking device types and **usage rate per week**. Fitbit activity tracking device brand had the highest usage rate per week. Seventeen (17) people used them throughout the entire week followed by Garmin watch 220 and 420 with 13 people usage throughout the entire week. Other devices - Apple watch brand had only one person that used it throughout entire week. See detail in appendix C.

DATA

Stimulus –Response Reinforcement(S-R) Variables

The association of operant stimulus-response variables with three major dependent variables ;the perception of the Activity Tracking Device(ATD) as a Lifetime Exercise Motivator (LEM), Device Type (DT) and Device Usage(DU) were tested using the Pearson reliability coefficient.

ATD as Lifetime Exercise Motivator and S-R Variables. Intermittent reward (variable reinforcement schedule) positively correlated with activity tracking device as a lifetime exercise motivator (LTEM) (r =0.333, Sig. level 0.05, 2-tail, N=43). Continuous reinforcement (reward regularly) and point rewards (token economy) also demonstrated moderate to strong relationship with activity tracking device as a life time exercise motivator at 0.520 (r=0.520, Sig level 0.001, N=43) and (r=0.335, sig level 0.001, N=43) respectively. Encouragement from the operant principle known as shaping demonstrated a weak correlation with activity tracking as an lifetime exercise motivator(r =0.251 Sig level., N=43).

Tracking Usage and S-r Variables. Per the purpose of this study, participants' activity tracking usage has been posited as a dependent variable. Intermittent Reward (Fixed interval Schedule), Point reward (token economy) and shaping (encouragement) demonstrated weak correlation with participants' activity tracking device usage (r=.176, sig level .05, N=43 & r=.132 sig. level =005, r=107, sig level .05, N=43 respectively). Regular rewards (continuous reinforcement) demonstrate a positive significant correlation with participants' activity tracking usage per week. (R=0.457 Sig level=001 N=43). The Participants' device usage however, indicated significant correlation with activity tracking device as Lifetime Exercise Motivator (LTM) (r=.407, Sig level = .01, N=43)

Activity Tracking Type and S-r variables. Furthermore, the type of Activity Tracking Device (ATD) was measured as a dependent variable against the four reinforcement principles implored in this study i.e. variable reinforcement schedule (Intermittent reward), continuous reinforcement, and token economy and shaping. The Activity Tracking Device (ATD) brands demonstrated negative relationships with the intermittent reinforcement strategies(r=-0.25, Sig level 0.01, N=43). The point reward system (token economy), continuous reinforcement and shaping demonstrated moderate-stronger negative correlation in the two- tail reliability test(r=-0.395, sig level 0.01, N =43, r= -0.59, sig level 0.01, N=43, & r=-0.432 Sig level =0.01, N=43). The Pearson reliability was run under 95 and 99 significance level in two tailed normal distribution data to enhance our understanding of the direction of the statistical power and possible hypotheses testing. More details can be found in Appendix C.

Self Determination Theoretical (STD) Construct

Based on the objective of this study, we analyzed the relationship between competence, relatedness, and autonomy variables alongside the activity tracking device type, participants' physical activity level, perception about activity tracking device as lifelong motivational tool and activity tracking usage rate. The perception of activity tracking device as a lifelong exercise motivator, the device type, and participants' current device usage rate were measured as dependent variable. The study identified a moderate correlation between Activity Tracking Device as Lifetime Exercise Motivator (LTEM) and the competence constructs variables which include provision of feedback, instilling confidence, the suggestion of exercise and setting achievable goals. (r=497**, Sig level= 0.01, r=0.363 Sig. level 0.05, 2-tail, r=0. 437** Sig. level 0.01 2- tail, r=0.357* sig. level 0.05 2-tail & r=0.319* Sig. level 0.05 2-tail respectively). The competency variables however, established moderate to weak relationship with the Device Type(r= 0.425 Sig. level 0.01 2 -tail, r=0.298 Sig. level 0.05, 2-tail, and r =0.207, sig. level=0.207 & r = 0.104, sig. level=0.104). The Device Type (DT) established negative moderate relationship with provision of feedback and suggesting of exercise, however established negative weak correlation with setting achievable exercise goal and feeling confident with confidence (r= -0.454 sig. level= 0.01, r= -0.434 and r= -0.1 sig. level 0.05, r= -0.238 sig. level =0.05 N=43) respectively.

Another major construct of STD investigated is relatedness. Relatedness refers to the desire for human beings to be socially connected and have sense of belongingness. The activity tracking device adaptability, social platform and activity

tracking device multi-functionality was correlated with activity tracking device as a lifetime Exercise Motivation (LEM)r, Device Usage(DU) and Device Type(DT). The study established a moderate correlation between activity tracking device as a Lifetime Exercise Motivator (LEM) with the provision of the social platform and device environmental adaptability but was not statistically significantly correlated with device multi-functional respectively (r=0.359 sig. level -0.05, r= 0.437 sig. level =0.01 & r=-0.298). The Relatedness (R) variables also established moderate correlation with activity tracking device environmental adaptability (r=0.486 sig. level 0.01), however identified low correlation with the provision of social platform and device multi-functionality(r= 0.172 sig level 0.05 and r= -0.013 sig level 0.05)

The last theoretical construct of STD investigated in this study was autonomous-related variables. The study established some level of association between factors that seek to promote the autonomous orientation of device users. The device “Is easy to use” correlated moderately with the perception of the device as lifetime exercise motivator, device usage at 2-tail 95 confident level (r=.352 sig. level =0.021, N =43, r=0.413 sig. level= 0.006 N=43) respectively. The ‘device easy to used’ however demonstrated insignificant correlation with the device type (r=-0.087 Sig level 0.581) at 2 –tail 95 confident level.

The general needs of participant, however, demonstrated insignificant relationship between the activity tracking device as lifetime exercise motivator, Device Usage and the Device type at 95 confident level (r=0.076 sig. level =0.626 r=0.183 sig. level=0.239 r=0.034 sig. level=0.83 N=43)

Multiple Regression Analysis of Activity Tracking as Life Exercise Motivator

To test the hypothesis that Stimulus-response and Self-determination theory (relatedness, competence and autonomy) variables can influence long term engagement with activity tracking device, we tested whether participant responses regarding variation occur by chance and predictability of theoretical variables through Multiple Regression Analysis(MRA) . Activity tracking device as a lifetime exercise motivator (dependent variable) against 20 predicted variables in the study. The change statistics of predicted variables against Lifetime Exercise Motivator R-square was 71.2% (R-s=.718) and the factorial change analysis significant at 0.12 at 95% confident interval level.

ANALYSIS/DISCUSSION

The study reveals that the crop of activity tracking device users in the study of younger adult generation with an average age 22.7 is not typical to other study's population with an age range of 24-34 (Endeavour Partners, 2015). Individuals in this age category are fitness enthusiasts or athletes who are likely to make the best use of facilities or tools available to optimize their health. The older adult of age 55+ often seeks to maintain their general wellbeing and longevity of life. Homogenous nature of this study population implicates a similar trend in responses to variables. For example, 62.8% were current associate or bachelor degree students and correspondingly, the majority of them were using Garmin 220/42O watches and Fitbit Flex that are also the cheapest in the activity tracking device market. With this trend, activity tracking device users are likely to face similar limitations and challenges. Similarly, the average usage

of the activity tracking device per week is 6.140 (6/7) which is typically of homogeneous group. Besides, the typical nature of participants; age and gender was not balanced hence rendering the variability impact of age and gender as dependent variables insignificant per the objective of this study.

Per the purpose of the study, it looked at how stimulus-response reinforcement motivation techniques affect the usage of activity tracking device and participants' perception of activity tracking devices as lifetime exercise motivators. The activity tracking device usage correlated significantly with variable reinforcement, continuous reinforcement, shaping and token economy (point based reward). Continuous reinforcement techniques established a strong correlation between device usage($r=0.520$). Given the important role the stimulus–response reinforcement have on habit formation (Yin et, 2006: Jog, M.S., et al. 1999; O'Tousa, D. et al. 2014), continuous reinforcement was likely to produce more behaviors than the others but subjected to a quick behavior relapsed. The study finding is consistent with these studies and can be helpful in improving the usage of activity tracking devices. Furthermore, the Stimulus–response principle has established that continuous reinforcement technique produced high desirable behavioral responses as compared to variable reinforcement but subjected to quick behavioral response extinction when behavior is no longer reinforce as compared to the variables reinforcement(Miltenberger, 2008). Although an overwhelming conclusion cannot be made about these findings due to the inherent limitation of the study, at least it has provided insight into how first timers users of activity trackers can be remotely

reinforced to develop the habit of using activity tracking devices. Also, graphic display appear to demonstrate the robustness of variable reinforcement techniques, shaping and the token economy in instigating and maintaining desirable, healthy behavior for a significant period until the habit was formed. See Appendix D, (Figure 5.3, Figure 5.4, and Figure 5.5)

Furthermore, the negative correlation between Device Type (DT) and Stimulus reinforcers (variable reinforcement schedule, Continuous reinforcement, shaping and token economy) provide an exciting challenge to the wearable activity tracking devices industry (r= -0.25, r=-0.395 and r=-0.434). Indeed, all things being equal, negative correlation implies that if wearable activity tracking devices technology meet the wider customers' satisfaction, the lesser customer will expect external motivation to get them going and the visa versa. Consumers' driven positive marginal utility of wearable devices will enhance long-term engagement. Furthermore, the non-interactive behavioral health intervention technology has been stated elsewhere as low potent in changing unhealthy lifestyles (Piette, 2007). Although the current study homogenized population who focus might be on optimizing their health, the majority of the population who are chronically sick may focus on getting technology like wearable tracking device to get them moving toward positive health outcome rather than extrinsic motivation hence underscoring the impact of activity tracking devices. "Design to be enjoyed" (rebranding) may be a concept this study conceived. Indeed, rigidly designing/developing wearables tracking devices only to count steps, calories, heart rate and sleep pattern might be limited in engagement (Green, 2015). In fact from the

operant conditioning theoretical approach, human beings naturally seek for a positive experience, cues that negatively reinforce or punished are avoided (Miltenberger, 2008 &Thorndike, 1898). With the current wearable activity tracking devices, what will be more enjoyable than the activity tracking devices user being able to have direct voice interaction with the device? (FITBIT Am up!!! Good Job Last night. 90% Quality sleep!!!)(Fitbit-Grocery!!!-Scan as we go!!!!) . Intuitively, ATD users will be highly engaged, and positive health outcome will be emerging.

Integrating Self-Determination Theoretical Perspective

Unhealthy behavioral lifestyle change and sustainability is a major challenge in the mainstream healthcare system. In fact, the situation has been described as 'the healthcare system prescribing failure rather than healthy behavioral change' (Sobel, 2014). Healthy behavioral change can be an epitome for positive health outcome. This study appears to demonstrate that fulfilling the basic psychology needs of competence, relatedness and autonomy in activity tracking devices can facilitate self-propelling for physical activities and ultimately a variety of related health conditions. Activity tracking device as lifetime exercise motivator demonstrated a significant correlation with competence, relatedness, and autonomous variables. For instance, the feeling of competency (provide feedback, set an achievable goal and my device instill confidence) correlated significantly with the perception of my device as life exercised motivator($r=0.497$, $r= .319$ and $r=0.437$) and overall multivariate predictability significant at 0.012. This finding is relevant given the fact that previous studies criticized material incentives in a healthy lifestyle intervention for suppressing long-

term engagement and autonomy (Moller et al., 2014; Segar et al., 2015). This finding is also consistent with the findings that competence premeditates the self-efficacy and autonomy to engage in healthy behaviors (Deci and Ray, 1985, Maarten et al., 2006; Teixeira et al. 2012). For example, exercise achievable goals/ targets/ achievements are likely to be perceived differently by device users and thus either provide stimulating environment for engagement or disengagement. Someone will feel the challenge to do more for falling short of daily step count goal whiles the other is likely to be frustrated.

Furthermore, relatedness provides the feeling of empathy and social engagement hence facilitating for positive environmental healthy lifestyle initiatives. Activity tracking devices obviously constitute the user's environment and the more useful it is to the user, the more successfully in supporting healthy behaviors and ultimately long –term engagement. Provision of social platform, provision of multi-functionality and lifestyle compatibility of activity (adapt to my environment) are important pieces activity tracking device can support physical activities. These variables demonstrated some level of correlation with the activity tracking type and devices usage (r=0.023, r -.0.258 & r= -359) and (r=0.172, r=0.304 & r=0.486) respectively. The low correlation of social platform with device usage and Device Type (DT) has been supported by the previous study conducted by Lee, Drake, Williamson, (2015). The use of social platform for engagement also raise some form of skepticism by activity tracking users due to privacy and confidentiality concerns.

Moreover, uploading of wearable data to the user's' wireless internet database at the background introduce logistical constraint to users without Bluetooth enhanced

devices or schools environment with limited firewall accessibility hence limits social platform engagement (Victor et al. 2105). This limitation is calling for the rebranding of activity tracking device as an independent multi-functional devices. Highly capable activity tracking device housing its' generated bio-feedback data in addition to multi-interactive services ultimately will enhance long-term engagement.

Finally, the need for autonomy is important at individualized healthy initiative level. The SDT posit that fostering an environment to enhance supportiveness will lead to effective self-propel initiative (Hagger, 2015; Deci et al. 1985; Teixeira et al., 2012) This study demonstrated the general responsiveness of activity tracking users along the autonomous dimension variables. The Pearson correlation demonstrated some level of correlation between all variables whiles a multi-regression analysis across variables was also statistically significant (P=0.012). The weak correlation between stimulus-reinforcement techniques and device type, suggests the loop areas ATD developers needs to reconsider. The social platform is an important source of intrinsic motivation, and yet this dimension performed poorly in this study for instance. Individual general needs including the needs for encouragement demonstrated weak correlation with the three major depend on variable (ATD as Lifetime Exercise Motivator, Device Type and Device Usage) suggesting the limited interactive nature of the current activity tracking devices.

USE OF RESULTS

Harnessing the stimulus–response theoretical concept and self-determination theoretical concept can promote the utilization of activity tracking devices and

ultimately enhancing long-term engagement. Given the background that human beings want to change under positive experiences, expanding, branding activity tracking devices into a more interactive platform can enhance long-term engagement. For example, improving social platform utilization through dependable data storage capabilities.

We also implored that understanding the basic psychological needs of individuals through assessment can give relevant information to activity tracking devices developers and other experts on the how to better support individuals' physical activities needs. Sedentary individuals with poor autonomous status can be propelled into physical activities through stimulus –response reinforcement strategies through gradual introduction of S-R reinforcement techniques until replaced with autonomous–supportive motivation strategies. Variable interval reinforcement and Variable ratio reinforcement offer two major opportunity for motivating individuals to active through incentives based of motivation. For example individuals that initiate physical activity can be rewarded at varying period of time (Variable Interval). Reinforcement doesn't rely on the amount of reactions during the intervals. See Appendix G for more details about the robustness of variable interval reinforcement. Also, depending on the attitude of the device user to be active he or she can be motivated by Variable ratio. Client achieving a particular calories burnt level can be rewarded or steps counts.

Furthermore, shaping can be a powerfully tool in a wider population base for physical activity promotion. For example tiered incentive design or multitier incentive an offer innovative approach in promoting employees engagement through physical

activity. Multitier incentive design have been reported for instance to offer participants choices for goal setting and may help shape behavior toward what may be perceived as a ‘difficult goal to achieve” (Norman et al 2015 pg. 1 and Doug, 2015). See Appendix H and J for the resilient nature of shaping and token economy in maintaining activity tracking device usage

Finally, STD has demonstrated to increase commitment level of individuals to healthy lifestyle given the fact there was a significant negative correlation between extrinsic motivation(S-R techniques) and the device type. Technology should therefore not just provides excellent esthetic design, but integrate and model the different individual orientations into autonomous healthy lifestyle. Expanding the frontier of SDT into the technology industry is warranted given its fundamental elements of supporting healthy behaviors intrinsically (Teixeira et al, 2015; Hagger et al, 2014; Teixeira et al, 2012; Silva et al, 2010; Choi et al ,2014).

LIMITATIONS

The study although strived for objective results and possible generalization also encountered some challenges. The target power sample size of 100 fell short to 43 participants. This challenge was anticipated as this study did not have adequate time frame to reach a wider population. Female representation constitutes 67.4% of the respondents making generalization quite minimal. Also, the average age of 22.7 undermined the participant variation. The age and educational may influence the highly

utilization of Garmin watch 220 and 420 which is typical of most young athletes. The homogeneity of the responses undermines the possible generalization of the study.

Furthermore, the significant correlation between variables and multi-variant predictable perhaps need to be studied in a randomized controlled condition. Lack of time and other resources also undermine the extension of the study to the similar organization or perhaps the general public.

FURTHER RESEARCH

More research is needed to cover a larger population for this proposal to be generalized. This study may also be replicated with some revision on the instrument with collaboration with activity tracking developers to a certain possible generalization.

Furthermore the stimulus response theoretical model has been criticized for underestimating the important role of human cognition in decision making process. The social cognitive theory may also be integrated into future research to explore its concepts in enhancing long term utilization of activity tracking device.

SUMMARY

The current low utilization of activity tracking devices has been discussed considerably in this study. Variables association and multi-variance analysis highlighted the importance role of Integrated Stimulus–Response reinforcement technique(S-R) and the Self Determination Theory (SDT) in enhancing long-term utilization of activity tracking device. The study recommends independent multi-interactional platform for activity tracking devices. Further research is also needed incorporating social-cognitive motivational techniques in a wider population based.

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APPENDIX A

Survey Questionnaires

OTTERBEIN UNIVERSITY

General Instruction
This questionnaire consist of a demographic section (a) and a perception questions section (b) respectively. Please answer the following questions about yourself by marking the appropriate box or filling in the requested information.

Section A

Demographic

1) **Age** …….

2) **What is your current level of education?**
   High School…….
   Associate degree…..
   Bachelor Degree….
   Master's Degree /
   PhD……

3) **Gender**
   Male –
   Female ---

4) **How often do you use activity tracking device**
   0/week …. 1/week …. 2/week … 3/week … 4/week… 5/week …. 6/week …7/week...

5) **Which of this activity tracking device do you use?**
a. Fitbit flexible activity wristband
b. Tom- tom runner
c. Garmin Vivofit activity tracker
d. Jaw bone Activity tracker
e. Other (specify)……..

6) **How many minutes do you spend on physical activity per week?**

0-30 … 30-60….. 60-90…. 90-120… 120- 150…. 150 -180…. 180 +……

Section B

PERCEIVED ENVIRONMENTAL SUPPORTIVENESS SCALE

This questionnaire aims to find out how you view you're your activity tracking devices. Using the scale below, please indicate to what extent you disagree or agree with each of the following statements. Please note that there are no right or wrong answers and no trick questions. We simply want to know how you personally feel. Your responses will be held in confidence and only used for our research purposes.

To answer, please CIRCLE the appropriate number beside each statement

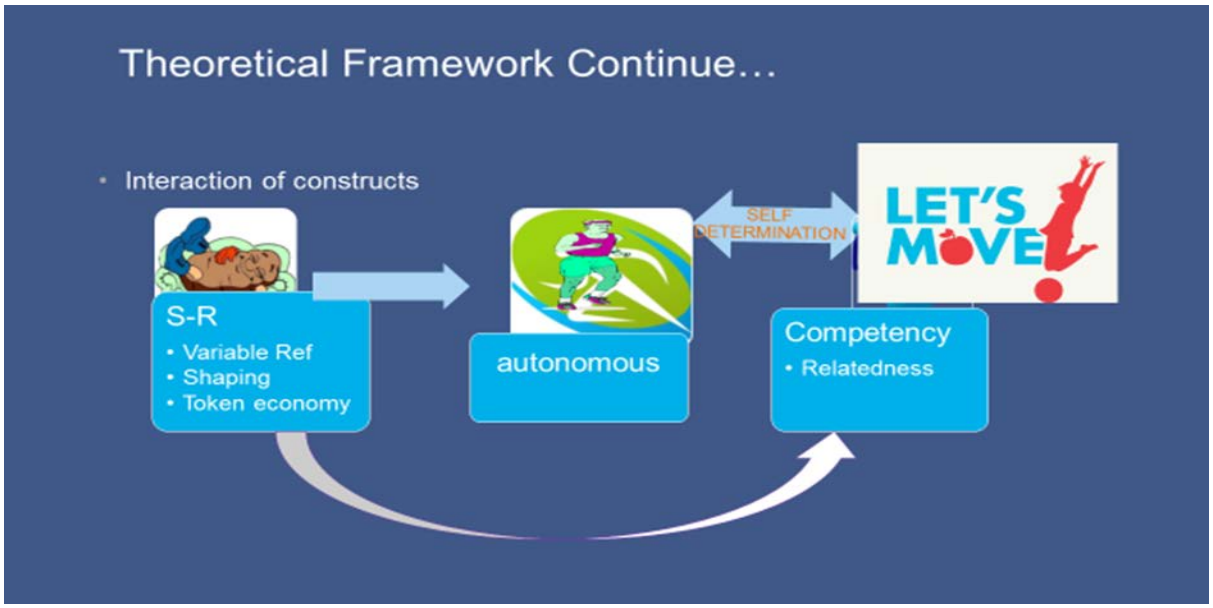
My Activity Tracking device ….	**Strongly disagree**			**Neutral**			**strongly agree**
8. Takes into account my individual needs	1	2	3	4	5	6	7
9. Intermittent rewards make me do exercise all the time	1	2	3	4	5	6	7
10. Provides social platform for sharing my data	1	2	3	4	5	6	7
11. Provides a range of activities and functions	1	2	3	4	5	6	7
12. Sets an achievable goal which keep me moving	1	2	3	4	5	6	7
13. Rewards me in points to do exercise	1	2	3	4	5	6	7
14. Provides me with choices and options	1	2	3	4	5	6	7
15. Provides me feedback on meeting activities goals	1	2	3	4	5	6	7
16. Rewards me at regular interval	1	2	3	4	5	6	7
17. Encourages me to reach a particular goal to get reward	1	2	3	4	5	6	7
18. Suggests exercises that are suited to my level	1	2	3	4	5	6	7

19. Is easy to use	1	2	3	4	5	6	7
20. Is likely to be my lifetime exercise motivator	1	2	3	4	5	6	7
21. Helps me to feel confident about exercising	1	2	3	4	5	6	7
22. Can adapt to my environment	1	2	3	4	5	6	7

Thank you for taking part in my MSAH research project

Appendix B

Figure 5.1 Theoretical S-R techniques and SDT l Frame Work

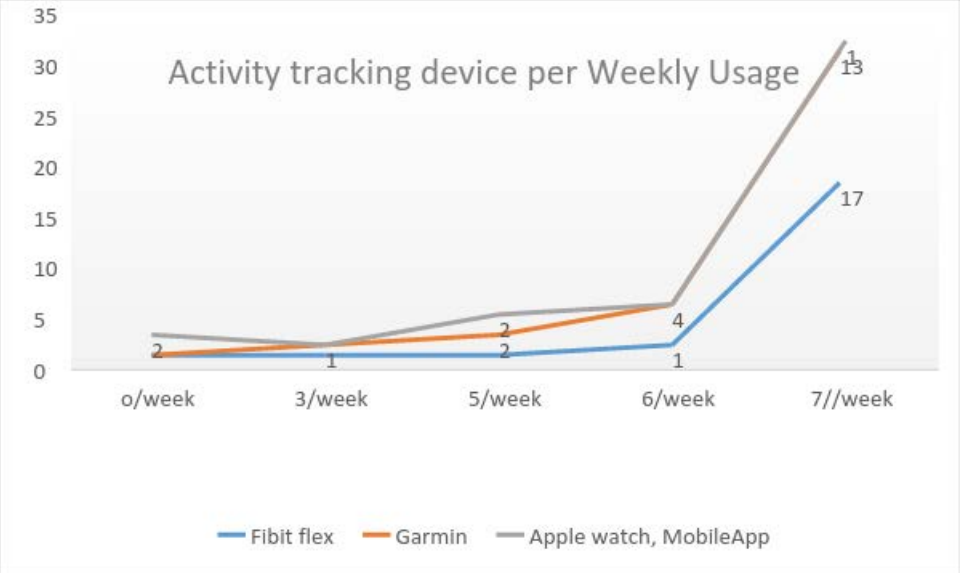


Appendix C

Educational Background

Education	Frequency	Percent
High School	11	25.6
Associate Degree	4	9.3
Bachelor Degree	23	53.5
Master/Ph.D.	5	11.6
Total	43	100

Appendix C


Activity tracking device per Weekly Usage
35
30
25
20
15
10
5
0
o/week
3/week
5/week
6/week
7//week
2
1
2
2
4
1
13
17
Fibit flex
Garmin
Apple watch, MobileApp

APPENDIX D

Table 1.4 Pearson Correlation

Variables	***Lifetime exercise Motivator***	Sig. 2-tail	***Device Usage***	***Sig 2-Tail***	***Device Type***	Sig 2-tail
Device Usage	.407**	0.007	1		-0.448**	0.003
Activeness per Week	-0.07	0.658	-0.051	0.743	0.247	0.111
Individual Needs	0.076	0.626	0.183	0.239	0.034	0.83
Intermittent Reward	.333*	0.029	0.176	0.26	-0.25	0.106
Range Activities	0.298	0.052	-0.013	0.934	0.079	0.615
Social Platform	.356*	0.019	0.172	0.271	-0.023	0.882
Achievable Goal	.319*	0.037	0.104	0.508	-0.1	0.522
Points Reward	.335*	0.028	0.132	0.397	-0.395*	0.009
Provide Choices1	0.254	0.1	.304*	0.048	-0.258	0.095
Provide Feed Back	.497**	0.001	0.425**	0.004	-0.454	0.002
Rewards Me Regular	.520**	0	0.457**	0.002	-0.59**	0
Encourages Me	0.251	0.104	0.104	0.508	-0.432**	0.004
Suggest Exercise	.363*	0.017	0.207	0.182	-0.434**	0.004
Is Easy to Use	.352*	0.021	0.413**	0.006	-0.087	0.581
Life Time Motivator	1		0.407	0.007	-0.294	0.055
Device Type	-0.294	0.055	-0.448**	0.003	1	
Adopt to Environment	.423**	0.005	0.486**	0.001	-.359*	0.018
Feel Confident	.437**	0.003	0.298	0.052	-0.238	0.124

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Table 2.1 Pearson Correlation Coefficient ®
Sample (N) =43

Appendix E

Table 4.4 Multi-linear Regression of 22 item

Model	R	R Square	Adjusted R Square	Std. Error Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.844a	0.712	0.45	1.41342	0.712	2.719	20	22	0.012

A. Predictors:
B. Dependent Variable: Life Time Exercise Motivator

Appendix F

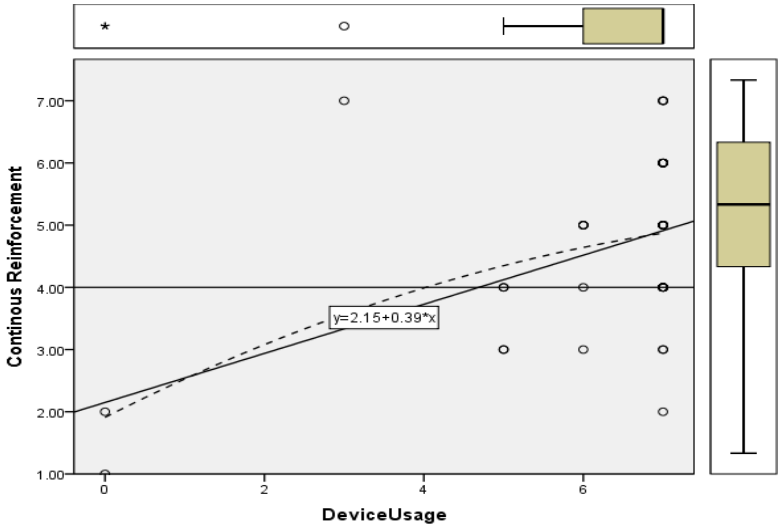


Figure 5.3 Continuous reinforcement

Appendix G

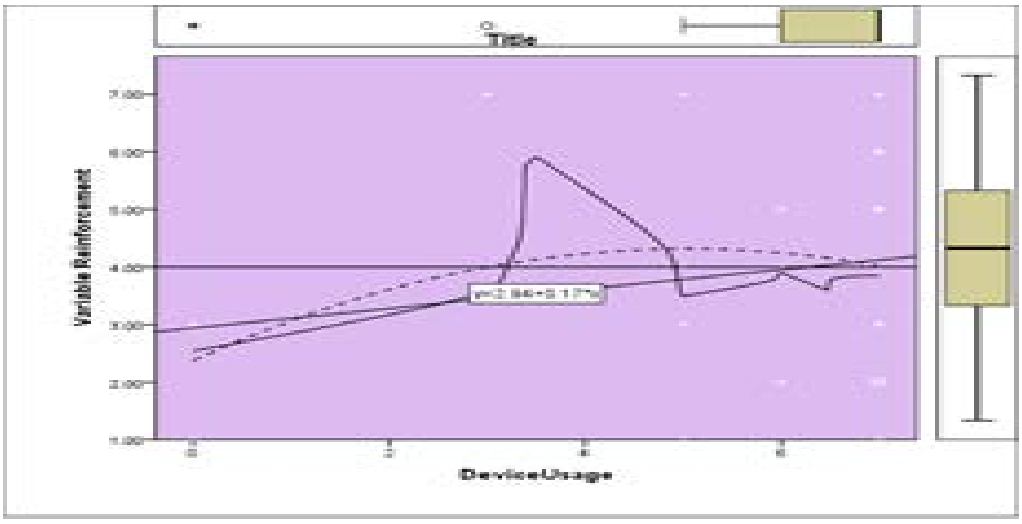


Figure 5.4 Variable Reinforcement and Device Usage

Appendix H

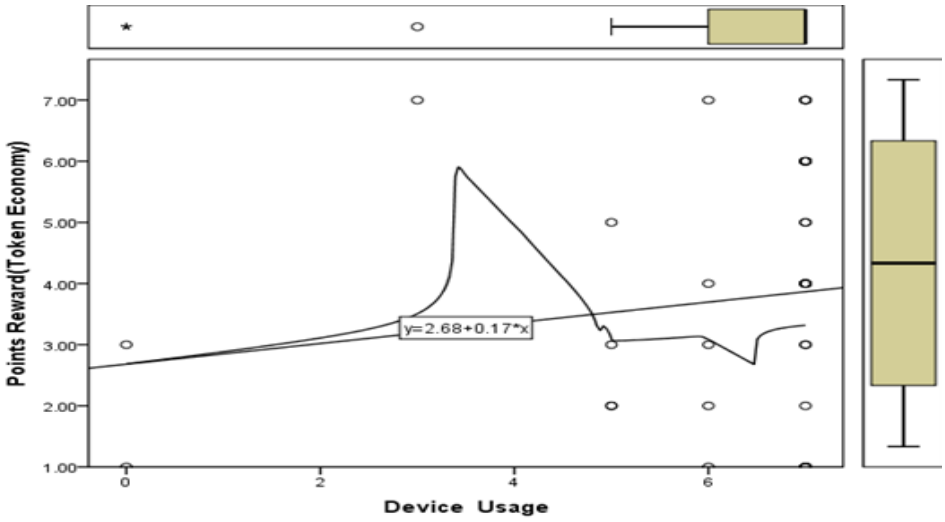


Figure 5.5 Points Reward and Device Usage

Appendix J

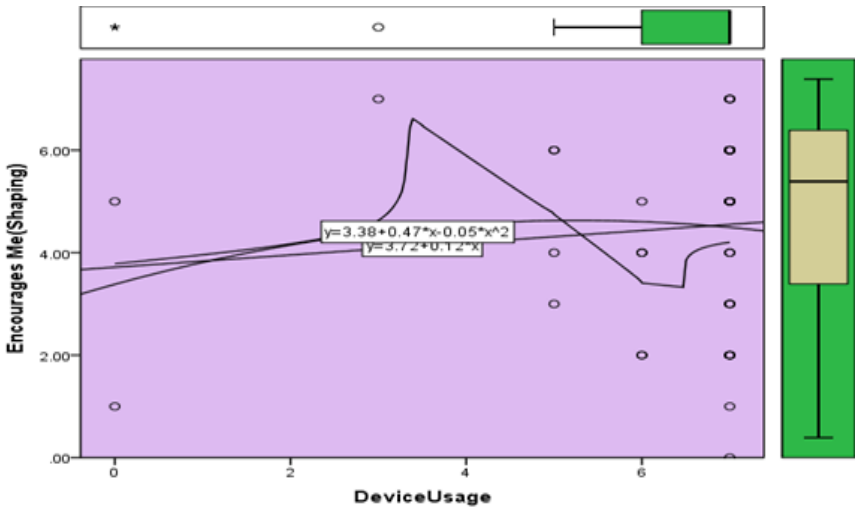


Figure 5.4 shaping reinforcement