Factors Affecting Behavioral Change through the Use of Computer-Mediated Technology

by

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ABSTRACT

This study explores the impact of feedback and feedforward and personality on computer-mediated behavior change. The impact of the effects were studied using subjects who entered information relevant to their diet and exercise into an online tool. Subjects were divided into four experimental groups: those receiving only feedback, those receiving only feedforward, those receiving both, and those receiving none. Results were analyzed using regression analysis. Results indicate that both feedforward and feedback impact behavior change and that individuals with individuals ranking low in conscientiousness experienced behavior change equivalent to that of individuals with high conscientiousness in the presence of feedforward and/or feedback.

DEDICATION

As I began my coursework in this doctoral program, a mentor told me that completion of the program would be lengthy, and not to be so focused on completion of the work that I let life pass me by. I followed this advice, becoming so focused on living my life that I nearly let my dissertation pass me by. I do not regret this, for the relationships and experiences I have had along the way are ones that I will cherish forever. During my time working towards completing my doctoral thesis, I have met and married my wife Katherine, experienced the birth of my son Cameron, and will soon experience the birth of my daughter, Ava. I dedicate this work to my lovely wife and kids. All that I do is for them.

ACKNOWLEDGEMENTS

I would like to thank Dr. Robert St. Louis for all of his help, encouragement, and patience in helping me to finish this work. Thank you also to Dr. Michael Goul and Dr. Benjamin Shao for all of their input during the process of completing the work.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Chapter 1

INTRODUCTION

Influencing an individual's behavior has been an area of interest in a number of different fields for many years. One could argue that a functioning society depends on the ability of a few people to influence the behavior of many. Indeed any functioning organization relies on the ability to influence human behavior in order to operate in a particular manner. Military leaders must influence their soldiers to go against many of their own instincts, put their lives at risk in order to serve a higher purpose. Being able to do so is not a trivial matter, and indeed much time has been invested in developing techniques and strategies for influencing the behavior of soldiers. Alexander's refusal to drink water offered to him by his soldiers was not a reflection of his great empathy but rather a calculated move to motivate his soldiers to follow him into battle when resources were very scarce. His success and his failure were both tied to his ability to influence the behavior of his soldiers.

Politicians attempt to influence the voting behavior of their constituents in order to stay in office. There are millions of dollars spent in every campaign on experts who have studied all the methods of influencing voting behavior. Surveys, focus groups, political ads are all created to influence behavior. Constituents also attempt to influence the behavior of politicians through the formation of special interest groups and lobbyists. Often, such practices employ monetary techniques, and often these practices involve simpler techniques. Grover Norquist has been able to influence a number of politicians to avoid raising taxes through something as simple as a pledge, an idea that he came up with at 12 years of age, which is more indicative of the simplicity of the idea than of the advanced intelligence of Mr. Norquist.

Educators are constantly concerned with how to influence the behavior of their students. Parents are always trying to affect the way their children behave. Correctional facilities face challenges each day in controlling the behavior of their inmates. Employers are always seeking out ways to influence the behavior of their employees. The list goes on and on. We are all involved on either side of forces that are intended to influence behavior. In almost every moment of our lives, we are simultaneously involved in an attempt to influence another's behavior and in having another individual or entity try to influence our behavior.

Former president Bill Clinton once said in an interview that he was confident if he could sit down with every voter in the country, he would win 100% of the popular vote. In saying this, he touched on something with implications that are very important in the area of information systems. Many leaders may feel the same way about their abilities to influence people's behaviors. But of course President Clinton could not sit down and meet with every voter in the United States, and neither can most leaders have a one on one relationship with the people they wish to influence. To put this in the language of agency theory (JensenEtAl1976), to attempt such a thing would be to raise monitoring costs to a level that would make it impractical for the principal to carry out his duties while also trying to ensure that the agent does as the principal desires. Principals must therefore rely on other techniques to influence the behavior of the agents with whom they have established relationships.

The dissemination of information to individuals is absolutely necessary when the number of people over whom an individual wishes to exert influence exceeds the number of people with whom that person can realistically communicate face to face. This of course is why mass media is so widely used by anyone wishing to influence a large number of people, because it allows a message to be distributed

without having to visit people individually to exert influence over them. Television allows an influential person to use persuasive abilities to move a person to do one thing over another. However, television lacks a very important feature which is present in face to face communication: it is not interactive, and so does not allow a persuasive individual to use all of his or her abilities to be persuasive. There is an inverse relationship between the amount of individual time a person can dedicate to someone whose behavior he is trying to change, and the number of people that can be persuaded. The more time a person can dedicate to one individual, the more likely he is to be able to influence that person. The less time a person can dedicate to one individual, the more people he can attempt to persuade.

To compensate for this problem, marketers and politicians attempt to appeal to certain demographics. They try to segment the population into groups that think one way or another and communicate messages to each demographic to try and influence their behavior. This approach has limited use in influencing one's behavior because it can only be used to influence people's behaviors in making fairly simple decisions: "Vote for this candidate. Buy this sneaker. Ask your doctor about this drug." However, many behaviors are not so simple. Many behaviors may involve organizational or societal goals whereby the path to achieving such goals is not so simple and may require someone to continue to behave in a certain way in order to help an organization or society accomplish a certain goal. Often it is the case that the immediate effects of a given behavior may be very appealing to an individual, while the longer term effects of another behavior that is sustained over a longer duration will have better benefits to the individual as well as to the organization.

A mid-level manager in a large organization may see more benefit to using workers' time by encouraging them to churn out more product rather than to spend

time refining processes which may improve efficiencies, thereby increasing output in the long term. Taking resources away from production to focus on refinement of processes will have a negative impact on short term production, but a positive impact on longer term production. A manager may not see this especially if he is only a few widgets away from managing the top production unit this month. It is important that this manager, and others in similar situations, be provided information which can encourage them not only to behave in the best interests of the organization, but to see how changing their behavior would also be in their own best long term interests.

Information systems provide a potential solution to this type of problem. Providing information to people while making behavioral decisions can affect the manner in which they behave. Providing information at the point at which any given behavior is being carried out, could make the outcome of the behavior more salient and will be likely to influence the behavior itself. A person who could see his credit card balance every time he made a purchase would likely decrease his use of the card. Customers of the electric company would likely decrease the amount of electricity they use if they could receive a projection of their electric bill based on current use each month. An overweight person may change his eating habits if each day he could see the future effects of the food he has consumed.

Information systems provide two important advantages over face to face interaction with respect to influencing human behavior: 1) As discussed, they provide the ability to reach many more people than could be reached with face to face interaction, 2) they have the ability to provide information regarding current behavior and the potential outcomes of that behavior at a speed which would be much more difficult for a human to provide. For this reason, information systems may play a key role in influencing the behavior of individuals in the coming years.

Individuals often weigh the benefits to be gained from any behavior against the cost of carrying out that behavior. This is related to the concept that has received some attention in decision support literature, that of effort vs. accuracy. The concept is that decision strategies which yield better or more accurate results, often require greater effort on the part of the decision maker. Individuals tend to avoid spending more effort on anything, and thus often adopt decision strategies which yield less accurate results, leading to poor decision making. Research in this area has shown that salience is an important factor in affecting the decisions people make. Saliency is a factor which can compensate for a person's natural tendency to stick to a strategy which requires less effort. If the outcomes of a decision that requires more effort are made more salient, then an individual is likely to invest more effort in decision making and make a decision that yields better accuracy, even while requiring more effort.

Cognitive feedforward may play an important role in making the outcomes of a given behavior more salient. Feedforward is information that is provided to an individual before a specific decision is made about the outcomes of that decision. This is different from cognitive feedback, which is information that is provided after a decision has been made which also has to do with the outcomes of that decision. Because it is being provided before the decision is made, feedforward is likely to have a larger impact on decision making than feedback.

In this study, an attempt is made to understand more about the relationship between feedforward and behavior, and also the impact of the effects of feedforward relative to feedback. In order to do this, it was necessary to find a behavior in which immediate decisions could have long term effects, and behavior which made it possible to observe the impact of feedback and feedforward. It was also necessary to find a behavior in which the benefits of short term decisions

were in conflict with that of long term effects. That is to say that decisions which would require less effort or would be more beneficial in the short run, would have poor long term outcomes. Weight loss behavior seemed to meet these criteria.

There are two types of behavior in which a person engages every day that affect weight loss or weight management. These two behaviors involve the consumption of food, and the expenditure of energy through physical activity. In either case, decisions that require less effort in the short run have poor long term outcomes. Spending less time exercising of course takes very little effort, but leads to weight gain. Spending less time planning out meals and counting calories and eating healthy takes less effort, but leads to poor long term outcomes or weight gain. There also seems to be a large concern among many people regarding the effects of weight gain on society, and there seems to be an abundance of people in the United States that could benefit from improving weight management strategies, leading to a large potential subject pool for the study.

To study the effects of cognitive feedforward and cognitive feedback on weight management behavior, an application was designed which would provide people with information regarding their weight management behavior. The application allowed for people to enter in the types of food they consume each day, and the types of activities in which they engage each day. The application then provided information to the individual regarding their weight management behavior. Information was in the form of cognitive feedfoward, cognitive feedback, both, or neither depending on the experimental group into which the given individual was placed. Analysis was then performed to determine if any differences in food consumption or physical activity were observed over the course of using the application between the four study groups.

Chapter 2

THE SCIENCE OF BEHAVIOR CHANGE

2.1 Classical Conditioning

Some of the earliest documented and perhaps most well known research on human behavior was conducted by Ivan Pavlov. Although Pavlov's earliest work focused on human digestion, this branch of research later led him into the area of psychology, where he performed groundbreaking work that influenced research in the area of human behavior for years to come. Pavlov studied what was termed an "unconditioned reflex" which is the nervous system's response to a stimulus. The particular stimulus he was studying was the insertion of food into a dog's mouth, which produced a flow of gastric juices to help with the digestion of the food. What Pavlov discovered is that if food is inserted into a dog's mouth alongside another stimulus, in particular the ringing of a bell, that the dog would come to associate the ringing of the bell with the insertion of the food, and begin salivating before the food is inserted into the mouth. This became termed a "conditioned response" and is the work to which people refer when they speak of Pavlov's Dog (Barnett, 2006). Pavlov's work on conditioned responses was first presented in 1903 and continues to influence researchers in psychology today.

2.2 Behaviorism

It seems that the birthplace of applied psychology may have been in the work of John Watson. Dr. Watson was a psychologist and professor at Yale University. He emphasized the importance of objectivity in psychology, which was in his view missing from the field at the time. He established the concept of behaviorism. Behaviorism, as he describes, is the study of what people do (Watson, 1925). Behaviorism is largely the study of cause and effect, of stimulus and response.

Watson's view in the establishment of behaviorism was that the purpose of psychological review should be to understand the factors that predict human behavior. Watson stated that all science starts with observation of happenings in nature. The next stage beyond observation, he says, is to attempt to get control of these happenings. That is, the knowledge gained from understanding nature is then used to influence nature. Watson couched behaviorism as a divergence from prior studies in subjective psychology.

Watson also pointed out, building on what Pavlov had discovered, that there are innate responses to stimulus, and there are conditioned responses. These conditioned responses are not only biological in nature as with the salivating of the dog, but psychological. Humans learn about outcomes of specific stimuli and depending on the outcomes of those stimuli, they learn to respond in specific ways. This concept has implications in the modification of human behavior. If individuals can be conditioned to act in certain ways, then human behavior can be shaped under the proper conditions. It was Watson's belief that most of human behavior is not innate, but rather shaped by surroundings. Nurture plays a larger role than nature in influencing the behavior of humans, that is the central theme of behaviorism. (Watson, 1925)

2.3 Social Learning Theory

Social learning theory is an important behavioral theory which has been built upon my different researcher over the year. Although its name implies that it is more about learning than about behavior, the theory ties learning to behavior and emphasizes that all behavior is learned and that human behavior is tied to the manner in which people learn. Although there are other researchers that have

contributed to social learning theory, this paper will focus on those contributions made by Neal Miller and John Dollard, Julian Rotter, and Albert Bandura.

Miller and Dollard's Fundamentals of Learning

The establishment of the Institute for Human Relations made headlines in many news periodicals in 1929 including Time Magazine and The New York Times. It was established by Yale's president, James Angell that same year with the intent of creating an approach toward understanding human behavior that would integrate knowledge from a number of different fields including biology, psychology, sociology, economics and physics (Morawski, 1986; Angell, 1929). Among the researchers hired by the institute in the area of psychology was Clark Hull, who discussed ideas with others to offer perspectives on psychology that would alter views of the field in the same way that work in the area of quantum mechanics had altered the field of physics (Morawski, 1986). Under Clark's general leadership two psychologists, Neal Miller and John Dollard began conducting experiments to understand how human behavior was shaped. Their work focused on the idea that behavior is shaped through imitation, and that imitative behavior itself is learned (Miller and Dollard, 1941). Miller and Dollard postulated that to understand or predict behavior, one must understand the principles involved in learning and the conditions under which learning take place. Their work builds on the work of predecessors, further helping to understand the relationship between stimulus and response that is so important to understanding human behavior. Miller and Dollard in their work identified four different factors which affect the way that people learn behavior. Those four factors are: Drive, Cues, Response, and Reward.

Drive

Drive is that factor which moves a person to respond to any stimulus (Miller and Dollard, 1941). If one does not have drive to learn, then one will not learn. There must be some reason that a person wants to alter his or her behavior, some end that one wants to reach or goal one wants to accomplish. This is perhaps the most simple factor that one focuses on when thinking of how to modify behavior.

Miller and Dollard discuss two different types of drives: primary drives and secondary or acquired drives. Primary drives are driven by the most innate human needs. It seems that primary drives are very much tied to physical feelings which anyone would feel from the time of early childhood. Primary drives are associated with anything that causes physical pain or pleasure. Any object or physical thing which could be acquired to extinguish pain or encourage pleasure or do both simultaneously would be something that would drive a person towards a specific behavior. Food is perhaps one of the earliest things that drove humans to learn. The avoidance of heat or cold would be another. (Miller and Dollard, 1941) Secondary drives are acquired drives that do not directly serve our innate needs, but serve them indirectly because of social structure. Indeed, many secondary drives exist to suppress or control primary drives in order to create a society which will function in a desired way. Perhaps the most recognized and most powerful secondary drive is the drive for the acquisition of money. Money serves to satisfy nearly all primary drives and indeed many other secondary or acquired drives as well. It certainly serves to satisfy the drive of hunger, the desire to be physically comfortable and to experience physical pleasure. It also serves to establish prestige, recognition, and admiration, which are other secondary or acquired drives. This is why the most common drive in society for encouraging a specific

behavior is money. Much of human behavior is affected by the drive to acquire money. In looking at the manner in which most people occupy their time, one could certainly explain most of it by the desire for money. The reason that most people get into a car every day and drive away from their families to spend time with people that they may not care to spend time with otherwise, is because they know that at specified time intervals, they will receive a given amount of money as long as they continue to do so.

Cues

A person is presented with many cues during the course of a day. Cues are stimuli which will lead a person to respond in a certain way. Cues act on drives. Miller and Dollard emphasize that cues vary in strength and in kind or distinctiveness. A loud sound may encourage someone to immediately move or to find its source to stop the sound. A peculiar sound may mean nothing initially, unless someone learns that this peculiar sound comes from a particular place or leads to an event which will satisfy a drive. Cues lead people to respond to their environment, and the manner in which they respond is another important factor in the learning process.(Miller and Dollard, 1941)

Response

Response is the action that people take when a cue is encountered. Cues are often presented in such a way to elicit specific responses. However, there are limitless possible responses to any given cue. This is why it is important to think carefully about designing appropriate cues when trying to evoke a certain behavior from any individual. One must take care to ensure that the desired response is likely to occur with a high enough probably that a reward may be given for the desired response in order to encourage the desired behavior (Miller and Dollard,

1941). Miller and Dollard discuss a hierarchy of potential responses, which evolve and change as rewards are given to encourage certain responses over others. A hierarchy of responses involves a range of potential responses whose likelihood is determined through observation. The most likely response to any given cue is called the dominant response and the least likely is referred to as the weakest response. An initial hierarchy or innate hierarchy is the hierarchy that exists without any influence of reward. It is only intuition that influences this hierarchy. As individuals are rewarded or punished for engaging in one response over another, the order of responses with respect to their likelihood of occurrence changes. This leads to what Miller and Dollard call a resultant hierarchy. It is here that imitation becomes very important. Imitation influences the initial hierarchy, moving the likelihood of occurrence of the response which will yield a reward higher in the initial hierarchy or responses. An individual who has seen a given behavior performed by another before is much more likely to succeed in receiving an award than is an individual who is encountering something for the first time without ever having seen it. One who is thrown onto a football field without ever having seen a game of football will only learn after being hit several times how the game is played. One who has been watching football for years is likely to have a higher success to hit ratio.

Reward

Reward is what determines whether or not a response to a cue will be repeated. The probability of re-occurrence of any given behavior will be inversely proportional to whether or not a reward is given for that behavior. Reward is what alters the hierarchy of responses to any cue. On each subsequent iteration of being presented with a number of cues, the dominant response will become the weak response or will be discarded altogether if no reward is received for carrying it out.

Reward is directly related to drive, and indeed serves to decrease drive. Once the reward is received, the drive is satisfied, if only temporarily. Reward is an important key to learning. Without reward, no learning will take place. Encouraging behavior requires the offering of a reward for that behavior, and discouraging behavior requires the removal of awards for that behavior. (Miller and Dollard, 1941)

Rotter's Social Learning Theory

The work by Miller and Dollard produced a valuable framework for understanding how learning occurs, and hence how human behavior is shaped. The work was built upon later. Social learning theory began to take shape with work done by Julian B. Rotter. Rotter was a student of Alfred Adler, who was professor of medical psychology at the Long Island College of Medicine and who greatly influenced Rotter's work (Rotter, 1982). Adler's work also dealt with the study and understanding of human behavior.

Rotter set forth seven principles or postulates deemed to be important in the study of human behavior. These postulates are listed below (Rotter, 1954).

1. The unit of investigation for the study of personality is the interaction of the individual and his meaningful environment.
2. Personality constructs are not dependent for explanation upon constructs in any other field (including physiology, biology, or neurology). Scientific constructs for one mode of description should be consistent with constructs in any other field of science, but no hierarchy or dependency exists among them.

3 Behavior as described by personality constructs takes place in space and time. Although all such events may be described by psychological constructs, it is presumed that they may also be described by physical constructs as they are in such fields as physics, chemistry, and neurology. Any conception that regards the events themselves, rather than the description of the events, as different is rejected as dualistic.

4 Not all behavior of an organism may be usefully described with personality constructs. Behavior that may usefully be described by personality constructs appears in organisms of a particular level or stage of complexity and a particular level or stage of development.

5 A person's experiences (or his interactions with his meaningful environment) influence each other. Otherwise stated, personality has unity. New experiences are a partial function of acquired meanings, and old acquired meanings or learnings are changed by new experience. Perfect prediction of acquired behavior would ideally require a complete knowledge of previous experience.

6 Behavior as described by personality constructs has a directional aspect. It may be said to be goal-directed. The directional aspect of behavior is inferred from the effect of reinforcing conditions.

7 The occurrence of a behavior of a person is determined not only by the nature or importance of goals or reinforcements but also by the person's anticipation or expectancy that these goals will occur.

Rotter's principles 5 - 7 are of particular interest to this work, and also clearly related to prior work. Principle 5 is closely related to the concept of the response hierarchy proposed by Miller and Dollard. That an individual's experiences influence each other explains why the hierarchy of responses would change in response to what happens when certain behaviors are followed in response to certain cues. Principle 6 is related to the concept of drive in Miller and Dollard's work. The idea that all behavior moves an individual toward a goal is similar to the concept that all individuals act in order to satisfy a drive. Principle 7 is related to the concept of reward in Miller and Dollard's work. A person's behavior is shaped by what they expect to happen in response to given behaviors.

Rotter also proposed some basic concepts important to social learning theory. Among these concepts were three constructs to be used in prediction and measurement of human behavior. These three concepts are behavior potential, expectancy and reinforcement value (Rotter, 1954).

Behavior Potential

Behavior potential is the likelihood of any behavior occurring in response to any given stimulus or reinforcement (Rotter, 1954). It is very similar in concept to Miller and Dollard's hierarchy of responses. Rotter also discusses the importance of behavior potential changing in response to reward or reinforcement.

Expectancy

Expectancy is the perceived likelihood by a person that a reinforcement or reward will be the result of any particular behavior (Rotter, 1954). This is a concept that must have existed in the work of Miller and Dollard but was not explicitly mentioned. Miller and Dollard spoke of response and that response is affected by

reward. Rotter emphasizes that it is the expectation of reward or what he terms reinforcement that actually influence the actions people take in response to cues from the environment. As also noted in Miller and Dollard's work, expectancy is affected by reinforcement.

Reinforcement Value

Reinforcement value is the degree of preference for one reinforcement over others given equal expectancy of the reinforcement (Rotter, 1954). Rotter emphasized that a given action is affected both by reinforcement value and expectancy. If one behavior has the potential to lead to a very large reward, but the likelihood of receiving that reward is very small, the behavior may not be favored over one which has a much higher probability of leading to a smaller reward.

One important distinction between Rotter's work and that of Miller and Dollard is that Rotter did not believe that individuals act to reduce drives, but rather carry out goal-directed behavior. Rotter stated that behavior of an organism has directionality (Rotter, 1954). This goal-directed behavior is learned and individuals judge the value of reinforcements in relation to each other with respect to the extent to which each reinforcement helps lead them toward a goal. This, Rotter believed, may help to explain why sometimes primary drives are completely abandoned, a behavior which may seem paradoxical in the absence of a larger goal. Some individuals may starve themselves, abandoning the hunger drive, in order to accomplish another goal.

Bandura's Social Learning Theory

Albert Bandura was a Canadian psychologist and professor at Standford University, where in the early 1950s he began doing some research with Robert

Sears involving the development of aggressive behavior in children (Bandura, 2005). Bandura challenged the notion that behavior was motivated by internal drives. His theory followed the view that behavior is a learned process mostly influenced by external forces, and not internal drives. Bandura believed that individuals learn by response consequences. Response consequences are similar in notion to Miller and Dollard's Response and Reward factor and Rotter's Reinforcement value concept. The concept is that people's responses to events have consequences, and that the consequences allow people to choose one behavior over the other. Bandura elaborated on the concept, providing three functions of response consequences: informative function, motivational function, and reinforcing function. (Bandura, 1977).

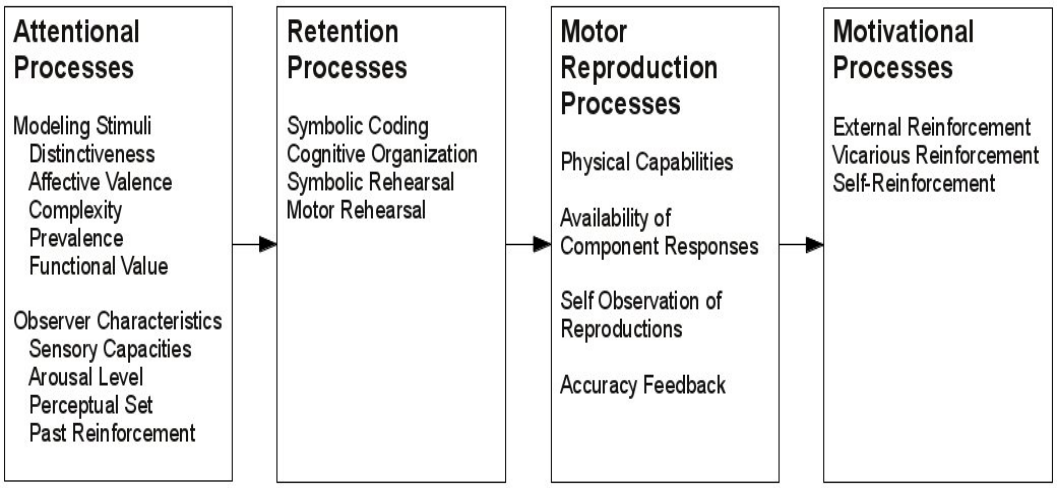
People receive information as a result of every response they take to an event, and so there is an informative function to response consequences. Individuals are constantly gathering and processing information regarding outcomes of their behavior(Bandura, 1977). Bandura seems to combine the concepts of Response hierarchy and Reinforcement Value, stating that individuals gather information about consequences, and not only engage in behavior that has shown them success in the past, but engage in behavior that they believe is likely to benefit them in the future, based on beliefs formed from information gathered about past consequences.

Motivational function is the anticipation of future events that affect current behavior. Individuals are constantly learning about their environment and know what will happen in the future, and what can be done in the present to benefit them in the future. This, Bandura states, is why people buy insurance before catastrophe, because they are able to anticipate what may occur in the future based on their knowledge of their own environment (Bandura, 1977).

Social Learning Processes

As other researchers before him, Bandura recognized that there is a reinforcement function to learning. Individuals receiving reward for one behavior are likely to engage in that behavior. Bandura, however, emphasized that reinforcement is more likely serving a regulatory role rather than a strengthening role in the control of behavior (Bandura, 1977). Bandura believed that reinforcement served mostly to regulate behaviors that already exist, but are mostly inefficient in creating new behaviors (Bandura, 1977). This is why individuals do not rely solely on reinforcement and on consequences of responses when learning how to behave. Observational learning, therefore, is what influences behavior most, and according to Bandura's social learning theory, is governed by four component processes (Bandura, 1977). These processes are illustrated in figure 2.1 below, from Bandura's 1977 publication of Social Learning Theory (Bandura, 1977). Bandura also identifies characteristics of events which are more likely to be modeled as well as characteristics of observers which make them more likely to model events.

Figure 2.1: Processes of observational learning (Bandura, 1977)



Attentional Processes Individuals learn when they are attentive towards modeled behavior and perceive it accurately (Bandura, 1977). Associational patterns are a very important attentional determinant. The social structure within which one lives, the people with whom one interacts, all affect the types of behavior to which one is likely to turn one's attention, and therefore affect the type of behavior that is likely to be modeled. Characteristics of a behavior which affect whether or not it is likely to be modeled are: salience, affective valence, complexity, prevalence, and functional value. An event which is not salient is not likely to capture the attention of anyone and therefore will not likely lead to them modeling the behavior. Affective valence refers to the attractiveness of an event. An event which has a pleasant effect is more likely to be modeled than one which has a negative effect. Complexity can also affect the extent to which a behavior is modeled. Simple behaviors are more easily imitated and therefore more likely to be modeled than ones which are very complex. Behaviors which are more prevalent are more likely to be modeled because they are observed more often

and therefore deemed perhaps to be more important than those which are not. Functional value is of course important because any behavior which has obvious benefits will be more likely to be modeled than one which does not. Observer attributes may also affect their ability to pay attention to any given modeled behavior. Such attributes include: perceptual capabilities, perceptual set, cognitive capabilities, arousal level, and acquired preferences. Cognitive capabilities, perceptual capabilities and perceptual set are all closely related. Perceptual capabilities will mostly be affected by what an individual has already been exposed to, or the perceptual sets one already contains within memory. This of course is also affected by cognitive capabilities, or the ability to process information to which one is exposed, thus forming perceptions of one's environment. Arousal level is shown to affect whether or not one will pay attention to any event which could potentially be modeled. This is precisely why advertisers attempt to produce visual and audio stimulation that arouse awareness of potential customers. Finally, all individuals throughout life are prone to acquiring preferences for certain behaviors over others. Some may be more interested in sports, some in music. Hence, one's preferences will determine the amount of attention they dedicate to one behavior over another.

Retention Processes In order to be able to model a behavior, one must be able to remember how that behavior is performed (Bandura, 1977). Bandura's social learning theory posits that individuals remember things in symbolic form, and that there are two symbolic representations upon which people rely to remember things: imaginal and verbal. At a young age, people mostly rely upon imagery to remember things, not yet having developed verbal skills. Adults are able to translate images into language and vice versa, in order to enhance memory and learning. This is the process of symbolic coding. During the retention process,

observed behaviors are coded symbolically and then the sets of symbolic codes are organized in some fashion (cognitive organization). Once behaviors are represented by images or words, they must be rehearsed in order to aid in their retention. This rehearsal takes place mentally and physically. Cognitive rehearsal is the mental rehearsal of a coded behavior. Much research has shown that cognitive rehearsal enhances physical or enactive rehearsal. An individual's cognitive skills will directly affect his ability to translate an observed behavior into coded form. The cognitive structures that already exist from observation of previous or related behaviors will also affect one's ability to translate observed behaviors into coded form.

Motor Reproduction Processes Motor reproduction is the conversion of symbolic representations of behavior into physical performance of that behavior (Bandura, 1977). Bandura emphasizes that this is a process that is refined by performing the behavior and most importantly receiving information about how the behavior is being performed in order to refine and improve upon the behavior to model it accurately. The ability to reproduce motor processes is going to be affected by a person's physical capabilities, as well as the availability of component responses. That is, some behaviors involve the integration of smaller components. If one possesses all of the components that make up a more complex behavior, one will be capable of integrating them together to perform the more complicated behavior. If not, then one must go back and fill in the missing gaps. Observation of one's behavior and accurate feedback about the behavior also affect whether or not it will be modeled correctly.

It is this concept of receiving information and refining behavior that is most important to the work being discussed in this paper. It is this concept that brings

psychology and information systems to an intersection that has been of interest to researchers in both fields and, as will be discussed further, has led to concepts such as cognitive feedback and feedforward which are most relevant to the work discussed in this paper.

Motivational Processes

Finally a behavior is more likely to be modeled if it is rewarding or results in less punishment than other behaviors (Bandura, 1977). This is perhaps the process that is the most obvious and commonly understood process, but perhaps the most over-emphasized of the four processes. People tend generally to think that motivation is the only thing driving people to behave a certain way or to learn a certain behavior. Bandura points out that all of the processes are important to learning, and that a failure to learn is not necessarily caused by a failure to motivate but rather could be because an individual is not properly exposed to the behavior, not properly coding that behavior into symbolic form, or has a physical hindrance to performing that behavior. Bandura discusses three types of motivational reinforcements: external, vicarious, and self-reinforcement which are discussed further in section 2.4.

Cognitive Control

Another important concept from Bandura's social learning theory is of expectation of reward having more direct influence than actual reward itself. Because learning to model behavior occurs before being rewarded, it is the anticipation of the reward that actually has influence on the learning process. Bandura points out that learning is achieved "more effectively by informing observers in advance about the benefits of adopting modeled behavior than by waiting until they happen to imitate a model and then rewarding them for it" (Bandura, 1977).

Anticipated future outcomes serve to motivate people in their current behavior. Further, individuals may also set goals which they wish to achieve and will adjust their behavior based on whether or not the behavior is leading them towards accomplishing a goal they have set. Bandura discusses the concept of goal proximity, that is how near in time a person is to achieving a goal they have set. Goals which have immediate consequences motivate people more in their current behavior than those goals that have more distant consequences. This raises the importance of setting subgoals, which are smaller goals that can be accomplished more immediately that will help towards accomplishing a more distant goal (Bandura, 1977). A student working on his Ph.D., for example, may set a goal to read two papers by the end of the day as a subgoal towards helping achieve the longer term goal of attaining the degree.

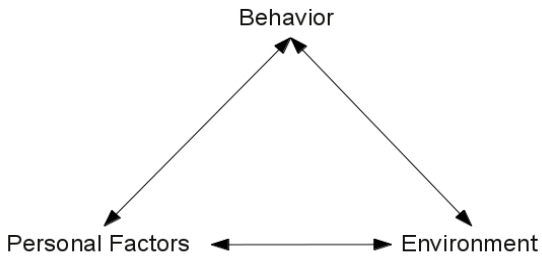
Research dating back prior to Bandura's work on Social Learning Theory has shown that information provided to people about how they will be rewarded will affect their behavior, even if they are all being rewarded the same way (Bandura, 1977; Kaufman et al., 1966; Dulany, 1968). Outcomes that lie in the distant future are often affected by a number of things, and determining what current behaviors might affect those future outcomes is often complicated, and therefore people rely on information to help them determine which current behaviors may lead to those outcomes. Again it is important to note that this is where information systems and learning theory intersect.

2.4 Social Cognitive Theory

Bandura's concepts related to human behavior were originally presented and labeled in the context of social learning and he himself referred to the theory he had laid out as social learning theory. Bandura believed the theory to have a

broader scope than simply learning and also differentiated his concept of learning from that of response acquisition to that of “knowledge acquisition through cognitive processing of information” (Bandura, 1986). He later built upon his original ideas and labeled his new theoretical framework *Social Cognitive Theory*. A central theme to social cognitive theory is that it views behavior as being part of a triad in which all parts of the triad have reciprocal effects on one another (Bandura, 1986). This triad is shown in figure 2.2 below and shows that human behavior, cognitive and other personal factors, and environmental influences all act on and are influenced by each other.

Figure 2.2: Triad Reciprocality of Social Cognitive Theory (Bandura, 1986)



Bandura’s Social Cognitive Theory also analyzed rewards or incentives in more detail than had been done previously. He looked at incentive systems that were based on external, vicarious, and self-produced outcomes.

External Outcomes

Social Cognitive Theory focuses on the effects of both extrinsic and intrinsic incentives on behavior. As shown in figure 2.3 below, Social Cognitive Theory breaks down intrinsic and extrinsic motivators based upon both the locus or source of the reward, and its contingency or relationship to the outcome. Extrinsic

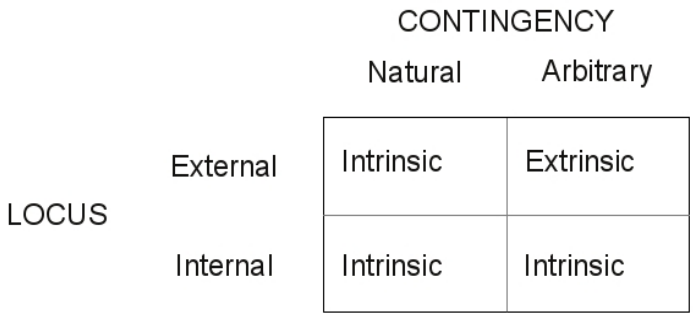
rewards have an external source and are arbitrarily related to the outcome. An individual who is paid to cut grass, for example, is receiving money from an outside source, and the relationship of money to the cutting of grass is arbitrary or completely artificial. That is to say that cutting grass does not naturally produce money, it is only produced as the result of an artificial contract between the owner of the grass and the person being paid to cut it. So there is only one relationship between the source of a behavior and its outcome with respect to extrinsic motivation. There are three different types of relationship between source and outcome with respect to intrinsic motivation.

One such relationship is that of external source to natural outcome. Eating a delicious meal is an example of this type of intrinsic reward. The food comes from an outside source, but the physiological response is a very natural one.

Another type of intrinsic reward is that which has an internal source with a natural outcome. Exercise is an example of such a reward. Exercise is done from within a person but has a very natural outcome, which may make a person feel better but may also cause pain, which is also a form of incentive even if a negative one.

The final type of intrinsic reward is that which has an internal source with an arbitrary outcome. Painting a portrait or playing an instrument are examples of such rewards. These certainly have an internal source, but have no naturally produced outcome. The outcome is only arbitrary and may differ depending on the person performing the action. What might produce a positive outcome for one person, may produce a negative outcome in another person.

Figure 2.3: Extrinsic vs. Intrinsic Motivators (Bandura, 1986)



Chapter 3

Behavior Change in Healthcare

The perception of large corporations is that it is always in their best interest to do whatever they can to increase profits. This of course involves increasing revenue and cutting expenses. In the health care field this perception has caused an ironical situation in which the very measures that corporations took in the past to keep salary expenses from cutting into profits have led to a situation in the present in which the same corporations are trying desperately to cut the costs of providing health benefits to employees. During WWII the economy faced a situation in which there was very little unemployment due to a large number of potential employees being conscripted into military service. The low supply of available workers meant that corporations had to pay higher salaries to those employees that were still available to provide labor. In an effort to avoid having to pay these high wages, many corporations put pressure on the government to issue a wage freeze. In 1942 the government caved in to this pressure, using the War Labor Board to pass this wage and price freeze, which was done under the pretense that it would help to stabilize the economy and prevent corporations from profiting off of war. Having lost the ability to compete for employees using salaries, corporations were forced to turn to other means of competing for employees. Many did so by offering health benefits. Year by year, health care costs have continued to rise. By the 1980s, health care costs consumed a substantial portion of corporate expenses.

Executives under pressure to cut costs were driven to find solutions to growing health care costs. This resulted in a number of complicated mechanisms to reduce costs, most of which fell under under the umbrella of the term “managed care.” A number of these mechanisms involved shifting the responsibility of payment

towards the employer or patient. During this period the concept of disease management began to emerge. Briefly, disease management involves the use of accepted clinical guidelines to involve patients in their own care and help them to reduce the likelihood of being at risk of serious illness in the future. Disease management is mostly targeted towards patients with chronic illnesses who, if left to follow a risky path of behavior, will become more severely diseased and incur higher medical costs. The idea behind disease management is to encourage patients to change their behavior in such a way that they will reduce their risk for serious illness in the future. It is attractive to health care payers because they are aware that a large portion of health care costs is consumed by a small percentage of a covered population. Therefore, a small investment in resources to attempt a change of behavior in these individuals can lead to a large change in the costs such individuals generate for an organization. The concept of disease management has been adopted by many corporations as part of a broader adoption of preventive care. It has extended to health and wellness programs, which are like disease management in that they attempt to reduce health care costs by reducing health risks, but target a larger population of individuals, not only those with chronic or high risk conditions. This has become an increasingly important issue now, as corporations face the challenge of being able to sustain themselves in the face of an aging population.

As with any other efforts to reduce costs, technology has the potential to contribute to the effort of corporations to reduce medical costs while implementing disease management programs. There are many ways in which technology can be used within a disease management organization to reduce costs. Many of them are obvious and easy to implement. All disease management efforts involve the use of data analysis techniques to identify and target employees who may be at risk for

medical conditions in order to put those patients on programs which may help prevent them from becoming higher risk patients. Electronic patient records and accounts of interactions between care providers and patients is also a necessity and used in all successful disease management efforts. Some potential uses of technology are not so obvious and are risky to implement, for it is not clear whether or not they will be well received by patients and other users of the technology, and also not clear whether or not they would provide benefit even if used by patients and other users. These questions can be answered through research in the area of information technology.

The domain of healthcare offers the ability to explore the impact of computer-mediated technology on a behavior that is very difficult to change and one that is of great importance at the national as well as at the individual level. Professor Peter Keen identified the target of decision enhancement services as being “Decisions That Matter” (DTM) (Keen and Sol, 2008). He identified two important characteristics of DTM: Urgent and Consequential. Consumption of healthcare resources is currently estimated to be $2.7 trillion (17.7% of GDP) and is expected to reach $4.6 trillion (19.8% of GDP) by 2020 (Keehan et al., 2011). Although a number of factors are contributing to the increase of healthcare costs, one very important contributor is an unhealthy population. Among health conditions contributing to rising healthcare costs is the epidemic of obesity. Obesity healthcare costs consume approximately 5-10% of total healthcare costs (Tsai and Wadden, 2005). This would mean if the status quo continues with respect to obesity, national costs could reach as high as $460 billion by the year 2020.

3.1 Computer Mediated Behavior Change

The focus of all disease management and health and wellness programs is to change the behavior of at-risk employees. Employees become at-risk mostly because of poor health habits. Many of them are unaware that they are participating in poor habits, or do not know how to change their existing habits. If their habits can be improved, then it follows that their health costs will likely be reduced.

Why do companies turn to disease management instead of relying on physicians and other health care providers to alter behavior? Briefly, many providers do not work with patients to alter their health habits, but rather simply treat the complications that arise as a result of poor health habits. In fact, many health payment plans actually create a situation in which providers have an incentive to continue to treat a patient's symptoms rather than attempting to resolve the issues which are causing the recurring symptoms. Disease management companies most often employ nurses and other clinicians who have clinical experience and have been trained to help patients change their behavior. These providers manage a patient's care remotely by interacting with patients on a periodic basis to ensure that the patient is following standardized care protocols. Second, the employment of health care providers is expensive, and all are limited in the number of patients with which they can communicate in a day. Companies could greatly benefit from the use of any technology which would complement the services of a clinician and help to decrease their workload. Because many of the protocols which are followed by patients are standardized, and because much of the information collected by clinicians is standardized, there is an opportunity for such companies to maximize the time a clinician spends communicating with a patient by deploying technology

to deliver and collect standardized information to and from patients. This would increase the number of patients that could be touched in a day, and allow clinicians to focus their time on the patients who are at the highest level of risk.

Because health care expenditures are so large, it is not important for any technology to be able to claim to reduce expenses by a large percentage. Rather, any technology which may propose to reduce expense by even a small percentage or fraction of a percentage can have a huge impact on the bottom line of a self-insured corporation or other health care payer. Computer mediated behavior change has the potential to reduce costs by decreasing the amount of face-time with a health care professional, which is where a significant portion of health care dollars are spent. Such systems are not currently used to any significant extent as part of disease management programs, mostly due to doubts about their effectiveness, although such systems have been used and have been the topic of research in a number of clinical research studies. As with any other technology, before dollars are spent there must be some assurance that the dollars spent will eventually lead to an increase in revenue or reduced future costs. The motivation behind the research in this paper is to add to existing research on a technology that has the potential to reduce costs, in order to provide potential investors with knowledge as to whether this technology would be effective, under what circumstances it would be effective, and for whom it would be effective.

Chapter 4

THEORETICAL FOUNDATION

This study draws from existing theories in the areas of health psychology and behavioral psychology. The theories which support the hypotheses proposed in this research focus on how individuals change their behavior, as this is a study on behavior change. In chapter 2, the science of behavior change was discussed. Chapter 2 focused on aspects of learned behavior and the factors affecting them, mostly focusing on how early influences in life may affect long term behavior. This chapter focuses on theories which are important to modifying existing behavior.

4.1 Behavior Change

The literature review will begin by addressing the question that is at the basis of behavior change: what makes people change their behavior? Because the context of this study is health care and the study involves questions about how to influence health related behavior, the area of health and wellness was explored for answers to how individuals change their behavior.

An overview of models of health behavior change is well reviewed in both (Schwarzer, 2008) and (Velicer and Prochaska, 2008). Models of behavior change can be characterized as either stage or non-stage models (Schwarzer, 2008; Velicer and Prochaska, 2008). Non-stage models, or continuum models as referred to by Schwarzer (2008), assume that change occurs in a linear fashion. Most non-stage models assume that the likelihood of a person changing behavior is predicted by intention to change, and the goal of such models is to change intention in order to move the individual along the path of behavior change. Examples of continuum models include the Theory of Reasoned Action (Ajzen and

Fishbein, 1980), the Theory of Planned Behavior (Ajzen, 1991) and Protection Motivation theory.

Stage Models of Behavior Change

Stage theories view change as being a punctuated event, with periods of change followed by periods of stability. Individuals evolve as each change is made and progress toward the next stage (Velicer and Prochaska, 2008). Progression to another stage may be triggered by some event or some realization that changes the person or the person's views.

Trans-Theoretical Model of Behavior Change

The most popular and widely cited stage model of behavior change is the trans-theoretical model of behavior change (Prochaska et al., 1992).

The trans-theoretical model of behavioral change was developed by researchers investigating the manner in which behaviors change in response to psychotherapy. The model posits that there are stages of change and processes of change (Prochaska et al., 1992). The stages of change consist of precontemplation, contemplation, Preparation, Action, and maintenance (Prochaska et al., 1992). These stages of change are summarized in table 4.1 below.

Table 4.1: Stages of Change of the Trans-Theoretical Model (Prochaska et al., 1992)

Stage	**Description**
Precontemplation	There is no real intention to change in the near future. Individuals are most often in denial that a need to change exists. Those that suspect there may be reason to change still have no intention of changing.

Table 4.1: Stages of Change of the Trans-Theoretical Model (Prochaska et al., 1992)

Stage	**Description**
Contemplation	It is recognized that a need to change exists, but no commitment to change has yet been made. Individuals are simply not yet ready to make the change. Many have weighed the pros and cons of continuing negative behavior versus making the change. The costs are determined to outweigh the benefits. Individuals can often remain in this stage for a great period of time.
Preparation	There is intent to change behavior soon, within the next month. Some changes may have already begun to take place, but mostly there exists a strong intent to change soon.
Action	Action is taken to change behavior. Behavior has been successfully altered for a given period of time, which may vary depending on the type of behavior which is being altered.
Maintenance	Change has been made successfully and criteria for change have been observed. Individuals continue to work to prevent relapse.

The processes of change associated with these stages of change help to understand how change is taking place. There are ten processes which are theorized to be involved in movement from one stage to the next and that help researchers to determine which stage of change an individual is in. The integration of processes and stages of change has provided the ability to predict with some success how likely individuals are to change their behavior (Prochaska et al., 1992). This research hopes to build on this theory in the area of computer-mediated technology by identifying factors that are involved in changing behavior once an individual is in the action stage of behavior change.

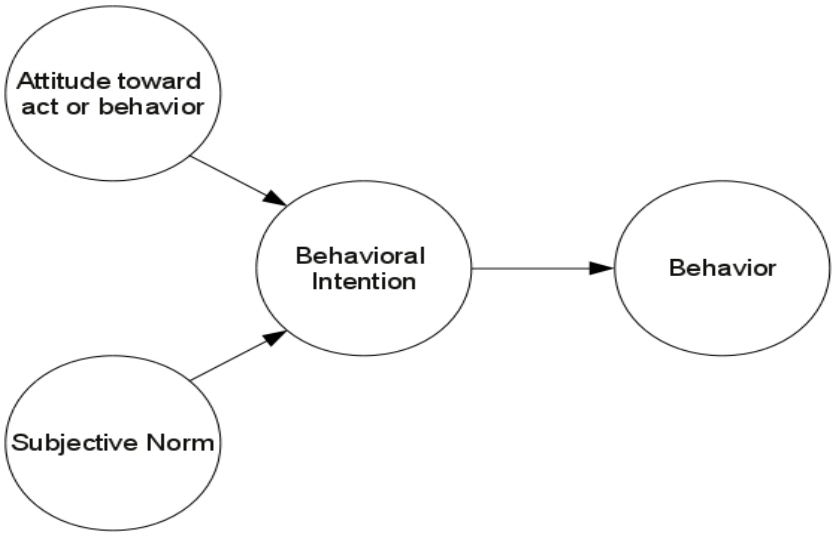
Non-Stage Models of Behavior Change

Non-stage models view behavior as a single event, with the movement from one behavior to another occurring along a continuum. Predictor variables are identified to determine what affects the likelihood of moving an individual along this continuum from one behavior pattern towards another.

Theory of Reasoned Action

The theory of reasoned action (Fishbein and Ajzen, 1975) is one of the earliest theories which received significant attention in the area of predicting behavior. The theory poses that the most important predictor of behavior is intention. Intentions are in turn predicted by attitudes and subjective norms (Fishbein and Ajzen, 1975). Attitude refers to an individual's perception of the given behavior, whether or not the behavior would be good or bad for the person. Subjective norms refers to an individual's perception of whether or not others important to that person may believe that it is important to engage in such a behavior. The theory of reasoned action model is depicted in figure 4.1 below.

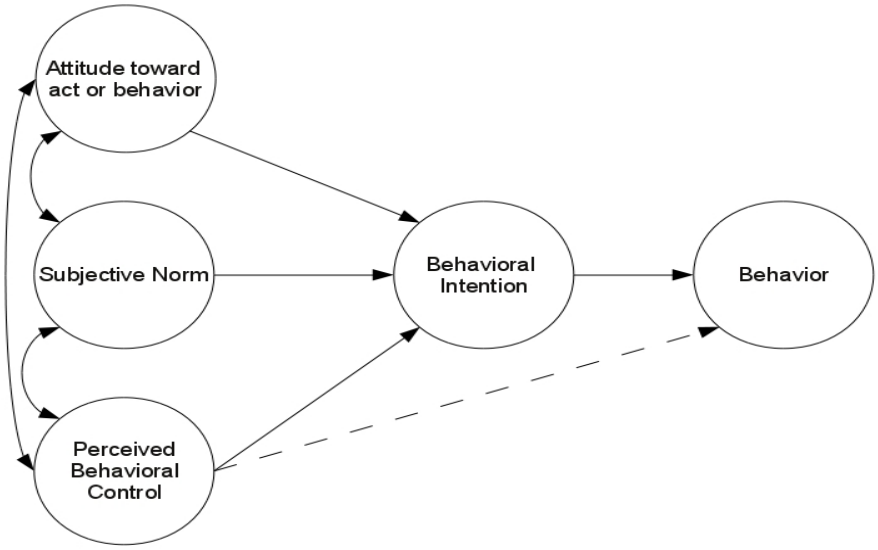
Figure 4.1: Theory of Reasoned Action (Fishbein and Ajzen, 1975)



Theory of Planned Behavior

The more recent adaptation of the theory of reasoned action is the theory of planned behavior (Ajzen, 1991; Sheeran et al., 2001). This theory also poses that intentions are predicted by attitudes, subjective norms, but added perceived behavioral control as a factor that also predicts behavioral intention. Perceived behavioral control refers to an individual's perception of their own ability to engage in a given behavior. The theory states that the effects of attitudes, subjective norms, and other external variables are mediated by intentions and perceived behavioral control. The theory of planned behavior model is depicted in figure 4.2 below.

Figure 4.2: Theory of Planned Behavior (Ajzen, 1991)



Chapter 5

LITERATURE REVIEW

Chapters 2 and 4 explored the factors affecting learned behavior and the factors affecting how that behavior may change. This chapter explores studies which have been done in the area of human-computer interaction, decision support, healthcare, and management control systems. The literature reviewed focuses on the factors which affect relationships between humans and machines, the factors that impact behavior change, and the factors that affect decision making. The goal of this study is to explore factors which influence computer-mediated behavior change. Computer-mediated behavior change involves both technology and individuals. Thus, it is likely that characteristics of technology and characteristics of humans are likely to affect technology's ability to influence the behavior of an individual. The literature review will show us that two factors, feedforward and feedback, are technological characteristics which could influence human behavior and that personality is a human factor which could impact the ability of technology to influence human behavior.

5.1 Human-Computer Interaction

Focusing on how information technology interacts with people to affect their behavior has been explored by researchers in the area of human computer interaction.

Computers as Social Actors

Research very directly relevant to computer mediated behavior change involves the concept of computers as social actors or CASA (Nass et al., 1995). This is the concept that social rules which apply to interactions between humans also apply to

interactions between humans and computers. Much of the research which has been done in this area involves exploring how human personalities react with computer personalities.

The background for research in this area is supported heavily by work done on personalities in the area of psychology. Although there is some controversy in this area, it is generally agreed upon that there are five personality factors which encompass human personalities. The history of the research that led to the arrival of these five factors is reviewed well in (Goldberg, 1993). The five factors of personality, also referred to as the “Big Five” or the “Five Factor Model” are extroversion (or surgency), agreeableness (or pleasantness), Dependability (or conscientiousness), neuroticism (or emotional stability, and openness (or intellect). An explanation of the five factors is shown in table 5.1 table below:

Table 5.1: Description of the Big Five Personality Traits (Goldberg, 1993)

Factor	High Ranking Traits	Low Ranking Traits
Extroversion	high activity level talkative assertive	reserved passive silent
Agreeableness	kindness trust warmth	hostility selfishness distrust
Conscientiousness	organized thorough reliable	careless negligent unreliable
Neuroticism	nervous moody temperamental	stable

Table 5.1: Description of the Big Five Personality Traits (Goldberg, 1993)

Factor	High Ranking Traits	Low Ranking Traits
Openness	open to experiencing new things imaginative curious creative	shallow imperceptive close-minded

5.2 Decision Support

Decisional Guidance

Influencing change in behavior has been an area of interest in research on decision support systems for many years. Since the late 1970s, researchers have recognized the importance of change agency in decision support systems (Silver, 1990). Silver (1990) discussed two types of change, directed and non-directed change, whose purpose can be served by the implementation of a decision support system. He also establishes different strategies for the implementation of systems intended to serve both purposes. Directed change, as defined by Silver, is change that occurs when the designers of a DSS know that a change will occur and deliberately force the direction of the change. Non-directed change also occurs when the designers of a DSS know that change will occur but do not attempt to influence the direction of change.

Silver (1991) establishes a unified approach intended to be used in studies dealing with influencing behavior using decision support systems. He defines decisional guidance as the manner in which a systems influences its user's decisions. Silver points out that there are two kinds of decisional guidance, inadvertent and deliberate decisional guidance. He also presents a typology of deliberate decisional guidance, which suggests that there are targets, forms and modes of guidance. Targets involve the end goal of the guidance, whether it is to aid in

structuring a decision, or whether it is to aid in the execution of a decision. Forms are of two types, suggestive and informative guidance. Suggestive guidance provides recommendations on what type of decision should be made, whereas informative guidance provides relevant inputs which may help to make a decision, without providing any specific recommendations. Silver suggests 3 modes of guidance: predefined, dynamic, and participative. Predefined guidance is that by which the designer of a system defines all possible recommendations associated with all given inputs. Dynamic guidance involves system learning and the generation of recommendations based on input and outcomes of users of the system. Participative guidance involves more input from the user in the decision making process, allowing the user to make recommendations. Silver's typology can be used to classify studies which have been conducted by clinicians as well as IS researchers to measure the effectiveness of technology in influencing the behavior of individuals. In directing behavior change, it would seem that non-directed change and informative guidance offer a safe approach to influencing behavior change. This type of guidance puts less liability on the responsibility of the DSS designer while allowing the system to serve its function in providing the information necessary to make an important decision. There has also been some research which suggests that informative guidance is more effective for complex task decision making than is suggestive guidance (Chenoweth et al., 2004; Montazemi et al., 1996)

Effort vs. Accuracy

The concept of effort vs. accuracy has been used in the decision support literature to aid in determining how individuals will formulate strategies for decision making. First, the concept is that individuals will weigh the benefits to be gained from using any decision strategy against the costs of using, formulating and implementing the

strategy (Benbasat and Todd, 1996). Individuals often choose strategies that involve less effort. In order to aid in determining whether effort invested is compensated for by improved accuracy, decision makers must be provided with feedback regarding their decision outcomes (Te'eni, 1991). Feedback is information regarding a specific decision process and outcome after a decision has been made (Dhaliwal and Benbasat, 1996). Research on effort vs. accuracy in decision support systems has been extended by showing that the salience of decision outcomes is a factor in determining whether or not individuals decide to adopt a given decision strategy (Chenoweth et al., 2004).

Individuals are more likely to invest effort in strategies when the outcomes of those efforts are made more salient. Specifically, individuals are more likely to invest effort in a strategy when the outcome of that effort affects them in the present rather than in the future. Feedforward, information regarding a specific decision provided before a decision is made, is believed to have an effect on decisions made about behavior (Dhaliwal and Benbasat, 1996). Systems which are able to offer feedback and feedforward are more likely to be successful in influencing individuals to choose a decision outcome with higher accuracy. This is due to individuals often discounting the future. That is, effort expended today affects a person today, but benefits to be gained from that effort do not affect a person today but rather at some time in the future. Therefore, individuals are likely to avoid any strategy which requires more effort.

This concept can be applied to the area of computer-mediated behavior change. Systems which are able to make outcomes of behavior decisions more clear to a person are more likely to influence behavior than those which do not. This is especially relevant in health care where most individuals become unhealthy by engaging in behavior which benefits them in the short term (e.g. drinking, smoking, poor diet) while discounting longer term effects such as heart disease,

lung disease, liver disease and diabetes. This leads individuals to ignore many public health warnings, thinking that what affects them in the future is not as important in the present. Only when the consequences of health behavior are immediate do individuals tend to actually change their behavior, such as the presence of an impending epidemic that could kill within a matter of days rather than over a period of years or decades.

5.3 Management Control Systems

The use of computer-mediated behavior change in organizations relates to the issue of organizational control of employees by management. Every organization seeks to obtain cooperation among a collection of individuals who may share interests or objectives which are only partially aligned with that of the organization (Ouchi, 1979). This problem is closely related to that of the principal-agent problem outlined in agency theory (Jensen and Meckling, 1976). With regard to an individual's health, as is being explored in this paper, the company has an objective to reduce health care costs of its employees. The employees would also like to reduce their health care costs, however for the most part the amount of financial risk they incur as a result of their health has been absorbed by the organization. The employees also have lifestyle preferences, which may conflict with their health. They may be likely to participate in activities which benefit them in the short run, but over time have negative effects on their health, effects which they may discount because they are far in the future. These activities may include poor diet, lack of exercise, infrequent or non-existent visits to primary care doctors or other health care providers, etc. This preference for short term pleasure will put an employee's preference in conflict with that of the organization for which he/she works, the organization which is covering his health care costs.

According to agency theory, there are two ways to deal with such a situation, one is to shift risk toward the employee in order to align the employee's interests with the corporation (Jensen and Meckling, 1976; Eisenhardt, 1989). This could involve making the employee pay a larger percentage of his own health care costs through a variety of payment mechanisms. However, due to increasing competition for employees and extremely high health care costs which make shifting large percentages of cost to employees impractical, these mechanisms have not proven to be very effective in lowering health care costs. Another way in which organizations seek to align employee interests with organizational interests is to put in place monitoring systems which provide information on an employee's behavior to his employee, thereby discouraging the employee from participating in any behavior of which he/she knows the employee would not approve.

In essence, agency theory describes an important aspect of human behavior: when a behavior is less likely to affect an individual in an adverse or positive way, that individual is less likely to avoid or participate in that behavior. However, if measures can be put into place which will make outcomes of an individual's behavior more salient, that individual may be more likely to alter his behavior. If an organization can do this in such a way that it aligns the behavior of the individual with that of the organization, then it has succeeded in controlling the behavior of that individual.

Three levels of commitment of employees to organizational goals have been identified in prior research: internalization, identification and compliance (Ouchi, 1979). Internalization is the complete congruence of individual's goals with that of the organization, without need for any intervention. Organizations may achieve this by recruiting individuals who share the same values as that of the organization (Ouchi, 1979). Identification is achieved through training an employee such that

he/she identifies with the trainer or the work group or department in which he/she works. Identification may eventually be converted into internalization over time (Ouchi, 1979). Compliance is the lowest level of commitment that may come from an individual and is achieved through monitoring the behavior of an individual (Ouchi, 1979). One becomes compliant simply because a contract with the organization requires an individual to do so. In the absence of internalization and identification, compliance requires monitoring of an individual and thus involves monitoring costs on the part of the organization.

Achieving identification can be done through the use of management control systems. A management control system can be defined as a system which is put in place in order to align the behavior of employees with the interests of the organization (Malmi and Brown, 2008). Malmi and Brown (2008) identified five different types of controls which organizations may use to influence the behavior of employees. These are planning , cybernetic, reward/compensation, administrative, and cultural controls. Planning controls identify short and long-term organizational goals and the standards which must be achieved with respect to those goals. Cybernetic controls involve the identification of standards to be achieved, mechanisms for measuring performance with respect to those standards, and feedback mechanisms which allow one to determine progress with respect to standards in order to determine what must be changed to achieve them. Reward/compensation goals involve the use of extrinsic or intrinsic rewards to individual for achieving certain goals. Administrative controls involve the creation of procedures and rules which must be followed and the monitoring of individuals to ensure compliance with those rules and procedures. Cultural controls involve the establishment of cultural beliefs and norms which may influence behavior (Malmi and Brown, 2008). This study proposes the use of a management control

system which would provide feedback at an individual level, in order to change how an individual behaves with respect to his own health. The system would use both planning and cybernetic control mechanisms as defined in previous literature.

5.4 Clinical Research

A review of the clinical literature was conducted using Silver's methodology to determine the type of decisional guidance. Papers were also categorized according to the condition for which behavior change was being targeted, any theories used in the study, dependent and independent variables, and outcomes.

Table 5.2: Clinical Studies Summary

Study	**Disease**	**Dependent Variable**	**Independent Variable**	**Result**
(Ausems et al., 2002)	Smoking	Smoking Prevalence	Participation in computer based program using tailored letters based on student responses to questions	Smoking initiation and continuation dropped
(Liang et al., 2006)	Multiple Sclerosis	Medication Compliance	Using a web based intervention support system	Medication compliance higher for patients using WISS
(Tate et al., 2001)	Obesity	Weight Loss	Participation in internet education vs internet therapy (internet intervention combined with behavior therapy	internet behavior therapy group lost more weight than internet eduction group.

Table 5.2: Clinical Studies Summary

Study	**Disease**	**Dependent Variable**	**Independent Variable**	**Result**
(Tate et al., 2003)	Diabetes	Weight Loss	Participation in basic internet vs internet plus behavioral e-counseling	internet plus e-counseling group lost more weight than internet eduction group.
(Glasgow et al., 2003)	Diabetes	Dietary, Behavior, Biological and Psychosocial outcomes	Participation in 1) Information only, 2) tailored self management, 3) peer support internet intervention	all groups improved on the majority of outcomes measures. Only psychosocial outcomes were different between the groups having peer support vs no peer support.
(Napolitano et al., 2003)	Obesity	Progress in emotional readiness for participating in physical activity	Participation in an internet intervention vs control	Intervention group was more emotional ready and had higher signs of activity than control group.
(McKay et al., 1998)	Diabetes	Satisfaction with D-NET system	-	Users showed high satisfaction with the system. The most used component of the system was the social support group component.

Table 5.2: Clinical Studies Summary

Study	**Disease**	**Dependent Variable**	**Independent Variable**	**Result**
(Booth et al., 2008)	Obesity	Weight change, physical activity change, dietary change	Use of a web-based program with exercise and dietary goal setting vs a web-based program with dietary goal setting only	No significant differences were found between the groups in any area.
(Buhrman et al., 2004)	Chronic Back Pain	Various pain measures	Use of internet based treatment vs control	Improvements found on most measures. Some improvements also found in control group.
(Cintron et al., 2006)	N/A	Completion of a health care proxy	Assignment to a group receiving electronic reminder vs control group	Patients in the control group had increased knowledge of HCPs. Neither group was more likely to have completed a HCP.
(Vandelanotte et al., 2007)	Obesity	Efficacy of web-based interventions	Intervention duration, number of contacts, theory, face to face contact, additional behaviors targeted, interaction method, behavioral modification	The number of contacts was found to be the only attribute that affected efficacy in the studies reviewed.

Many of the clinical studies focus on whether or not the implementation of a computer system had an effect on behavioral outcomes. However, these studies do not focus on why the systems do or do not influence behavior. It is likely that for every study showing positive impact of computer systems on behavioral outcomes, there are many studies which failed to show positive outcomes, and thus did not make it to publication. For anyone wishing to implement a system which is intended to modify human behavior, it is not important simply to show that the implementation of computer mediated systems has previously had a positive effect on modification of behavior. It is important for anyone to realize that certain behaviors are likely to be different and that it may be difficult to find a study that relates closely enough to any given situation to determine whether or not implementation of a system is successful. It is therefore important to understand at a high level the things that are likely to impact the success of a computer-mediated technology to influence human behavior.

Chapter 6

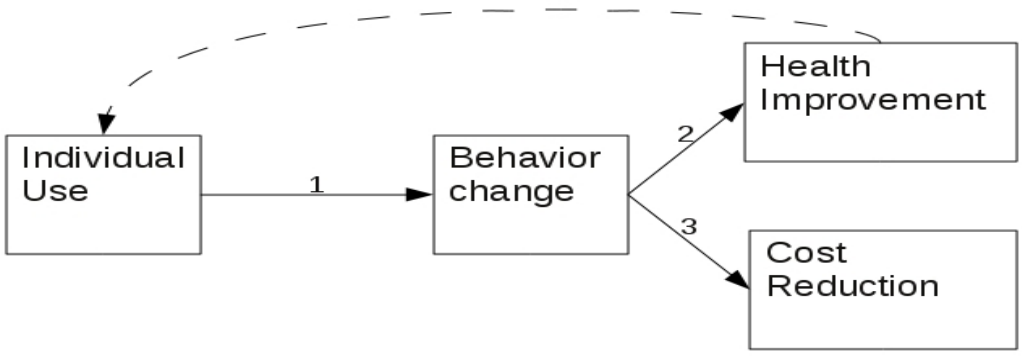
STUDY DESIGN

Interaction between computer and human involves the exchange of information, just as interaction between human and human involves the exchange of information. The types of information that people are likely to exchange depends largely on the type of person, which is shaped by a person's history but is measurable by the BFI, as discussed in section 5.1. The type of information a computer is likely to exchange depends on the manner in which it is programmed. Research in the area of decision support has shown that feedback and feedforward are two types of information which are likely to influence human behavior, but does not explore the manner in which these two types affect people of different personalities. This study will explore the interaction between feedforward, feedback and personality. Feedforward and feedback are good, safe forms of communication that can be provided back to a user. They are legal and ethical means of communicating information that can be helpful in the making of a decision. Each is objective and the manner in which they are provided can easily be cited and justified.

The focus of this study is contribute to the understanding how the use of computer mediated behavior change technology can reduce health care costs while maintaining the quality of health care provided to a patient. The question is a multi dimensional one. In order to determine whether or not the technology will effectively reduce health care costs, one must first determine whether or not the technology will be used by a patient who is a candidate for health improvement, whether or not the use of the technology will affect the patient's behavior in a manner that will improve the patient's health, and whether or not the improvement

in health will translate to a reduction in cost. This chain of events is depicted in figure 6.1 below.

Figure 6.1: Initial Model of Behavioral Change



In order for an individual's behavior to be affected by any computer-mediated technology, the technology must first be used. The factors affecting use of computer-mediated technology will not be explored here, as technology acceptance is not the focus of this study. The factors affecting the reduction of health care costs will also not be explored here, as it falls outside of the scope of the field of information technology and lies closer to the field of health care. Although this study is of interest to the health care industry, it is not a health care study but rather a study of the effects of computer-mediated technology on behavior change using health care as a context.

The primary focus of this study is on the first relationship depicted in Figure 1, that is the effect of the use of computer-mediated technology on behavior change. In the literature review portion of this paper, a number of theories relevant to this research were reviewed. In this section, the method by which these theories and concepts will be applied to the current study will be outlined. As discussed above,

there are several factors which may impact the effect of digital health care management technology on health behavior. There are factors related to the technology itself, the type of condition being treated, and the individual being targeted for treatment. Each of the constructs outlined below will tie an existing theory or concept to one of these factors.

6.1 Feedback, Feedforward and Behavior Change

Because feedback and feedforward are believed to make outcomes of a given behavior more salient, and because the theory of planned behavior states that an individual's beliefs regarding whether or not participating in a given behavior is important affects intention to participate in that behavior (Ajzen, 1991), it is hypothesized that feedback and feedforward will have a positive effect on computer-mediated behavior change. Additionally, it is hypothesized that the impact of feedforward will be greater than that of feedback, as it may make outcomes more salient to the user. There is also a hypothesized interaction between these two, in that feedback will have a greater effect in the presence of feedforward.

H 1 *Feedback will have a positive effect on computer-mediated behavior change.*

H 2 *Feedforward will have a positive effect on computer-mediated behavior change.*

H 3 *Feedforward will have a greater impact on behavior change than feedback.*

H 4 *The effect of feedback on behavior change will be greater when feedforward is provided than when it is not.*

6.2 Personality and Behavior Change

All individuals are different. The field of psychology is filled with literature exploring human personalities. Research in the area of psychology has shown that individuals react differently to different stimuli depending on their personalities. Personalities can be measured in various ways, as will be discussed in section 7 below. Because all individuals react differently to different stimuli, and because feedback and feedforward are stimuli that will be given in this study, it is hypothesized that the impact of feedback and feedforward, particularly feedback and feedforward which make a given outcome more salient, will vary depending on individual personality.

Research has shown that individuals ranking high in the areas of Extroversion and conscientiousness are more likely to follow an exercise regimen and than individuals ranking high in neuroticism (Courneya and Hellsten, 1998). Research has also shown that neuroticism and conscientiousness are the two factors most commonly associated with exercise barriers. Individuals ranking high on neuroticism are more likely to indicate that common barriers to exercise (such as lack of time, energy, motivation and embarrassment about ability to perform) are barriers to them personally. Individuals ranking high on conscientiousness are much less likely to indicate that common barriers to exercise are barriers to them personally (Courneya and Hellsten, 1998).

H 5 *Extroversion will have a positive effect on behavior change.*

H 6 *Conscientiousness will have a positive effect on behavior change.*

H 7 *Neuroticism will have a negative effect on behavior change.*

H 8 *Openness will have a positive effect on behavior change.*

H 9 *Agreeableness will have no effect on behavior change.*

6.3 Feedback, Feedforward Interactions with Personality

The assumption is made that factors which relate to exercise behavior will also relate to weight management as weight management requires similar efforts. As behavior change is associated with overcoming barriers, it is hypothesized that the effect of feedback and feedforward on behavior change will be most strongly related to conscientiousness and neuroticism. Specifically, individuals who rank low on conscientiousness and high on neuroticism scales will be more likely to be influenced by feedback and feedforward than those that do not. The reasoning is that if an individual is of a personality type that is already willing to engage in positive health behaviors, then efforts to influence those individuals using feedback and feedforward will have a smaller effect than on someone who is less willing to engage in positive health behaviors, where feedback and feedforward may push them to overcome perceived barriers. That is, where there is little room for improvement, feedback and feedforward are less likely to have an effect than where there is more room for improvement. For this reason, it is hypothesized that feedback and feedforward will have a smaller effect on individuals ranking high on extroversion than on those ranking low, as extroversion is positively associated with positive adherence to exercise.

H 10 *The effect of feedback on behavior change will be greater on introverts than on extroverts.*

H 11 *The effect of feedforward on behavior change will be greater on introverts than on extroverts.*

H 12 *The effect of feedback on behavior change will be greater for low-conscientiousness subjects than for high.*

H 13 *The effect of feedforward on behavior change will be greater for low-conscientiousness subjects than for high.*

H 14 *The effect of feedback on behavior change will be greater for neurotics than for non-neurotics.*

H 15 *The effect of feedforward on behavior change will be greater for neurotics than for non-neurotics.*

H 16 *The effect of feedback on behavior change will be greater for open minded individuals than for close minded individuals.*

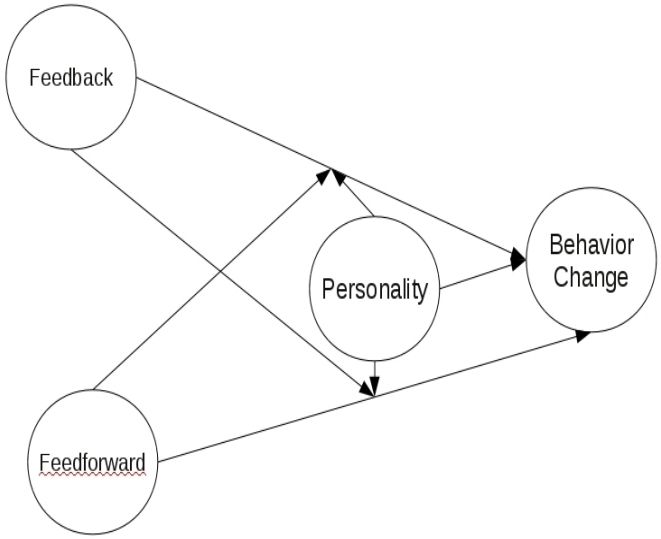
H 17 *The effect of feedforward on behavior change will be greater for open minded individuals than for close minded individuals.*

H 18 *The effect of feedback on behavior change will not vary depending on agreeableness ranking.*

H 19 *The effect of feedforward on behavior change will not vary depending on agreeableness ranking.*

Figure 6.2 below depicts this relationship.

Figure 6.2: Behavioral Change Model with Salience Feedback and Personality



Chapter 7

METHODS

To measure how well the model explains factors affecting computer-mediated behavior change, an experimental design was used, using both control variables and classification variables. An experiment was conducted on different groups of individuals. The experiment involved the recruitment of individuals to use an on-line weight and physical activity management application, referred to as OWPAMA. This application, as its name suggests, aids individuals in the management of their weight and physical activity, which are the conditions in question. Weight and physical activity are two of the most commonly cited precursors to health problems, and hence very relevant to the area of disease management. The system was used to manipulate variables that involve attributes of the system, to record individual attributes, and to record measures of behavior change.

Candidates for recruitment to the study were individuals who were wishing to increase their physical activity, or to decrease their weight. All individuals participating in the study, regardless of whether they wished to simply increase physical activity or to decrease weight, answered questions regarding their current weight, diet, physical activity, and other relevant statistics (e.g. height used in calculating BMI). Based on responses to these questions, the OWPAMA was able to make calculations estimating the amount of weight lost or gained after each data entry into the system. The constructs used in this study are summarized in table 7.1 below. Some of these factors were manipulated by the OWPAMA (experimental variables), some were determined by collecting data about subjects through the use of the OWPAMA (control variables), and some were determined

by collecting data on subject behaviors through the use of the OWPAMA (dependent variables).

Table 7.1: Variable List

Experimental Variable	**Control Variable**	**Dependent Variable**
Feedback Feedforward	Personality	Behavior Change

7.1 Measuring Behavior Change

This study looked at three different indicators of behavior change: weight, caloric intake, and physical activity. Baseline values for each of these indicators were taken at the beginning of a subject's participation in the study. As subjects progressed in using the OWPAMA, they continued to record daily weight measurements, caloric intake and physical activity. The change in levels of activity from the baseline measurement to the end of the three month participation period were used to indicate whether behavior change occurred.

Weight

Participants were asked by the OWPAMA to record their weight and current body fat content when registering to participate in the study. Weight were recorded in pounds, with precision to the level of the quarter pound. The OWPAMA calculated a goal weight based on the individual's current weight, body fat composition, gender, and age. The recommended goal weight was based on the body composition technique for estimating healthy body weight (Heyward, 2006). This estimation technique calculates ideal body weight based on a healthy body fat composition, taking into account a person's age and gender. Healthy Body fat percentages based on age and gender are provided in the appendix. Current body

fat percentage is used to calculate an individual's Fat Free Mass (FFM). This fat free mass number is then divided by the target healthy body fat percentage to arrive at an ideal weight (Heyward, 2006). Weight change was measured as a percentage of total weight loss (W_{pt}) and as a percentage of completion towards one's healthy goal weight (W$_{pg}$). In addition to measuring the difference between baseline and final weight, differences of interim periods were also be measured, to determine if behavior change occurred initially, and then tapered off later, or vice versa. The calculations used for W_{pt} and W_{pg} are specified below.

$$W_{pt} = \frac{W_0 - W_i}{W_0}$$

$$W_{pg} = \frac{W_0 - W_i}{W_0 - W_g}$$

Here W_0 is an individual's initial weight entered at baseline, W_i is the weight measured at any specified point during the study, and W_g is an individual's goal weight.

Caloric Intake

Participants were asked to answer questions about what foods and in what quantities they consume in an average day, and what specifically they consume on the day of registration as well as all days moving forward. Each day, participants entered the amount of food that had been consumed throughout the course of that particular day. Daily caloric intake was estimated by using the USDA National Nutrient Database for Standard Reference, Release 21 (U.S. Department of Agriculture, 2008). In order to calculate recommended daily intake, the factorial

method were used (Heyward, 2006). This method involves first estimating the individual's resting metabolic rate (RMR), and then determining the number of calories required in a day to maintain a healthy calorie deficit, based on an individual's RMR and the amount of physical activity in which they engage on any given day. RMR was calculated using the equations tested in (Mifflin et al., 1990), which have been found by the American Dietetic Association to be accurate compared to other measures of RMR (Association, 2003; Heyward, 2006). These equations are summarized below.

$$Males : RMR = 9.99 * BodyMass + 6.25 * Height - 4.92 * Age + 5$$

$$Females : RMR = 9.99 * BodyMass + 6.25 * Height - 4.92 * Age - 161$$

Once RMR was determined, the amount of calories burned during average daily activity were determined by using data collected from subjects regarding regular daily activities. This was used to determine the number of calories needed in a day to maintain one's current weight. From this, a recommended caloric intake was calculated by determining a healthy calorie deficit (between 500 and 1000 calories) and subtracting that amount from the total number of calories needed in a day to function. Changes in caloric intake were also measured as a percentage change (C_{pt}) as well as a percentage achievement towards goal (C_{pg}), with calculations specified below.

$$C_{pt} = \frac{C_0 - C_i}{C_0}$$

$$C_{pg} = \frac{C_0 - C_i}{C_0 - C_g}$$

Physical Activity

Participants were asked questions about the types of physical activity they participate in and the duration of these activities during the course of an average day, as well as what types of activities they participate in and the duration of these activities moving forward. The number of calories burned during the course of a day was estimated based on an individual's weight, and the intensity and duration of the physical activities in which they participate during a particular day, as well as an estimate of their resting metabolic rate. The factorial method (Heyward, 2006) was used to estimate the number of calories burned based on the type of exercise and other information about the participant. A chart is available in (Heyward, 2006) which maps a number of physical activities to METs. METs are a measure of Calories burned per kilogram per hour. So by collecting an individual's weight, and the number of hours in which they participate in a given activity, it was possible to determine the number of calories which they burned. Increase in physical activity was measured both as an increase in the number of average calories burned per day (E_t) and as a percentage increase from the baseline level of average daily calories burned (E_p).

$$E_t = E_i - E_0$$

$$E_p = \frac{E_t}{E_0}$$

7.2 Measuring Personality

Personality was measured using the BFI, which was used to determine an individual's score on all five of the personality factors in the BFI. A copy of the BFI instrument is in appendix 11.

7.3 Manipulating Feedforward and Feedback

Feedback and feedforward were manipulated by the OWPAMA. Individuals were placed into one of four groups, one offering no feedforward or feedback, one offering only feedforward, one offering only feedback, and one which offered both feedforward and feedback. Feedback and feedforward were provided as results of food consumption and physical activity were entered into the OWPAMA each day. Feedback simply gave an individual information about the number of calories they consumed in a day and what their calorie deficit was, in addition to their overall calorie deficit for the length of the program. Feedforward provided information about where their current calorie deficit would place them at 1 month, 3 months, 6 months as well as where their overall calorie deficit will take them for the same time periods.

7.4 Statistical Model

The hypotheses were tested using the general linear model. The dependent variable in the regression model was behavior change, as measured by physical activity, weight, and caloric intake. The effects of the independent variable on all three measures of behavior change was tested. The regression equation for all three equations is shown below:

$$BC_i = \beta_0 + \beta_1 FB + \beta_2 FF + \beta_3 FFxFB +$$
$$\beta_4 EV + \beta_5 CO + \beta_6 NE + \beta_7 OP + \beta_8 AG +$$
$$\beta_9 EVxFB + \beta_{10} COxFB + \beta_{11} NExFB + \beta_{12} OPxFB + \beta_{13} AGxFB +$$
$$\beta_{14} EVxFF + \beta_{15} COxFF + \beta_{16} NExFF + \beta_{17} OPxFF + \beta_{18} AGxFF + \varepsilon_i$$

where BC = Behavior change, FB = feedback, FF = Feedforward, EV = Extroversion, CO = conscientiousness, NE = neuroticism, OP = openness, AG = agreeableness. All interactions between variables are represented by VAR1xVAR2.

Chapter 8

RESULTS

8.1 Subject Recruitment

Subjects were recruited for this study in three ways: 1) Through direct contact with the researchers conducting the study 2) Via communication to graduate student associations of universities throughout the country 3) Through the use of online social networking tools. A list of graduate student associations to which communications were sent and a sample of communications sent are available in appendix 11. A total of 195 subjects signed up to participate in the study. Of these 195 subjects, 64 opted to withdraw from the study before completing the study. Most cited time constraints as the reason for not being able to complete the study.

8.2 Data Collection

The data collection tool used for this study was an online weight and physical activity management application, referred to as the OWPAMA. The tool was created and managed by Tamuchin McCreless. The tool was developed using php and hosted on a third party, secure, Apache web server running Linux. The data for the OWPAMA were stored in a MySQL database also hosted by a third party on a secure server. The OWPAMA tool allowed users to sign up with a unique user ID and password. The login screen for the OWPAMA is shown in appendix 11, figure 11.1. Upon submitting information to the system, users were asked to consent to participating in the program. The consent form is available in appendix 11, figure 11.2. Once the consent form was completed, a user was assigned to an experimental group. Assignment to experimental group was done in sequence, with each subsequent user being assigned to a different experimental group than the previous user that registered to participate. There were four experimental

groups into which users could be placed. These experimental groups are: users receiving no feedforward or feedback, users receiving feedforward only, users receiving feedback only, and users receiving both. The first user that signed up, for example, would be placed in the first experimental group, the next would be placed in the second, etc. This assured that there was no bias present in the placement of users into groups.

Upon first logging in to the system, users were presented with a modified version of the BFI survey in appendix 11. This survey was later used to determine scores on each of the big five personality traits shown in table 5.1. Upon completing the BFI survey questions and successfully registering in the program, users were then asked to enter their daily caloric intake as well as their daily physical activities. Users were expected to complete this information each day, and reminders were sent to users to complete such activities if gaps were found in data. The data entry screen for daily caloric intake is shown in appendix 11, figure 11.3. The data entry screen for daily physical activities is shown in appendix 11, figure 11.4. Upon completing data entry for each day, a summary screen was shown to users containing some information on each user's participation in the program. As there were four experimental groups, users were shown different screens depending on the experimental group in which they were placed. The screens contained different combinations of information depending on the experimental group. There were three levels of information presented to participants. Those levels are defined in table 8.1 below. A view of the actual screen presented to users is shown in appendix 11, figure 11.5.

Table 8.1: Variable List

Level	**Information Description**
Descriptive	The number of calories consumed and burned for the current day as well as over the course of the entire program
Feedback	The subject's calorie differential (number of calories consumed minus number of calories burned for the current day and for the course of the whole program.
Feedforward	The subject's projected weight loss if they continue the current day's trend as well as the projected weight loss if the overall trend since beginning the program is continued.

The levels of information presented to the different experimental groups are shown in table 8.2 below.

Table 8.2: Levels of information displayed to different experimental groups

Experimental Group	**Descriptive**	**Feedback**	**Feedforward**
Control Group	✓		
Feedback only	✓	✓	
Feedforward only	✓		✓
Feedback and feedforward	✓	✓	✓

8.3 Behavior Change

Data were collected from 195 subjects over a six month period of time. Sixty four subjects chose to withdraw from the study formally before completion. Effects of behavior change were measured with respect to three different variables: weight, caloric intake and physical activity.

Weight

The chosen measure of weight loss as an independent variable was percentage weight loss per day of participation in the study. In order to measure the impact of all of the chosen independent variables on an individual's weight, it was necessary to limit the results only to subjects that had at least two data points for weight. This limited the result set to 55 subjects. To determine percentage weight loss per day of participation, the last weight entry value was subtracted from the first, and then divided by the first value to obtain a percentage. This percentage was then divided by the total number of days that passed between the first weight entry and the final weight entry. This was done to compensate for the fact that different individuals chose to enter their weights at different times. The formula for percentage weight loss is shown below:

$$W_{pt} = \frac{\frac{W_0 - W_i}{W_0}}{T_i - T_0}$$

where $T_i - T_0$ is the final weight entry time minus the first weight entry time, measured in days. Using weight as a measure of behavior change in this manner did not yield any results that showed support for the proposed hypotheses. Although some of the coefficients were in the desired direction, none were found to be statistically significant. The actual output of the regression analysis can be seen in figure 8.1.

Figure 8.1: Regression output using weight change as a dependent variable

The REG Procedure
Model: MODEL1
Dependent Variable: PctWeightChange

Number of Observations Read	195
Number of Observations Used	53
Number of Observations with Missing Values	142

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	25	153.68894	6.14756	0.71	0.8083
Error	27	235.32140	8.71561		
Corrected Total	52	389.01035			

Root MSE	2.95222	R-Square	0.3951
Dependent Mean	0.66736	Adj R-Sq	-0.1650
Coeff Var	442.37407		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.34022	23.90100	-0.01	0.9887
FFOnly	1	6.48253	27.80027	0.23	0.8174
FBOnly	1	-8.45346	27.09844	-0.31	0.7575
FFFB	1	6.97365	27.16545	0.26	0.7993
ExtraversionScore	1	0.22840	0.21811	1.05	0.3043
AgreeablenessScore	1	-0.19131	0.18282	-1.05	0.3046
ConscientiousnessScore	1	-0.21528	0.50874	-0.42	0.6755
NeuroticismScore	1	0.10880	0.40181	0.27	0.7886
OpennessScore	1	0.19630	0.22605	0.87	0.3928
FFExtraversion	1	-0.20851	0.28669	-0.73	0.4733
FBExtraversion	1	-0.09880	0.28039	-0.35	0.7273
FFFBExtraversion	1	-0.26761	0.25486	-1.05	0.3030
FFAgreeableness	1	0.47153	0.25361	1.86	0.0739
FBAgreeableness	1	0.52922	0.29669	1.78	0.0857
FFFBAgreeableness	1	0.04428	0.30759	0.14	0.8866
FFConscientiousness	1	-0.28523	0.53618	-0.53	0.5991
FBConscientiousness	1	0.12221	0.55852	0.22	0.8284
FFFBConscientiousness	1	0.26415	0.53230	0.50	0.6237
FFNeuroticism	1	0.04557	0.43300	0.11	0.9170
FBNeuroticism	1	0.08130	0.44586	0.18	0.8567
FFFBNeuroticism	1	-0.12514	0.44474	-0.28	0.7806
FFOpenness	1	-0.22360	0.34782	-0.64	0.5257
FBOpenness	1	-0.35099	0.30772	-1.14	0.2641
FFFBOpenness	1	-0.18228	0.28725	-0.63	0.5310
Age	1	-0.01146	0.05943	-0.19	0.8485
Female	1	-1.18463	1.64109	-0.72	0.4766

An additional analysis was performed using weight as a dependent variable and measure of behavior change. However, instead of measuring weight change as described above, the slope of weight change over the course of using the OWPAMA was used as a dependent variable. A slope was calculated using a regression equation for each person with at least two data points for weight and this slope was used as the dependent variable. The use of slope as a dependent variable is a valid method for analyzing the impact of independent variables on

changes over time and is covered in (Cohen et al., 2003). This analysis also did not yield any statistically significant results. The output is of the analysis is shown in figure 8.2.

Figure 8.2: Regression output using slope of weight change as a dependent variable

Feedforward and FeedBack with PersonalityFactors (Weight) 1750
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	55
Number of Observations Used	35
Number of Observations with Missing Values	20

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	0.01928	0.00241	0.10	0.9988
Error	26	0.61467	0.02364		
Corrected Total	34	0.63395			

Root MSE	0.15376	R-Square	0.0304
Dependent Mean	-0.04138	Adj R-Sq	-0.2679
Coeff Var	-371.57469		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.04822	0.37524	-0.13	0.8987
FFOnly	1	-0.02879	0.09488	-0.30	0.7640
FBOnly	1	-0.00948	0.09374	-0.10	0.9202
FFFB	1	-0.05268	0.08940	-0.59	0.5607
ExtraversionScore	1	-0.00044652	0.00435	-0.10	0.9191
AgreeablenessScore	1	0.00006524	0.00618	0.01	0.9917
ConscientiousnessScore	1	0.00135	0.00660	0.20	0.8392
NeuroticismScore	1	-0.00236	0.00551	-0.43	0.6716
OpennessScore	1	0.00127	0.00462	0.28	0.7849

Additional analyses were performed using only conscientiousness, agreeableness, and openness as well as all three together. These analyses can be seen in appendix 11.

Caloric Intake

Caloric intake was also used as a proxy for behavior change in this study. In order to measure the effect of all factors on caloric intake, a trend line for each person's caloric intake over the course of the program was plotted. A slope was then calculated for this trend line. The slope of the trend line was used as the independent variable in a regression analysis. The results of the regression analysis are shown in table 8.3 below. The actual output of the regression analysis can be seen in figure 8.3.

Table 8.3: Effect of variables on caloric intake

Hypothesis	Description	Supported
1	Feedback will have a positive effect on computer-mediated behavior change	No
2	Feedforward will have a positive effect on computer-mediated behavior change	No
3	Feedforward will have a greater impact on behavior change than feedback	No
4	The effect of feedback on behavior change will be greater when feedforward is provided than when it is not	No
5	Extroversion will have a positive effect on behavior change	No
6	Conscientiousness will have a positive effect on behavior change	Yes**
7	Neuroticism will have no effect on behavior change	No
8	Openness will have a positive effect on behavior change	Yes**
9	Agreeableness will have no effect on behavior change	No
10	The effect of feedback on behavior change will be greater on introverts than on extroverts	No
11	The effect of feedforward on behavior change will be greater on introverts than on extroverts	No
12	The effect of feedback on behavior change will be greater for low-conscientiousness subjects than for high	No
13	The effect of feedforward on behavior change will be greater for low-conscientiousness subjects than for high	Yes**

Table 8.3: Effect of variables on caloric intake

Hypothesis	**Description**	**Supported**
14	The effect of feedback on behavior change will not vary depending on neuroticism ranking	No
15	The effect of feedforward on behavior change will not vary depending on neuroticism ranking	No
16	The effect of feedback on behavior change will be greater for open minded individuals than for close minded individuals	Yes**
17	The effect of feedforward on behavior change will be greater for open minded individuals than for close minded individuals	No
18	The effect of feedback on behavior change will not vary depending on agreeableness ranking	No
19	The effect of feedforward on behavior change will not vary depending on agreeableness ranking	No

(* indicates statistical significance α=.10 ** indicates statistical significance at α=.05)

Figure 8.3: Regression output using caloric intake trend as a dependent variable

Feedforward and FeedBack with PersonalityFactors and Demographics plus Interactions (Calori 831
07:0 Wednesday, June 6, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	25	71821	2872.83288	1.76	0.0843
Error	24	39066	1627.74580		
Corrected Total	49	110887			

Root MSE	40.34533	R-Square	0.6477
Dependent Mean	9.89628	Adj R-Sq	0.2807
Coeff Var	407.68168		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-242.34813	455.89501	-0.53	0.5999
FFOnly	1	76.72699	501.81568	0.15	0.8798
FBOnly	1	292.66545	500.75496	0.58	0.5644
FFFB	1	246.59027	480.90548	0.51	0.6128
ExtraversionScore	1	9.73270	5.91972	1.64	0.1132
AgreeablenessScore	1	2.78638	2.40350	1.16	0.2577
ConscientiousnessScore	1	-12.73471	4.02016	-3.17	0.0042
NeuroticismScore	1	3.42148	6.17797	0.55	0.5848
OpennessScore	1	6.54517	1.90558	3.43	0.0022
FFExtraversion	1	-10.02301	7.01054	-1.43	0.1657
FBExtraversion	1	-7.77633	6.46939	-1.20	0.2411
FFFBExtraversion	1	-9.19321	6.16411	-1.49	0.1489
FFAgreeableness	1	0.28995	4.75990	0.06	0.9519
FBAgreeableness	1	-2.41040	4.46774	-0.54	0.5945
FFFBAgreeableness	1	-1.27567	3.81471	-0.33	0.7410
FFConscientiousness	1	11.80756	5.44768	2.17	0.0403
FBConscientiousness	1	8.47433	5.17751	1.64	0.1147
FFFBConscientiousness	1	11.66463	5.13322	2.27	0.0323
FFNeuroticism	1	-0.92469	6.97789	-0.13	0.8957
FBNeuroticism	1	-2.07278	6.99671	-0.30	0.7696
FFFBNeuroticism	1	-2.27314	6.53809	-0.35	0.7311
FFOpenness	1	-6.33233	3.75615	-1.69	0.1048
FBOpenness	1	-7.03739	3.37336	-2.09	0.0478

An additional analysis was performed using only the experimental groups, demographic variables and big five factor scores. The results of this analysis are shown in table 8.4 below. The output of the regression analysis can be seen in figure 8.4 below.

Table 8.4: Effect of variables on caloric intake

Hypothesis	Description	Supported
1	Feedback will have a positive effect on computer-mediated behavior change	Yes**
2	Feedforward will have a positive effect on computer-mediated behavior change	Yes**
3	Feedforward will have a greater impact on behavior change than feedback	Yes**
4	The effect of feedback on behavior change will be greater when feedforward is provided than when it is not	No
5	Extroversion will have a positive effect on behavior change	No
6	Conscientiousness will have a positive effect on behavior change	Yes**
7	Neuroticism will have a negative effect on behavior change	No
8	Openness will have a positive effect on behavior change	No
9	Agreeableness will have no effect on behavior change	Yes

(* indicates statistical significance α=.10 ** indicates statistical significance at α=.05)

Figure 8.4: Regression output using caloric intake trend as a dependent variable

Feedforward and FeedBack with PersonalityFactors and Demographics (Calories) 830
07:0 Wednesday, June 6, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	36263	3626.29595	1.90	0.0757
Error	39	74624	1913.42979		
Corrected Total	49	110887			

Root MSE	43.74277	R-Square	0.3270
Dependent Mean	9.89628	Adj R-Sq	0.1545
Coeff Var	442.01212		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	48.89956	87.09434	0.56	0.5777
FFOnly	1	-65.50251	20.71385	-3.16	0.0030
FBOnly	1	-56.68109	19.12485	-2.96	0.0052
FFFB	1	-51.95014	19.79504	-2.62	0.0123
ExtraversionScore	1	0.91331	1.10834	0.82	0.4149
AgreeablenessScore	1	0.69266	1.35199	0.51	0.6113
ConscientiousnessScore	1	-2.46290	1.46368	-1.68	0.1004
NeuroticismScore	1	0.89238	1.32660	0.67	0.5051
OpennessScore	1	0.61424	0.96432	0.64	0.5279
Age	1	0.13776	0.56523	0.24	0.8087
Female	1	-9.66897	18.91765	-0.51	0.6122

Additional analyses were conducted to include only the effects of conscientiousness (figure 11.28), openness (figure 11.32), and agreeableness (figure 11.36 as well as conscientiousness and agreeableness together (figure 11.40).

Figure 8.5: Regression output using caloric intake trend as a dependent variable with conscientiousness

Feedforward and FeedBack with Conscientiousness and Interactions 1730
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	46023	6574.75761	4.26	0.0012
Error	42	64863	1544.36710		
Corrected Total	49	110887			

Root MSE	39.29844	R-Square	0.4150
Dependent Mean	9.89628	Adj R-Sq	0.3176
Coeff Var	397.10301		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	356.79125	95.93193	3.72	0.0006
FFOnly	1	-389.74792	130.49108	-2.99	0.0047
FBOnly	1	-262.90305	121.37421	-2.17	0.0360
FFFB	1	-361.27320	122.42458	-2.95	0.0052
ConscientiousnessScore	1	-9.00367	2.84801	-3.16	0.0029
FFConscientiousness	1	9.64143	3.80131	2.54	0.0150
FBConscientiousness	1	6.24796	3.57646	1.75	0.0880
FFFBConscientiousness	1	9.21846	3.55764	2.59	0.0131

Figure 8.6: Regression output using caloric intake trend as a dependent variable with openness

Feedforward and FeedBack with Openness and Interactions 1735
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	31994	4570.64250	2.43	0.0346
Error	42	78892	1878.38628		
Corrected Total	49	110887			

Root MSE	43.34035	R-Square	0.2885
Dependent Mean	9.89628	Adj R-Sq	0.1700
Coeff Var	437.94580		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-15.25417	54.32947	-0.28	0.7803
FFOnly	1	5.66959	120.67434	0.05	0.9627
FBOnly	1	3.00055	89.70537	0.03	0.9735
FFFB	1	58.80950	95.31066	0.62	0.5405
OpennessScore	1	1.94871	1.43640	1.36	0.1821
FFOpenness	1	-1.97855	3.09024	-0.64	0.5255
FBOpenness	1	-1.62377	2.33173	-0.70	0.4900
FFFBOpenness	1	-2.93805	2.37979	-1.23	0.2238

Figure 8.7: Regression output using caloric intake trend as a dependent variable with agreeableness

Feedforward and FeedBack with Agreeableness and Interactions 1740
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	30970	4424.34422	2.33	0.0424
Error	42	79916	1902.76933		
Corrected Total	49	110887			

Root MSE	43.62074	R-Square	0.2793
Dependent Mean	9.89628	Adj R-Sq	0.1592
Coeff Var	440.77909		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	111.19860	71.62501	1.55	0.1280
FFOnly	1	-179.67803	114.58193	-1.57	0.1244
FBOnly	1	-78.24770	108.26828	-0.72	0.4739
FFFB	1	-155.14314	105.95103	-1.46	0.1506
AgreeablenessScore	1	-1.71744	2.18954	-0.78	0.4372
FFAgreeableness	1	3.29707	3.26400	1.01	0.3182
FBAgreeableness	1	0.79372	3.14955	0.25	0.8023
FFFBAgreeableness	1	3.02924	3.07210	0.99	0.3298

Figure 8.8: Regression output using caloric intake trend as a dependent variable with conscientiousness and openness

Feedforward and FeedBack with Conscientiousness and Openness and Interactions 1745
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	46542	4654.19779	2.82	0.0098
Error	39	64345	1649.86522		
Corrected Total	49	110887			

Root MSE	40.61853	R-Square	0.4197
Dependent Mean	9.89628	Adj R-Sq	0.2709
Coeff Var	410.44233		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	356.79125	99.15444	3.60	0.0009
FFOnly	1	-383.89013	157.27874	-2.44	0.0193
FBOnly	1	-256.37051	151.10136	-1.70	0.0977
FFFB	1	-307.59475	159.74191	-1.93	0.0615
ConscientiousnessScore	1	-9.00367	2.94368	-3.06	0.0040
FFConscientiousness	1	9.68788	3.98104	2.43	0.0196
FBConscientiousness	1	6.20985	3.72911	1.67	0.1039
FFFBConscientiousness	1	8.87640	3.72926	2.38	0.0223
FFOpenness	1	-0.19122	2.64106	-0.07	0.9427
FBOpenness	1	-0.13670	1.76249	-0.08	0.9386
FFFBOpenness	1	-1.01720	1.84758	-0.55	0.5851

Other analyses were conducted as well, which can be seen in appendix 11.

Physical Activity

Physical activity was also used as a proxy for behavior change. Physical activity was measured using self reported results of activities in which subjects participated over the course of their participation in the program. The change in physical activity over the course of participation in the program was measured the same way that the change in caloric intake was measured. Trend lines were plotted measuring average calories burned in a day and also the number of

minutes of active exercise in a day based on self reported data. The slope of these trend lines was used as the dependent variable in the regression analysis. The analyses using physical activity as a dependent variable did not yield any statistically significant results. The actual regression output from SAS is shown in figures 8.9 and 8.10.

Figure 8.9: Regression output using calories burned trend as a dependent variable

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	63
Number of Observations Used	62
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	25	906432	36257	0.64	0.8803
Error	36	2053004	57028		
Corrected Total	61	2959436			

Root MSE	238.80513	R-Square	0.3063
Dependent Mean	70.14770	Adj R-Sq	-0.1755
Coeff Var	340.43186		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1432.14823	3711.92732	0.39	0.7019
FFOnly	1	-460.01520	3757.36879	-0.12	0.9032
FBOnly	1	-1048.33879	3894.46881	-0.27	0.7893
FFFB	1	-1290.20957	3782.19503	-0.34	0.7350
ExtraversionScore	1	11.02300	32.12692	0.34	0.7335
AgreeablenessScore	1	-2.30314	31.16957	-0.07	0.9415
ConscientiousnessScore	1	-29.96086	21.95818	-1.36	0.1809
NeuroticismScore	1	-41.49886	55.42322	-0.75	0.4589
OpennessScore	1	9.15060	12.82155	0.71	0.4800
FFExtraversion	1	-4.88171	36.83341	-0.13	0.8953
FBExtraversion	1	-16.83958	34.96957	-0.48	0.6330
FFFBExtraversion	1	-28.20798	32.24487	-0.87	0.3875
FFAgreeableness	1	-20.11749	35.64781	-0.56	0.5760
FBAgreeableness	1	9.84414	36.73663	0.27	0.7903
FFFBAgreeableness	1	9.49881	35.31825	0.27	0.7895
FFConscientiousness	1	35.61222	28.02111	1.27	0.2119
FBConscientiousness	1	26.51557	27.22317	0.97	0.3366
FFFBConscientiousness	1	32.67076	25.33345	1.29	0.2054
FFNeuroticism	1	27.50576	55.83296	0.49	0.6253
FBNeuroticism	1	32.43160	57.23509	0.57	0.5745
FFFBNeuroticism	1	33.52592	55.28109	0.61	0.5480
FFOpenness	1	-13.47378	21.35639	-0.63	0.5321
FBOpenness	1	-13.01962	20.79132	-0.63	0.5351
FFFBOpenness	1	-3.61715	16.87304	-0.21	0.8315
Age	1	-2.78175	3.84835	-0.72	0.4744
Female	1	156.15878	108.42098	1.44	0.1584

Figure 8.10: Regression output using minutes exercised trend as a dependent variable

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	195
Number of Observations Used	62
Number of Observations with Missing Values	133

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	25	117126	4685.04165	0.72	0.7980
Error	36	232673	6463.13122		
Corrected Total	61	349799			

Root MSE	80.39360	R-Square	0.3348
Dependent Mean	30.47834	Adj R-Sq	-0.1271
Coeff Var	263.77286		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	600.94037	1249.61809	0.48	0.6335
FFOnly	1	-141.87888	1264.91593	-0.11	0.9113
FBOnly	1	-511.45343	1311.07057	-0.39	0.6988
FFFB	1	-635.88966	1273.27367	-0.50	0.6205
ExtraversionScore	1	3.76029	10.81551	0.35	0.7301
AgreeablenessScore	1	-1.02522	10.49322	-0.10	0.9227
ConscientiousnessScore	1	-12.17012	7.39221	-1.65	0.1084
NeuroticismScore	1	-14.68108	18.65819	-0.79	0.4365
OpennessScore	1	3.86775	4.31637	0.90	0.3762
FFExtraversion	1	1.60166	12.39995	0.13	0.8979
FBExtraversion	1	-4.41859	11.77249	-0.38	0.7096
FFFBExtraversion	1	-7.70045	10.85522	-0.71	0.4827
FFAgreeableness	1	-10.09815	12.00081	-0.84	0.4056
FBAgreeableness	1	2.02565	12.36736	0.16	0.8708
FFFBAgreeableness	1	1.25085	11.88987	0.11	0.9168
FFConscientiousness	1	15.13225	9.43329	1.60	0.1174
FBConscientiousness	1	12.76572	9.16466	1.39	0.1722
FFFBConscientiousness	1	15.68685	8.52849	1.84	0.0741
FFNeuroticism	1	8.26316	18.79613	0.44	0.6628
FBNeuroticism	1	11.79933	19.26816	0.61	0.5441
FFFBNeuroticism	1	13.67952	18.61035	0.74	0.4671
FFOpenness	1	-6.01565	7.18961	-0.84	0.4083
FBOpenness	1	-4.33111	6.99939	-0.62	0.5400
FFFBOpenness	1	-1.80025	5.68030	-0.32	0.7531
Age	1	-1.05764	1.29555	-0.82	0.4197
Female	1	10.63874	36.49986	0.29	0.7724

Additional analyses using trends of both calories burned and minutes exercised were conducted and the results are shown in appendix 11.

Chapter 9

DISCUSSION

9.1 Behavior Change

When focusing on the rate of change of caloric intake as a function of time using conscientiousness and its interactions with feedforward and feedback, the results did provide support for hypotheses 1, 2, 6, 12, and 13. These results are shown in figure 8.5 Hypotheses 1 and 2 indicate that feedback and feedforward both had a positive effect on behavior change, respectively. This is an encouraging and expected result, one that shows that even in the presence of important personality factors, these two factors will have an impact on a person's caloric intake behavior. The results help to inform anyone wishing to affect an individual's behavior in that providing one or the other is important.

Although it appears that feedforward has more of an impact on caloric intake than feedback, the difference is not statistically significant, leaving open the question of whether feedforward has a larger impact on behavior change than feedback, not providing support for hypothesis 3. The combination of both feedback and feedforward together also did not appear to have a larger impact than either of the two alone, failing to provide support for hypothesis 4. This is perhaps an indication that there is not a linear relationship between the amount of information presented to an individual regarding behavior, and the impact of that information on behavior. It seems that subjects are only likely to digest a small amount of information, emphasizing the importance of presenting individuals with the smallest amount of information that is most likely to have an impact on behavior change. This notion is supported by information processing theory which suggests that there is an asymptotic relationship between the amount of information presented to an

individual, and the ability of the person to process that information (Miller, 1956). A more plausible explanation is that the amount of effort required by an individual to arrive at information provided to the feedback only group is not very large if the person is in the feedback only group. That is to say that if one already knows one's calorie deficit, it does not take very much effort to figure out how much weight one would gain or lose extrapolating that deficit out over time. So the added value of the feedforward statements in this experiment was perhaps not large enough to see an impact given the size of the sample on which the analysis was performed. A larger sample size or a restructuring of the information provided in the feedforward statements could perhaps help provide support for hypothesis 3.

The most interesting finding of the study is the relationship between conscientiousness and both feedforward and feedback. The main effect of conscientiousness on behavior change was shown to be significant as expected from hypothesis 6. The interactions between feedforward and feedback with conscientiousness show, however, that the two seem to balance the effects of conscientiousness. From figure 8.5 one can see that the coefficient of the main effect of conscientiousness is -9, indicating that for every day one participates in this program, they will consume nine fewer calories for every point they scored on the conscientiousness scale from the BFI. The coefficient of the interaction of conscientiousness in the presence of feedback, feedforward, and both together, is 9.6, 6.2, and 9.2, respectively. This shows that a person who is not very conscientious but is receiving feedforward and/or feedback will have almost the same reduction in calories consumed per day as an individual who is conscientious and is in the control group. This is illustrated in table 9.1 below, at which one can arrive by performing the math on the statistical model presented in figure 8.5.

Table 9.1: Predicted reduction in consumption of calories per day by experimental group and conscientiousness level

	Conscientiousness Level	
Experimental Group	**High**	**Low**
Control	48	-312
Feedback Only	32	-80
Feedforward Only	6	30
Feedforward and Feedback	-4.5	3.5

This says that a person who is conscientious and in the control group (not receiving feedforward or feedback) would see a reduction in calories consumed per day that would be roughly equivalent to 48. A person of low conscientiousness in the control group would, however, experience an increase in calorie consumption of 312 calories per day, emphasizing the importance of conscientiousness in behavior change. One can see that in the absence of feedforward and feedback, there is a large difference between a conscientious and an individual who is not conscientious. However, in the presence of feedforward and/or feedback, these differences are not as large. In fact, low conscientiousness individuals in the feedforward and feedforward+feedback experimental groups experienced a greater decrease in daily caloric intake than their high conscientiousness counterparts. This indicates that feedforward and feedback may have the effect of bringing low conscientiousness individuals to the same level as that of high conscientiousness individuals when it comes to behavior change. This could be an important finding for those wanting to design a program which would attempt to modify one's behavior.

Another interesting finding in the results are the differences of the impact of feedforward and feedback on the dependent variables tested. When testing the effects of feedforward and feedback on caloric intake, a positive effect was observed. However, when testing the effects of feedforward and feedback on physical activity, no effect was observed. A possible explanation for this may be that these are two types of behavior change. In attempting to alter one's caloric intake, one is trying to change habits and move past psychological barriers, but in doing so one is not expending more physical effort or spending more time to change one's habits. However, changes in physical activity require one to spend more time and effort to change one's behavior. This may be indicative of limitations of the effects of feedforward and feedback on behavior change. Perhaps changing behavior in such a way as would require someone to expend more effort would require different types of information to be presented to an individual.

Chapter 10

LIMITATIONS

It is important to note that there are limitations to the research presented in this paper. One limitation is that all of the data used in this study were self reported. Because there was no way to validate anyone's responses to BFI questionnaires, entries of caloric intake, physical activity, or weight, the study relies on the honesty of the subjects and on their ability to accurately report data. This is a common limitation of behavioral research and likely only to have minimal impact on the results.

Another limitation is that individuals participating in this study were not in similar environments. Some may have been students, some may have been working full time, some may have been unemployed, etc. There are a number of variables that could affect an individual's ability to change their behavior, and not all of those variables were controlled for in this study. However, because of the recruitment methods used, the majority of the students participating in the study were likely to have been graduate students and a majority of them from Northern Arizona University. Therefore, there were likely to be many similarities between the participants and variations in lifestyle and location were unlikely to have impacted the results to any large extent.

Chapter 11

FUTURE RESEARCH

As reported in chapter 9, an interesting finding of this research is that feedforward and feedback had an affect on behavior requiring little or no change in time or effort spent on a given behavior, but did not have an impact on changes in behavior which required spending more time or effort than one is currently spending. A possible direction for future research would be to review the literature to determine if there are any types of information which can be provided to a person which would influence changes in behavior requiring more energy or time to be spent. Before doing so, it would be interesting to set up a study which was designed to observe the impact of feedback and feedforward on these two different types of behavior change. This study was not designed to do this, it was only observed to be the case in analysis of results. This would require explicit definitions of these two types of behavior and choosing two behaviors that meet the descriptions.

Another direction for future research would involve determining the types of information that would be likely to impact individuals on opposite ends of the other factors of the personality index. This study seemed to indicate that feedforward and feedback brought low conscientiousness individuals up to the level of high conscientiousness individuals with respect to their changes in caloric intake. It would be interesting as well to discover types of information that would influence, for example, open minded individuals differently than close minded individuals.

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APPENDIX A

BFI

Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who likes to spend time with others? Please write a number next to each statement to indicate the extent to which you agree or disagree with that statement.

Disagree strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
1	2	3	4	5

I see Myself as Someone Who...

___1. Is talkative

___2. Tends to find fault with others

___3. Does a thorough job

___4. Is depressed, blue

___5. Is original, comes up with new ideas

___6. Is reserved

___7. Is helpful and unselfish with others

___8. Can be somewhat careless

___9. Is relaxed, handles stress well

___10. Is curious about many different things

___11. Is full of energy

___12. Starts quarrels with others

___13. Is a reliable worker

___14. Can be tense

___15. Is ingenious, a deep thinker

___16. Generates a lot of enthusiasm

___17. Has a forgiving nature

___18. Tends to be disorganized

___19. Worries a lot

___20. Has an active imagination

___21. Tends to be quiet

___22. Is generally trusting

___23. Tends to be lazy

___24. Is emotionally stable, not easily upset

___25. Is inventive

___26. Has an assertive personality

___27. Can be cold and aloof

___28. Perseveres until the task is finished

___29. Can be moody

___30. Values artistic, aesthetic experiences

___31. Is sometimes shy, inhibited

___32. Is considerate and kind to almost everyone

___33. Does things efficiently

___34. Remains calm in tense situations

___35. Prefers work that is routine

___36. Is outgoing, sociable

___37. Is sometimes rude to others

___38. Makes plans and follows through with them

___39. Gets nervous easily

___40. Likes to reflect, play with ideas

___41. Has few artistic interests

___42. Likes to cooperate with others

___43. Is easily distracted

___44. Is sophisticated in art, music, or literature

Please check: Did you write a number in front of each statement?

BFI scale scoring ("R" denotes reverse-scored items):

Extraversion: 1, 6R, 11, 16, 21R, 26, 31R, 36

Agreeableness: 2R, 7, 12R, 17, 22, 27R, 32, 37R, 42

Conscientiousness: 3, 8R, 13, 18R, 23R, 28, 33, 38, 43R

Neuroticism: 4, 9R, 14, 19, 24R, 29, 34R, 39

Openness: 5, 10, 15, 20, 25, 30, 35R, 40, 41R, 44

Note.

APPENDIX B

SUBJECT RECRUITMENT

Table 11.1: Graduate student organizations contacted for subject recruitment

Arizona State University	University of Arizona
Northern Arizona University	Texas A&M University
East Tennessee State University	Indiana University
George Mason University	University of Minnesota
University of South Florida	University of New England
Tulane University	University of Pittsburgh
Ole Miss University	University of Tennessee, Knoxville
University of Pennsylvania	Duke University
Grand Valley State University	Kentucky University
University of California, Los Angeles	Rutgers University
University of California, Davis	University of Nevada, Reno
Rice University	University of California, San Diego
University of Buffalo	Boston College
Baylor University	University of Oklahoma
University of Alabama	Louisiana State University
Stanford University	University of Nebraska, Lincoln
University of South Carolina	University of Arkansas, Little Rock
University of Hawaii	University of California, Santa Barbara
Hunter College	Pennsylvania State University
National Black Graduate Student Assn.	Catholic University of America
University of California, Riverside	University of Maryland (UMBC)
Stony Brook University	North Carolina State University
University of California, Santa Cruz	Fordham University
North Carolina Central University	SUNY ESF
University of Central Florida	Temple University
Suffolk University	Miami University
University of California, San Francisco	University of Maryland
Towson University	Washington State University
Indiana State University	University of Toledo

Sample of communication to graduate student organizations:

I am a graduate student at Arizona State University conducting a weight management study as part of my doctoral thesis and am trying to recruit subjects to participate. I have had a lot of success trying to get graduate students to participate here at ASU and also at other universities. I am wondering if you would be willing to post a note to (University Name) graduate students on your listserv or other mode of communication about the study. You can read more about the study at www.owpama.org. You can also contact me at XXX-XXX-XXXX if you have questions on it or email me with questions. Below is an example of a note I have sent out on other listservs regarding the study.

Please let me know if this would be possible,

Tamuchin McCreless

Weight Management Study

Researchers at Arizona Statue University are conducting a study involving the use of a computer application used to track calories consumed and daily activity in order to aid in the management of an individual's weight and exercise activities. Those who participate in this study will have the benefit of being able to track and measure food consumption and exercise activities in a structured manner, while potentially getting feedback which will help keep them on track with weight management. Participants will also be helping researchers improve understanding of how computers can be used to aid people in weight management.

If you are interested in participating in this study, please visit www.owpama.org or contact Tamuchin McCreless by sending an email to tamuchin.mccreless@asu.edu.

APPENDIX C

OWPAMA SCREENSHOTS

Figure 11.1: OWPAMA Login Screen

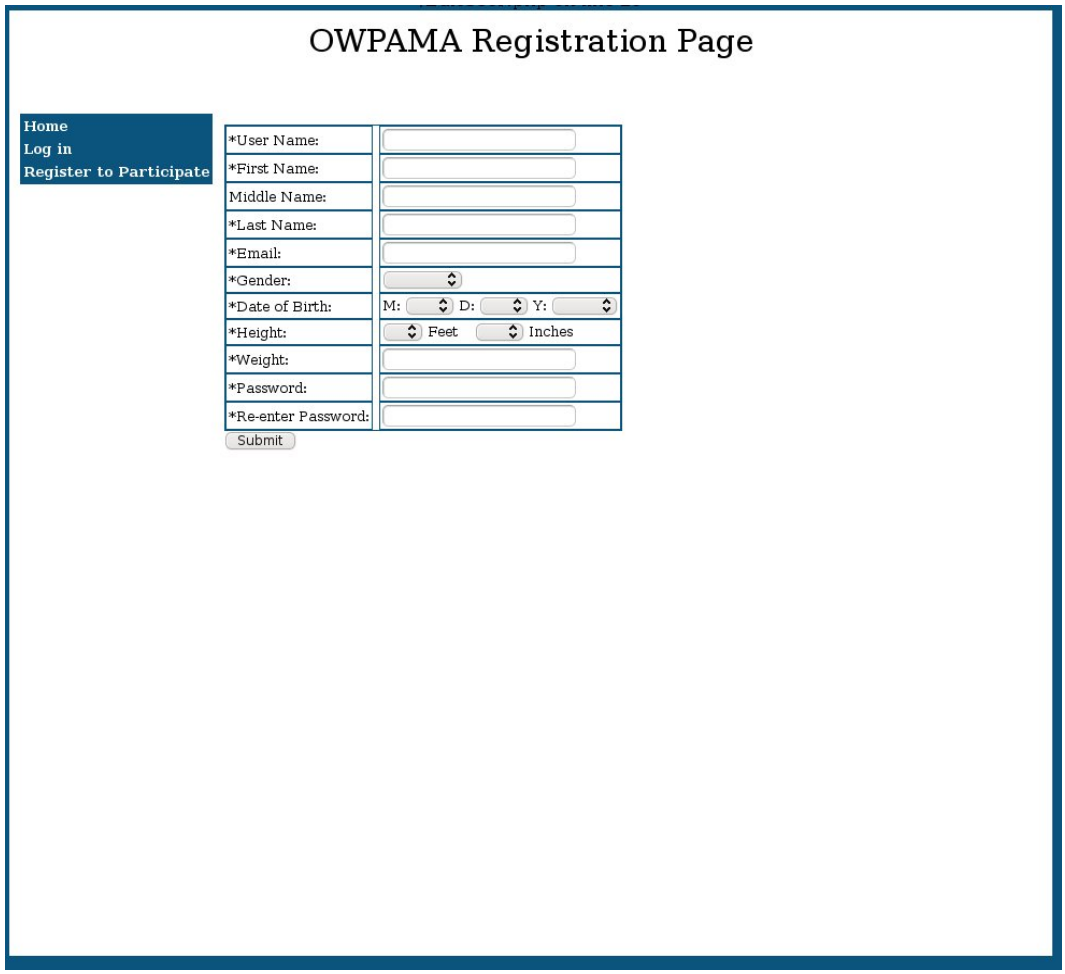


Figure 11.2: OWPAMA Informed Consent

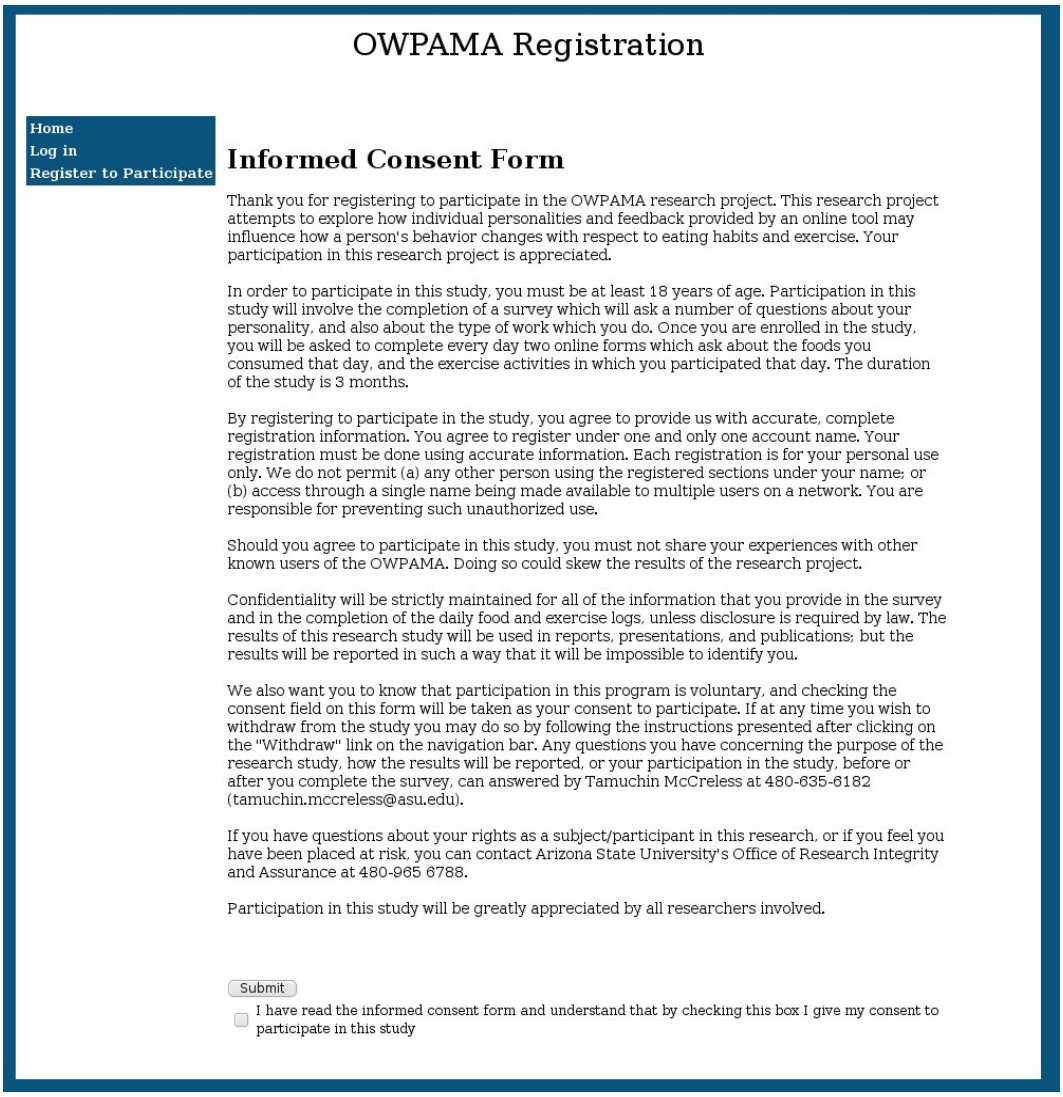


Figure 11.3: OWPAMA caloric intake entry screen

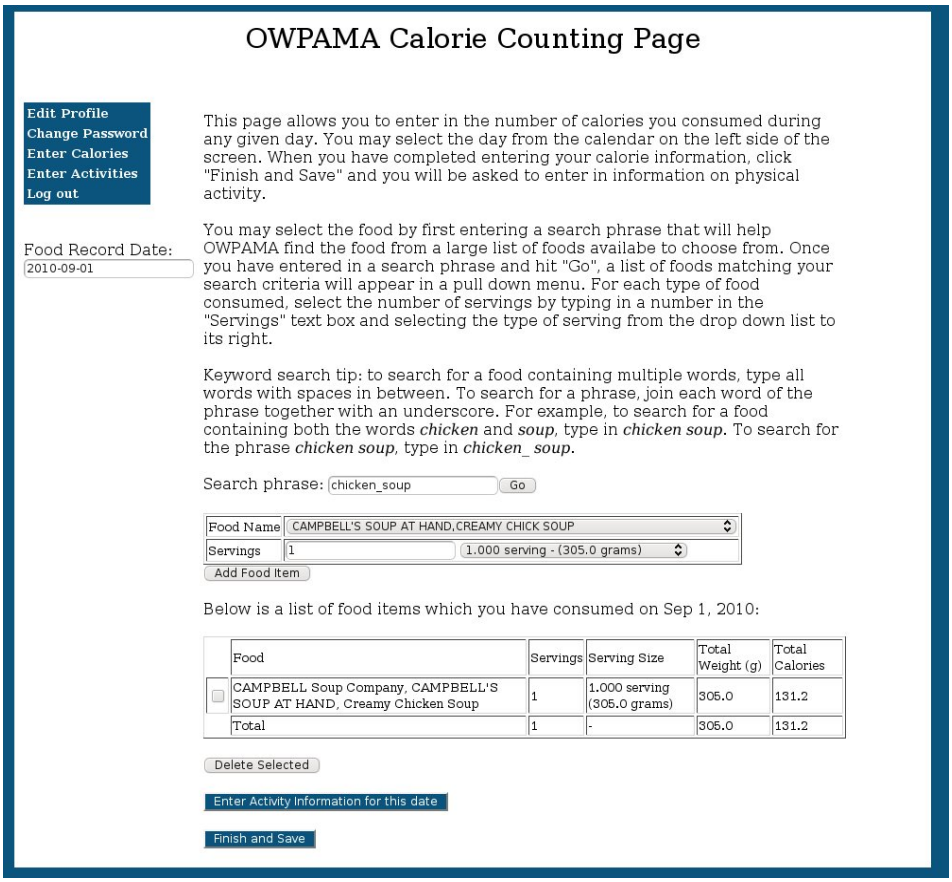


Figure 11.4: OWPAMA physical activity entry screen

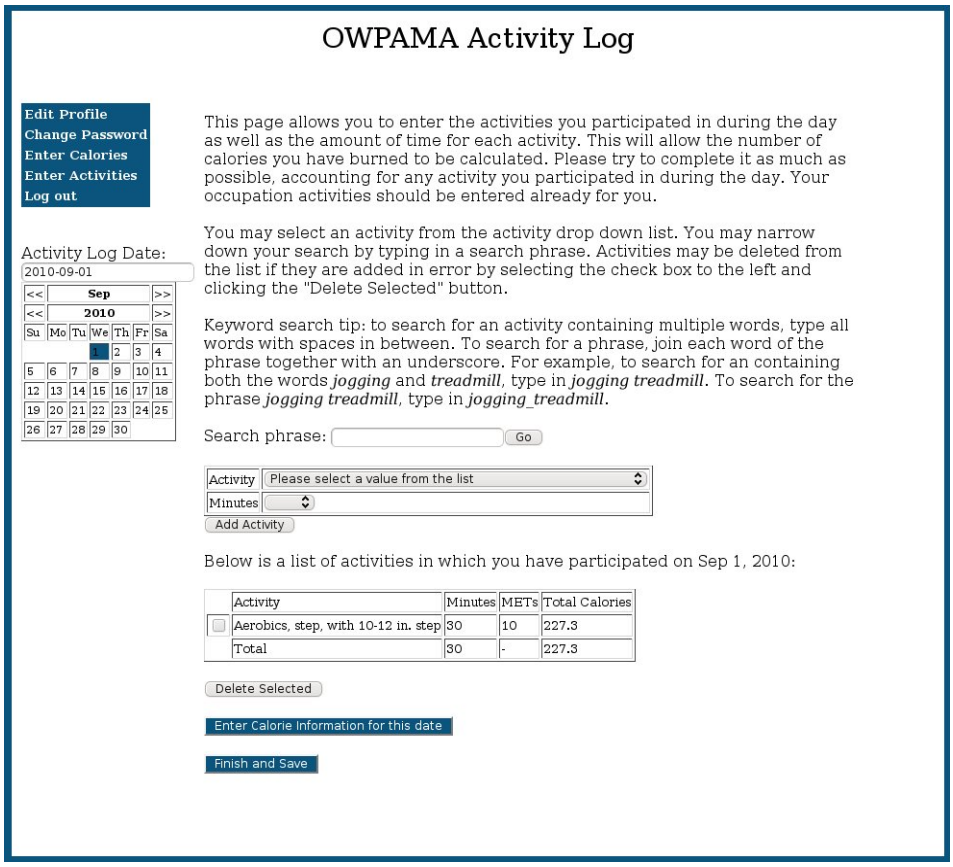
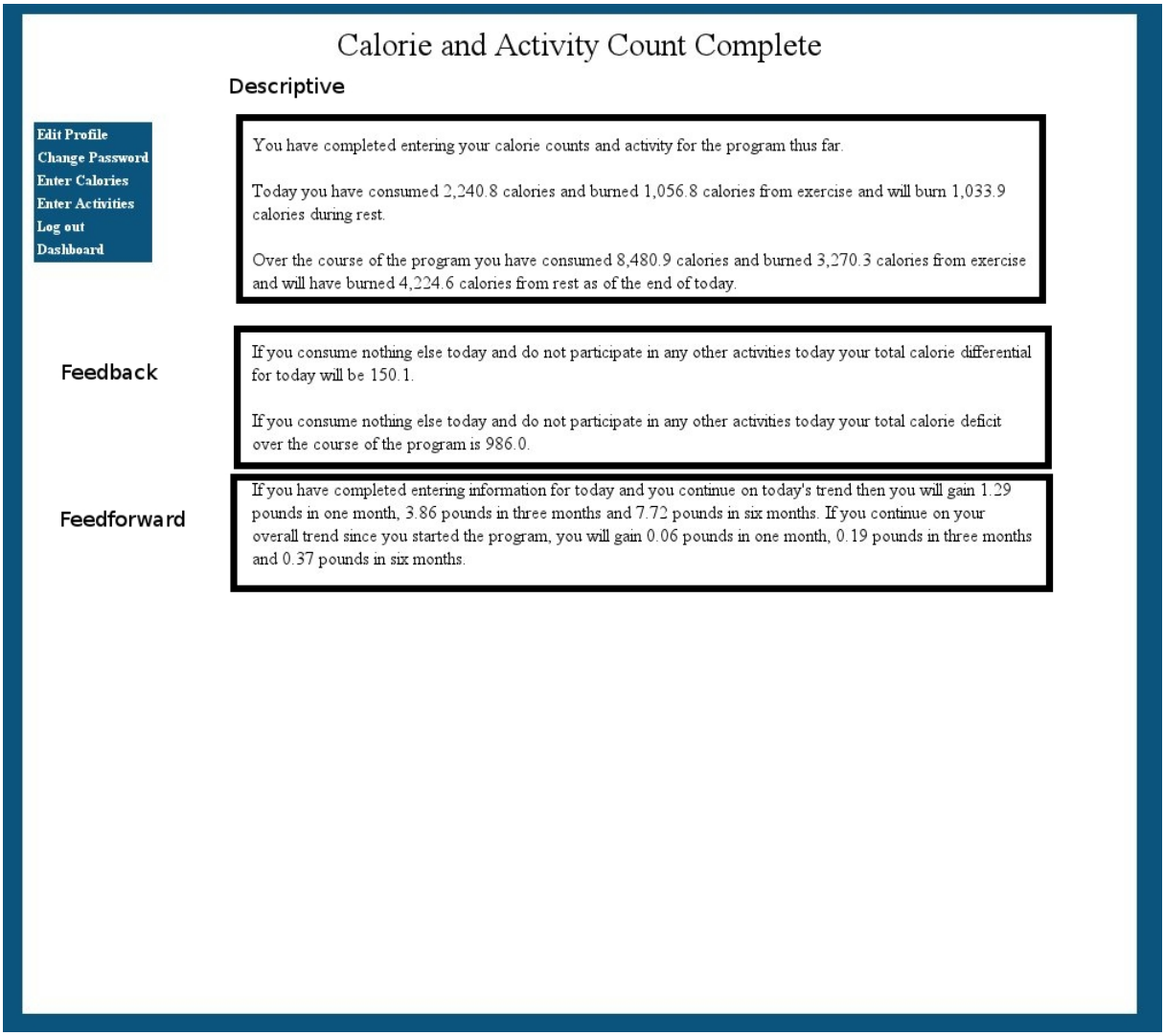


Figure 11.5: OWPAMA data entry completion screen (boxes and information descriptions of Descriptive, Feedforward, and Feedback were not displayed to the user)



APPENDIX D

ADDITIONAL ANALYSES OUTPUT

Figure 11.6: Regression output using slope of weight change and conscientiousness

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.10461	0.19723	-0.53	0.5997
FFOnly	1	-0.02662	0.08061	-0.33	0.7435
FBOnly	1	0.00375	0.08217	0.05	0.9639
FFFB	1	-0.03348	0.07623	-0.44	0.6637
ConscientiousnessScore	1	0.00232	0.00542	0.43	0.6711

Figure 11.7: Regression output using slope of weight change and conscientiousness with demographics

Feedforward and FeedBack with Conscientiousness and Demographics 1755
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	55
Number of Observations Used	35
Number of Observations with Missing Values	20

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	0.02787	0.00464	0.21	0.9690
Error	28	0.60609	0.02165		
Corrected Total	34	0.63395			

Root MSE	0.14713	R-Square	0.0440
Dependent Mean	-0.04138	Adj R-Sq	-0.1609
Coeff Var	-355.54864		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.12773	0.20431	-0.63	0.5369
FFOnly	1	-0.02202	0.08278	-0.27	0.7921
FBOnly	1	0.00668	0.08430	0.08	0.9374
FFFB	1	-0.02284	0.08262	-0.28	0.7843
ConscientiousnessScore	1	0.00046933	0.00592	0.08	0.9374
Age	1	0.00153	0.00199	0.77	0.4482
Female	1	0.03488	0.06844	0.51	0.6143

Figure 11.8: Regression output using slope of weight change and conscientiousness with interactions

Feedforward and FeedBack with Conscientiousness and Interactions 1756
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	55
Number of Observations Used	35
Number of Observations with Missing Values	20

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	0.10797	0.01542	0.79	0.6006
Error	27	0.52598	0.01948		
Corrected Total	34	0.63395			

Root MSE	0.13957	R-Square	0.1703
Dependent Mean	-0.04138	Adj R-Sq	-0.0448
Coeff Var	-337.29902		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.98062	0.51219	-1.91	0.0662
FFOnly	1	0.60102	0.67139	0.90	0.3786
FBOnly	1	1.26866	0.59755	2.12	0.0431
FFFB	1	0.90250	0.60614	1.49	0.1481
ConscientiousnessScore	1	0.02779	0.01478	1.88	0.0709
FFConscientiousness	1	-0.01848	0.01912	-0.97	0.3425
FBConscientiousness	1	-0.03690	0.01727	-2.14	0.0418
FFFBConscientiousness	1	-0.02714	0.01729	-1.57	0.1282

Figure 11.9: Regression output using slope of weight change and conscientiousness with interactions and demographics

Feedforward and FeedBack with Conscientiousness and Interactions and Demographics 1757
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	55
Number of Observations Used	35
Number of Observations with Missing Values	20

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	0.12758	0.01418	0.70	0.7030
Error	25	0.50637	0.02025		
Corrected Total	34	0.63395			

Root MSE	0.14232	R-Square	0.2012
Dependent Mean	-0.04138	Adj R-Sq	-0.0863
Coeff Var	-343.93496		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.99378	0.53068	-1.87	0.0729
FFOnly	1	0.56358	0.69908	0.81	0.4277
FBOnly	1	1.29881	0.62343	2.08	0.0476
FFFB	1	0.86520	0.62229	1.39	0.1767
ConscientiousnessScore	1	0.02536	0.01559	1.63	0.1164
FFConscientiousness	1	-0.01720	0.01991	-0.86	0.3957
FBConscientiousness	1	-0.03763	0.01798	-2.09	0.0467
FFFBConscientiousness	1	-0.02551	0.01776	-1.44	0.1631
Age	1	0.00119	0.00196	0.61	0.5486
Female	1	0.05636	0.06836	0.82	0.4175

Figure 11.10: Regression output using slope of weight change and conscientiousness with interactions and demographics and gender interaction

Feedforward and FeedBack with Conscientiousness and Interactions and Demographics with Inte 1758
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	55
Number of Observations Used	35
Number of Observations with Missing Values	20

Analysis of Variance

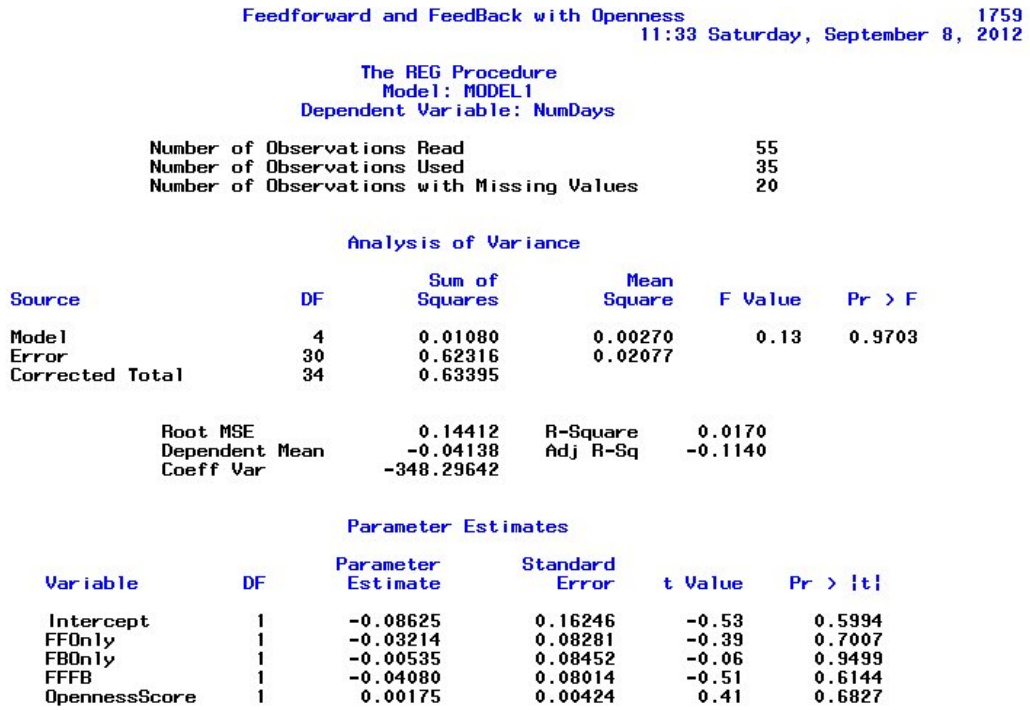
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	0.14116	0.01412	0.69	0.7259
Error	24	0.49279	0.02053		
Corrected Total	34	0.63395			

Root MSE	0.14329	R-Square	0.2227
Dependent Mean	-0.04138	Adj R-Sq	-0.1012
Coeff Var	-346.28685		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-1.35914	0.69804	-1.95	0.0633
FFOnly	1	0.57433	0.70399	0.82	0.4226
FBOnly	1	1.46357	0.65957	2.22	0.0362
FFFB	1	1.05173	0.66720	1.58	0.1280
ConscientiousnessScore	1	0.03610	0.02051	1.76	0.0912
FFConscientiousness	1	-0.01747	0.02004	-0.87	0.3921
FBConscientiousness	1	-0.04208	0.01892	-2.22	0.0358
FFFBConscientiousness	1	-0.03096	0.01909	-1.62	0.1179
Age	1	0.00117	0.00197	0.59	0.5589
Female	1	0.42092	0.45347	0.93	0.3625
FemaleConscientiousness	1	-0.01070	0.01315	-0.81	0.4240

Figure 11.11: Regression output using slope of weight change and openness



Feedforward and FeedBack with Openness 1759
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	55
Number of Observations Used	35
Number of Observations with Missing Values	20

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	0.01080	0.00270	0.13	0.9703
Error	30	0.62316	0.02077		
Corrected Total	34	0.63395			

Root MSE	0.14412	R-Square	0.0170
Dependent Mean	-0.04138	Adj R-Sq	-0.1140
Coeff Var	-348.29642		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.08625	0.16246	-0.53	0.5994
FFOnly	1	-0.03214	0.08281	-0.39	0.7007
FBOnly	1	-0.00535	0.08452	-0.06	0.9499
FFFB	1	-0.04080	0.08014	-0.51	0.6144
OpennessScore	1	0.00175	0.00424	0.41	0.6827

Figure 11.12: Regression output using slope of weight change and openness with demographics

Feedforward and FeedBack with Openness and Demographics 1760
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	55
Number of Observations Used	35
Number of Observations with Missing Values	20

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	0.03900	0.00650	0.31	0.9285
Error	28	0.59495	0.02125		
Corrected Total	34	0.63395			

Root MSE	0.14577	R-Square	0.0615
Dependent Mean	-0.04138	Adj R-Sq	-0.1396
Coeff Var	-352.26729		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.25041	0.21908	-1.14	0.2627
FFOnly	1	-0.03594	0.08405	-0.43	0.6722
FBOnly	1	-0.00758	0.08576	-0.09	0.9302
FFFB	1	-0.03926	0.08445	-0.46	0.6456
OpennessScore	1	0.00327	0.00449	0.73	0.4725
Age	1	0.00191	0.00193	0.99	0.3304
Female	1	0.04580	0.06767	0.68	0.5041

Figure 11.13: Regression output using slope of weight change and openness with interactions

Feedforward and FeedBack with Openness and Interactions 1761
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	55
Number of Observations Used	35
Number of Observations with Missing Values	20

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	0.04176	0.00597	0.27	0.9596
Error	27	0.59219	0.02193		
Corrected Total	34	0.63395			

Root MSE	0.14810	R-Square	0.0659
Dependent Mean	-0.04138	Adj R-Sq	-0.1763
Coeff Var	-357.89822		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	0.09079	0.25071	0.36	0.7201
FFOnly	1	-0.27905	0.51027	-0.55	0.5890
FBOnly	1	-0.67093	0.59913	-1.12	0.2726
FFFB	1	-0.27726	0.39918	-0.69	0.4933
OpennessScore	1	-0.00328	0.00687	-0.48	0.6368
FFOpenness	1	0.00678	0.01303	0.52	0.6070
FBOpenness	1	0.01728	0.01522	1.14	0.2662
FFFBOpenness	1	0.00647	0.01014	0.64	0.5288

Figure 11.14: Regression output using slope of weight change and openness with interactions and demographics

Feedforward and FeedBack with Openness and Interactions and Demographics 1762
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	55
Number of Observations Used	35
Number of Observations with Missing Values	20

Analysis of Variance

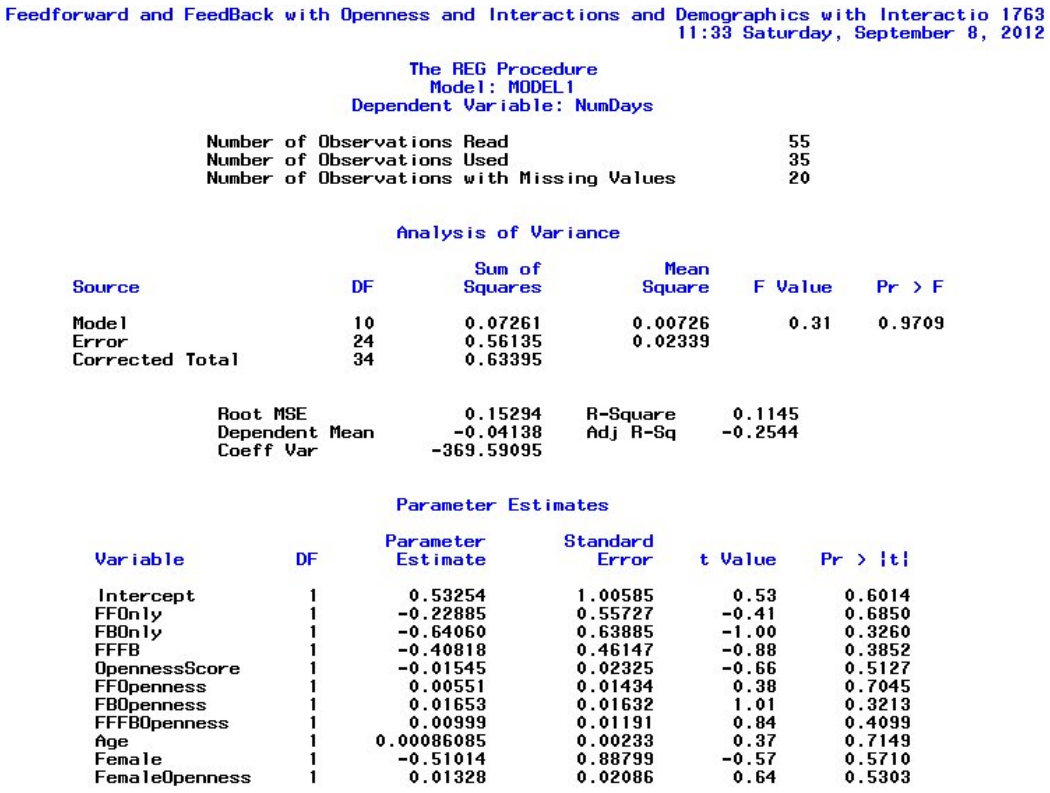
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	0.06312	0.00701	0.31	0.9653
Error	25	0.57083	0.02283		
Corrected Total	34	0.63395			

Root MSE	0.15111	R-Square	0.0996
Dependent Mean	-0.04138	Adj R-Sq	-0.2246
Coeff Var	-365.16941		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.07428	0.31780	-0.23	0.8171
FFOnly	1	-0.18827	0.54699	-0.34	0.7336
FBOnly	1	-0.60698	0.62905	-0.96	0.3438
FFFB	1	-0.28160	0.41146	-0.68	0.5000
OpennessScore	1	-0.00147	0.00753	-0.19	0.8473
FFOpenness	1	0.00441	0.01407	0.31	0.7566
FBOpenness	1	0.01562	0.01606	0.97	0.3403
FFFBOpenness	1	0.00668	0.01059	0.63	0.5338
Age	1	0.00141	0.00214	0.66	0.5174
Female	1	0.05341	0.07099	0.75	0.4589

Figure 11.15: Regression output using slope of weight change and openness with interactions and demographics and gender interaction



Feedforward and FeedBack with Openness and Interactions and Demographics with Interactio 1763
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	55
Number of Observations Used	35
Number of Observations with Missing Values	20

Analysis of Variance

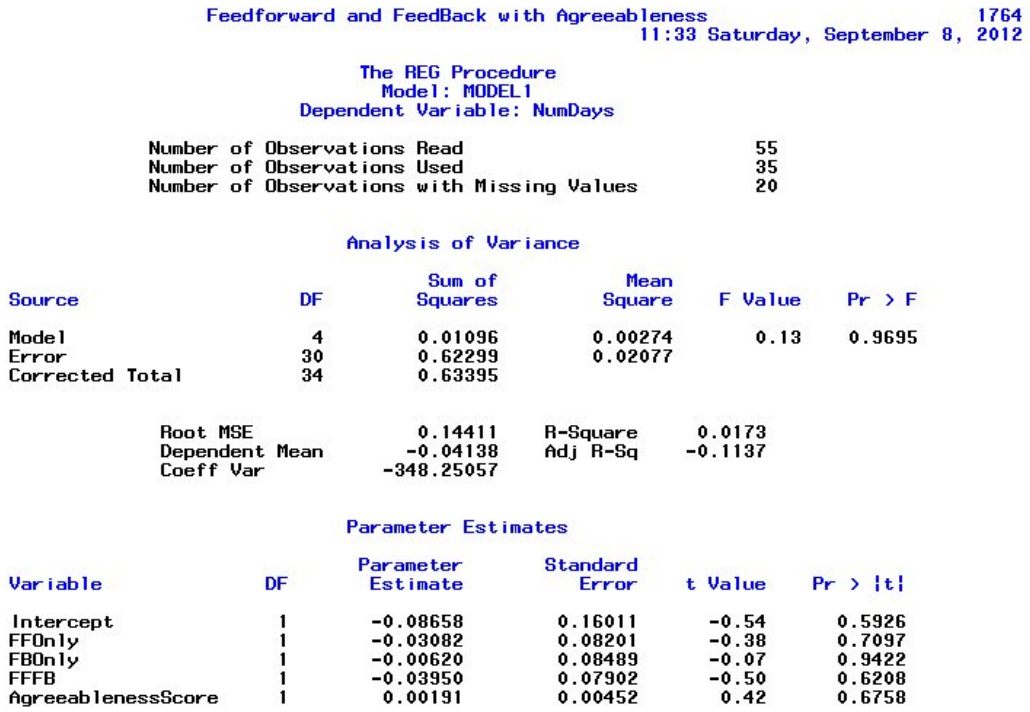
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	0.07261	0.00726	0.31	0.9709
Error	24	0.56135	0.02339		
Corrected Total	34	0.63395			

Root MSE	0.15294	R-Square	0.1145
Dependent Mean	-0.04138	Adj R-Sq	-0.2544
Coeff Var	-369.59095		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	0.53254	1.00585	0.53	0.6014
FFOnly	1	-0.22885	0.55727	-0.41	0.6850
FBOnly	1	-0.64060	0.63885	-1.00	0.3260
FFFB	1	-0.40818	0.46147	-0.88	0.3852
OpennessScore	1	-0.01545	0.02325	-0.66	0.5127
FFOpenness	1	0.00551	0.01434	0.38	0.7045
FBOpenness	1	0.01653	0.01632	1.01	0.3213
FFFBOpenness	1	0.00999	0.01191	0.84	0.4099
Age	1	0.00086085	0.00233	0.37	0.7149
Female	1	-0.51014	0.88799	-0.57	0.5710
FemaleOpenness	1	0.01328	0.02086	0.64	0.5303

Figure 11.16: Regression output using slope of weight change and agreeableness



Feedforward and FeedBack with Agreeableness 1764
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	55
Number of Observations Used	35
Number of Observations with Missing Values	20

Analysis of Variance

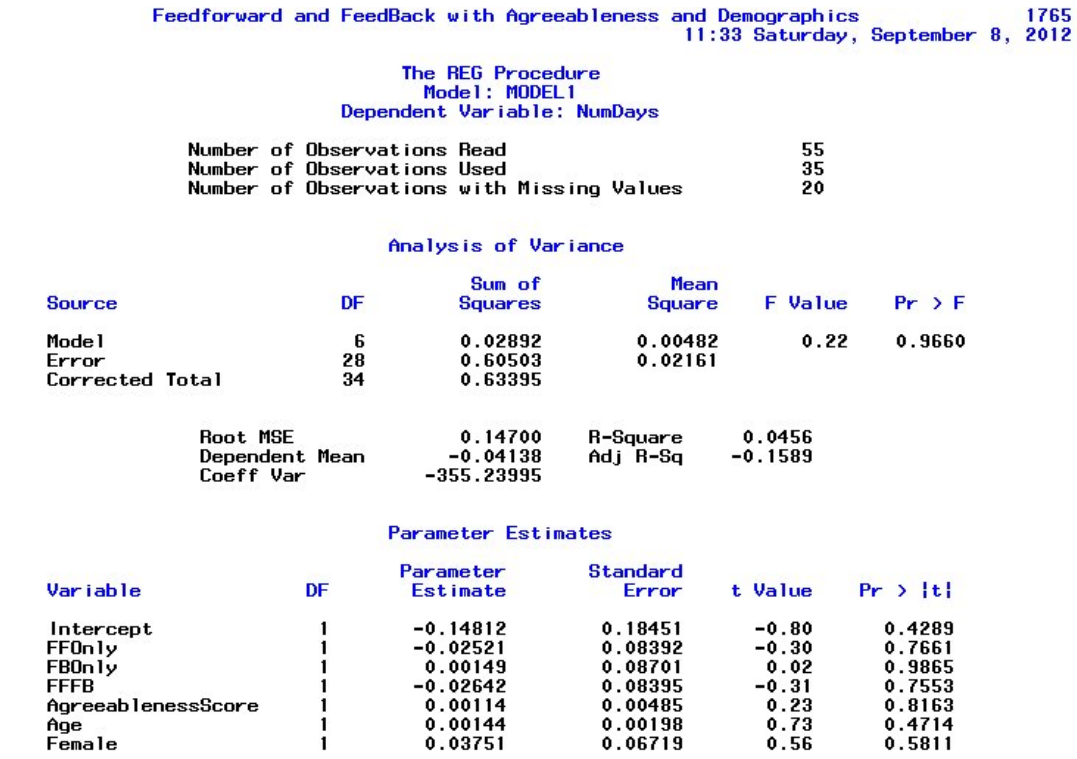
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	0.01096	0.00274	0.13	0.9695
Error	30	0.62299	0.02077		
Corrected Total	34	0.63395			

Root MSE	0.14411	R-Square	0.0173
Dependent Mean	-0.04138	Adj R-Sq	-0.1137
Coeff Var	-348.25057		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.08658	0.16011	-0.54	0.5926
FFOnly	1	-0.03082	0.08201	-0.38	0.7097
FBOnly	1	-0.00620	0.08489	-0.07	0.9422
FFFB	1	-0.03950	0.07902	-0.50	0.6208
AgreeablenessScore	1	0.00191	0.00452	0.42	0.6758

Figure 11.17: Regression output using slope of weight change and agreeableness with demographics



Feedforward and FeedBack with Agreeableness and Demographics 1765
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	55
Number of Observations Used	35
Number of Observations with Missing Values	20

Analysis of Variance

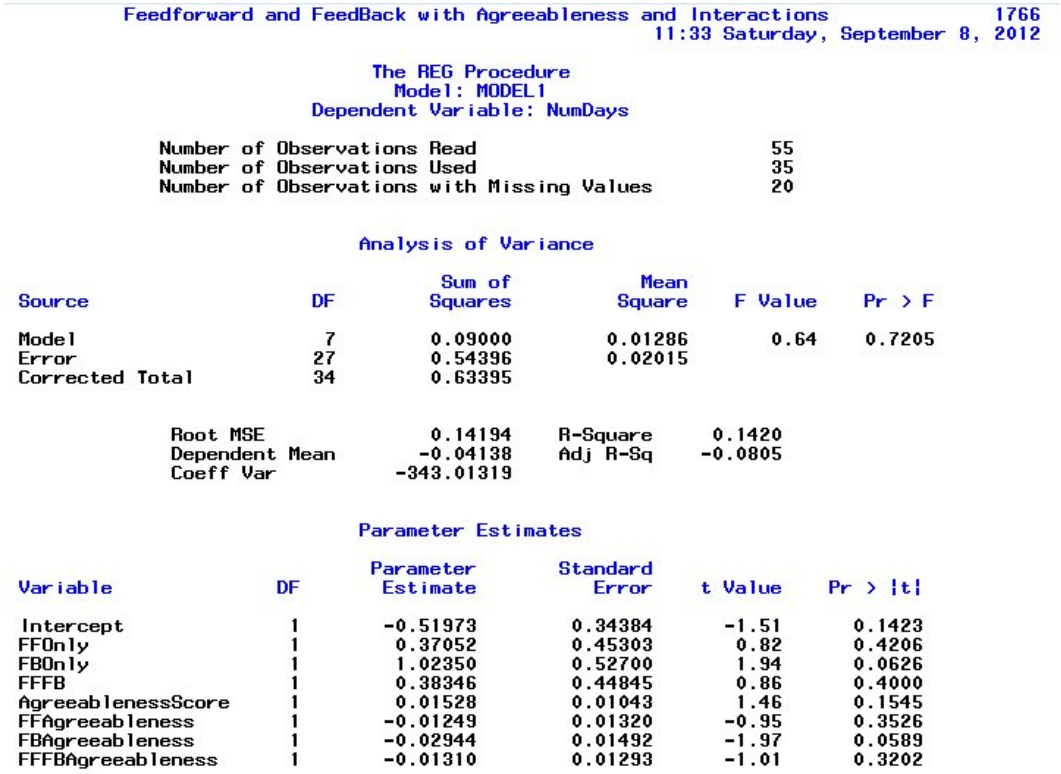
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	0.02892	0.00482	0.22	0.9660
Error	28	0.60503	0.02161		
Corrected Total	34	0.63395			

Root MSE	0.14700	R-Square	0.0456
Dependent Mean	-0.04138	Adj R-Sq	-0.1589
Coeff Var	-355.23995		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.14812	0.18451	-0.80	0.4289
FFOnly	1	-0.02521	0.08392	-0.30	0.7661
FBOnly	1	0.00149	0.08701	0.02	0.9865
FFFB	1	-0.02642	0.08395	-0.31	0.7553
AgreeablenessScore	1	0.00114	0.00485	0.23	0.8163
Age	1	0.00144	0.00198	0.73	0.4714
Female	1	0.03751	0.06719	0.56	0.5811

Figure 11.18: Regression output using slope of weight change and agreeableness with interactions



Feedforward and FeedBack with Agreeableness and Interactions 1766
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	55
Number of Observations Used	35
Number of Observations with Missing Values	20

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	0.09000	0.01286	0.64	0.7205
Error	27	0.54396	0.02015		
Corrected Total	34	0.63395			

Root MSE	0.14194	R-Square	0.1420
Dependent Mean	-0.04138	Adj R-Sq	-0.0805
Coeff Var	-343.01319		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.51973	0.34384	-1.51	0.1423
FFOnly	1	0.37052	0.45303	0.82	0.4206
FBOnly	1	1.02350	0.52700	1.94	0.0626
FFFB	1	0.38346	0.44845	0.86	0.4000
AgreeablenessScore	1	0.01528	0.01043	1.46	0.1545
FFAgreeableness	1	-0.01249	0.01320	-0.95	0.3526
FBAgreeableness	1	-0.02944	0.01492	-1.97	0.0589
FFFBAgreeableness	1	-0.01310	0.01293	-1.01	0.3202

Figure 11.19: Regression output using slope of weight change and agreeableness with interactions and demographics

Feedforward and FeedBack with Agreeableness and Interactions and Demographics 1767
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	55
Number of Observations Used	35
Number of Observations with Missing Values	20

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	0.11820	0.01313	0.64	0.7553
Error	25	0.51575	0.02063		
Corrected Total	34	0.63395			

Root MSE	0.14363	R-Square	0.1865
Dependent Mean	-0.04138	Adj R-Sq	-0.1064
Coeff Var	-347.10533		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.59232	0.35632	-1.66	0.1089
FFOnly	1	0.44406	0.46535	0.95	0.3491
FBOnly	1	1.08305	0.53672	2.02	0.0545
FFFB	1	0.23341	0.47374	0.49	0.6265
AgreeablenessScore	1	0.01370	0.01072	1.28	0.2131
FFAgreeableness	1	-0.01420	0.01350	-1.05	0.3029
FBAgreeableness	1	-0.03063	0.01516	-2.02	0.0542
FFFBAgreeableness	1	-0.00832	0.01381	-0.60	0.5524
Age	1	0.00163	0.00196	0.83	0.4138
Female	1	0.06838	0.07616	0.90	0.3778

Figure 11.20: Regression output using slope of weight change and agreeableness with interactions and demographics and gender interaction

Feedforward and FeedBack with Agreeableness and Interactions and Demographics with Interact 1768
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	55
Number of Observations Used	35
Number of Observations with Missing Values	20

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	0.11927	0.01193	0.56	0.8325
Error	24	0.51468	0.02144		
Corrected Total	34	0.63395			

Root MSE	0.14644	R-Square	0.1881
Dependent Mean	-0.04138	Adj R-Sq	-0.1501
Coeff Var	-353.89459		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.47878	0.62441	-0.77	0.4507
FFOnly	1	0.41651	0.49020	0.85	0.4039
FBOnly	1	1.07700	0.54789	1.97	0.0610
FFFB	1	0.19966	0.50606	0.39	0.6967
AgreeablenessScore	1	0.01061	0.01763	0.60	0.5529
FFAgreeableness	1	-0.01352	0.01410	-0.96	0.3472
FBAgreeableness	1	-0.03050	0.01547	-1.97	0.0603
FFFBAgreeableness	1	-0.00727	0.01484	-0.49	0.6289
Age	1	0.00161	0.00200	0.80	0.4297
Female	1	-0.04510	0.51350	-0.09	0.9307
FemaleAgreeAbleness	1	0.00311	0.01392	0.22	0.8250

Figure 11.21: Regression output using slope of weight change and conscientiousness and openness

Feedforward and FeedBack with Conscientiousness and Openness 1769
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	55
Number of Observations Used	35
Number of Observations with Missing Values	20

Analysis of Variance

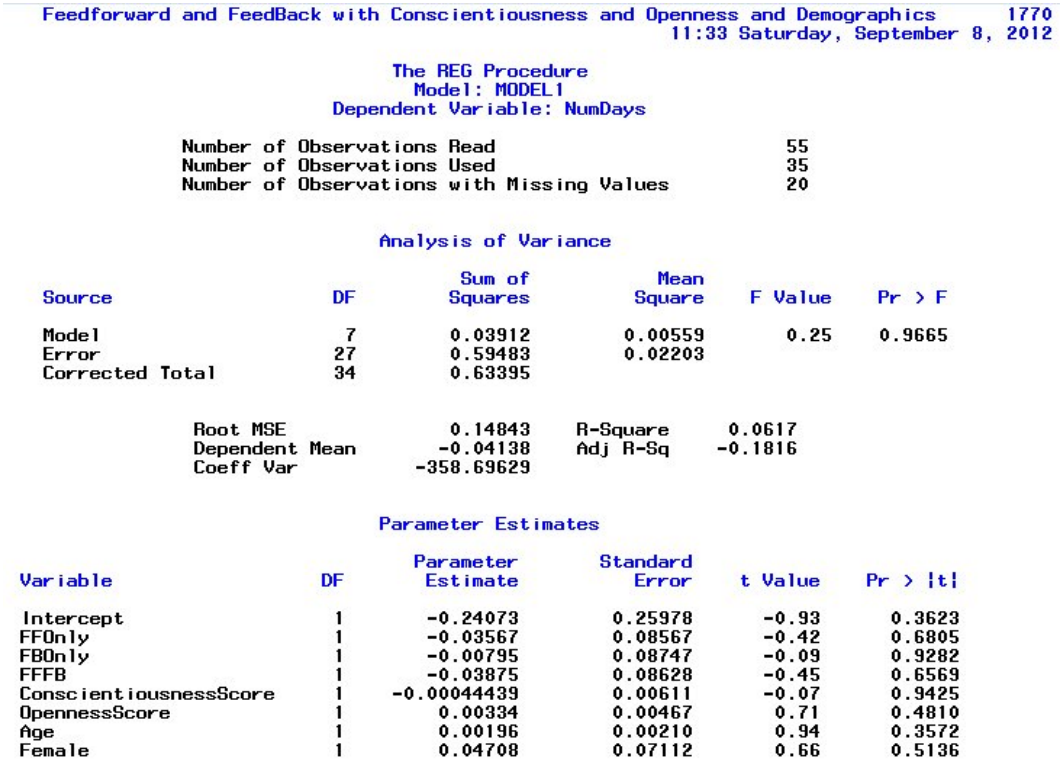
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	0.01405	0.00281	0.13	0.9839
Error	29	0.61990	0.02138		
Corrected Total	34	0.63395			

Root MSE	0.14620	R-Square	0.0222
Dependent Mean	-0.04138	Adj R-Sq	-0.1464
Coeff Var	-353.32396		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.15542	0.24202	-0.64	0.5258
FFOnly	1	-0.03398	0.08413	-0.40	0.6893
FBOnly	1	-0.00384	0.08582	-0.04	0.9646
FFFB	1	-0.04307	0.08150	-0.53	0.6012
ConscientiousnessScore	1	0.00215	0.00552	0.39	0.6992
OpennessScore	1	0.00161	0.00431	0.37	0.7116

Figure 11.22: Regression output using slope of weight change and conscientiousness and openness with demographics



Feedforward and FeedBack with Conscientiousness and Openness and Demographics 1770
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	55
Number of Observations Used	35
Number of Observations with Missing Values	20

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	0.03912	0.00559	0.25	0.9665
Error	27	0.59483	0.02203		
Corrected Total	34	0.63395			

Root MSE	0.14843	R-Square	0.0617
Dependent Mean	-0.04138	Adj R-Sq	-0.1816
Coeff Var	-358.69629		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.24073	0.25978	-0.93	0.3623
FFOnly	1	-0.03567	0.08567	-0.42	0.6805
FBOnly	1	-0.00795	0.08747	-0.09	0.9282
FFFB	1	-0.03875	0.08628	-0.45	0.6569
ConscientiousnessScore	1	-0.00044439	0.00611	-0.07	0.9425
OpennessScore	1	0.00334	0.00467	0.71	0.4810
Age	1	0.00196	0.00210	0.94	0.3572
Female	1	0.04708	0.07112	0.66	0.5136

Figure 11.23: Regression output using slope of weight change and conscientiousness and openness with interactions

Feedforward and FeedBack with Conscientiousness and Openness and Interactions 1771
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	55
Number of Observations Used	35
Number of Observations with Missing Values	20

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	0.14240	0.01424	0.70	0.7193
Error	24	0.49155	0.02048		
Corrected Total	34	0.63395			

Root MSE	0.14311	R-Square	0.2246
Dependent Mean	-0.04138	Adj R-Sq	-0.0984
Coeff Var	-345.85192		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.98062	0.52518	-1.87	0.0741
FFOnly	1	0.35585	0.86128	0.41	0.6832
FBOnly	1	0.69969	0.79568	0.88	0.3879
FFFB	1	0.75970	0.69854	1.09	0.2876
ConscientiousnessScore	1	0.02779	0.01515	1.83	0.0791
FFConscientiousness	1	-0.01737	0.01975	-0.88	0.3878
FBConscientiousness	1	-0.03745	0.01771	-2.11	0.0451
FFFBConscientiousness	1	-0.02688	0.01774	-1.52	0.1428
FFOpenness	1	0.00516	0.01089	0.47	0.6400
FBOpenness	1	0.01473	0.01314	1.12	0.2735
FFFBOpenness	1	0.00323	0.00722	0.45	0.6583

Figure 11.24: Regression output using slope of weight change and conscientiousness and openness with interactions and demographics

Feedforward and FeedBack with Conscientiousness and Interactions and Demographics 1772
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	55
Number of Observations Used	35
Number of Observations with Missing Values	20

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	0.17181	0.01432	0.68	0.7512
Error	22	0.46214	0.02101		
Corrected Total	34	0.63395			

Root MSE	0.14494	R-Square	0.2710
Dependent Mean	-0.04138	Adj R-Sq	-0.1266
Coeff Var	-350.25769		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-1.01912	0.54081	-1.88	0.0728
FFOnly	1	0.35452	0.87425	0.41	0.6890
FBOnly	1	0.72595	0.80888	0.90	0.3792
FFFB	1	0.61748	0.72208	0.86	0.4017
ConscientiousnessScore	1	0.02548	0.01591	1.60	0.1235
FFConscientiousness	1	-0.01672	0.02035	-0.82	0.4201
FBConscientiousness	1	-0.03924	0.01835	-2.14	0.0439
FFFBConscientiousness	1	-0.02495	0.01812	-1.38	0.1824
FFOpenness	1	0.00487	0.01118	0.44	0.6672
FBOpenness	1	0.01582	0.01343	1.18	0.2514
FFFBOpenness	1	0.00572	0.00761	0.75	0.4601
Age	1	0.00113	0.00205	0.55	0.5866
Female	1	0.07952	0.07229	1.10	0.2832

Figure 11.25: Regression output using slope of weight change and conscientiousness and openness with interactions and demographics and gender interaction

Feedforward and FeedBack with Conscientiousness and Interactions and Demographics with Inte 1773
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	55
Number of Observations Used	35
Number of Observations with Missing Values	20

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	0.22886	0.01635	0.81	0.6540
Error	20	0.40509	0.02025		
Corrected Total	34	0.63395			

Root MSE	0.14232	R-Square	0.3610
Dependent Mean	-0.04138	Adj R-Sq	-0.0863
Coeff Var	-343.93284		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-2.13102	0.85023	-2.51	0.0209
FFOnly	1	0.49105	0.86427	0.57	0.5762
FBOnly	1	0.96474	0.80696	1.20	0.2459
FFFB	1	1.14140	0.77711	1.47	0.1574
ConscientiousnessScore	1	0.05727	0.02461	2.33	0.0306
FFConscientiousness	1	-0.03310	0.02352	-1.41	0.1748
FBConscientiousness	1	-0.06115	0.02252	-2.72	0.0133
FFFBConscientiousness	1	-0.04708	0.02224	-2.12	0.0470
FFOpenness	1	0.01690	0.01432	1.18	0.2517
FBOpenness	1	0.03042	0.01619	1.88	0.0748
FFFBOpenness	1	0.01294	0.00949	1.36	0.1879
Age	1	-0.00031173	0.00228	-0.14	0.8925
Female	1	1.04789	0.59213	1.77	0.0920
FemaleConscientiousness	1	-0.01535	0.01340	-1.15	0.2657
FemaleOpenness	1	-0.01059	0.00824	-1.29	0.2134

Figure 11.26: Regression output using slope of caloric intake and conscientiousness

Feedforward and FeedBack with Conscientiousness 1728
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

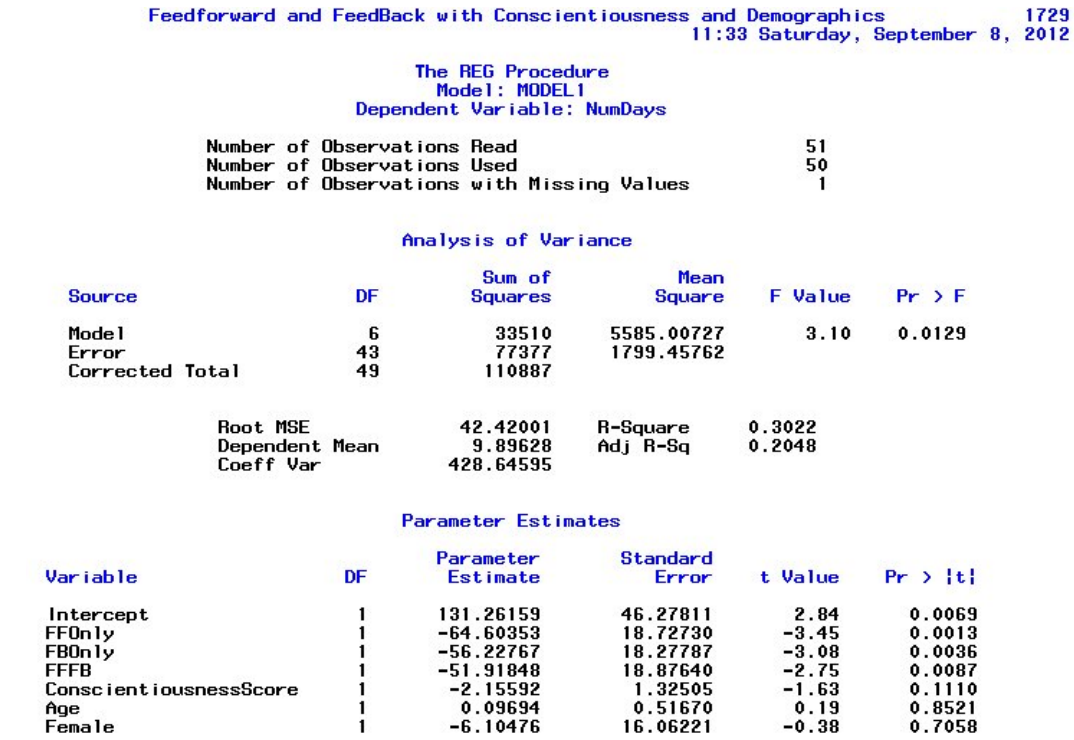
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	33166	8291.41382	4.80	0.0026
Error	45	77721	1727.13480		
Corrected Total	49	110887			

Root MSE	41.55881	R-Square	0.2991
Dependent Mean	9.89628	Adj R-Sq	0.2368
Coeff Var	419.94366		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	128.55000	43.79807	2.94	0.0052
FFOnly	1	-63.74221	18.24480	-3.49	0.0011
FBOnly	1	-54.57247	17.49667	-3.12	0.0032
FFFB	1	-48.66646	16.93407	-2.87	0.0062
ConscientiousnessScore	1	-2.17010	1.25089	-1.73	0.0896

Figure 11.27: Regression output using slope of caloric intake and conscientiousness with demographics



Feedforward and FeedBack with Conscientiousness and Demographics 1729
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

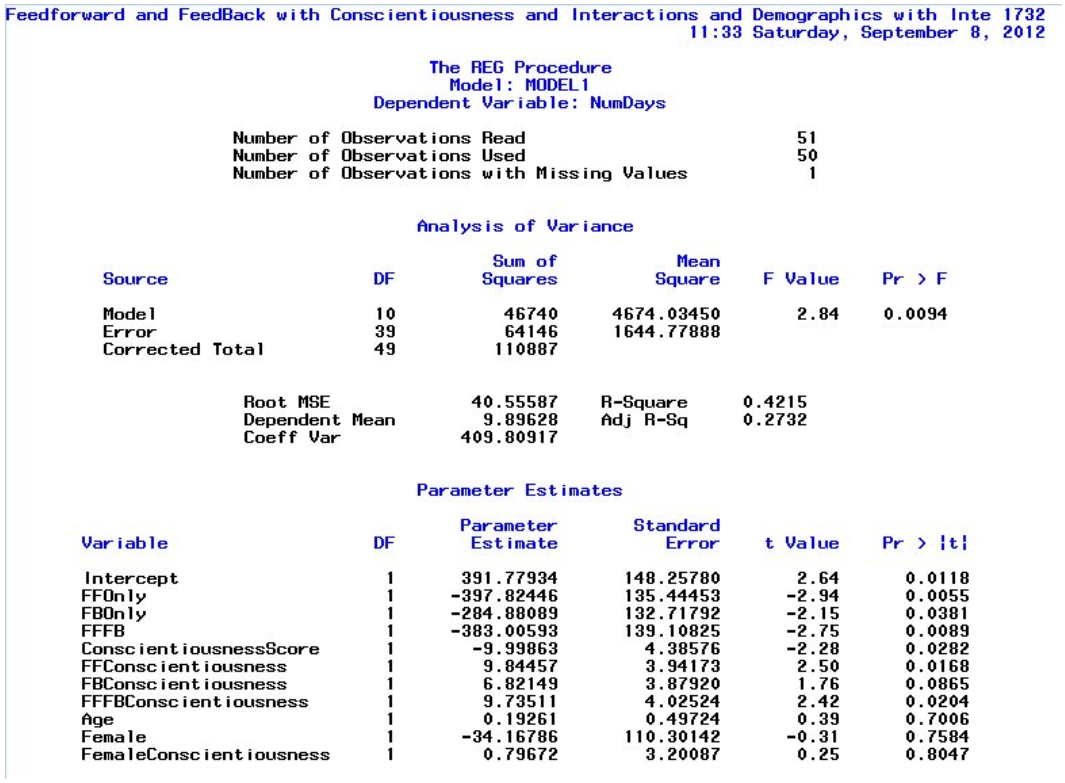
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	33510	5585.00727	3.10	0.0129
Error	43	77377	1799.45762		
Corrected Total	49	110887			

Root MSE	42.42001	R-Square	0.3022
Dependent Mean	9.89628	Adj R-Sq	0.2048
Coeff Var	428.64595		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	131.26159	46.27811	2.84	0.0069
FFOnly	1	-64.60353	18.72730	-3.45	0.0013
FBOnly	1	-56.22767	18.27787	-3.08	0.0036
FFFB	1	-51.91848	18.87640	-2.75	0.0087
ConscientiousnessScore	1	-2.15592	1.32505	-1.63	0.1110
Age	1	0.09694	0.51670	0.19	0.8521
Female	1	-6.10476	16.06221	-0.38	0.7058

Figure 11.28: Regression output using slope of caloric intake and conscientiousness with interactions



Feedforward and FeedBack with Conscientiousness and Interactions and Demographics with Inte 1732
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	46740	4674.03450	2.84	0.0094
Error	39	64146	1644.77888		
Corrected Total	49	110887			

Root MSE	40.55587	R-Square	0.4215
Dependent Mean	9.89628	Adj R-Sq	0.2732
Coeff Var	409.80917		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	391.77934	148.25780	2.64	0.0118
FFOnly	1	-397.82446	135.44453	-2.94	0.0055
FBOnly	1	-284.88089	132.71792	-2.15	0.0381
FFFB	1	-383.00593	139.10825	-2.75	0.0089
ConscientiousnessScore	1	-9.99863	4.38576	-2.28	0.0282
FFConscientiousness	1	9.84457	3.94173	2.50	0.0168
FBConscientiousness	1	6.82149	3.87920	1.76	0.0865
FFFBConscientiousness	1	9.73511	4.02524	2.42	0.0204
Age	1	0.19261	0.49724	0.39	0.7006
Female	1	-34.16786	110.30142	-0.31	0.7584
FemaleConscientiousness	1	0.79672	3.20087	0.25	0.8047

Figure 11.29: Regression output using slope of caloric intake and conscientiousness with interactions and demographics

Feedforward and FeedBack with Conscientiousness and Interactions and Demographics 1731
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

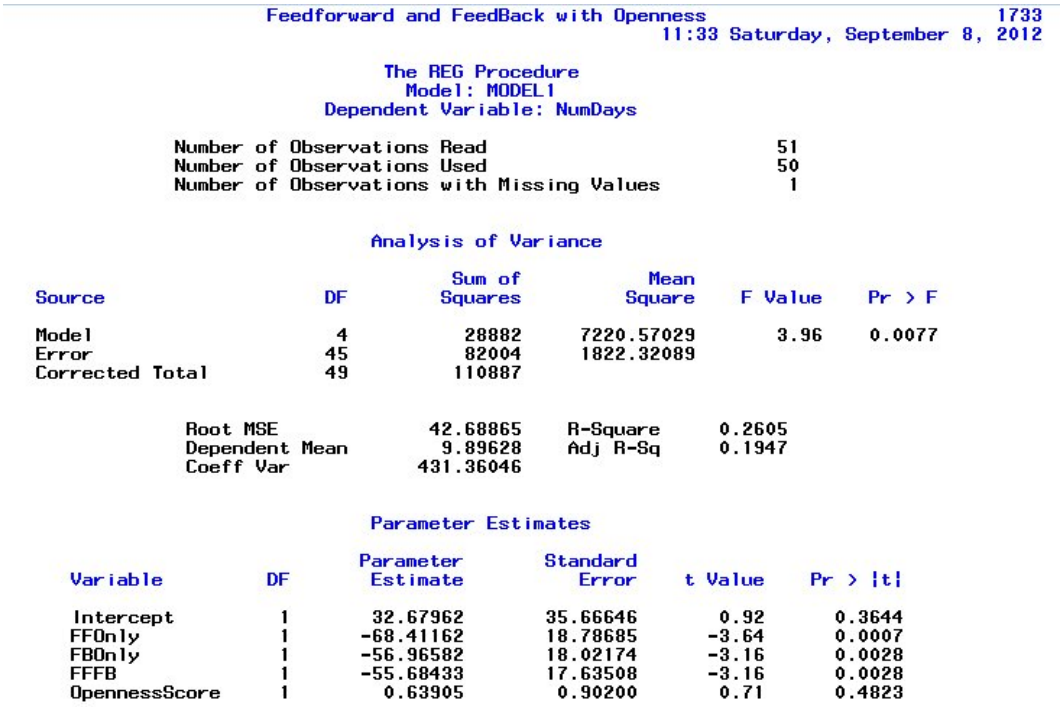
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	46638	5182.04915	3.23	0.0050
Error	40	64248	1606.20698		
Corrected Total	49	110887			

Root MSE	40.07751	R-Square	0.4206
Dependent Mean	9.89628	Adj R-Sq	0.2902
Coeff Var	404.97542		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	364.58058	99.01764	3.68	0.0007
FFOnly	1	-397.41874	133.83725	-2.97	0.0050
FBOnly	1	-275.17291	125.36137	-2.20	0.0340
FFFB	1	-368.85746	125.46730	-2.94	0.0054
ConscientiousnessScore	1	-9.19846	2.94814	-3.12	0.0033
FFConscientiousness	1	9.83539	3.89506	2.53	0.0156
FBConscientiousness	1	6.55122	3.68021	1.78	0.0827
FFFBConscientiousness	1	9.32683	3.63252	2.57	0.0141
Age	1	0.18925	0.49119	0.39	0.7021
Female	1	-6.98339	15.26185	-0.46	0.6497

Figure 11.30: Regression output using slope of caloric intake and openness



Feedforward and FeedBack with Openness 1733
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	28882	7220.57029	3.96	0.0077
Error	45	82004	1822.32089		
Corrected Total	49	110887			

Root MSE	42.68865	R-Square	0.2605
Dependent Mean	9.89628	Adj R-Sq	0.1947
Coeff Var	431.36046		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	32.67962	35.66646	0.92	0.3644
FFOnly	1	-68.41162	18.78685	-3.64	0.0007
FBOnly	1	-56.96582	18.02174	-3.16	0.0028
FFFB	1	-55.68433	17.63508	-3.16	0.0028
OpennessScore	1	0.63905	0.90200	0.71	0.4823

Figure 11.31: Regression output using slope of caloric intake and openness with demographics

Feedforward and FeedBack with Openness and Demographics 1734
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

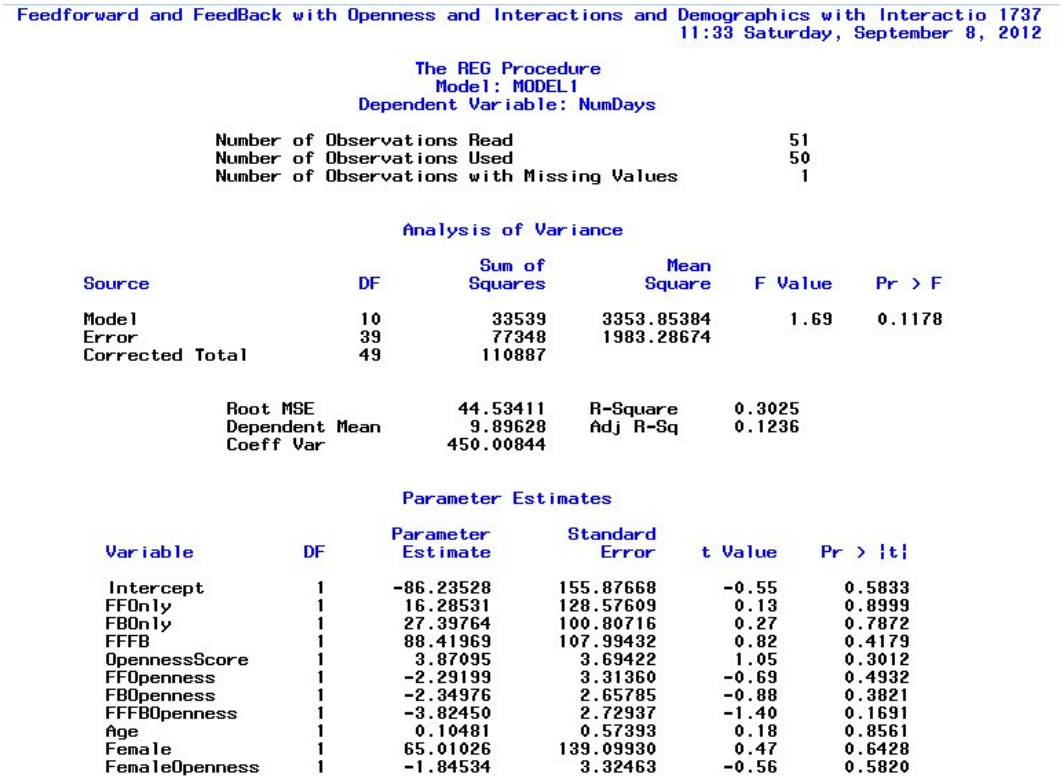
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	29382	4897.04843	2.58	0.0316
Error	43	81504	1895.45188		
Corrected Total	49	110887			

Root MSE	43.53679	R-Square	0.2650
Dependent Mean	9.89628	Adj R-Sq	0.1624
Coeff Var	439.93072		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	46.94337	46.66800	1.01	0.3201
FFOnly	1	-68.66747	19.25045	-3.57	0.0009
FBOnly	1	-58.48601	18.74803	-3.12	0.0032
FFFB	1	-58.37742	19.31203	-3.02	0.0042
OpennessScore	1	0.54378	0.93882	0.58	0.5655
Age	1	-0.08550	0.51643	-0.17	0.8693
Female	1	-8.20176	16.61904	-0.49	0.6242

Figure 11.32: Regression output using slope of caloric intake and openness with interactions



Feedforward and FeedBack with Openness and Interactions and Demographics with Interactio 1737
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	33539	3353.85384	1.69	0.1178
Error	39	77348	1983.28674		
Corrected Total	49	110887			

Root MSE	44.53411	R-Square	0.3025
Dependent Mean	9.89628	Adj R-Sq	0.1236
Coeff Var	450.00844		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-86.23528	155.87668	-0.55	0.5833
FFOnly	1	16.28531	128.57609	0.13	0.8999
FBOnly	1	27.39764	100.80716	0.27	0.7872
FFFB	1	88.41969	107.99432	0.82	0.4179
OpennessScore	1	3.87095	3.69422	1.05	0.3012
FFOpenness	1	-2.29199	3.31360	-0.69	0.4932
FBOpenness	1	-2.34976	2.65785	-0.88	0.3821
FFFBOpenness	1	-3.82450	2.72937	-1.40	0.1691
Age	1	0.10481	0.57393	0.18	0.8561
Female	1	65.01026	139.09930	0.47	0.6428
FemaleOpenness	1	-1.84534	3.32463	-0.56	0.5820

Figure 11.33: Regression output using slope of caloric intake and openness with interactions and demographics

Feedforward and FeedBack with Openness and Interactions and Demographics 1736
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	32928	3658.61363	1.88	0.0839
Error	40	77959	1948.97997		
Corrected Total	49	110887			

Root MSE	44.14725	R-Square	0.2969
Dependent Mean	9.89628	Adj R-Sq	0.1388
Coeff Var	446.09936		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-8.07884	66.27937	-0.12	0.9036
FFOnly	1	14.38686	127.41408	0.11	0.9107
FBOnly	1	14.24793	97.13263	0.15	0.8841
FFFB	1	63.68592	97.51758	0.65	0.5174
OpennessScore	1	2.00572	1.52111	1.32	0.1948
FFOpenness	1	-2.23803	3.28340	-0.68	0.4994
FBOpenness	1	-1.99478	2.55735	-0.78	0.4400
FFFBOpenness	1	-3.19833	2.46373	-1.30	0.2017
Age	1	0.07769	0.56688	0.14	0.8917
Female	1	-11.60163	17.09188	-0.68	0.5012

Figure 11.34: Regression output using slope of caloric intake and agreeableness

Feedforward and FeedBack with Agreeableness 1738
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	27968	6992.00517	3.79	0.0096
Error	45	82919	1842.63779		
Corrected Total	49	110887			

Root MSE	42.92596	R-Square	0.2522
Dependent Mean	9.89628	Adj R-Sq	0.1858
Coeff Var	433.75840		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	55.51560	38.05060	1.46	0.1515
FFOnly	1	-66.89642	19.39099	-3.45	0.0012
FBOnly	1	-55.93245	18.43535	-3.03	0.0040
FFFB	1	-53.01746	17.80180	-2.98	0.0047
AgreeablenessScore	1	0.01723	1.10738	0.02	0.9877

Figure 11.35: Regression output using slope of caloric intake and agreeableness with demographics

Feedforward and FeedBack with Agreeableness and Demographics 1739
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	28750	4791.63060	2.51	0.0360
Error	43	82137	1910.16134		
Corrected Total	49	110887			

Root MSE	43.70539	R-Square	0.2593
Dependent Mean	9.89628	Adj R-Sq	0.1559
Coeff Var	441.63444		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	70.62013	45.37337	1.56	0.1269
FFOnly	1	-67.25972	19.75358	-3.40	0.0014
FBOnly	1	-57.84366	19.03627	-3.04	0.0040
FFFB	1	-56.72095	19.35141	-2.93	0.0054
AgreeablenessScore	1	-0.05021	1.19084	-0.04	0.9666
Age	1	-0.09018	0.53893	-0.17	0.8679
Female	1	-10.22340	16.59083	-0.62	0.5410

Figure 11.36: Regression output using slope of caloric intake and agreeableness with interactions

Feedforward and FeedBack with Agreeableness and Interactions and Demographics with Interact 1742
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	33030	3303.04312	1.65	0.1273
Error	39	77856	1996.31513		
Corrected Total	49	110887			

Root MSE	44.68014	R-Square	0.2979
Dependent Mean	9.89628	Adj R-Sq	0.1178
Coeff Var	451.48410		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	3.94621	161.02239	0.02	0.9806
FFOnly	1	-166.86581	123.01982	-1.36	0.1828
FBOnly	1	-74.05606	112.24791	-0.66	0.5133
FFFB	1	-66.64901	141.18335	-0.47	0.6395
AgreeablenessScore	1	1.73231	4.63108	0.37	0.7104
FFAgreeableness	1	2.98535	3.47122	0.86	0.3950
FBAgreeableness	1	0.58327	3.27133	0.18	0.8594
FFFBAgreeableness	1	0.27152	4.21283	0.06	0.9489
Age	1	-0.10318	0.55778	-0.18	0.8542
Female	1	109.45430	142.85831	0.77	0.4482
FemaleAgreeAbleness	1	-3.42153	4.04835	-0.85	0.4032

Figure 11.37: Regression output using slope of caloric intake and agreeableness with interactions and demographics

Feedforward and FeedBack with Agreeableness and Interactions and Demographics 1741
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

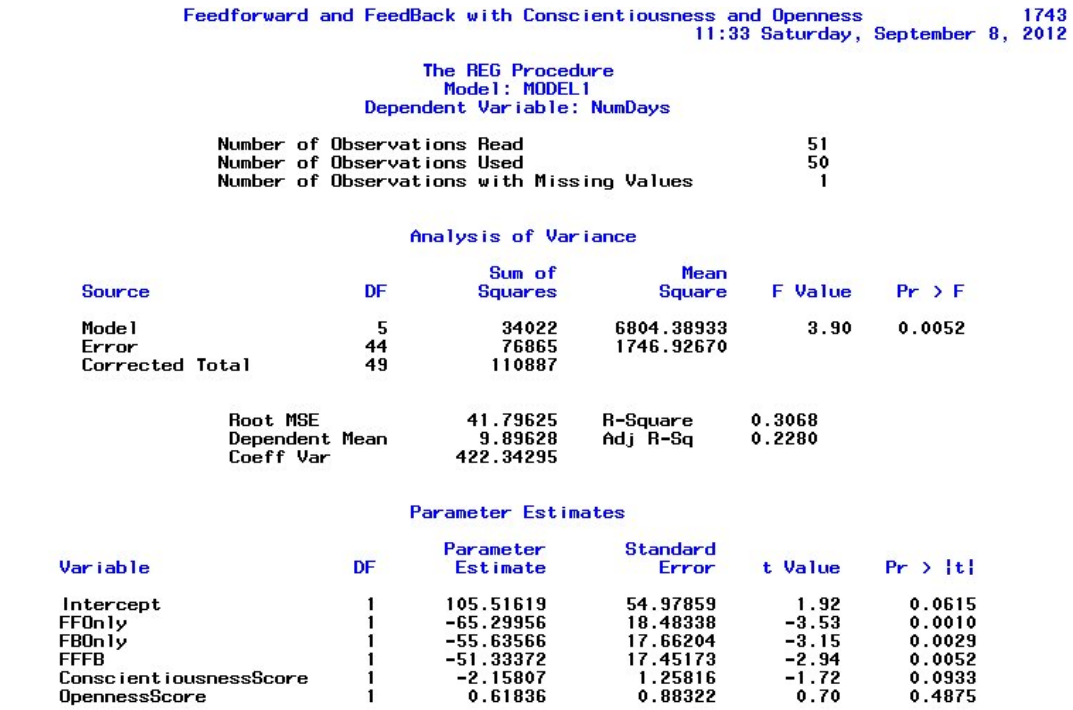
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	31604	3511.60572	1.77	0.1045
Error	40	79282	1982.05675		
Corrected Total	49	110887			

Root MSE	44.52030	R-Square	0.2850
Dependent Mean	9.89628	Adj R-Sq	0.1241
Coeff Var	449.86888		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	123.57195	76.49989	1.62	0.1141
FFOnly	1	-191.95573	118.95712	-1.61	0.1145
FBOnly	1	-80.84990	111.55916	-0.72	0.4728
FFFB	1	-138.19540	112.58471	-1.23	0.2268
AgreeablenessScore	1	-1.68971	2.23985	-0.75	0.4550
FFAgreeableness	1	3.61245	3.37886	1.07	0.2914
FBAgreeableness	1	0.80505	3.24913	0.25	0.8056
FFFBAgreeableness	1	2.44553	3.32443	0.74	0.4663
Age	1	-0.10139	0.55578	-0.18	0.8562
Female	1	-10.20974	18.95271	-0.54	0.5931

Figure 11.38: Regression output using slope of caloric intake and conscientiousness and openness



Feedforward and FeedBack with Conscientiousness and Openness 1743
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	34022	6804.38933	3.90	0.0052
Error	44	76865	1746.92670		
Corrected Total	49	110887			

Root MSE	41.79625	R-Square	0.3068
Dependent Mean	9.89628	Adj R-Sq	0.2280
Coeff Var	422.34295		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	105.51619	54.97859	1.92	0.0615
FFOnly	1	-65.29956	18.48338	-3.53	0.0010
FBOnly	1	-55.63566	17.66204	-3.15	0.0029
FFFB	1	-51.33372	17.45173	-2.94	0.0052
ConscientiousnessScore	1	-2.15807	1.25816	-1.72	0.0933
OpennessScore	1	0.61836	0.88322	0.70	0.4875

Figure 11.39: Regression output using slope of caloric intake and conscientiousness and openness with demographics

Feedforward and FeedBack with Conscientiousness and Openness and Demographics 1744
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

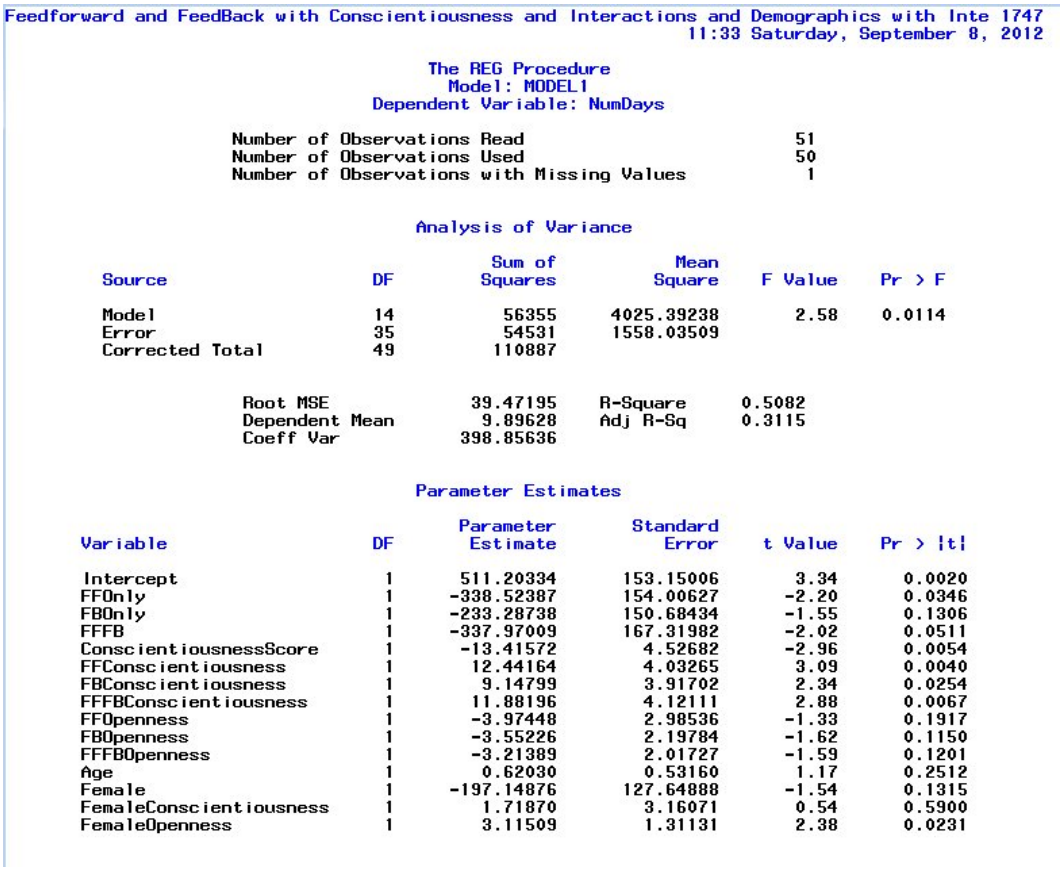
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	34230	4890.01517	2.68	0.0218
Error	42	76657	1825.15751		
Corrected Total	49	110887			

Root MSE	42.72186	R-Square	0.3087
Dependent Mean	9.89628	Adj R-Sq	0.1935
Coeff Var	431.69606		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	108.26410	59.26909	1.83	0.0749
FFOnly	1	-65.86959	18.96797	-3.47	0.0012
FBOnly	1	-56.76123	18.42752	-3.08	0.0036
FFFB	1	-53.52829	19.18270	-2.79	0.0079
ConscientiousnessScore	1	-2.17547	1.33484	-1.63	0.1106
OpennessScore	1	0.57880	0.92150	0.63	0.5333
Age	1	0.11034	0.52081	0.21	0.8332
Female	1	-4.04203	16.50649	-0.24	0.8077

Figure 11.40: Regression output using slope of caloric intake and conscientiousness and openness with interactions



Feedforward and FeedBack with Conscientiousness and Interactions and Demographics with Inte 1747
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	56355	4025.39238	2.58	0.0114
Error	35	54531	1558.03509		
Corrected Total	49	110887			

Root MSE	39.47195	R-Square	0.5082
Dependent Mean	9.89628	Adj R-Sq	0.3115
Coeff Var	398.85636		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	511.20334	153.15006	3.34	0.0020
FFOnly	1	-338.52387	154.00627	-2.20	0.0346
FBOnly	1	-233.28738	150.68434	-1.55	0.1306
FFFB	1	-337.97009	167.31982	-2.02	0.0511
ConscientiousnessScore	1	-13.41572	4.52682	-2.96	0.0054
FFConscientiousness	1	12.44164	4.03265	3.09	0.0040
FBConscientiousness	1	9.14799	3.91702	2.34	0.0254
FFFBConscientiousness	1	11.88196	4.12111	2.88	0.0067
FFOpenness	1	-3.97448	2.98536	-1.33	0.1917
FBOpenness	1	-3.55226	2.19784	-1.62	0.1150
FFFBOpenness	1	-3.21389	2.01727	-1.59	0.1201
Age	1	0.62030	0.53160	1.17	0.2512
Female	1	-197.14876	127.64888	-1.54	0.1315
FemaleConscientiousness	1	1.71870	3.16071	0.54	0.5900
FemaleOpenness	1	3.11509	1.31131	2.38	0.0231

Figure 11.41: Regression output using slope of caloric intake and conscientiousness and openness with interactions and demographics

Feedforward and FeedBack with Conscientiousness and Interactions and Demographics 1746
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	51
Number of Observations Used	50
Number of Observations with Missing Values	1

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	47464	3955.33302	2.31	0.0256
Error	37	63423	1714.12771		
Corrected Total	49	110887			

Root MSE	41.40203	R-Square	0.4280
Dependent Mean	9.89628	Adj R-Sq	0.2425
Coeff Var	418.35937		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	367.20119	102.37735	3.59	0.0010
FFOnly	1	-383.41039	160.31976	-2.39	0.0220
FBOnly	1	-254.01638	154.30583	-1.65	0.1082
FFFB	1	-308.89072	163.12255	-1.89	0.0661
ConscientiousnessScore	1	-9.24311	3.04980	-3.03	0.0044
FFConscientiousness	1	10.01344	4.09305	2.45	0.0193
FBConscientiousness	1	6.49600	3.82102	1.70	0.0975
FFFBConscientiousness	1	8.96114	3.80469	2.36	0.0239
FFOpenness	1	-0.52426	2.73931	-0.19	0.8493
FBOpenness	1	-0.52003	1.88149	-0.28	0.7838
FFFBOpenness	1	-1.18056	1.90745	-0.62	0.5398
Age	1	0.23264	0.53085	0.44	0.6638
Female	1	-9.41924	16.20481	-0.58	0.5646

Figure 11.42: Regression output using slope of calories burned and conscientiousness

Feedforward and FeedBack with Conscientiousness 1780
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	196
Number of Observations Used	62
Number of Observations with Missing Values	134

Analysis of Variance

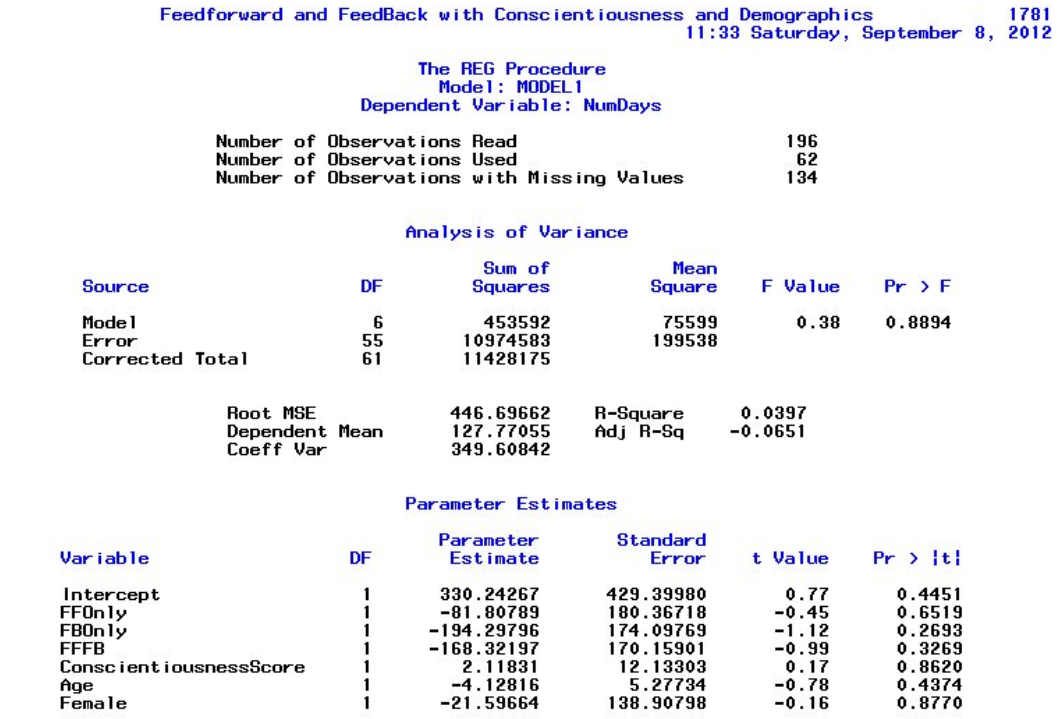
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	329129	82282	0.42	0.7917
Error	57	11099046	194720		
Corrected Total	61	11428175			

Root MSE	441.27101	R-Square	0.0288
Dependent Mean	127.77055	Adj R-Sq	-0.0394
Coeff Var	345.36205		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	246.24180	406.50517	0.61	0.5471
FFOnly	1	-89.87181	177.39079	-0.51	0.6144
FBOnly	1	-191.13722	170.03050	-1.12	0.2657
FFFB	1	-177.56951	161.30924	-1.10	0.2756
ConscientiousnessScore	1	0.28571	11.69790	0.02	0.9806

Figure 11.43: Regression output using slope of calories burned and conscientiousness with demographics



Feedforward and FeedBack with Conscientiousness and Demographics 1781
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	196
Number of Observations Used	62
Number of Observations with Missing Values	134

Analysis of Variance

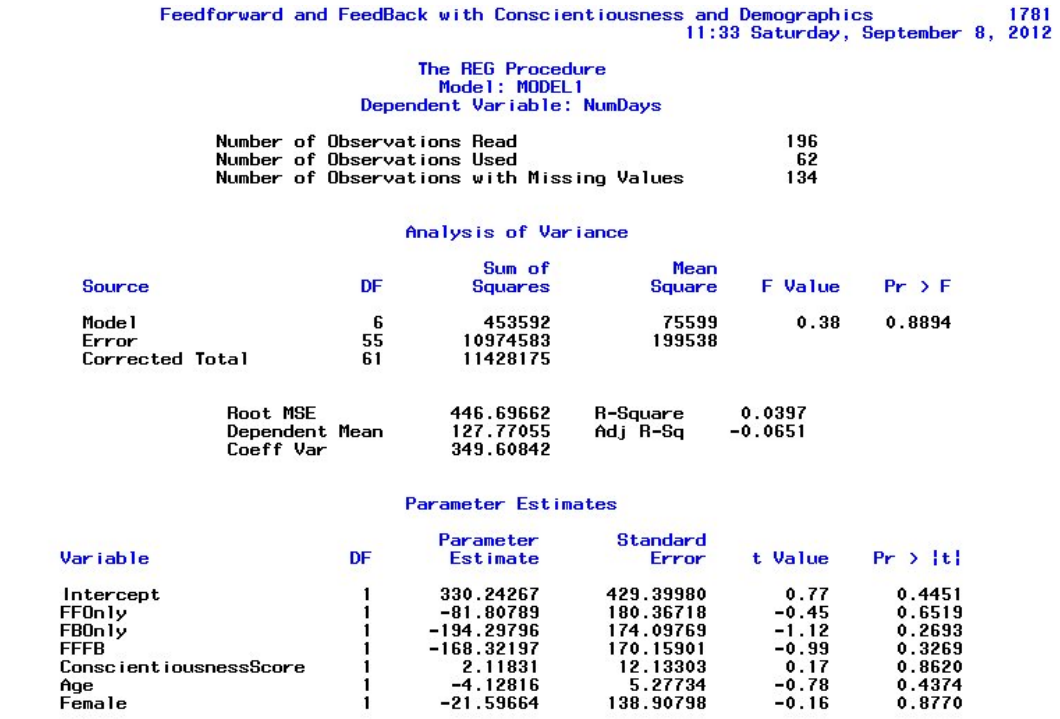
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	453592	75599	0.38	0.8894
Error	55	10974583	199538		
Corrected Total	61	11428175			

Root MSE	446.69662	R-Square	0.0397
Dependent Mean	127.77055	Adj R-Sq	-0.0651
Coeff Var	349.60842		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	330.24267	429.39980	0.77	0.4451
FFOnly	1	-81.80789	180.36718	-0.45	0.6519
FBOnly	1	-194.29796	174.09769	-1.12	0.2693
FFFB	1	-168.32197	170.15901	-0.99	0.3269
ConscientiousnessScore	1	2.11831	12.13303	0.17	0.8620
Age	1	-4.12816	5.27734	-0.78	0.4374
Female	1	-21.59664	138.90798	-0.16	0.8770

Figure 11.44: Regression output using slope of calories burned and conscientiousness with interactions



Feedforward and FeedBack with Conscientiousness and Demographics 1781
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	196
Number of Observations Used	62
Number of Observations with Missing Values	134

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	453592	75599	0.38	0.8894
Error	55	10974583	199538		
Corrected Total	61	11428175			

Root MSE	446.69662	R-Square	0.0397
Dependent Mean	127.77055	Adj R-Sq	-0.0651
Coeff Var	349.60842		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	330.24267	429.39980	0.77	0.4451
FFOnly	1	-81.80789	180.36718	-0.45	0.6519
FBOnly	1	-194.29796	174.09769	-1.12	0.2693
FFFB	1	-168.32197	170.15901	-0.99	0.3269
ConscientiousnessScore	1	2.11831	12.13303	0.17	0.8620
Age	1	-4.12816	5.27734	-0.78	0.4374
Female	1	-21.59664	138.90798	-0.16	0.8770

Figure 11.45: Regression output using slope of calories burned and conscientiousness with interactions and demographics

Feedforward and FeedBack with Conscientiousness and Interactions and Demographics 1783
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	196
Number of Observations Used	62
Number of Observations with Missing Values	134

Analysis of Variance

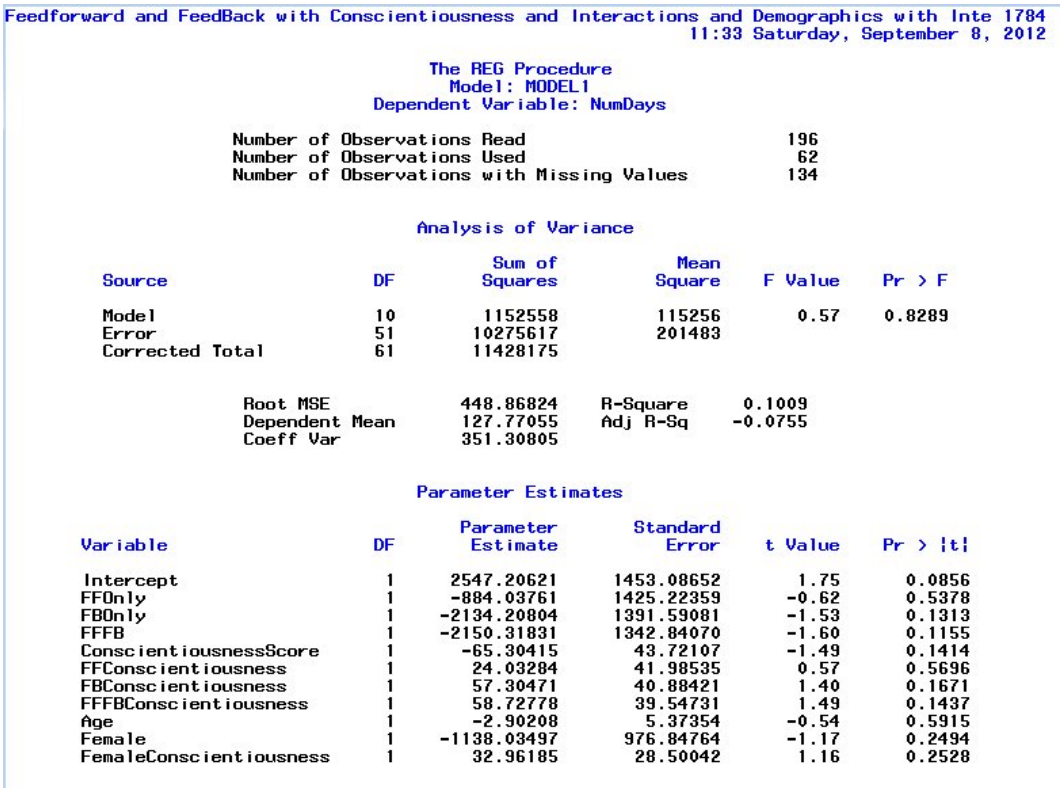
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	883058	98118	0.48	0.8789
Error	52	10545117	202791		
Corrected Total	61	11428175			

Root MSE	450.32290	R-Square	0.0773
Dependent Mean	127.77055	Adj R-Sq	-0.0824
Coeff Var	352.44654		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1426.30878	1086.16538	1.31	0.1949
FFOnly	1	-658.14461	1416.35177	-0.46	0.6441
FBOnly	1	-1708.18362	1346.30078	-1.27	0.2102
FFFB	1	-1732.71949	1297.57664	-1.34	0.1876
ConscientiousnessScore	1	-31.87423	32.90913	-0.97	0.3373
FFConscientiousness	1	18.06488	41.80207	0.43	0.6674
FBConscientiousness	1	45.20156	39.65026	1.14	0.2595
FFFBConscientiousness	1	46.56281	38.24641	1.22	0.2289
Age	1	-3.32489	5.37847	-0.62	0.5392
Female	1	-20.03949	141.07559	-0.14	0.8876

Figure 11.46: Regression output using slope of calories burned and conscientiousness with interactions and demographics and gender interaction



Feedforward and FeedBack with Conscientiousness and Interactions and Demographics with Inte 1784
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	196
Number of Observations Used	62
Number of Observations with Missing Values	134

Analysis of Variance

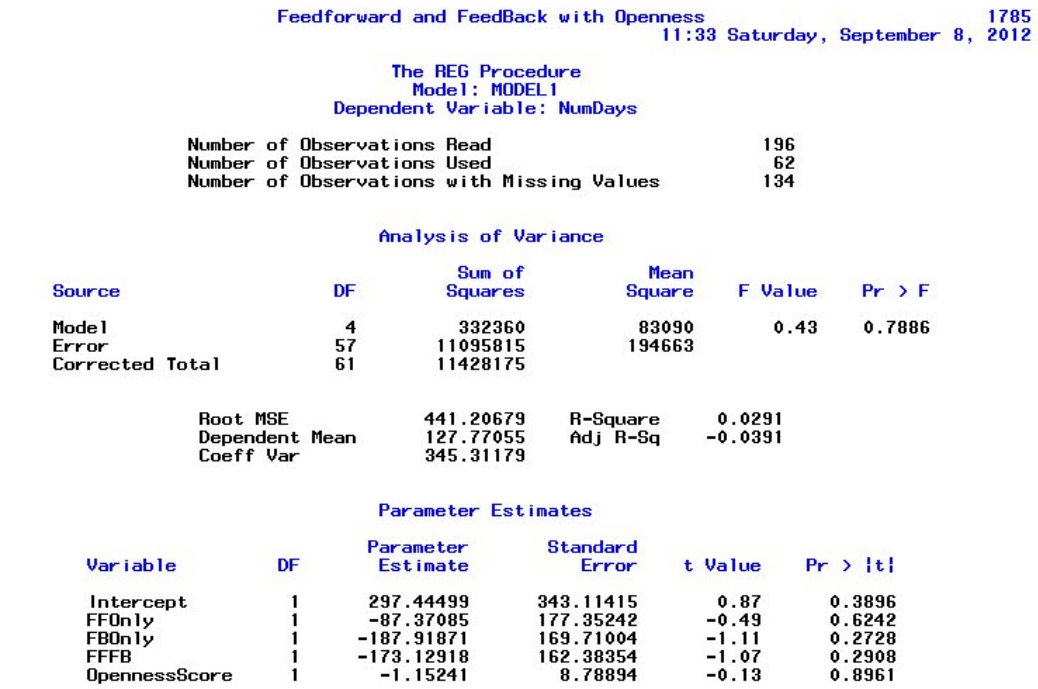
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	1152558	115256	0.57	0.8289
Error	51	10275617	201483		
Corrected Total	61	11428175			

Root MSE	448.86824	R-Square	0.1009
Dependent Mean	127.77055	Adj R-Sq	-0.0755
Coeff Var	351.30805		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	2547.20621	1453.08652	1.75	0.0856
FFOnly	1	-884.03761	1425.22359	-0.62	0.5378
FBOnly	1	-2134.20804	1391.59081	-1.53	0.1313
FFFB	1	-2150.31831	1342.84070	-1.60	0.1155
ConscientiousnessScore	1	-65.30415	43.72107	-1.49	0.1414
FFConscientiousness	1	24.03284	41.98535	0.57	0.5696
FBConscientiousness	1	57.30471	40.88421	1.40	0.1671
FFFBConscientiousness	1	58.72778	39.54731	1.49	0.1437
Age	1	-2.90208	5.37354	-0.54	0.5915
Female	1	-1138.03497	976.84764	-1.17	0.2494
FemaleConscientiousness	1	32.96185	28.50042	1.16	0.2528

Figure 11.47: Regression output using slope of calories burned and openness



Feedforward and FeedBack with Openness 1785
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	196
Number of Observations Used	62
Number of Observations with Missing Values	134

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	332360	83090	0.43	0.7886
Error	57	11095815	194663		
Corrected Total	61	11428175			

Root MSE	441.20679	R-Square	0.0291
Dependent Mean	127.77055	Adj R-Sq	-0.0391
Coeff Var	345.31179		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	297.44499	343.11415	0.87	0.3896
FFOnly	1	-87.37085	177.35242	-0.49	0.6242
FBOnly	1	-187.91871	169.71004	-1.11	0.2728
FFFB	1	-173.12918	162.38354	-1.07	0.2908
OpennessScore	1	-1.15241	8.78894	-0.13	0.8961

Figure 11.48: Regression output using slope of calories burned and openness with demographics

Feedforward and FeedBack with Openness and Demographics 1786
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	196
Number of Observations Used	62
Number of Observations with Missing Values	134

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	451777	75296	0.38	0.8904
Error	55	10976398	199571		
Corrected Total	61	11428175			

Root MSE	446.73357	R-Square	0.0395
Dependent Mean	127.77055	Adj R-Sq	-0.0652
Coeff Var	349.63734		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	444.61463	432.72948	1.03	0.3087
FFOnly	1	-77.03351	180.27845	-0.43	0.6708
FBOnly	1	-187.49079	172.89472	-1.08	0.2829
FFFB	1	-160.88372	169.58606	-0.95	0.3469
OpennessScore	1	-1.33695	9.14347	-0.15	0.8843
Age	1	-3.95542	5.19688	-0.76	0.4498
Female	1	-22.92768	141.29534	-0.16	0.8717

Figure 11.49: Regression output using slope of calories burned and openness with interactions

Feedforward and FeedBack with Openness and Interactions 1787
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	196
Number of Observations Used	62
Number of Observations with Missing Values	134

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	406767	58110	0.28	0.9572
Error	54	11021408	204100		
Corrected Total	61	11428175			

Root MSE	451.77445	R-Square	0.0356
Dependent Mean	127.77055	Adj R-Sq	-0.0894
Coeff Var	353.58260		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	188.37221	570.25964	0.33	0.7424
FFOnly	1	554.89520	1118.75797	0.50	0.6219
FBOnly	1	-135.27784	902.89365	-0.15	0.8815
FFFB	1	-121.60825	894.38526	-0.14	0.8924
OpennessScore	1	1.85649	15.31439	0.12	0.9040
FFOpenness	1	-17.01196	29.37141	-0.58	0.5649
FBOpenness	1	-1.54552	23.56850	-0.07	0.9480
FFFBOpenness	1	-1.55627	23.03861	-0.07	0.9464

Figure 11.50: Regression output using slope of calories burned and openness with interactions and demographics

Feedforward and FeedBack with Openness and Interactions and Demographics 1788
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	196
Number of Observations Used	62
Number of Observations with Missing Values	134

Analysis of Variance

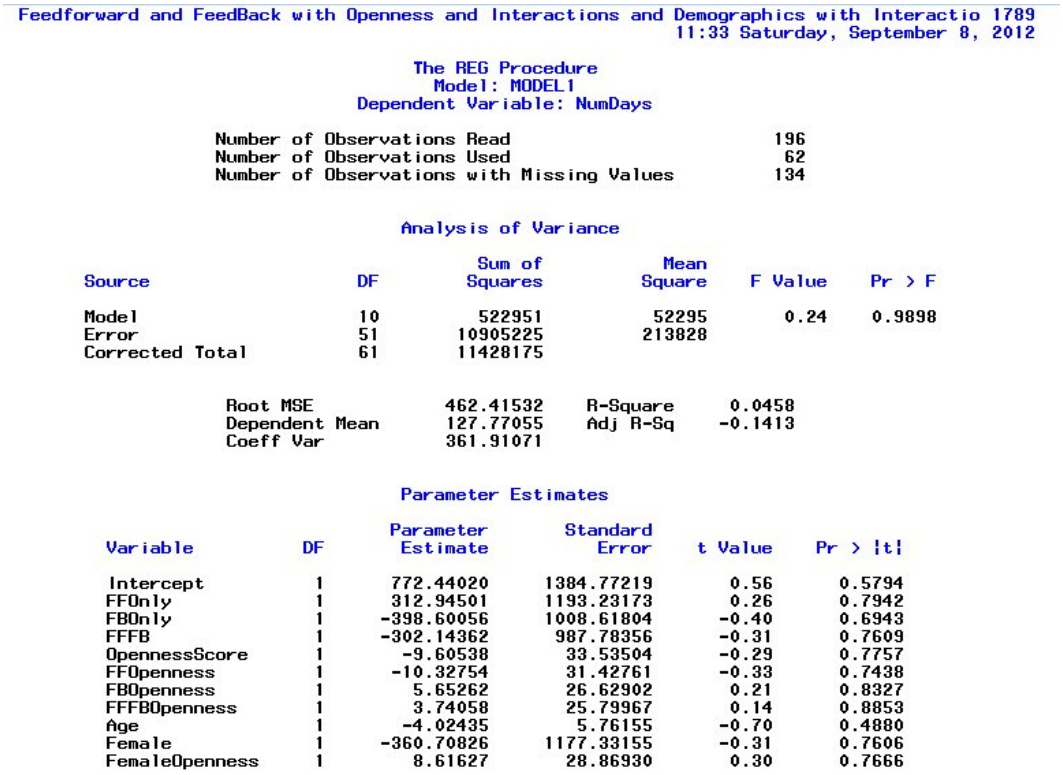
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	503903	55989	0.27	0.9809
Error	52	10924272	210082		
Corrected Total	61	11428175			

Root MSE	458.34719	R-Square	0.0441
Dependent Mean	127.77055	Adj R-Sq	-0.1214
Coeff Var	358.72678		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	412.87196	676.75473	0.61	0.5445
FFOnly	1	370.60455	1167.12939	0.32	0.7521
FBOnly	1	-323.16420	967.84504	-0.33	0.7398
FFFB	1	-200.88447	919.52884	-0.22	0.8279
OpennessScore	1	-0.83823	16.03541	-0.05	0.9585
FFOpenness	1	-11.76979	30.78068	-0.38	0.7037
FBOpenness	1	3.53180	25.43763	0.14	0.8901
FFFBOpenness	1	1.03342	23.94012	0.04	0.9657
Age	1	-3.83006	5.67429	-0.67	0.5027
Female	1	-12.15193	147.74760	-0.08	0.9348

Figure 11.51: Regression output using slope of calories burned and openness with interactions and demographics and gender interaction



Feedforward and FeedBack with Openness and Interactions and Demographics with Interactio 1789
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	196
Number of Observations Used	62
Number of Observations with Missing Values	134

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	522951	52295	0.24	0.9898
Error	51	10905225	213828		
Corrected Total	61	11428175			

Root MSE	462.41532	R-Square	0.0458
Dependent Mean	127.77055	Adj R-Sq	-0.1413
Coeff Var	361.91071		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	772.44020	1384.77219	0.56	0.5794
FFOnly	1	312.94501	1193.23173	0.26	0.7942
FBOnly	1	-398.60056	1008.61804	-0.40	0.6943
FFFB	1	-302.14362	987.78356	-0.31	0.7609
OpennessScore	1	-9.60538	33.53504	-0.29	0.7757
FFOpenness	1	-10.32754	31.42761	-0.33	0.7438
FBOpenness	1	5.65262	26.62902	0.21	0.8327
FFFBOpenness	1	3.74058	25.79967	0.14	0.8853
Age	1	-4.02435	5.76155	-0.70	0.4880
Female	1	-360.70826	1177.33155	-0.31	0.7606
FemaleOpenness	1	8.61627	28.86930	0.30	0.7666

Figure 11.52: Regression output using slope of calories burned and agreeableness

Feedforward and FeedBack with Agreeableness 1790
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	196
Number of Observations Used	62
Number of Observations with Missing Values	134

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	351997	87999	0.45	0.7699
Error	57	11076178	194319		
Corrected Total	61	11428175			

Root MSE	440.81619	R-Square	0.0308
Dependent Mean	127.77055	Adj R-Sq	-0.0372
Coeff Var	345.00609		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	371.57470	360.23605	1.03	0.3067
FFOnly	1	-74.39709	181.83299	-0.41	0.6840
FBOnly	1	-176.21027	173.44979	-1.02	0.3140
FFFB	1	-163.07520	164.58618	-0.99	0.3260
AgreeablenessScore	1	-3.66980	10.67055	-0.34	0.7322

Figure 11.53: Regression output using slope of calories burned and agreeableness with demographics

Feedforward and FeedBack with Agreeableness and Demographics 1791
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	196
Number of Observations Used	62
Number of Observations with Missing Values	134

Analysis of Variance

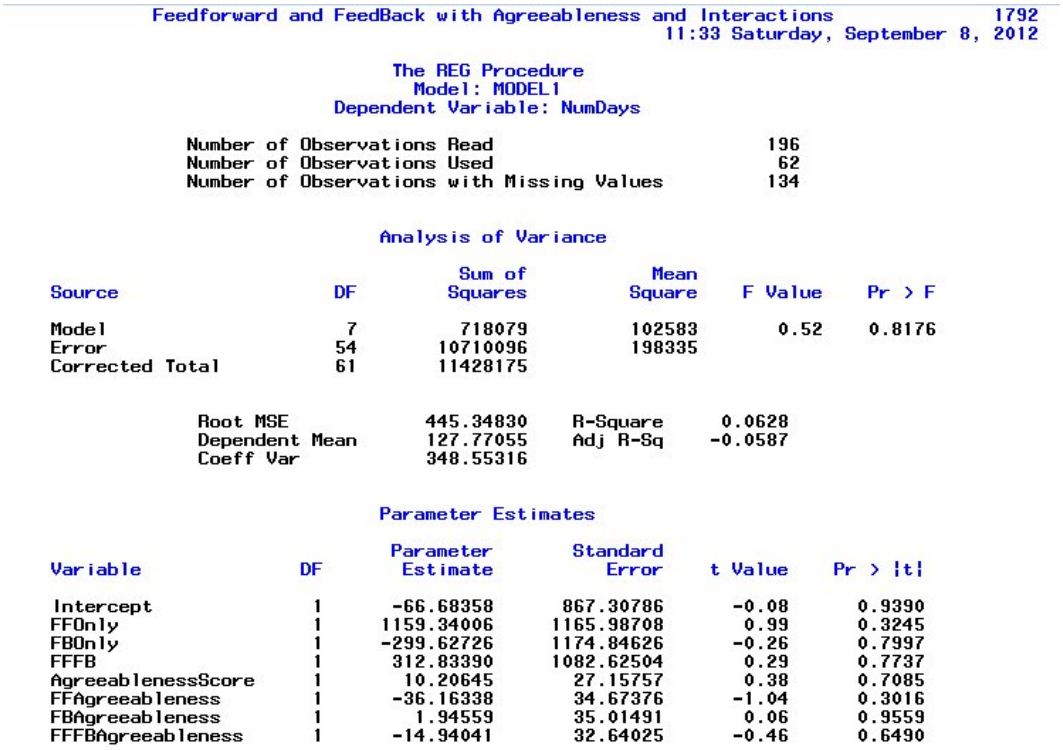
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	450647	75108	0.38	0.8910
Error	55	10977528	199591		
Corrected Total	61	11428175			

Root MSE	446.75656	R-Square	0.0394
Dependent Mean	127.77055	Adj R-Sq	-0.0654
Coeff Var	349.65534		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	433.57960	409.54712	1.06	0.2944
FFOnly	1	-73.98688	184.31432	-0.40	0.6897
FBOnly	1	-184.75740	176.79806	-1.05	0.3006
FFFB	1	-160.20225	170.91620	-0.94	0.3527
AgreeablenessScore	1	-1.44417	11.51998	-0.13	0.9007
Age	1	-3.75119	5.47396	-0.69	0.4960
Female	1	-20.73079	139.02901	-0.15	0.8820

Figure 11.54: Regression output using slope of calories burned and agreeableness with interactions



Feedforward and FeedBack with Agreeableness and Interactions 1792
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	196
Number of Observations Used	62
Number of Observations with Missing Values	134

Analysis of Variance

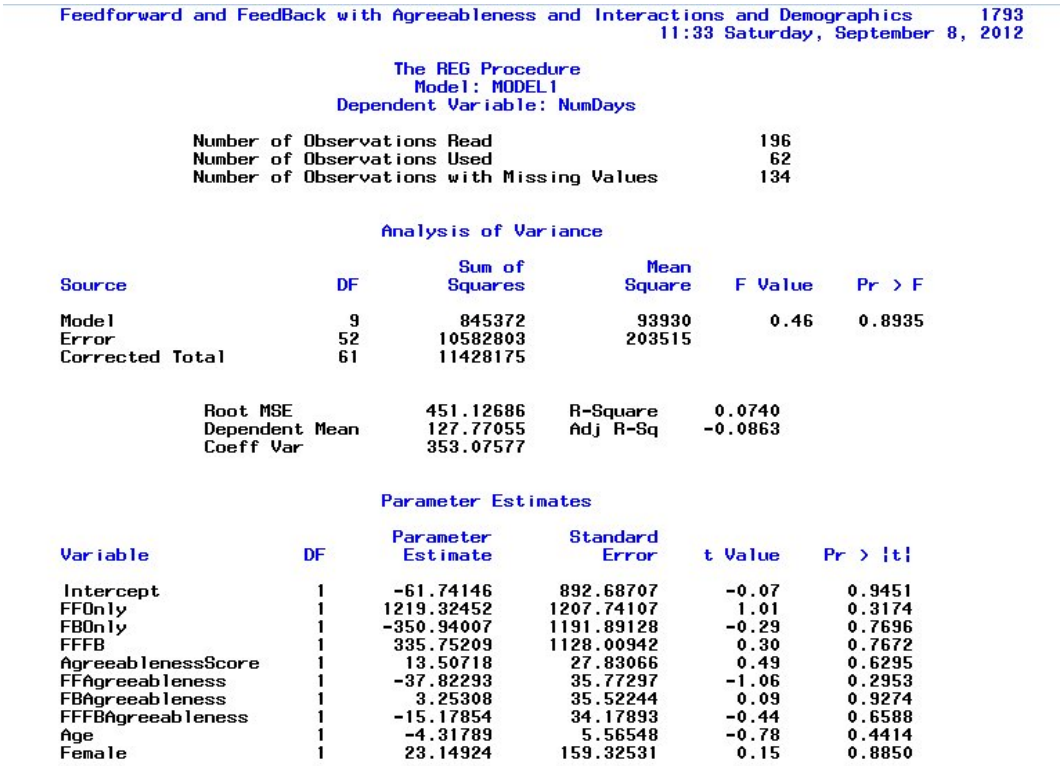
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	718079	102583	0.52	0.8176
Error	54	10710096	198335		
Corrected Total	61	11428175			

Root MSE	445.34830	R-Square	0.0628
Dependent Mean	127.77055	Adj R-Sq	-0.0587
Coeff Var	348.55316		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-66.68358	867.30786	-0.08	0.9390
FFOnly	1	1159.34006	1165.98708	0.99	0.3245
FBOnly	1	-299.62726	1174.84626	-0.26	0.7997
FFFB	1	312.83390	1082.62504	0.29	0.7737
AgreeablenessScore	1	10.20645	27.15757	0.38	0.7085
FFAgreeableness	1	-36.16338	34.67376	-1.04	0.3016
FBAgreeableness	1	1.94559	35.01491	0.06	0.9559
FFFBAgreeableness	1	-14.94041	32.64025	-0.46	0.6490

Figure 11.55: Regression output using slope of calories burned and agreeableness with interactions and demographics



Feedforward and FeedBack with Agreeableness and Interactions and Demographics 1793
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	196
Number of Observations Used	62
Number of Observations with Missing Values	134

Analysis of Variance

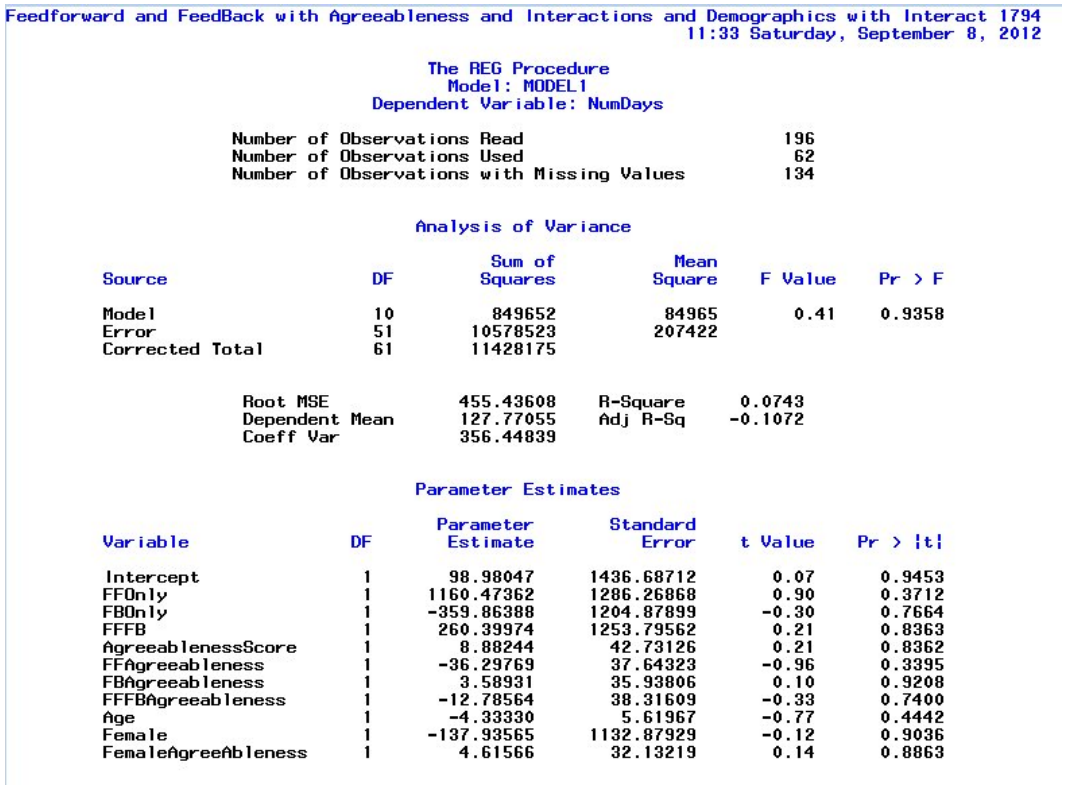
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	845372	93930	0.46	0.8935
Error	52	10582803	203515		
Corrected Total	61	11428175			

Root MSE	451.12686	R-Square	0.0740
Dependent Mean	127.77055	Adj R-Sq	-0.0863
Coeff Var	353.07577		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-61.74146	892.68707	-0.07	0.9451
FFOnly	1	1219.32452	1207.74107	1.01	0.3174
FBOnly	1	-350.94007	1191.89128	-0.29	0.7696
FFFB	1	335.75209	1128.00942	0.30	0.7672
AgreeablenessScore	1	13.50718	27.83066	0.49	0.6295
FFAgreeableness	1	-37.82293	35.77297	-1.06	0.2953
FBAgreeableness	1	3.25308	35.52244	0.09	0.9274
FFFBAgreeableness	1	-15.17854	34.17893	-0.44	0.6588
Age	1	-4.31789	5.56548	-0.78	0.4414
Female	1	23.14924	159.32531	0.15	0.8850

Figure 11.56: Regression output using slope of calories burned and agreeableness with interactions and demographics and gender interaction



Feedforward and FeedBack with Agreeableness and Interactions and Demographics with Interact 1794
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	196
Number of Observations Used	62
Number of Observations with Missing Values	134

Analysis of Variance

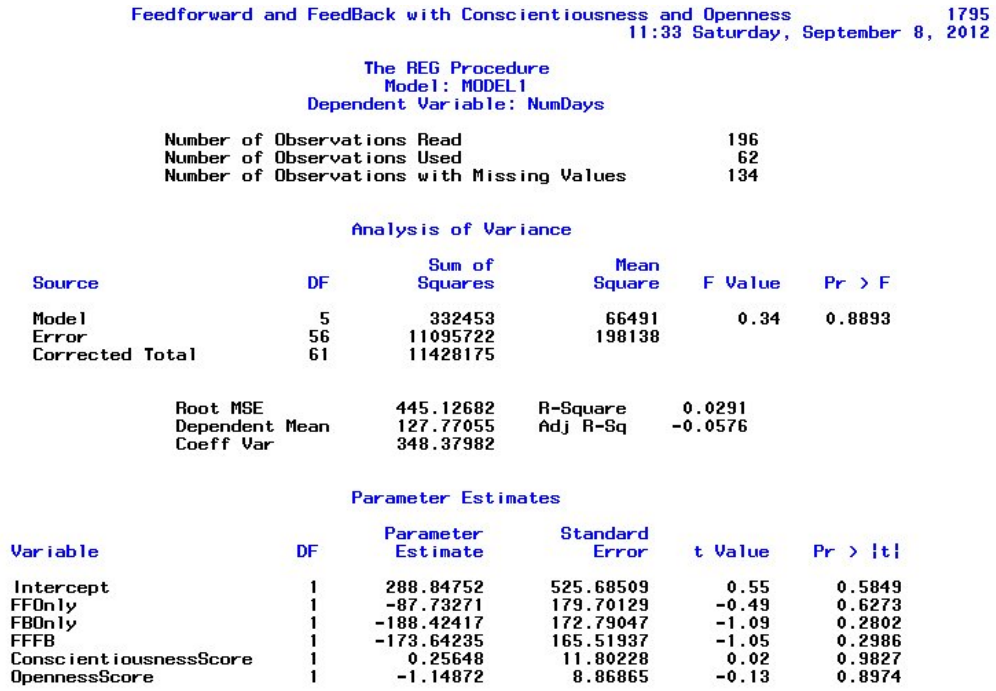
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	849652	84965	0.41	0.9358
Error	51	10578523	207422		
Corrected Total	61	11428175			

Root MSE	455.43608	R-Square	0.0743
Dependent Mean	127.77055	Adj R-Sq	-0.1072
Coeff Var	356.44839		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	98.98047	1436.68712	0.07	0.9453
FFOnly	1	1160.47362	1286.26868	0.90	0.3712
FBOnly	1	-359.86388	1204.87899	-0.30	0.7664
FFFB	1	260.39974	1253.79562	0.21	0.8363
AgreeablenessScore	1	8.88244	42.73126	0.21	0.8362
FFAgreeableness	1	-36.29769	37.64323	-0.96	0.3395
FBAgreeableness	1	3.58931	35.93806	0.10	0.9208
FFFBAgreeableness	1	-12.78564	38.31609	-0.33	0.7400
Age	1	-4.33330	5.61967	-0.77	0.4442
Female	1	-137.93565	1132.87929	-0.12	0.9036
FemaleAgreeAbleness	1	4.61566	32.13219	0.14	0.8863

Figure 11.57: Regression output using slope of calories burned and conscientiousness and openness



Feedforward and FeedBack with Conscientiousness and Openness 1795
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	196
Number of Observations Used	62
Number of Observations with Missing Values	134

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	332453	66491	0.34	0.8893
Error	56	11095722	198138		
Corrected Total	61	11428175			

Root MSE	445.12682	R-Square	0.0291
Dependent Mean	127.77055	Adj R-Sq	-0.0576
Coeff Var	348.37982		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	288.84752	525.68509	0.55	0.5849
FFOnly	1	-87.73271	179.70129	-0.49	0.6273
FBOnly	1	-188.42417	172.79047	-1.09	0.2802
FFFB	1	-173.64235	165.51937	-1.05	0.2986
ConscientiousnessScore	1	0.25648	11.80228	0.02	0.9827
OpennessScore	1	-1.14872	8.86865	-0.13	0.8974

Figure 11.58: Regression output using slope of calories burned and conscientiousness and openness with demographics

Feedforward and FeedBack with Conscientiousness and Openness and Demographics 1796
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	196
Number of Observations Used	62
Number of Observations with Missing Values	134

Analysis of Variance

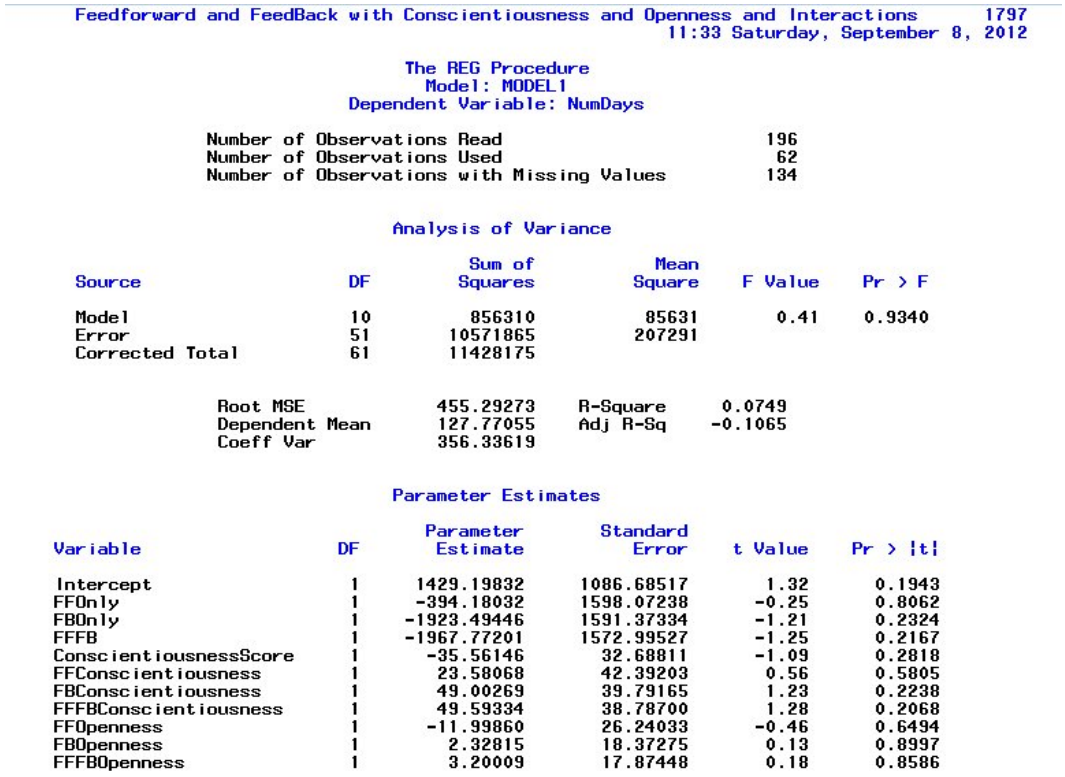
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	457951	65422	0.32	0.9408
Error	54	10970224	203152		
Corrected Total	61	11428175			

Root MSE	450.72419	R-Square	0.0401
Dependent Mean	127.77055	Adj R-Sq	-0.0844
Coeff Var	352.76061		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	382.78606	562.48832	0.68	0.4991
FFOnly	1	-79.73011	182.54537	-0.44	0.6640
FBOnly	1	-192.01395	176.35807	-1.09	0.2811
FFFB	1	-165.27717	172.94691	-0.96	0.3435
ConscientiousnessScore	1	2.13438	12.24292	0.17	0.8623
OpennessScore	1	-1.35136	9.22552	-0.15	0.8841
Age	1	-4.11780	5.32539	-0.77	0.4428
Female	1	-26.39593	143.93894	-0.18	0.8552

Figure 11.59: Regression output using slope of calories burned and conscientiousness and openness with interactions



Feedforward and FeedBack with Conscientiousness and Openness and Interactions 1797
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	196
Number of Observations Used	62
Number of Observations with Missing Values	134

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	856310	85631	0.41	0.9340
Error	51	10571865	207291		
Corrected Total	61	11428175			

Root MSE	455.29273	R-Square	0.0749
Dependent Mean	127.77055	Adj R-Sq	-0.1065
Coeff Var	356.33619		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1429.19832	1086.68517	1.32	0.1943
FFOnly	1	-394.18032	1598.07238	-0.25	0.8062
FBOnly	1	-1923.49446	1591.37334	-1.21	0.2324
FFFB	1	-1967.77201	1572.99527	-1.25	0.2167
ConscientiousnessScore	1	-35.56146	32.68811	-1.09	0.2818
FFConscientiousness	1	23.58068	42.39203	0.56	0.5805
FBConscientiousness	1	49.00269	39.79165	1.23	0.2238
FFFBConscientiousness	1	49.59334	38.78700	1.28	0.2068
FFOpenness	1	-11.99860	26.24033	-0.46	0.6494
FBOpenness	1	2.32815	18.37275	0.13	0.8997
FFFBOpenness	1	3.20009	17.87448	0.18	0.8586

Figure 11.60: Regression output using slope of calories burned and conscientiousness and openness with interactions and demographics

Feedforward and FeedBack with Conscientiousness and Interactions and Demographics 1798
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	196
Number of Observations Used	62
Number of Observations with Missing Values	134

Analysis of Variance

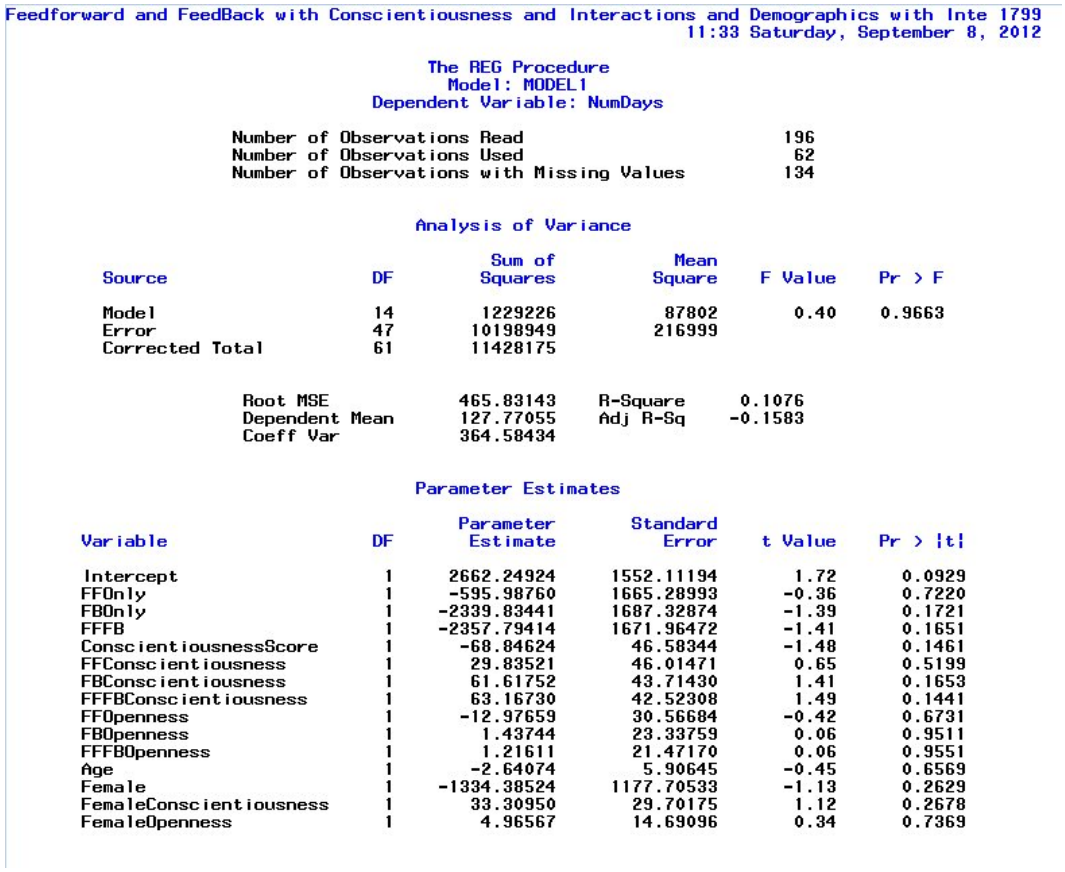
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	932280	77690	0.36	0.9705
Error	49	10495895	214202		
Corrected Total	61	11428175			

Root MSE	462.81956	R-Square	0.0816
Dependent Mean	127.77055	Adj R-Sq	-0.1433
Coeff Var	362.22709		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1413.14968	1117.69161	1.26	0.2121
FFOnly	1	-359.38968	1634.76645	-0.22	0.8269
FBOnly	1	-1911.41056	1619.03154	-1.18	0.2435
FFFB	1	-1896.59298	1605.35969	-1.18	0.2431
ConscientiousnessScore	1	-31.74402	33.87211	-0.94	0.3533
FFConscientiousness	1	20.38358	43.82034	0.47	0.6439
FBConscientiousness	1	45.97012	40.84396	1.13	0.2659
FFFBConscientiousness	1	47.38546	39.61189	1.20	0.2374
FFOpenness	1	-9.91830	26.92100	-0.37	0.7141
FBOpenness	1	4.61927	19.58532	0.24	0.8145
FFFBOpenness	1	3.49910	18.58548	0.19	0.8514
Age	1	-3.38625	5.71649	-0.59	0.5563
Female	1	-8.34995	151.30492	-0.06	0.9562

Figure 11.61: Regression output using slope of calories burned and conscientiousness and openness with interactions and demographics and gender interaction



Feedforward and FeedBack with Conscientiousness and Interactions and Demographics with Inte 1799
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	196
Number of Observations Used	62
Number of Observations with Missing Values	134

Analysis of Variance

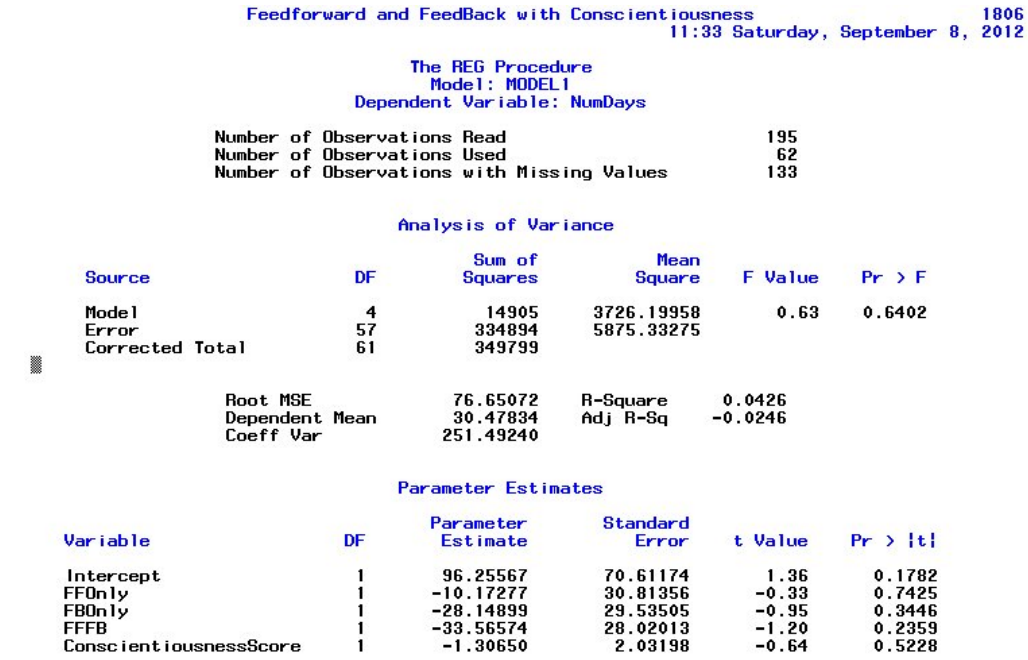
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	1229226	87802	0.40	0.9663
Error	47	10198949	216999		
Corrected Total	61	11428175			

Root MSE	465.83143	R-Square	0.1076
Dependent Mean	127.77055	Adj R-Sq	-0.1583
Coeff Var	364.58434		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	2662.24924	1552.11194	1.72	0.0929
FFOnly	1	-595.98760	1665.28993	-0.36	0.7220
FBOnly	1	-2339.83441	1687.32874	-1.39	0.1721
FFFB	1	-2357.79414	1671.96472	-1.41	0.1651
ConscientiousnessScore	1	-68.84624	46.58344	-1.48	0.1461
FFConscientiousness	1	29.83521	46.01471	0.65	0.5199
FBConscientiousness	1	61.61752	43.71430	1.41	0.1653
FFFBConscientiousness	1	63.16730	42.52308	1.49	0.1441
FFOpenness	1	-12.97659	30.56684	-0.42	0.6731
FBOpenness	1	1.43744	23.33759	0.06	0.9511
FFFBOpenness	1	1.21611	21.47170	0.06	0.9551
Age	1	-2.64074	5.90645	-0.45	0.6569
Female	1	-1334.38524	1177.70533	-1.13	0.2629
FemaleConscientiousness	1	33.30950	29.70175	1.12	0.2678
FemaleOpenness	1	4.96567	14.69096	0.34	0.7369

Figure 11.62: Regression output using slope of minutes exercised and conscientiousness



Feedforward and FeedBack with Conscientiousness 1806
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	195
Number of Observations Used	62
Number of Observations with Missing Values	133

Analysis of Variance

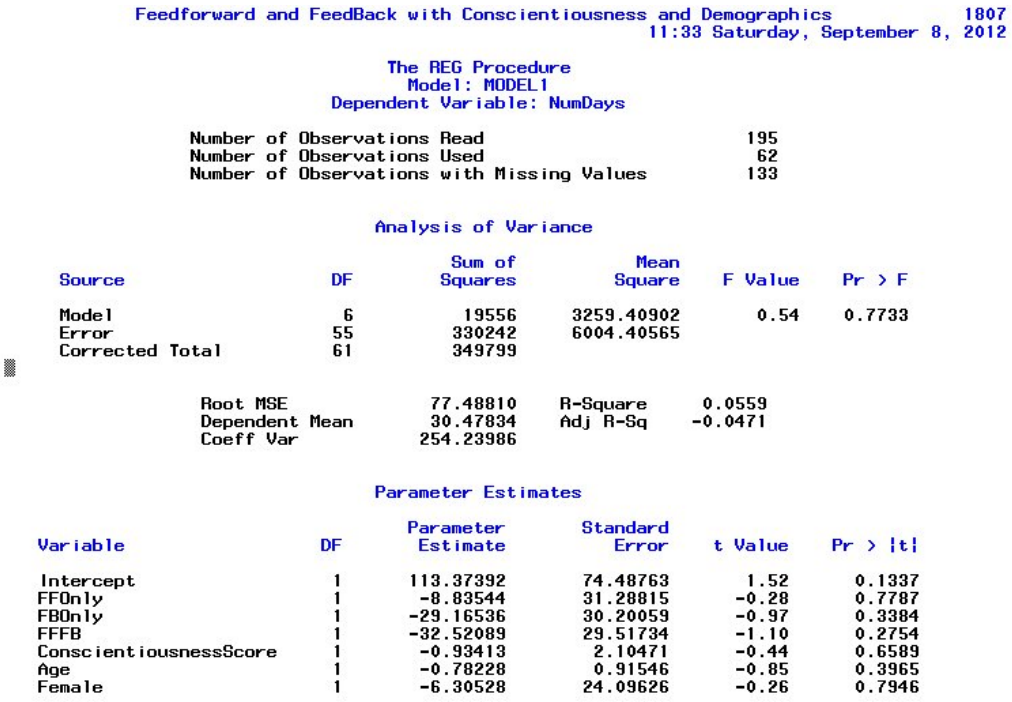
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	14905	3726.19958	0.63	0.6402
Error	57	334894	5875.33275		
Corrected Total	61	349799			

Root MSE	76.65072	R-Square	0.0426
Dependent Mean	30.47834	Adj R-Sq	-0.0246
Coeff Var	251.49240		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	96.25567	70.61174	1.36	0.1782
FFOnly	1	-10.17277	30.81356	-0.33	0.7425
FBOnly	1	-28.14899	29.53505	-0.95	0.3446
FFFB	1	-33.56574	28.02013	-1.20	0.2359
ConscientiousnessScore	1	-1.30650	2.03198	-0.64	0.5228

Figure 11.63: Regression output using slope of minutes exercised and conscientiousness with demographics



Feedforward and FeedBack with Conscientiousness and Demographics 1807
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	195
Number of Observations Used	62
Number of Observations with Missing Values	133

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	19556	3259.40902	0.54	0.7733
Error	55	330242	6004.40565		
Corrected Total	61	349799			

Root MSE	77.48810	R-Square	0.0559
Dependent Mean	30.47834	Adj R-Sq	-0.0471
Coeff Var	254.23986		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	113.37392	74.48763	1.52	0.1337
FFOnly	1	-8.83544	31.28815	-0.28	0.7787
FBOnly	1	-29.16536	30.20059	-0.97	0.3384
FFFB	1	-32.52089	29.51734	-1.10	0.2754
ConscientiousnessScore	1	-0.93413	2.10471	-0.44	0.6589
Age	1	-0.78228	0.91546	-0.85	0.3965
Female	1	-6.30528	24.09626	-0.26	0.7946

Figure 11.64: Regression output using slope of minutes exercised and conscientiousness with interactions

Feedforward and FeedBack with Conscientiousness and Interactions 1808
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	195
Number of Observations Used	62
Number of Observations with Missing Values	133

Analysis of Variance

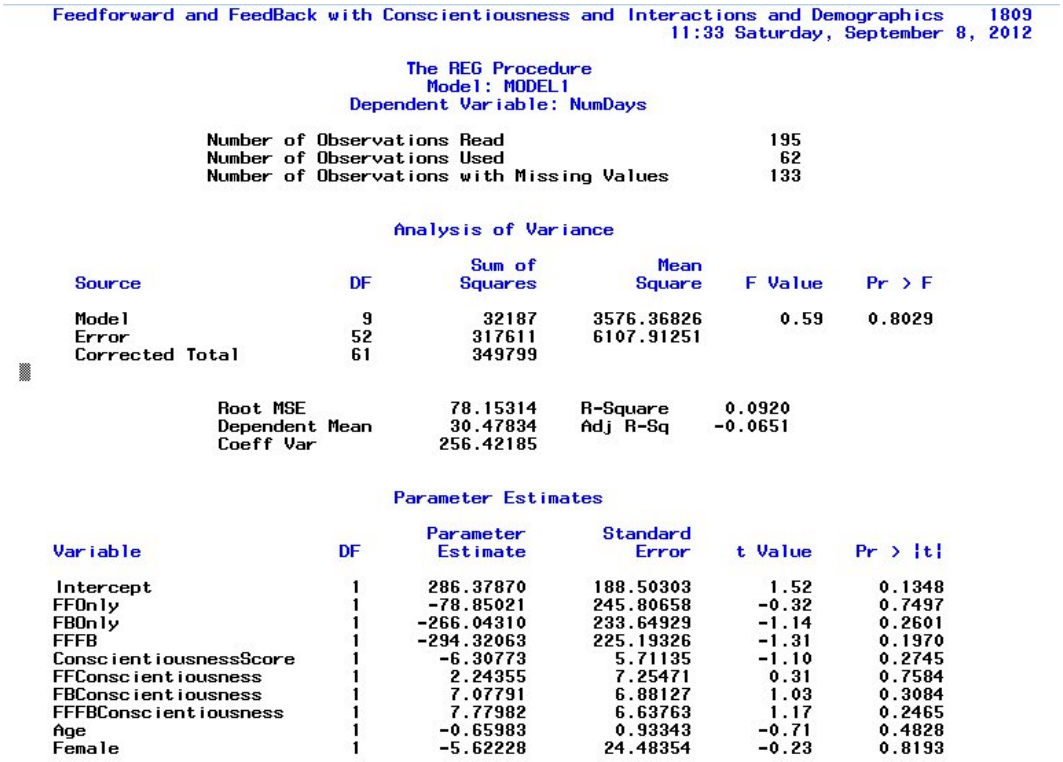
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	28901	4128.68984	0.69	0.6761
Error	54	320898	5942.55438		
Corrected Total	61	349799			

Root MSE	77.08797	R-Square	0.0826
Dependent Mean	30.47834	Adj R-Sq	-0.0363
Coeff Var	252.92701		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	285.16400	183.99228	1.55	0.1270
FFOnly	1	-92.29392	239.14471	-0.39	0.7011
FBOnly	1	-285.91335	227.20482	-1.26	0.2137
FFFB	1	-308.47998	220.25758	-1.40	0.1671
ConscientiousnessScore	1	-7.03099	5.53459	-1.27	0.2094
FFConscientiousness	1	2.61883	7.06992	0.37	0.7125
FBConscientiousness	1	7.69533	6.69960	1.15	0.2558
FFFBConscientiousness	1	8.18515	6.51155	1.26	0.2142

Figure 11.65: Regression output using slope of minutes exercised and conscientiousness with interactions and demographics



Feedforward and FeedBack with Conscientiousness and Interactions and Demographics 1809
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	195
Number of Observations Used	62
Number of Observations with Missing Values	133

Analysis of Variance

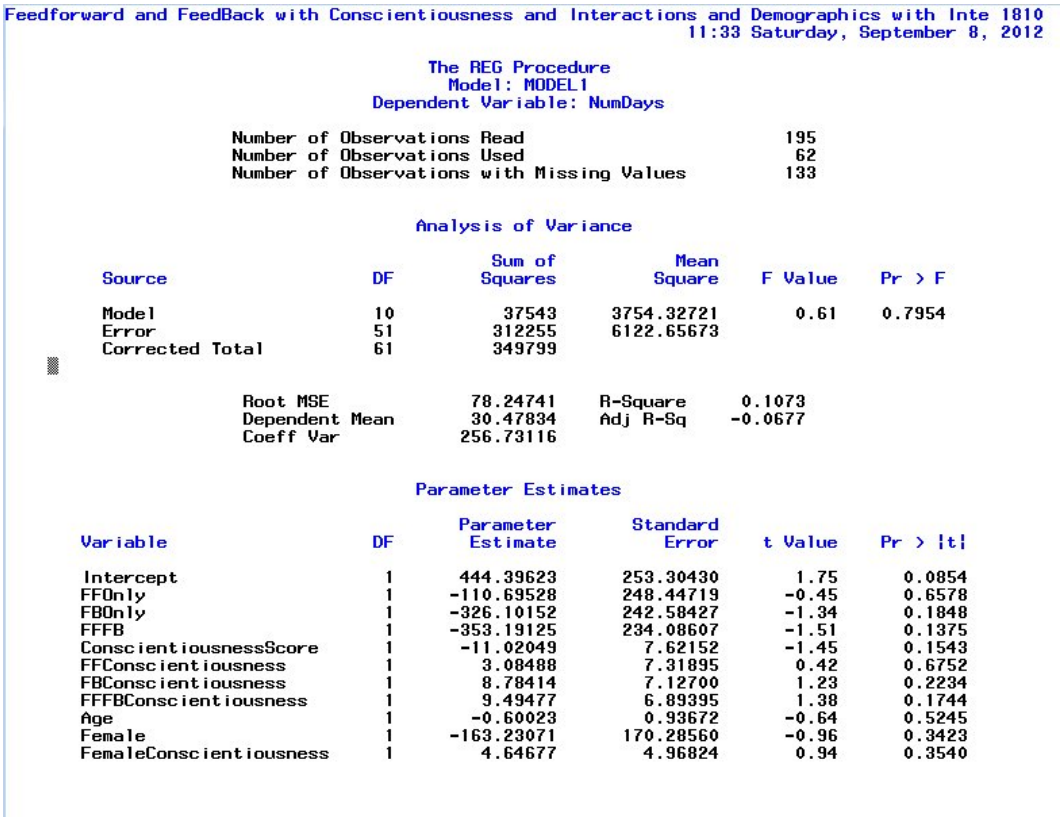
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	32187	3576.36826	0.59	0.8029
Error	52	317611	6107.91251		
Corrected Total	61	349799			

Root MSE	78.15314	R-Square	0.0920
Dependent Mean	30.47834	Adj R-Sq	-0.0651
Coeff Var	256.42185		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	286.37870	188.50303	1.52	0.1348
FFOnly	1	-78.85021	245.80658	-0.32	0.7497
FBOnly	1	-266.04310	233.64929	-1.14	0.2601
FFFB	1	-294.32063	225.19326	-1.31	0.1970
ConscientiousnessScore	1	-6.30773	5.71135	-1.10	0.2745
FFConscientiousness	1	2.24355	7.25471	0.31	0.7584
FBConscientiousness	1	7.07791	6.88127	1.03	0.3084
FFFBConscientiousness	1	7.77982	6.63763	1.17	0.2465
Age	1	-0.65983	0.93343	-0.71	0.4828
Female	1	-5.62228	24.48354	-0.23	0.8193

Figure 11.66: Regression output using slope of minutes exercised and conscientiousness with interactions and demographics and gender interaction



Feedforward and FeedBack with Conscientiousness and Interactions and Demographics with Inte 1810
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	195
Number of Observations Used	62
Number of Observations with Missing Values	133

Analysis of Variance

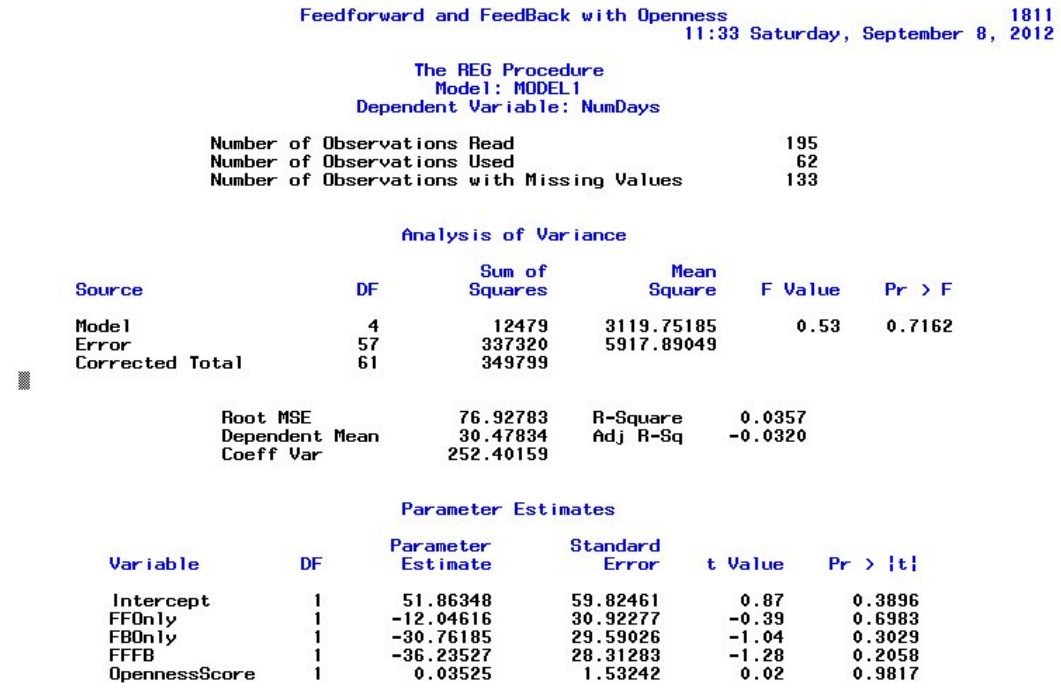
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	37543	3754.32721	0.61	0.7954
Error	51	312255	6122.65673		
Corrected Total	61	349799			

Root MSE	78.24741	R-Square	0.1073
Dependent Mean	30.47834	Adj R-Sq	-0.0677
Coeff Var	256.73116		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	444.39623	253.30430	1.75	0.0854
FFOnly	1	-110.69528	248.44719	-0.45	0.6578
FBOnly	1	-326.10152	242.58427	-1.34	0.1848
FFFB	1	-353.19125	234.08607	-1.51	0.1375
ConscientiousnessScore	1	-11.02049	7.62152	-1.45	0.1543
FFConscientiousness	1	3.08488	7.31895	0.42	0.6752
FBConscientiousness	1	8.78414	7.12700	1.23	0.2234
FFFBConscientiousness	1	9.49477	6.89395	1.38	0.1744
Age	1	-0.60023	0.93672	-0.64	0.5245
Female	1	-163.23071	170.28560	-0.96	0.3423
FemaleConscientiousness	1	4.64677	4.96824	0.94	0.3540

Figure 11.67: Regression output using slope of minutes exercised and openness



Feedforward and FeedBack with Openness 1811
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	195
Number of Observations Used	62
Number of Observations with Missing Values	133

Analysis of Variance

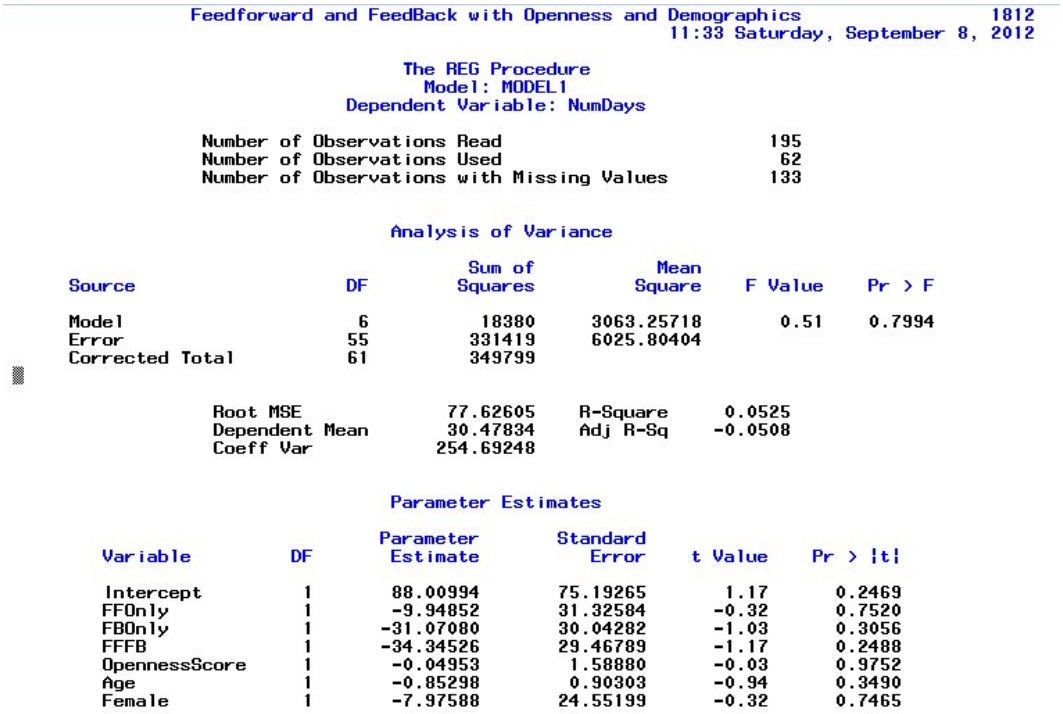
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	12479	3119.75185	0.53	0.7162
Error	57	337320	5917.89049		
Corrected Total	61	349799			

Root MSE	76.92783	R-Square	0.0357
Dependent Mean	30.47834	Adj R-Sq	-0.0320
Coeff Var	252.40159		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	51.86348	59.82461	0.87	0.3896
FFOnly	1	-12.04616	30.92277	-0.39	0.6983
FBOnly	1	-30.76185	29.59026	-1.04	0.3029
FFFB	1	-36.23527	28.31283	-1.28	0.2058
OpennessScore	1	0.03525	1.53242	0.02	0.9817

Figure 11.68: Regression output using slope of minutes exercised and openness with demographics



Feedforward and FeedBack with Openness and Demographics 1812
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	195
Number of Observations Used	62
Number of Observations with Missing Values	133

Analysis of Variance

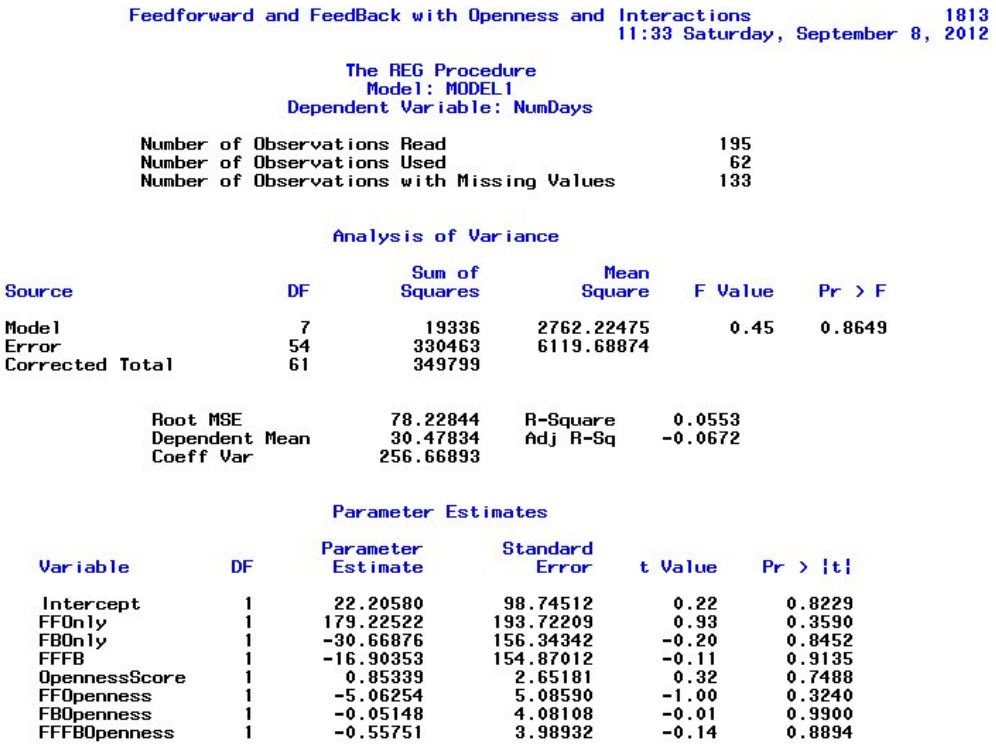
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	18380	3063.25718	0.51	0.7994
Error	55	331419	6025.80404		
Corrected Total	61	349799			

Root MSE	77.62605	R-Square	0.0525
Dependent Mean	30.47834	Adj R-Sq	-0.0508
Coeff Var	254.69248		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	88.00994	75.19265	1.17	0.2469
FFOnly	1	-9.94852	31.32584	-0.32	0.7520
FBOnly	1	-31.07080	30.04282	-1.03	0.3056
FFFB	1	-34.34526	29.46789	-1.17	0.2488
OpennessScore	1	-0.04953	1.58880	-0.03	0.9752
Age	1	-0.85298	0.90303	-0.94	0.3490
Female	1	-7.97588	24.55199	-0.32	0.7465

Figure 11.69: Regression output using slope of minutes exercised and openness with interactions



Feedforward and FeedBack with Openness and Interactions 1813
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	195
Number of Observations Used	62
Number of Observations with Missing Values	133

Analysis of Variance

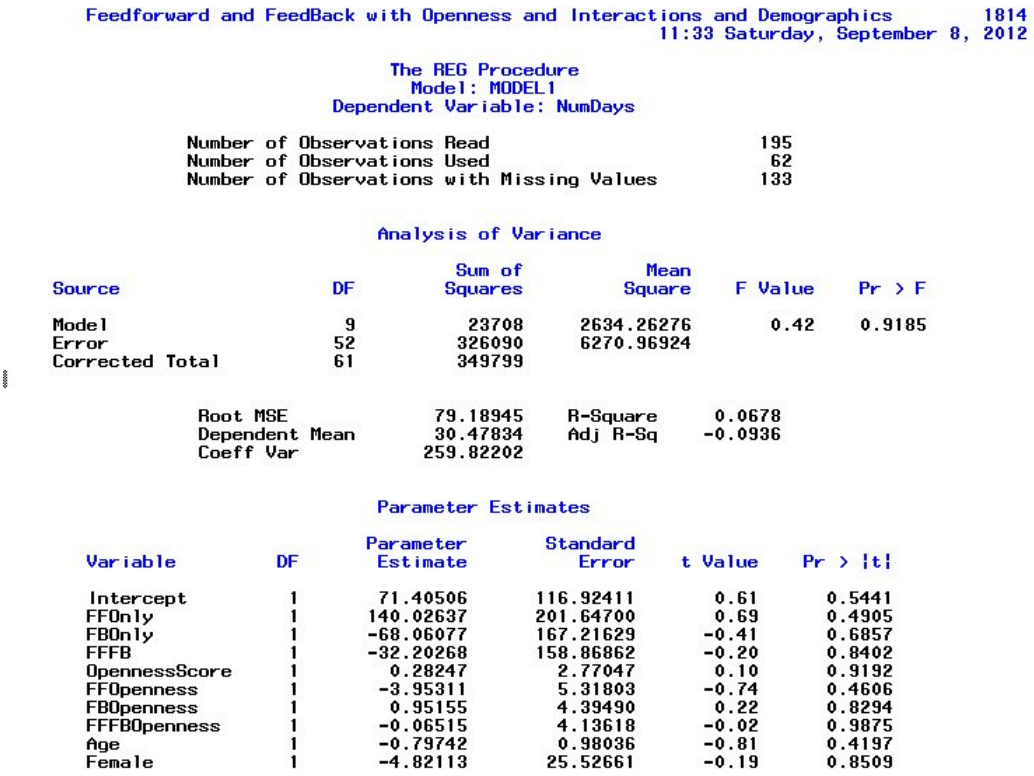
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	19336	2762.22475	0.45	0.8649
Error	54	330463	6119.68874		
Corrected Total	61	349799			

Root MSE	78.22844	R-Square	0.0553
Dependent Mean	30.47834	Adj R-Sq	-0.0672
Coeff Var	256.66893		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	22.20580	98.74512	0.22	0.8229
FFOnly	1	179.22522	193.72209	0.93	0.3590
FBOnly	1	-30.66876	156.34342	-0.20	0.8452
FFFB	1	-16.90353	154.87012	-0.11	0.9135
OpennessScore	1	0.85339	2.65181	0.32	0.7488
FFOpenness	1	-5.06254	5.08590	-1.00	0.3240
FBOpenness	1	-0.05148	4.08108	-0.01	0.9900
FFFBOpenness	1	-0.55751	3.98932	-0.14	0.8894

Figure 11.70: Regression output using slope of minutes exercised and openness with interactions and demographics



Feedforward and FeedBack with Openness and Interactions and Demographics 1814
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	195
Number of Observations Used	62
Number of Observations with Missing Values	133

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	23708	2634.26276	0.42	0.9185
Error	52	326090	6270.96924		
Corrected Total	61	349799			

Root MSE	79.18945	R-Square	0.0678
Dependent Mean	30.47834	Adj R-Sq	-0.0936
Coeff Var	259.82202		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	71.40506	116.92411	0.61	0.5441
FFOnly	1	140.02637	201.64700	0.69	0.4905
FBOnly	1	-68.06077	167.21629	-0.41	0.6857
FFFB	1	-32.20268	158.86862	-0.20	0.8402
OpennessScore	1	0.28247	2.77047	0.10	0.9192
FFOpenness	1	-3.95311	5.31803	-0.74	0.4606
FBOpenness	1	0.95155	4.39490	0.22	0.8294
FFFBOpenness	1	-0.06515	4.13618	-0.02	0.9875
Age	1	-0.79742	0.98036	-0.81	0.4197
Female	1	-4.82113	25.52661	-0.19	0.8509

Figure 11.71: Regression output using slope of minutes exercised and openness with interactions and demographics and gender interaction

Feedforward and FeedBack with Openness and Interactions and Demographics with Interactio 1815
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	195
Number of Observations Used	62
Number of Observations with Missing Values	133

Analysis of Variance

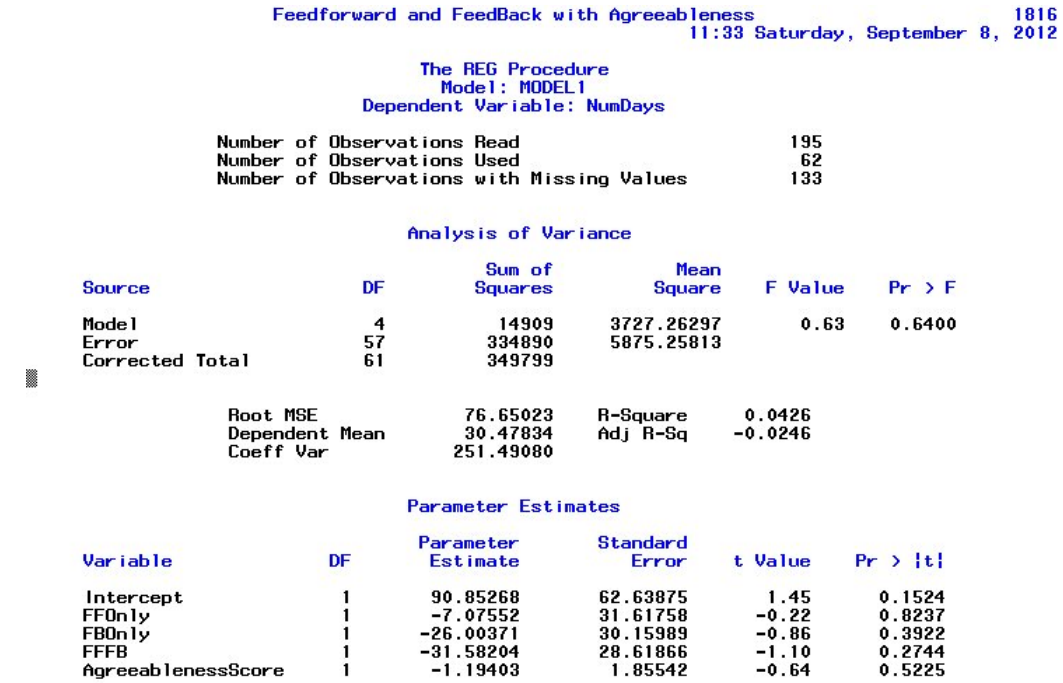
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	27207	2720.71161	0.43	0.9250
Error	51	322592	6325.32645		
Corrected Total	61	349799			

Root MSE	79.53192	R-Square	0.0778
Dependent Mean	30.47834	Adj R-Sq	-0.1030
Coeff Var	260.94567		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	225.51210	238.17029	0.95	0.3482
FFOnly	1	115.31412	205.22679	0.56	0.5767
FBOnly	1	-100.39197	173.47464	-0.58	0.5653
FFFB	1	-75.60125	169.89126	-0.44	0.6582
OpennessScore	1	-3.47503	5.76777	-0.60	0.5495
FFOpenness	1	-3.33497	5.40531	-0.62	0.5400
FBOpenness	1	1.86052	4.57999	0.41	0.6863
FFFBOpenness	1	1.09511	4.43735	0.25	0.8061
Age	1	-0.88070	0.99094	-0.89	0.3783
Female	1	-154.20859	202.49208	-0.76	0.4498
FemaleOpenness	1	3.69284	4.96530	0.74	0.4605

Figure 11.72: Regression output using slope of minutes exercised and agreeableness



Feedforward and FeedBack with Agreeableness 1816
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	195
Number of Observations Used	62
Number of Observations with Missing Values	133

Analysis of Variance

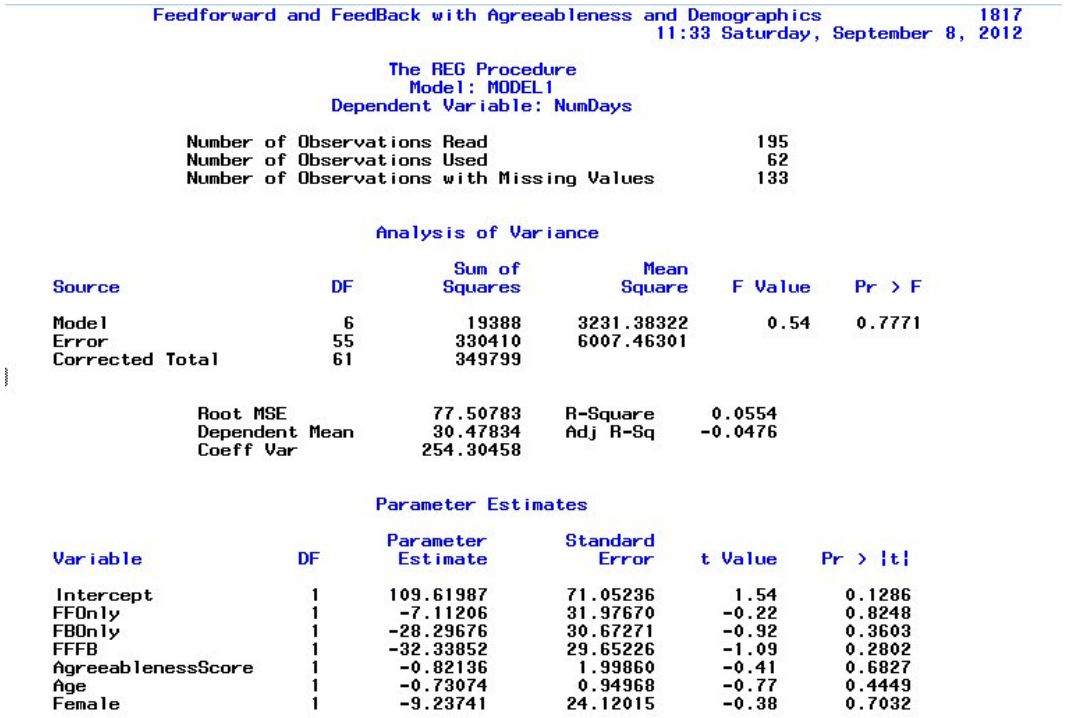
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	14909	3727.26297	0.63	0.6400
Error	57	334890	5875.25813		
Corrected Total	61	349799			

Root MSE	76.65023	R-Square	0.0426
Dependent Mean	30.47834	Adj R-Sq	-0.0246
Coeff Var	251.49080		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	90.85268	62.63875	1.45	0.1524
FFOnly	1	-7.07552	31.61758	-0.22	0.8237
FBOnly	1	-26.00371	30.15989	-0.86	0.3922
FFFB	1	-31.58204	28.61866	-1.10	0.2744
AgreeablenessScore	1	-1.19403	1.85542	-0.64	0.5225

Figure 11.73: Regression output using slope of minutes exercised and agreeableness with demographics



Feedforward and FeedBack with Agreeableness and Demographics 1817
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	195
Number of Observations Used	62
Number of Observations with Missing Values	133

Analysis of Variance

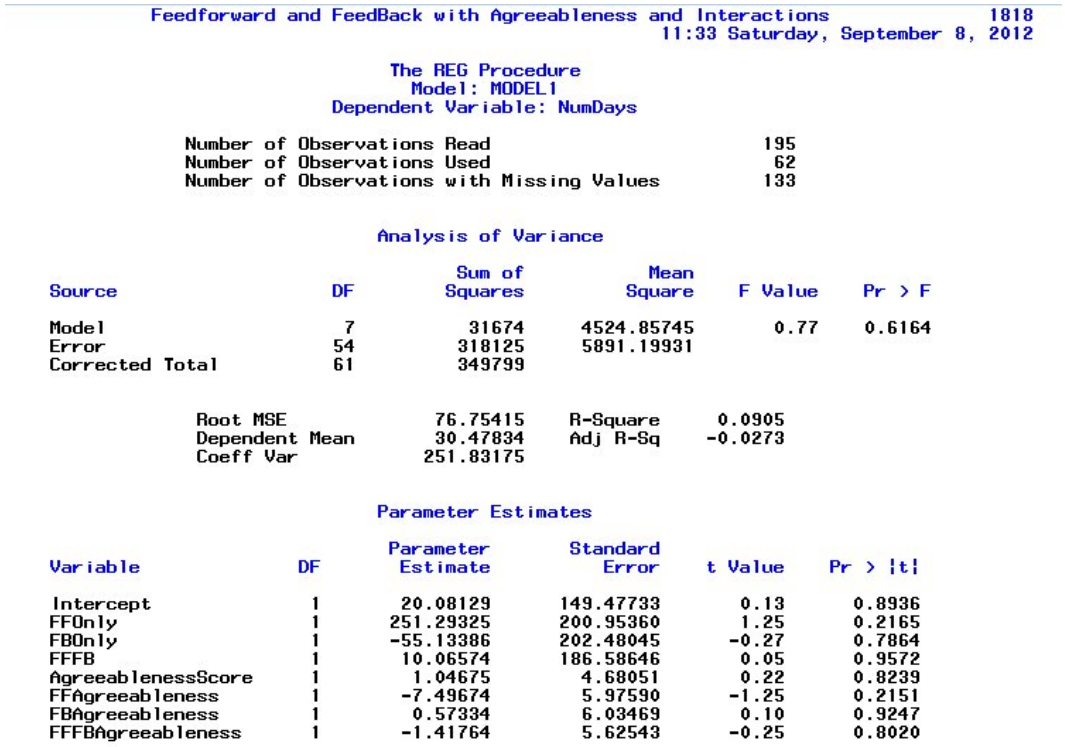
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	19388	3231.38322	0.54	0.7771
Error	55	330410	6007.46301		
Corrected Total	61	349799			

Root MSE	77.50783	R-Square	0.0554
Dependent Mean	30.47834	Adj R-Sq	-0.0476
Coeff Var	254.30458		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	109.61987	71.05236	1.54	0.1286
FFOnly	1	-7.11206	31.97670	-0.22	0.8248
FBOnly	1	-28.29676	30.67271	-0.92	0.3603
FFFB	1	-32.33852	29.65226	-1.09	0.2802
AgreeablenessScore	1	-0.82136	1.99860	-0.41	0.6827
Age	1	-0.73074	0.94968	-0.77	0.4449
Female	1	-9.23741	24.12015	-0.38	0.7032

Figure 11.74: Regression output using slope of minutes exercised and agreeableness with interactions



Feedforward and FeedBack with Agreeableness and Interactions 1818
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	195
Number of Observations Used	62
Number of Observations with Missing Values	133

Analysis of Variance

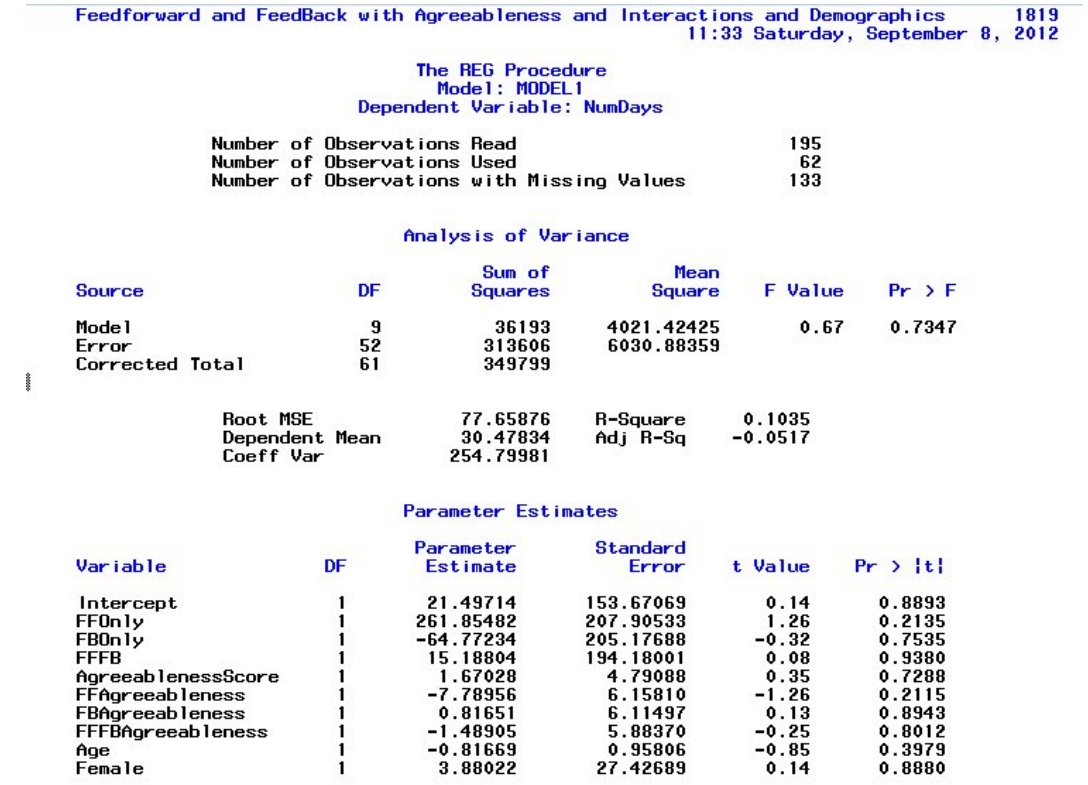
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	31674	4524.85745	0.77	0.6164
Error	54	318125	5891.19931		
Corrected Total	61	349799			

Root MSE	76.75415	R-Square	0.0905
Dependent Mean	30.47834	Adj R-Sq	-0.0273
Coeff Var	251.83175		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	20.08129	149.47733	0.13	0.8936
FFOnly	1	251.29325	200.95360	1.25	0.2165
FBOnly	1	-55.13386	202.48045	-0.27	0.7864
FFFB	1	10.06574	186.58646	0.05	0.9572
AgreeablenessScore	1	1.04675	4.68051	0.22	0.8239
FFAgreeableness	1	-7.49674	5.97590	-1.25	0.2151
FBAgreeableness	1	0.57334	6.03469	0.10	0.9247
FFFBAgreeableness	1	-1.41764	5.62543	-0.25	0.8020

Figure 11.75: Regression output using slope of minutes exercised and agreeableness with interactions and demographics



Feedforward and FeedBack with Agreeableness and Interactions and Demographics 1819
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	195
Number of Observations Used	62
Number of Observations with Missing Values	133

Analysis of Variance

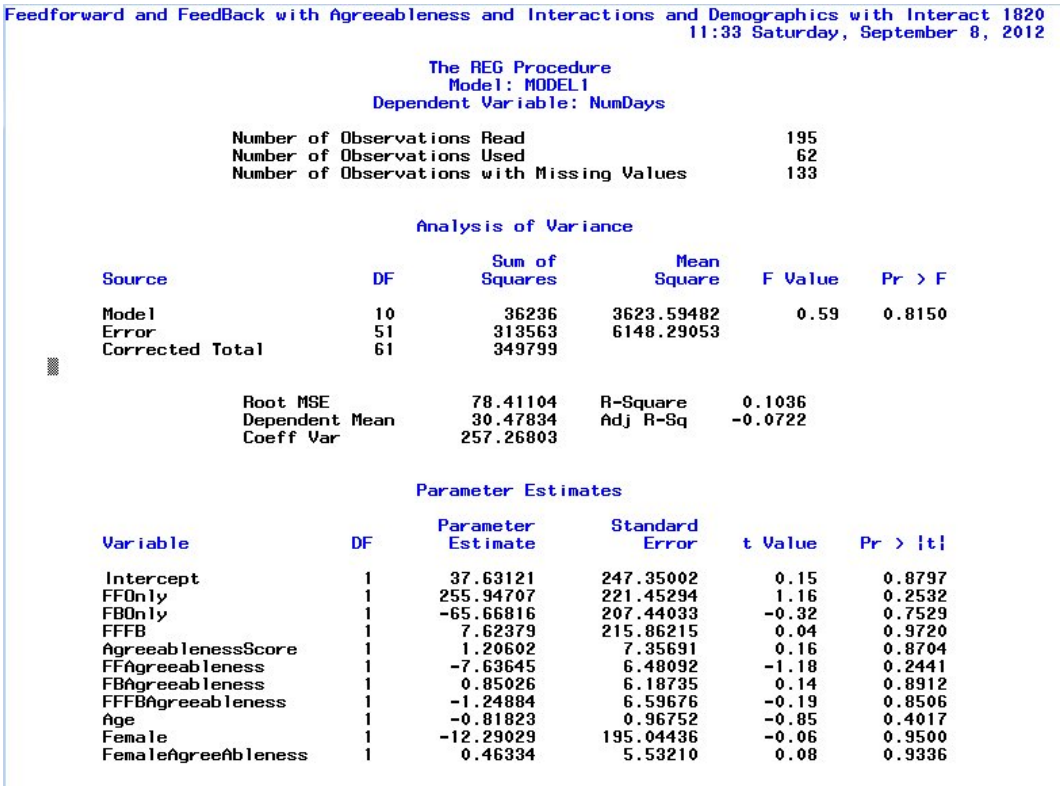
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	36193	4021.42425	0.67	0.7347
Error	52	313606	6030.88359		
Corrected Total	61	349799			

Root MSE	77.65876	R-Square	0.1035
Dependent Mean	30.47834	Adj R-Sq	-0.0517
Coeff Var	254.79981		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	21.49714	153.67069	0.14	0.8893
FFOnly	1	261.85482	207.90533	1.26	0.2135
FBOnly	1	-64.77234	205.17688	-0.32	0.7535
FFFB	1	15.18804	194.18001	0.08	0.9380
AgreeablenessScore	1	1.67028	4.79088	0.35	0.7288
FFAgreeableness	1	-7.78956	6.15810	-1.26	0.2115
FBAgreeableness	1	0.81651	6.11497	0.13	0.8943
FFFBAgreeableness	1	-1.48905	5.88370	-0.25	0.8012
Age	1	-0.81669	0.95806	-0.85	0.3979
Female	1	3.88022	27.42689	0.14	0.8880

Figure 11.76: Regression output using slope of minutes exercised and agreeableness with interactions and demographics and gender interaction



Feedforward and FeedBack with Agreeableness and Interactions and Demographics with Interact 1820
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	195
Number of Observations Used	62
Number of Observations with Missing Values	133

Analysis of Variance

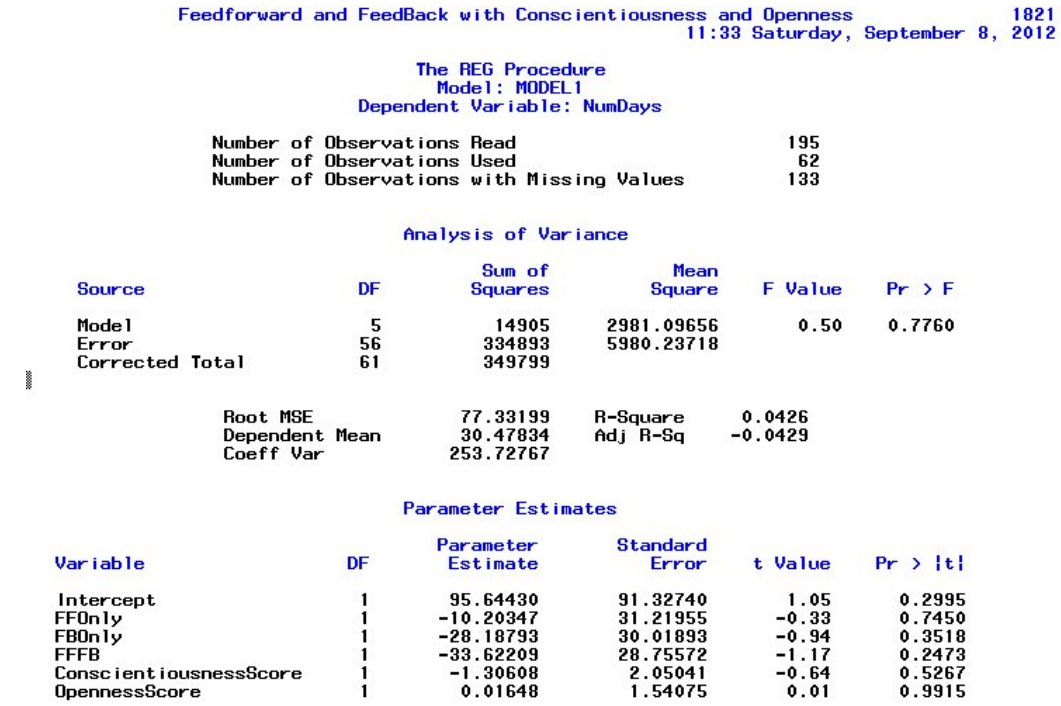
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	36236	3623.59482	0.59	0.8150
Error	51	313563	6148.29053		
Corrected Total	61	349799			

Root MSE	78.41104	R-Square	0.1036
Dependent Mean	30.47834	Adj R-Sq	-0.0722
Coeff Var	257.26803		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	37.63121	247.35002	0.15	0.8797
FFOnly	1	255.94707	221.45294	1.16	0.2532
FBOnly	1	-65.66816	207.44033	-0.32	0.7529
FFFB	1	7.62379	215.86215	0.04	0.9720
AgreeablenessScore	1	1.20602	7.35691	0.16	0.8704
FFAgreeableness	1	-7.63645	6.48092	-1.18	0.2441
FBAgreeableness	1	0.85026	6.18735	0.14	0.8912
FFFBAgreeableness	1	-1.24884	6.59676	-0.19	0.8506
Age	1	-0.81823	0.96752	-0.85	0.4017
Female	1	-12.29029	195.04436	-0.06	0.9500
FemaleAgreeAbleness	1	0.46334	5.53210	0.08	0.9336

Figure 11.77: Regression output using slope of minutes exercised and conscientiousness and openness



Feedforward and FeedBack with Conscientiousness and Openness 1821
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	195
Number of Observations Used	62
Number of Observations with Missing Values	133

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	14905	2981.09656	0.50	0.7760
Error	56	334893	5980.23718		
Corrected Total	61	349799			

Root MSE	77.33199	R-Square	0.0426
Dependent Mean	30.47834	Adj R-Sq	-0.0429
Coeff Var	253.72767		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	95.64430	91.32740	1.05	0.2995
FFOnly	1	-10.20347	31.21955	-0.33	0.7450
FBOnly	1	-28.18793	30.01893	-0.94	0.3518
FFFB	1	-33.62209	28.75572	-1.17	0.2473
ConscientiousnessScore	1	-1.30608	2.05041	-0.64	0.5267
OpennessScore	1	0.01648	1.54075	0.01	0.9915

Figure 11.78: Regression output using slope of minutes exercised and conscientiousness and openness with demographics

Feedforward and FeedBack with Conscientiousness and Openness and Demographics 1822
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	195
Number of Observations Used	62
Number of Observations with Missing Values	133

Analysis of Variance

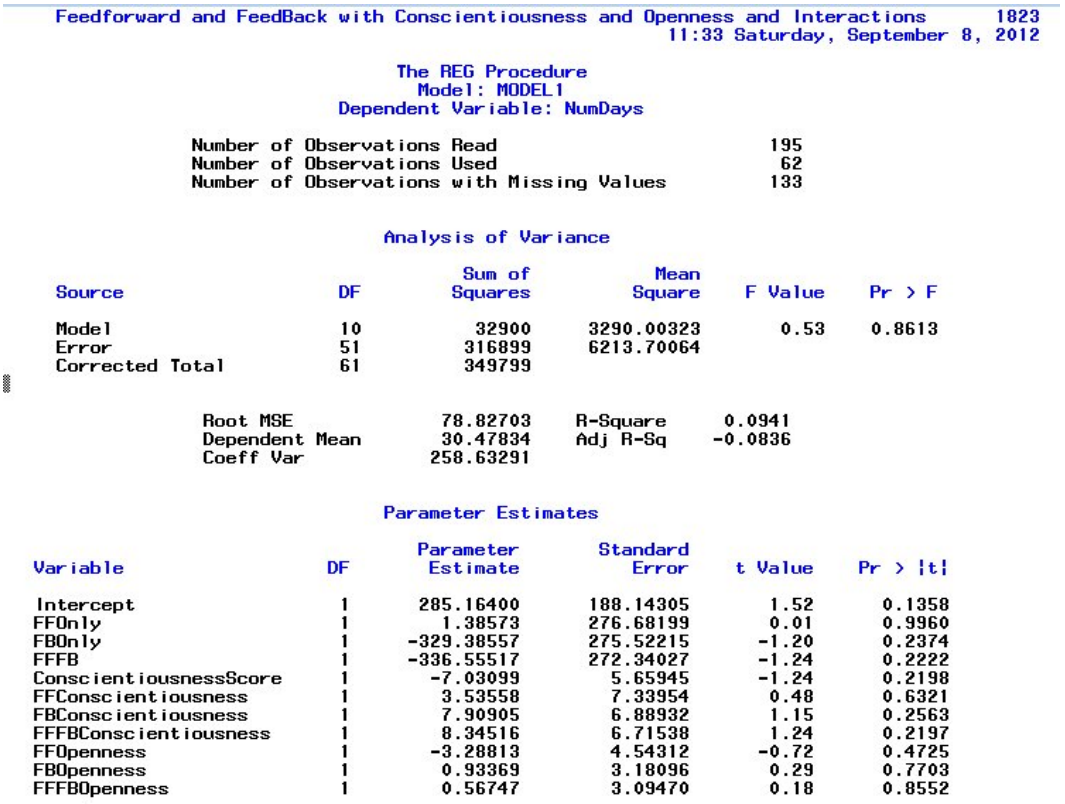
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	19561	2794.41641	0.46	0.8611
Error	54	330238	6115.51574		
Corrected Total	61	349799			

Root MSE	78.20176	R-Square	0.0559
Dependent Mean	30.47834	Adj R-Sq	-0.0665
Coeff Var	256.58140		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	115.05479	97.59312	1.18	0.2436
FFOnly	1	-8.76898	31.67207	-0.28	0.7829
FBOnly	1	-29.09230	30.59856	-0.95	0.3460
FFFB	1	-32.42349	30.00672	-1.08	0.2847
ConscientiousnessScore	1	-0.93361	2.12418	-0.44	0.6620
OpennessScore	1	-0.04323	1.60065	-0.03	0.9786
Age	1	-0.78195	0.92397	-0.85	0.4011
Female	1	-6.45881	24.97376	-0.26	0.7969

Figure 11.79: Regression output using slope of minutes exercised and conscientiousness and openness with interactions



Feedforward and FeedBack with Conscientiousness and Openness and Interactions 1823
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	195
Number of Observations Used	62
Number of Observations with Missing Values	133

Analysis of Variance

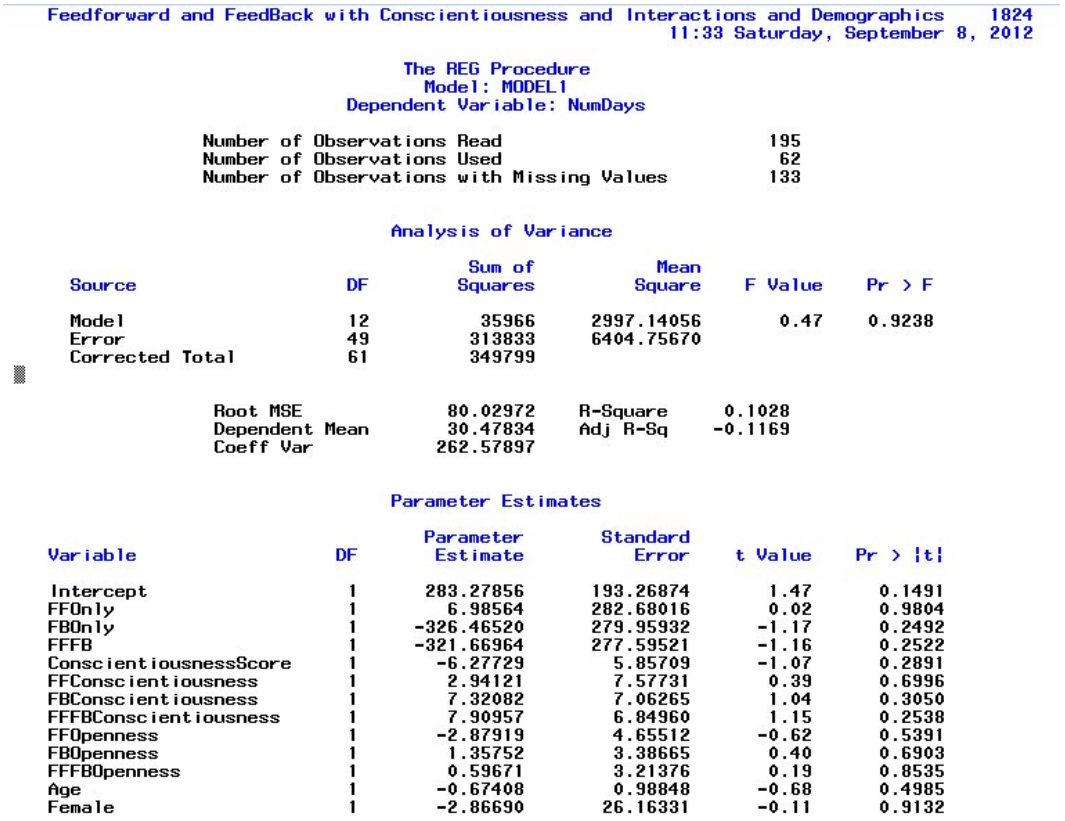
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	32900	3290.00323	0.53	0.8613
Error	51	316899	6213.70064		
Corrected Total	61	349799			

Root MSE	78.82703	R-Square	0.0941
Dependent Mean	30.47834	Adj R-Sq	-0.0836
Coeff Var	258.63291		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	285.16400	188.14305	1.52	0.1358
FFOnly	1	1.38573	276.68199	0.01	0.9960
FBOnly	1	-329.38557	275.52215	-1.20	0.2374
FFFB	1	-336.55517	272.34027	-1.24	0.2222
ConscientiousnessScore	1	-7.03099	5.65945	-1.24	0.2198
FFConscientiousness	1	3.53558	7.33954	0.48	0.6321
FBConscientiousness	1	7.90905	6.88932	1.15	0.2563
FFFBConscientiousness	1	8.34516	6.71538	1.24	0.2197
FFOpenness	1	-3.28813	4.54312	-0.72	0.4725
FBOpenness	1	0.93369	3.18096	0.29	0.7703
FFFBOpenness	1	0.56747	3.09470	0.18	0.8552

Figure 11.80: Regression output using slope of minutes exercised and conscientiousness and openness with interactions and demographics



Feedforward and FeedBack with Conscientiousness and Interactions and Demographics 1824
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	195
Number of Observations Used	62
Number of Observations with Missing Values	133

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	12	35966	2997.14056	0.47	0.9238
Error	49	313833	6404.75670		
Corrected Total	61	349799			

Root MSE	80.02972	R-Square	0.1028
Dependent Mean	30.47834	Adj R-Sq	-0.1169
Coeff Var	262.57897		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	283.27856	193.26874	1.47	0.1491
FFOnly	1	6.98564	282.68016	0.02	0.9804
FBOnly	1	-326.46520	279.95932	-1.17	0.2492
FFFB	1	-321.66964	277.59521	-1.16	0.2522
ConscientiousnessScore	1	-6.27729	5.85709	-1.07	0.2891
FFConscientiousness	1	2.94121	7.57731	0.39	0.6996
FBConscientiousness	1	7.32082	7.06265	1.04	0.3050
FFFBConscientiousness	1	7.90957	6.84960	1.15	0.2538
FFOpenness	1	-2.87919	4.65512	-0.62	0.5391
FBOpenness	1	1.35752	3.38665	0.40	0.6903
FFFBOpenness	1	0.59671	3.21376	0.19	0.8535
Age	1	-0.67408	0.98848	-0.68	0.4985
Female	1	-2.86690	26.16331	-0.11	0.9132

Figure 11.81: Regression output using slope of minutes exercised and conscientiousness and openness with interactions and demographics and gender interaction

Feedforward and FeedBack with Conscientiousness and Interactions and Demographics with Inte 1825
11:33 Saturday, September 8, 2012

The REG Procedure
Model: MODEL1
Dependent Variable: NumDays

Number of Observations Read	195
Number of Observations Used	62
Number of Observations with Missing Values	133

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	44738	3195.59450	0.49	0.9258
Error	47	305060	6490.64770		
Corrected Total	61	349799			

Root MSE	80.56456	R-Square	0.1279
Dependent Mean	30.47834	Adj R-Sq	-0.1319
Coeff Var	264.33377		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	486.70395	268.43446	1.81	0.0762
FFOnly	1	-18.84227	288.00835	-0.07	0.9481
FBOnly	1	-376.70910	291.81992	-1.29	0.2031
FFFB	1	-382.31854	289.16274	-1.32	0.1925
ConscientiousnessScore	1	-12.29059	8.05651	-1.53	0.1338
FFConscientiousness	1	5.22536	7.95815	0.66	0.5146
FBConscientiousness	1	10.30257	7.56030	1.36	0.1795
FFFBConscientiousness	1	10.88035	7.35428	1.48	0.1457
FFOpenness	1	-4.41300	5.28647	-0.83	0.4081
FBOpenness	1	-0.06722	4.03619	-0.02	0.9868
FFFBOpenness	1	-0.54675	3.71348	-0.15	0.8836
Age	1	-0.46700	1.02151	-0.46	0.6497
Female	1	-235.34862	203.68163	-1.16	0.2537
FemaleConscientiousness	1	4.67313	5.13686	0.91	0.3676
FemaleOpenness	1	1.84996	2.54077	0.73	0.4702

APPENDIX E

SAS CODE FOR ANALYSIS

TrendLines.sas

```
proc sort data=sasuser.CaloriesPerDay out=CaloriesPerDay;
        by UserID Date;
run;

data CaloriesPerDay;
        retain FirstDate;
        set CaloriesPerDay;
        by UserID Date;
        if first.UserID then FirstDate=Date;
        NumDays=Date-FirstDate;
run;



%RemoveOutliersByGroup(Dataset=CaloriesPerDay,DepVar=
   TotalCalories,OutputSet=CaloriesPerDayNoOutliers,ByVar=
   UserID);

data CaloriesPerDayNoOutliers;
        set CaloriesPerDayNoOutliers;
        if TotalCalories gt 500 and TotalCalories lt 3500;
run;

proc sql;
        create table CalRecsPerUser as
        select
                UserID,
                count(distinct Date) as NumRecs
        from
                CaloriesPerDayNoOutliers
        group by
                UserID;

proc reg data=CaloriesPerDayNoOutliers OutEst=CalTrendLines;
        title 'Calorie TrendLines';
        by UserID;
        model TotalCalories=NumDays;
run;
quit;

proc sql noprint;
```

```
        select distinct UserID into :CalUsers1-:CalUsers300
           from CaloriesPerDayNoOutliers;

%let NumUsers=&sqlobs.;

%macro CreateScatterPlots;
        %do i=1 %to &NumUsers;

                data plotdata;
                        set CaloriesPerDayNoOutliers;
                        where UserID=&&CalUsers&i;
                run;

                symbol1 V=circle I=r;

                proc gplot data=plotdata;
                plot TotalCalories*NumDays ;
                run;

        %end;

%mend CreateScatterPlots;
%CreateScatterPlots;

data CalTrendLines;
        set CalTrendLines;
        where _RMSE_ ne .;
run;

proc sort data=CalTrendLines;
        by UserID;
run;

proc sort data=CalRecsPerUser;
        by UserID;
run;

data CalTrendLines;
        merge CalTrendLines CalRecsPerUser;
        by UserID;
run;
```

```
proc sort data=sasuser.ActivityPerDay out=ActivityPerDay;
        by UserID Date;
run;

data ActivityPerDay;
        retain FirstDate;
        set ActivityPerDay;
        by UserID Date;
        if first.UserID then FirstDate=Date;
        NumDays=Date-FirstDate;
run;

proc sql;
        create table ActivityWeightMatch as
        select
                UserWeight.UserID,
                max(UserWeightID) as maxUserWeightID
        from
                sasuser.UserWeight inner  join
                ActivityPerDay
                        on ActivityPerDay.UserID=UserWeight.
                           UserID
        where
                datepart(UserWeight.EntryTime) <=
                   ActivityPerDay.Date
        group by
                UserWeight.UserID;

proc sql;
        create table TotalActivityPerDay as
        select
                ActivityPerDay.*,
                UserWeight.Weight / 2.2 * 9.9 + 6.25 * (
                   Users.Height / .393700787) - 4.92 * Users
                   .Age as RMR,
                case when Users.Gender='M' then ((calculated
                    RMR) + 5)/(1-TotalMinutes/1440) +
                   ActivityPerDay.TotalCalories
                        when Users.Gender='F' then ((
                           calculated RMR) -161)/(1-
                           TotalMinutes/1440) +
                           ActivityPerDay.TotalCalories
                end as TotalCalsBurned
        from
```

```
                Users inner join
                ActivityPerDay
                        on Users.UserID=ActivityPerDay.
                           UserID inner join
                ActivityWeightMatch
                        on ActivityPerDay.UserID=
                           ActivityWeightMatch.UserID inner
                           join
                UserWeight
                        on ActivityWeightMatch.
                           maxUserWeightID=UserWeight.
                           UserWeightID;


proc sql;
        create table ActRecsPerUser as
        select
                UserID,
                count(distinct Date) as NumRecs
        from
                ActivityPerDay
        group by
                UserID;

%RemoveOutliersByGroup(Dataset=ActivityPerDay,DepVar=
   TotalCalsBurned,ByVar=UserID,Outputset=
   ActivityPerDayNoOutliers);

proc reg data=ActivityPerDayNoOutliers OutEst=ActTrendLines;
        title 'Activity TrendLines';
        by UserID;
        model TotalCalories=NumDays;
run;
quit;

data ActTrendLines;
        set ActTrendLines;
        where _RMSE_ ne .;
run;

proc sort data=ActTrendLines;
        by UserID;
run;
```

```
proc sort data=ActRecsPerUser;
        by UserID;
run;

data ActTrendLines;
        merge ActTrendLines ActRecsPerUser;
        by UserID;
run;

%RemoveOutliersByGroup(Dataset=ActivityPerDay,DepVar=
    TotalMinutes,ByVar=UserID,OutputSet=
    ActivityPerDayNoOutliers);

proc reg data=ActivityPerDayNoOutliers OutEst=MinTrendLines;
        title 'Minutes TrendLine';
        by UserID;
        model TotalMinutes=NumDays;
run;
quit;

data MinTrendLines;
        set MinTrendLines;
        where _RMSE_ ne .;
run;
```

CMBC3.sas

```
/*Create BFI Scores for each individual*/

        %let SubSurvey1=Extraversion;
        %let SubSurvey2=Agreeableness;
        %let SubSurvey3=Conscientiousness;
        %let SubSurvey4=Neuroticism;
        %let SubSurvey5=Openness;

        %let BFIString=;
        %let BFIVariables=;
        %let InteractionVariables=;

        %macro BFIScores;
```

```
        %do i=1 %to 5;

                proc sql;
                create table UserBFI&&SubSurvey&i as
                select
                        usq.UserID,
                        sum(case when sq.Scoring='
                           Reverse' then abs(6-usq.
                           response) else usq.
                           response end) as &&
                           Subsurvey&i..Score
                from
                        sasuser.usersurveyquestion
                           usq inner join
                        sasuser.surveyquestion sq
                                on usq.
                                   SurveyQuestionID=
                                   sq.
                                   SurveyQuestionID
                where
                        sq.SubSurveyName="&&
                           SubSurvey&i"
                group by
                        usq.UserID;

                proc sort data=UserBFI&&SubSurvey&i;
                        by UserID;
                run;

                %let BFIString=&BFIString UserBFI&&
                   SubSurvey&i;
                %let BFIVariables=&BFIVariables &&
                   Subsurvey&i..Score;
                %let InteractionVariables=&
                   InteractionVariables FF&&
                   SubSurvey&i FB&&SubSurvey&i FFFB
                   &&SubSurvey&i;
        %end;
%mend BFIScores;

%BFIScores;

data BFIScores;
```

```
/*Get First and last weight recorded for each individual*/
        proc sort data=sasuser.UserWeight out=SortedWeight;
                by UserID EntryTime;

        data FirstAndLastWeight(drop=Weight WeightCount
           UserWeightID);
                retain WeightCount FirstWeight SecondWeight
                   LastWeight FirstEntryTime SecondEntryTime
                    LastEntryTime;
                set SortedWeight(where = (UserID ne 0));
                by UserID EntryTime;
                if first.UserID then do;
                        WeightCount=0;
                        FirstWeight=Weight;
                        FirstEntryTime=datepart(EntryTime);
                end;
                WeightCount=WeightCount+1;
                if WeightCount=2 then do;
                        SecondWeight=Weight;
                        SecondEntryTime=datepart(EntryTime);
                end;

                if last.UserID then do;
                        LastWeight=Weight;
                        LastEntryTime=datepart(EntryTime);
                        ElapsedTime=datdif(FirstEntryTime,
                           LastEntryTime,'act/act');
                        ResultWeight=LastWeight;
                        WeightChange=(FirstWeight-
                           ResultWeight)/ElapsedTime*28;
                        PctWeightChange=WeightChange/
                           FirstWeight*100;
                end;
                if last.UserID;
                if WeightCount>1;
        run;

/*Create dataset for analysis*/
        proc sort data=sasuser.Users out=Users;
                by UserID;
        run;

        data Users;
                set     Users;
```

```
        Age=yrdif(DOB,today(),'act/act');
        if Gender='M' then Female=0;
        if Gender='F' then Female=1;
run;

proc sort data=FirstAndLastWeight;
        by UserID;
run;

proc sort data=Users;
        by UserID;
run;

data AnalyticSet;
        merge Users(in=a) FirstAndLastWeight(in=b);
        by UserID;
        if b;
run;

proc sort data=AnalyticSet;
        by UserID;
run;

data AnalyticSet;
        merge AnalyticSet &BFIString;
        by UserID;
        if FeedForward=1 and FeedBack=0 then FFOnly
           =1;
        else FFOnly=0;
        if FeedBack=1 and FeedForward=0 then FBOnly
           =1;
        else FBOnly=0;
        FFFB=FeedForward*FeedBack;
        FFExtraversion=FFOnly*ExtraversionScore;
        FFAgreeableness=FFOnly*AgreeablenessScore;
        FFConscientiousness=FFOnly*
           ConscientiousnessScore;
        FFNeuroticism=FFOnly*NeuroticismScore;
        FFOpenness=FFOnly*OpennessScore;
        FBExtraversion=FBOnly*ExtraversionScore;
        FBAgreeableness=FBOnly*AgreeablenessScore;
        FBConscientiousness=FBOnly*
           ConscientiousnessScore;
        FBNeuroticism=FBOnly*NeuroticismScore;
```

```
                FBOpenness=FBOnly*OpennessScore;
                FFFBExtraversion=FFFB*ExtraversionScore;
                FFFBAgreeableness=FFFB*AgreeablenessScore;
                FFFBConscientiousness=FFFB*
                   ConscientiousnessScore;
                FFFBNeuroticism=FFFB*NeuroticismScore;
                FFFBOpenness=FFFB*OpennessScore;
                ActWeightChange=FirstWeight-LastWeight;
                if Gender='M' then GoalWeight=110 + 5.06 * (
                   Height - 60);
                if Gender='F' then GoalWeight=100.1 + 5.06 *
                    (Height - 60);
                ProgTowardGoal=(FirstWeight - LastWeight)/(
                   FirstWeight - GoalWeight)*100;
        run;



%macro RemoveOutliers(Dataset=,DepVar=,OutputSet=,Deviations
   =3);

        proc univariate data=&Dataset;
        var &DepVar;
        output out=UnivOutput std=stdev mean=mean;
        run;

        proc sql;
                select stdev,mean into :stdev,:mean from
                   UnivOutput;
        run;

        data &Outputset;
                set &Dataset;
                MeanDiff=abs(&DepVar - &mean);
                if MeanDiff le (&Deviations * &stdev);
        run;

%mend RemoveOutliers;

%macro RemoveOutliersByGroup(Dataset=,DepVar=,ByVar=,
   OutputSet=,Deviations=3);

        proc univariate data=&Dataset;
        var &DepVar;
```

```
        by &ByVar;
        output out=UnivOutput std=stdev mean=mean;
        run;

        proc sql;
                create table InterMed as
                select Dataset.*, UnivOutput.stdev,
                   UnivOutput.mean
                from UnivOutput inner join &DataSet Dataset
                   on DataSet.&ByVar=UnivOutput.&ByVar;
        run;

        data &Outputset;
                set &Dataset;
                MeanDiff=abs(&DepVar - mean);
                if MeanDiff le (&Deviations * stdev);
        run;
%mend RemoveOutliersByGroup;


%RemoveOutliers(Dataset=AnalyticSet,DepVar=PctWeightChange,
   OutputSet=AnalyticSetNoOutliers);


/*Run Analysis*/
%macro RunRegressions(Dataset=,TitleSuffix=,DepVar=);
                proc reg data=&DataSet;
                title "Feedforward and FeedBack only &
                   TitleSuffix";
                        model &DepVar=FFOnly FBOnly FFFB;
                run;

                proc reg data=&DataSet;
                        title "Feedforward and FeedBack with
                            Demographics &TitleSuffix";
                        model &DepVar=FFOnly FBOnly FFFB Age
                            Female;
                run;


                proc reg data=&DataSet;
                        title "Feedforward and FeedBack with
                            PersonalityFactors &TitleSuffix
                           ";
```

```
                        model &DepVar=FFOnly FBOnly FFFB &
                           BFIVariables;
                run;

                proc reg data=&DataSet;
                        title "Feedforward and FeedBack with
                            PersonalityFactors and
                           Demographics &TitleSuffix";
                        model &DepVar=FFOnly FBOnly FFFB &
                           BFIVariables Age Female;
                run;

                proc reg data=&DataSet;
                        title "Feedforward and FeedBack with
                            PersonalityFactors and
                           Demographics plus Interactions &
                           TitleSuffix";
                        model &DepVar=FFOnly FBOnly FFFB &
                           BFIVariables &
                           InteractionVariables Age Female
                           ;
                run;

quit;
%mend RunRegressions;

%macro RunLogistic(Dataset=,TitleSuffix=,DepVar=);
                proc logistic data=&DataSet;
                title "Feedforward and FeedBack only &
                   TitleSuffix";
                        model &DepVar=FFOnly FBOnly FFFB;
                run;

                proc logistic data=&DataSet;
                        title "Feedforward and FeedBack with
                            Demographics &TitleSuffix";
                        model &DepVar=FFOnly FBOnly FFFB Age
                            Female;
                run;


                proc logistic data=&DataSet;
```

```
                title "Feedforward and FeedBack with
                    PersonalityFactors &TitleSuffix
                    ";
                model &DepVar=FFOnly FBOnly FFFB &
                    BFIVariables;
        run;

        proc logistic data=&DataSet;
                title "Feedforward and FeedBack with
                    PersonalityFactors and
                    Demographics &TitleSuffix";
                model &DepVar=FFOnly FBOnly FFFB &
                    BFIVariables Age Female;
        run;

        proc logistic data=&DataSet;
                title "Feedforward and FeedBack with
                    PersonalityFactors and
                    Demographics plus Interactions &
                    TitleSuffix";
                model &DepVar=FFOnly FBOnly FFFB &
                    BFIVariables &
                    InteractionVariables Age Female
                    ;
        run;

quit;
%mend RunLogistic;

%RunRegressions(Dataset=AnalyticSetNoOutliers,TitleSuffix=
    Pct Weight Change,DepVar=PctWeightChange);
%RunRegressions(Dataset=AnalyticSetNoOutliers,TitleSuffix=
    Progress Towards Weight Goal,DepVar=ProgTowardGoal);

%include 'G:\TrendLines.sas';
run;

proc sort data=CalTrendLines;
        by UserID;

data CTLAnalyticSet;
        merge Users(in=a) CalTrendLines(in=b);
        by UserID;
        if b;
```

```
run;

data CTLAnalyticSet;
        merge CTLAnalyticSet &BFIString;
        by UserID;
        if FeedForward=1 and FeedBack=0 then FFOnly=1;
        else FFOnly=0;
        if FeedBack=1 and FeedForward=0 then FBOnly=1;
        else FBOnly=0;
        FFFB=FeedForward*FeedBack;
        FFExtraversion=FFOnly*ExtraversionScore;
        FFAgreeableness=FFOnly*AgreeablenessScore;
        FFConscientiousness=FFOnly*ConscientiousnessScore;
        FFNeuroticism=FFOnly*NeuroticismScore;
        FFOpenness=FFOnly*OpennessScore;
        FBExtraversion=FBOnly*ExtraversionScore;
        FBAgreeableness=FBOnly*AgreeablenessScore;
        FBConscientiousness=FBOnly*ConscientiousnessScore;
        FBNeuroticism=FBOnly*NeuroticismScore;
        FBOpenness=FBOnly*OpennessScore;
        FFFBExtraversion=FFFB*ExtraversionScore;
        FFFBAgreeableness=FFFB*AgreeablenessScore;
        FFFBConscientiousness=FFFB*ConscientiousnessScore;
        FFFBNeuroticism=FFFB*NeuroticismScore;
        FFFBOpenness=FFFB*OpennessScore;
        if NumRecs gt 4;
run;

%RunRegressions(Dataset=CTLAnalyticSet,TitleSuffix=(Calories
   ),DepVar=NumDays);

proc sort data=ActTrendLines;
        by UserID;

data ATLAnalyticSet;
        merge Users(in=a) ActTrendLines(in=b);
        by UserID;
        if b;
run;

data ATLAnalyticSet;
        merge ATLAnalyticSet &BFIString;
        by UserID;
        if FeedForward=1 and FeedBack=0 then FFOnly=1;
```

```
        else FFOnly=0;
        if FeedBack=1 and FeedForward=0 then FBOnly=1;
        else FBOnly=0;
        FFFB=FeedForward*FeedBack;
        FFExtraversion=FFOnly*ExtraversionScore;
        FFAgreeableness=FFOnly*AgreeablenessScore;
        FFConscientiousness=FFOnly*ConscientiousnessScore;
        FFNeuroticism=FFOnly*NeuroticismScore;
        FFOpenness=FFOnly*OpennessScore;
        FBExtraversion=FBOnly*ExtraversionScore;
        FBAgreeableness=FBOnly*AgreeablenessScore;
        FBConscientiousness=FBOnly*ConscientiousnessScore;
        FBNeuroticism=FBOnly*NeuroticismScore;
        FBOpenness=FBOnly*OpennessScore;
        FFFBExtraversion=FFFB*ExtraversionScore;
        FFFBAgreeableness=FFFB*AgreeablenessScore;
        FFFBConscientiousness=FFFB*ConscientiousnessScore;
        FFFBNeuroticism=FFFB*NeuroticismScore;
        FFFBOpenness=FFFB*OpennessScore;
run;

%RunRegressions(Dataset=ATLAnalyticSet,TitleSuffix=(Activity
    ),DepVar=NumDays);


proc sort data=MinTrendLines;
        by UserID;

data MinAnalyticSet;
        merge Users(in=a) MinTrendLines(in=b);
        by UserID;
        if b;
run;

data MinAnalyticSet;
        merge MinAnalyticSet &BFIString;
        by UserID;
        if FeedForward=1 and FeedBack=0 then FFOnly=1;
        else FFOnly=0;
        if FeedBack=1 and FeedForward=0 then FBOnly=1;
        else FBOnly=0;
        FFFB=FeedForward*FeedBack;
        FFExtraversion=FFOnly*ExtraversionScore;
        FFAgreeableness=FFOnly*AgreeablenessScore;
```

```
        FFConscientiousness=FFOnly*ConscientiousnessScore;
        FFNeuroticism=FFOnly*NeuroticismScore;
        FFOpenness=FFOnly*OpennessScore;
        FBExtraversion=FBOnly*ExtraversionScore;
        FBAgreeableness=FBOnly*AgreeablenessScore;
        FBConscientiousness=FBOnly*ConscientiousnessScore;
        FBNeuroticism=FBOnly*NeuroticismScore;
        FBOpenness=FBOnly*OpennessScore;
        FFFBExtraversion=FFFB*ExtraversionScore;
        FFFBAgreeableness=FFFB*AgreeablenessScore;
        FFFBConscientiousness=FFFB*ConscientiousnessScore;
        FFFBNeuroticism=FFFB*NeuroticismScore;
        FFFBOpenness=FFFB*OpennessScore;
run;

%RunRegressions(Dataset=MinAnalyticSet,TitleSuffix=(Minutes)
    ,DepVar=NumDays);
run;

%include 'G:\UsageMapCals.sas';
%include 'G:\UserDuration.sas';

data DurationAnalyticSet;
        merge Users(in=a) Weeks(in=b);
        by UserID;
        if b;
run;

data DurationAnalyticSet;
        merge DurationAnalyticSet &BFIString;
        by UserID;
        if FeedForward=1 and FeedBack=0 then FFOnly=1;
        else FFOnly=0;
        if FeedBack=1 and FeedForward=0 then FBOnly=1;
        else FBOnly=0;
        FFFB=FeedForward*FeedBack;
        FFExtraversion=FFOnly*ExtraversionScore;
        FFAgreeableness=FFOnly*AgreeablenessScore;
        FFConscientiousness=FFOnly*ConscientiousnessScore;
        FFNeuroticism=FFOnly*NeuroticismScore;
        FFOpenness=FFOnly*OpennessScore;
        FBExtraversion=FBOnly*ExtraversionScore;
        FBAgreeableness=FBOnly*AgreeablenessScore;
        FBConscientiousness=FBOnly*ConscientiousnessScore;
```

```
        FBNeuroticism=FBOnly*NeuroticismScore;
        FBOpenness=FBOnly*OpennessScore;
        FFFBExtraversion=FFFB*ExtraversionScore;
        FFFBAgreeableness=FFFB*AgreeablenessScore;
        FFFBConscientiousness=FFFB*ConscientiousnessScore;
        FFFBNeuroticism=FFFB*NeuroticismScore;
        FFFBOpenness=FFFB*OpennessScore;
run;

%RunRegressions(Dataset=DurationAnalyticSet,TitleSuffix=(
   Duration),DepVar=PartWeeks);
run;

data ExpectationAnalyticSet;
        merge Users(in=a) DeficitDecrease(in=b);
        by UserID;
        if b;
run;

data ExpectationAnalyticSet;
        merge ExpectationAnalyticSet &BFIString;
        by UserID;
        if FeedForward=1 and FeedBack=0 then FFOnly=1;
        else FFOnly=0;
        if FeedBack=1 and FeedForward=0 then FBOnly=1;
        else FBOnly=0;
        FFFB=FeedForward*FeedBack;
        FFExtraversion=FFOnly*ExtraversionScore;
        FFAgreeableness=FFOnly*AgreeablenessScore;
        FFConscientiousness=FFOnly*ConscientiousnessScore;
        FFNeuroticism=FFOnly*NeuroticismScore;
        FFOpenness=FFOnly*OpennessScore;
        FBExtraversion=FBOnly*ExtraversionScore;
        FBAgreeableness=FBOnly*AgreeablenessScore;
        FBConscientiousness=FBOnly*ConscientiousnessScore;
        FBNeuroticism=FBOnly*NeuroticismScore;
        FBOpenness=FBOnly*OpennessScore;
        FFFBExtraversion=FFFB*ExtraversionScore;
        FFFBAgreeableness=FFFB*AgreeablenessScore;
        FFFBConscientiousness=FFFB*ConscientiousnessScore;
        FFFBNeuroticism=FFFB*NeuroticismScore;
        FFFBOpenness=FFFB*OpennessScore;
run;
```

```
%RunLogistic(Dataset=ExpectationAnalyticSet,TitleSuffix=(
    Expectation),DepVar=ExpMet);
run;

%RunRegressions(Dataset=ExpectationAnalyticSet,TitleSuffix=(
    Deficit Change),DepVar=DeficitChange);

quit;
```

BIOGRAPHICAL SKETCH

Tamuchin McCreless is a Texas native and graduate of Texas A&M University, from which he received a bachelor's degree in genetics in 1997. He attended Trinity University in San Antonio from which he received a master's of science in health administration in 2000. In the year 2004, he was admitted to the W.P. Carey School of Business doctoral program at Arizona State University where he began his doctoral studies in computer information systems. He completed his doctoral work while working full time in the health care industry in 2012.