

**Longitudinal Measurement of Self-Control in Children Undergoing  
Orthodontic Treatment**

BY

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THESIS

Submitted as partial fulfillment of the requirements  
for the degree of Master of Science in Oral Sciences  
in the Graduate College of the  
University of Illinois at Chicago, 2014

Chicago, Illinois

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This thesis is dedicated to my husband, Matt for all of his love and support and to my parents for always helping me see the light at the end of the tunnel.

## **ACKNOWLEDGEMENTS**

I would like to thank my thesis committee and fellow authors, Drs. Ellen BeGole, Leslie Pitner, Carla Evans and Sheela Raja for their support and assistance.

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## **LIST OF ABBREVIATIONS**

IDPA	Illinois Department of Public Aid
IRB	Institutional Review Board
LAR	Legally Authorized Representative
SD	Standard Deviation
SDT	Self-determination Theory
UIC	University of Illinois at Chicago

## SUMMARY

The purpose of this study is to investigate the ability of a child to increase their capacity for self-control by engaging in regular acts of self-control over time as well as the subsequent development of self-efficacy in relation to these acts. A number of authors have demonstrated that one's capacity for self-control is similar to a muscle gaining increased strength with continued exercise; however, it can also be depleted in the short term when employed. Bandura's concept of self-efficacy connects a person's *belief* that they have the ability to accomplish a goal, and their capacity to persevere through the obstacles presented by the task. Like most things in life, increases in self-efficacy develop with practice. Undertaking challenging activities and learning to work through inevitable frustrations and setbacks equip the belief system with the strength to aspire towards ambitious future endeavors.

This study examines three hypotheses. First, regular mandatory acts of taking care of orthodontic appliances, an activity that requires self-regulation, will increase global self-control in adolescents. Second, there will be an increase in self-regulation available to complete other daily tasks. Lastly, the challenges presented by orthodontic treatment will enhance self-efficacy in adolescents. Twenty-two patients between the ages of 10-15 years old were recruited from the University of Illinois at Chicago and divided into two groups: Group 1 (n=12) began orthodontic immediately and Group 2 (n=10) waited 4-6 weeks to begin orthodontic treatment. Both groups completed a series of questionnaires and laboratory procedure at time points 0 (baseline), 1 (4-6 weeks), and 2 (6-8 weeks). The laboratory procedure consists of two timed hand-grip tasks with an intervening thought suppression task.

## **SUMMARY** (continued)

We found no statistically significant difference in hand-grip task time differences for either group. A statistically significant increase was seen in self-efficacy responses in regards to orthodontic tasks for Group 1, but not Group 2. Responses to the General Self-Efficacy Scale and the Parental Questionnaire were not statistically significant for either group. Study results suggest that although self-regulatory capacity was not found to increase in adolescents undergoing orthodontics, adolescent patients may develop increased self-efficacy as they work through the challenging process of orthodontic therapy.

# 1. INTRODUCTION

## 1.1 Background

Self-regulation (or self-control) is defined as the ability to control one's own behavior. Self-regulation plays a crucial role in allowing individuals to avoid destructive behaviors (such as smoking, drugs, alcohol, and other unsafe behaviors) and to choose constructive behaviors (such as eating a healthy diet, exercising, or completing work and school tasks). Self-regulation is fundamental to a life of meaning and engagement. Without a basic level of self-control, it is difficult, if not impossible, to avoid self-destructive habits and activities.

Work by Roy Baumeister and others suggest that self-regulation can be thought of as a muscle (Baumeister, 2002; Baumeister et al., 2006; Baumeister and Heatherton, 1996; Baumeister et al., 2000; Baumeister and Vohs, 2011; Muraven and Baumeister, 2000; Muraven et al., 1999; Muraven et al., 1998; Oaten and Cheng, 2006a; Oaten and Cheng, 2006b). In this model, capacity for self-control can be depleted with continued use similar to muscles after a work-out at the gym; however with continued regular exercise, just as the capacity for muscular endurance can increase, self-control capacity can increase as well. Exercise of self-control can be any type of activity that requires controlling one's personal impulses. Examples may include a dieting individual that refrains from eating their favorite cookie, or refusing an immediate reward to wait for a larger reward in the future. Self-regulatory strength can be understood as a limited resource that can be depleted by use, but can also be strengthened by regular exercise, thereby raising the threshold for depletion.

Self-efficacy encompasses the *belief* that one is able to achieve their goals (Bandura, 1994). It is quintessentially linked to success due to the simple fact that a person is less likely to attempt a challenging activity if they do not think that they will succeed. Like most things in

life, self-efficacy can be improved with practice. Undertaking challenging tasks and learning to overcome difficulties and shortcomings to accomplish the ultimate endpoint will bleed into future experiences. Every avenue of life presents new encounters that require resilience and adaptation. Deficiencies in self-efficacy cause a person to “give up” quickly or feel threatened by adversity and have been linked to depression, stress and anxiety.

Orthodontic treatment requires patient compliance with a number of behaviors that are both typical and unique. Requirements can vary from simply keeping the teeth and brackets clean and free of plaque to wearing headgear or inter-arch elastics for a prescribed number of hours each day. A patient’s level of cooperation can be one of the determining factors for the length of treatment and the quality of the orthodontic outcome. These required daily tasks of careful oral hygiene and cooperation in wearing removable orthodontic appliances require self-regulation on the part of these adolescent patients and can be quite difficult.

Several experiments have been conducted that demonstrate that self-regulation can be increased through repeated small exercises of self-control (Muraven et al., 1999; Oaten and Cheng, 2006a; Oaten and Cheng, 2006b). These experiments, however, have been limited to samples of college undergraduates with self-regulatory tasks that are not necessary activities. This model has not been tested with children or adolescents, a particularly important group in which to target better self-regulation and self-efficacy. In addition, no real life self-regulatory task has been tested. This study would address both of these untested areas by examining the responses of adolescents when presented with a real-life mandatory regulatory task – taking care of orthodontic appliances.

## 1.2 **Specific Aims**

The specific aim of this project is to conduct an experiment to determine if self-regulation and self-efficacy are improved in a group of adolescents undergoing orthodontic treatment. Adolescents who have begun orthodontic treatment will be compared to a group of wait-list controls to see if a necessary real life act of self-regulation has the effect of strengthening global self-regulation and if those challenges result in an increase in self-efficacy.

## 1.3 **Hypotheses**

The study aims to address three null hypotheses. First, the self-control required to take care of orthodontic appliances will have no effect on self-control capacity in adolescents as measured with two consecutive hand-grip tasks and intervening thought suppression task. Second, there will be no effect on the use of self-control to complete other daily activities as reported by parent observations during initial orthodontic treatment. Lastly, there will be no effect on self-efficacy in adolescents undergoing orthodontic treatment as measured by subject response to the Orthodontic Self-Efficacy Scale and the General Self-Efficacy Scale over a period of two to three months.

## 2. REVIEW OF LITERATURE

### 2.1 Self-regulation as a muscle

Failure of self-regulation is one of the most significant problems in the United States. Obesity, drug and alcohol abuse, and failure in school can all be attributed to failure of self-regulation. In children, high self-control is correlated with better grades, better emotional adjustment, and better interpersonal skills (Tangney et al., 2004). Muraven and Baumeister (2000) have offered a theory of self-regulation as a strength model with limited and depleteable resources. In their model, self-regulation is a resource that is universal for any form of self-regulation, be it resisting chocolate cookies or not thinking about a white bear. Once used, self-regulatory strength is depleted temporarily, much like a muscle that is fatigued and depleted after use. But like a muscle, self-regulation can also be strengthened through regular exercise (Baumeister et al., 2006).

Several previous studies have demonstrated that regular use of self-regulation, whether as simple as observing one's posture or adhering to a regular study schedule, increases subjects' ability to persist in laboratory tasks after experiencing self-regulatory depletion (Muraven et al., 1999; Oaten and Cheng, 2006a; Oaten and Cheng, 2006b). In addition, these subjects also demonstrated increased self-regulation in a variety of areas not related directly to the tasks of the experiment. These included dietary habits, exercise habits, and general regulatory habits such as washing dishes and not overspending. These studies suggest that self-regulation can be increased through regular use and that increasing self-regulation in one particular area increases overall self-regulation.

The ego-depletion concept is central to the strength model of self-regulation. Baumeister (2002) describes this concept as "the condition that arises when the self's resources have been

expended and the self is temporarily at less than full power.” Each person has a reservoir of energy that is finite, but replenishable with rest. When a self-regulatory act is performed, the energy stores are initially depleted, which starts the process to conserve future energy expenditures. Energy is therefore less available for mundane acts of choice (i.e. not eating a cupcake), but maintained for more crucial matters of executive function. This system is similar to an athlete that conserves his strength during the warm up in preparation for the race (Baumeister, 2002).

## 2.2 **Measurement of self-regulation**

There are many methods of measuring self-regulatory capacity in individuals. The strength model of self-regulation maintains that there is a limited pool from which this *willpower* can be obtained (Muraven et al., 1998). Any task requiring the use of self-regulation depletes this resource, thus providing less self-regulation availability for an immediately subsequent task (Muraven and Baumeister, 2000; Muraven et al., 1998). A hand-grip requires self-control to override discomfort produced by squeezing the hand-grip handles together and can thus provide a measurement tool for self-regulation (Bray et al., 2008; Muraven et al., 1998; Rethlingshafer, 1942; Thornton, 1939). As described by Muraven et al. (1998), “a commercially available hand-grip that has two handles separated by a spring” is used. Participants are asked to squeeze the handles together for as long as they are able. To uniformly measure time elapse, a piece of paper is inserted between the handles and held in place while the handles are pressed together. The timer is stopped when the paper falls from between the handles (Muraven et al., 1998). This method for measuring self-regulatory capacity has been validated in the Muraven et al. (1998) paper and has been used in several studies as a measurement of self-regulatory capacity (Hong



and Lee, 2008; Inzlicht et al., 2006; Martijn et al., 2006; Muraven et al., 1999; Muraven, 2010; Seeley and Gardner, 2003).

Bray et al. (2008) examined the effect of self-regulatory depletion on repeating hand-grip performance with an intervening cognitive task. Participants were separated into two groups: one underwent a self-regulatory depletion task (Stroop Color Word test) and the control performed a neutral color task. The group measured EMG forearm muscle activity during all hand-grip tasks. Participants underwent a baseline hand-grip performance task, followed by either a depleting cognitive task or a control task (depending on random group assignment) and a final hand-grip performance task. They found that hand-grip performance declined significantly more in the cognitively depleted group than the control group. Additionally both groups recorded similar baseline EMG readings, but the depleted group showed higher EMG activity in the second hand-grip task compared to the control, despite lower hand-grip performance time. In other words, depleted subjects not only performed worse on the self-regulatory task, but also showed greater physical muscle fatigue. Their results support the self-regulatory limited strength model from a neuromuscular perspective (Bray et al., 2008).

### 2.3 **Thought suppression task**

The thought suppression task of not thinking about a white bear is a standard task inducing self-regulatory depletion (Muraven et al., 1999; Muraven et al., 1998, Wegner et al., 1987). It has been shown to deplete self-control capacity, thus decreasing remaining self-control available to complete a subsequent self-regulatory task (Muravan et al., 1998, 1999). After being told “not to think about a white bear,” an individual is required to control their thoughts despite the natural impulse is to immediately think of the forbidden white bear. This process of thought

control depletes the reservoir of available self-regulation to then complete subsequent tasks requiring self-control.

#### 2.4 **Self-efficacy**

Bandura (1994) defines self-efficacy as “people’s beliefs about their capabilities to produce designated levels of performance that exercise influence over other events that affect their lives.” In other words, self-efficacy is the *belief* that one has the ability to overcome challenges to achieve a goal. It is the ability of an individual to visualize success that enables them to set high goals, develop methods to achieve, and not be derailed when met with unforeseen challenges, failures, or rejection. Efficacious individuals are able to maintain their *commitment* to their goals despite setbacks, whereas those without self-efficacy are plagued by self-doubt and tend to give up on goals when met with adversity or avoid situations where they perceive themselves to be incapable. Self-efficacy provides the persistent effort necessary to push through adversity to achieve a desired endpoint.

Self-efficacy is built by setting goals and overcoming challenges to achieve them. Goals that are too quickly or easily attained do not increase self-efficacy and in contrast create an expectancy that goals should come without challenges or sufficient working time. Observing others overcoming obstacles to achieve goals can serve to strengthen the belief that an individual can succeed as well. Encouragement and guidance from others place an individual in a nurturing environment that promotes success and can also enhance self-efficacy. These situations are helpful because they often “measure success in terms of self-improvement rather than by triumphs over others” and thus emphasize the abilities of the internal self (Bandura, 1994).

Self-efficacy has a profound effect on cognitive and motivational processes (Bandura, 1994). Efficacious individuals set higher goals and have a higher commitment to those goals. They develop a task oriented approach that is resilient to set-backs and flexible to change; whereas, a less efficacious individual may lower their expectations blaming their perceived inabilities rather than changing their tactics or increases their efforts to achieve a goal. This can be a self-perpetuated phenomenon that can diminish their ability to manage life events and achieve success leading to an increased risk of stress and depression.

## 2.5 **Effect of individual motivation and self-regulation**

Murtagh and Todd (2004) performed a series of experiments to test the strength model of self-regulation. Unlike previous studies by Baumeister, Muraven and colleagues, their results did not demonstrate universal self-regulatory depletion after a series of tasks requiring self-regulation. They reported a large degree of variation amongst subjects. Some subjects showed decreased self-regulatory capacity while others actually increased self-regulatory display after task designed to deplete resources. In their discussion, they observed that some “subjects were motivated to increase [hand-grip] time” after a depleting exercise. They suggest that there is a role of internal motivation that may affect individual depletion rates and subsequent drain on self-regulatory capacity.

Other studies also suggest that the concept of self-regulation is more complex than the strength model implies. A variety of factors may influence self-regulatory depletion, challenging the theory that any act of self-control universally reduces capacity for self-control available for future tasks (Moller et al., 2006). Muraven and Slessareva (2003) revealed that increased motivation directed towards an act of self-control does not cause ego-depletion. One may even

overcome previous depletion by increasing their motivation. An individual's capacity for self-regulation is therefore dependent on both internal self-control resources and motivation towards the activity (Muraven and Slessareva, 2003). The differences in internal motivating factors, beliefs, and determinations may explain variable responses to depleting events.

Martijin et al. (2002) conducted an experiment that examined preconceived ideas toward an activity and its effect on ego-depletion. Self-regulation depletion was compared in three groups measured by two hand-grip tasks with an intervening emotional video. The *No Suppression* group was not asked to suppress their emotions during the video. The *Suppression* group was asked to suppress their emotions during the video. The *Suppression + Expectancy* group was also asked to suppress their emotions during the video, but prior to the second hand-grip task, they were told that challenging tasks such as controlling emotions could subsequently increase future performance on other tasks. Ego-depletion was observed only in the *Suppression* group. The lack of ego-depletion observed in the *Suppression + Expectancy* group reveals the influence that internal philosophies concerning an activity can have on future performance.

Similarly, Job et al. (2010) suggest in their study that depletion depends on the individual's belief in their source of *willpower*. If one believes that their source of self-control is limited, they are at greater risk of depleting their internal resource of self-regulation with each self-regulating task. In a laboratory procedure, they were able to manipulate the subject's belief system proposing causal effect between core belief systems and susceptibility to depletion of self-control stores.

The Self-Determination Theory (SDT) offers a different perspective on the concept of self-regulation and ego-depletion (Dice and Ryan, 2008). In order to explain the complexity of decision processes and self-control, it differentiates between autonomous regulation and

controlled regulation. Autonomous regulation is sustained and initiated by one's internal self and controlled by internal motivations. It encompasses choices and tasks that an individual finds interesting or has a personal adherence. Controlled regulation is defined by outside influences and includes choices and tasks that are demanded or coerced by external factors such as society or authoritative figures. It is not internally rooted in the true self and thus depletes internal stores of self-control capacity. This theory may help explain the interaction between motivational factors and self-regulation (Dice and Ryan, 2008; Moller et al., 2006).

## 2.6 **Cognitive and emotional development in children and adolescents**

Adolescence is a complex period of human life that encompasses changes in the physical, behavioral, social, and cognitive self. The developmental *rate* of these different facets varies widely from one individual to another; however the *sequence* to which these developments arise appears to be more consistent (Proffit, 2000). Erikson (1987) described the stages of emotional development as critical turning points at which a psychosocial crisis occurs. Environment and social cues sway an individual to tend toward one of two conflicting personality choices. These crises occur sequentially in order to lay the foundation for the development of the personality and identity of an individual. Orthodontic patients typically lie within the "Industry versus Inferiority" stage which occurs from ages 7-11 years and the "Identity versus Role confusion" stage which occurs from ages 12-17 years (Proffit, 2000).

During the "Industry versus Inferiority" stage, school-aged children begin to learn not only academic subjects, but social norms and rules (Proffit, 2000). Parental influence begins to decline as socialization with peers increases. Industrial concepts of hard work take hold due to

the realization of competition and the idea that someone else may excel at something over the individual.

The “Identity versus Role confusion stage” (Proffit, 2000) comprises the adolescent’s/teenager’s development toward becoming an individual. They begin to find their identity outside of the family and ideally find an identity that is distinct from their peers as well. Peers continue to increase in importance and far outweigh parental influence. Often, rejection of authority accompanies this identity crisis. From a motivational and compliance standpoint, it is extremely important for this age group to be internally motivated toward a medical regimen. It is not enough that their parents desire treatment. It needs to be their decision to undergo treatment, particularly orthodontic treatment.

By eleven years, most adolescents have developed the ability to comprehend abstract ideas such as concepts concerning health (Proffit, 2000). This allows the practitioner to explain treatment objectives and issues with the same language that could be used for an adult. As described previously, adolescents are heavily influenced by the thoughts and opinions of their peers, but in a very egocentric way. They are burdened by the belief that everyone is thinking about them and feel as if they are constantly “on stage.” This egomania may lead to a feeling that they are abnormally *unique* and perhaps immune to the various consequences that may affect others. Often risk-taking behavior, common in adolescents and teenagers, evolves from this egocentric period in cognitive development.

## 2.7 **Factors affecting adolescent compliance during orthodontic treatment**

The success of orthodontic treatment relies heavily on patient compliance. Like many areas of healthcare, the patient plays an active role in facilitating treatment progression. The

term of compliance in reference to orthodontic treatment incorporates a vastly complex topic. Patients are asked to keep appliances and teeth clean, wear elastic rubber bands in a variety of shapes, wear extraoral appliances, show up for regular appointments, and refrain from foods and activities that may break appliances. Many papers have tried to develop a predictive way to measure a patient's ability to comply with treatment recommendations; however no successful method has been developed.

Studies have conflicting results concerning adolescent treatment compliance. Age has been shown to help predict patient cooperation. Allan and Hodgson (1968) and Sergl and Zentner (2000) showed that patients 12 years old and younger had greater compliance than older children, whereas other studies show conflicting results. During the adolescent developmental period, children begin to veer away from parental direction and align themselves more with the approval and opinions of their peers (Proffit, 2000). It can be inferred that younger children adhere to orthodontic instructions whereas older children determine their own degree of cooperation. The age at which children diverge from their parents is unique to one's individual cognitive developmental stage; furthermore adolescence has differing effects on individuals such as an increase in self-sustaining responsibility versus an increase in risk-taking behaviors (Albino et al., 1991). These adolescent variations may evolve over the course of treatment as it corresponds to the patient's psychosocial maturation (Albino et al., 1991).

Parental support is beneficial to increase the degree of child cooperation with medical regimens (Albino et al., 1991). Kreit et al. (1968) demonstrated that one of the strongest predictors of poor compliance in children is a poor parental relationship. Parental attitudes toward treatment have a strong influence on subsequent patient attitudes and thus affect patient cooperation and treatment acceptance (Albino et al., 1991; Daniels et al., 2009). Albino et al.

(1991) found the strongest predictor of adolescent compliance 8-10 months into treatment to be parents' attitude toward the importance of braces. Parental monitoring at home can reiterate orthodontic regimens providing a support system away from the orthodontic clinic.

Daniels et al. (2009) analyzed the relationship between parent motivation, patient motivation and their subsequent correlation between patient compliance during orthodontic treatment. They found that parents were often more motivated than children for orthodontic treatment; however, higher parent motivation did not significantly correspond with increased patient compliance. Importantly, higher *patient* motivation correlated significantly with higher compliance. Similarly Brattstrom et al. (1991) found that high patient motivation correlated with a patient's continuation versus discontinuation of treatment.



### 3. MATERIALS AND METHODS

#### 3.1 Methodology

The primary research question is to determine if following braces care instructions (brushing, flossing, avoiding foods that can damage the braces), improves self-control and/or self-efficacy in a group of adolescents undergoing orthodontic treatment. Adolescents who have begun orthodontic treatment were compared to a group of wait-list controls to see if a necessary real life act of self-regulation has the effect of strengthening global self-regulation or increasing self-efficacy.

Twenty-two children were recruited from the orthodontic clinic at the University of Illinois at Chicago (UIC) and enrolled in the study. The mean age of the sample was 13.4 +/- 1.5 years. The sample included 11 girls and 11 boys. The girls had a mean age of 13.09 +/- 1.0 years. The boys had a mean age of 13.6 +/- 1.9 years. The demographic composition of the subject sample is listed in Table I. Subjects were divided into two groups: Group 1 (n=12) - subjects beginning orthodontic treatment immediately and Group 2 (n=10) - wait-list controls (children who are not yet ready to begin orthodontic treatment). Group 1 was composed of 7 girls and 5 boys with a mean age of 13 +/- 1.6 years. Group 2 was composed of 4 girls and 6 boys with a mean age of 13.8 +/- 1.3 years.

**TABLE I**  
**DEMOGRAPHIC COMPOSITION OF ENROLLED SUBJECTS**

Demographic	American Indian or Alaskan Native	Asian or Pacific Islander	Black, not of Hispanic origin	Hispanic	White, not of Hispanic origin	Other or unknown	Total
Females	0	1	4	4	1	1	11
Male	0	0	3	4	4	0	11
Unknown	0	0	0	0	0	0	0
Total	0	1	7	8	5	1	22

The inclusion criteria were children age 10 to 15 years old that have not yet begun treatment. The exclusion criteria were children with craniofacial syndromes or developmental delays. Children and/or children with parent/guardian/Legally Authorized Representative (LAR) that cannot understand English were not included in the study. Consent and assent forms were distributed at records, screening and/or consultation appointments, and obtained prior to the start of orthodontic treatment. Recruitment and data collection took place in the Brodie Library at UIC Department of Orthodontics in order to ensure privacy for potential subjects. All consent and assent forms were kept in a locked drawer and will be maintained for up to three years after the completion of the study, at which time all forms will be destroyed. The principal investigator acted as the sole recruiter and data collector.

During face to face recruitment communication, approximately twenty subjects declined to participate in the study prior to obtaining consent or assent. Reasons for declining participation were generally lack of time willing to devote to participation. Forty subjects were recruited and consented/assented to participate in the research study of which eighteen subjects

did not complete the study. Eleven subjects withdrew from the study after providing consent because coverage of their orthodontic treatment was not approved by Illinois Department Public Aid (IDPA) and they did not continue with orthodontic treatment at UIC. One subject was not included due to lack of response to follow-up contact. Six subjects were withdrawn by the researcher because it was determined that they did not meet the exclusion criteria or complications related to orthodontic treatment extended the treatment timeline past the time limits of the study. No subjects withdrew after beginning data collection.

The research project lasted approximately 2-3 months for each subject. Group 1 began orthodontic treatment immediately, whereas Group 2 served as an experimental control because they did not receive orthodontic appliances until four to six weeks into the study. Both groups underwent a laboratory procedure (Hand-grip task/thought suppression task) and completed a series of questionnaires at time points 1 (baseline), 2 (4-6 weeks) and 3 (6-8 weeks).

By delaying orthodontic treatment in Group 2, a wait-list control was created in order to reduce potential bias from repetitive testing. If the hypothesis is true, the results should show no difference in laboratory scores between time point 1 and 2 in Group 2, but an increase in self-regulation capacity will be evident at time point 3. In Group 1, overall increase in self-control capacity would be observed from time point 1-3.

GROUP	T1	T2	T3
1	APPLIANCE PLACEMENT	FIRST APPOINTMENT	SECOND APPOINTMENT
2 (WAIT-LIST CONTROL)	FOUR-SIX WEEKS PRIOR TO APPLIANCE PLACEMENT	APPLIANCE PLACEMENT	SECOND APPOINTMENT

Figure 1. Timepoints for Group 1 versus Group 2 (wait-list control)

For the experimental subjects, the primary manipulation is the self-regulatory activity of taking care of their orthodontic appliances. At the placement of the orthodontic appliance, the subjects were taught proper home care, told what foods to avoid, and instructed in proper wear of any removable appliances.

A standard laboratory task was utilized to measure self-regulation capacity and depletion. A Hand-grip task was administered twice in each session with an intervening thought suppression exercise. A commercially available hand-grip with two handles separated by a spring was used for the task. Participants were instructed to squeeze the hand-grip for as long as they are able. A piece of paper was inserted between the two handles and held by the approximation of the handles during activation. The timer began when the paper was secured by the hand-grip handles and ended when the paper fell from hand-grip release. This test was administered twice at each session with an intervening thought suppression task.



Figure 2. Laboratory procedure performed at each timepoint.

The thought suppression task was performed for five minutes, during which subjects were asked not to think about a white bear. Subjects were instructed to write down all of their thoughts including any thoughts of a white bear. The principal investigator reminded them every minute for the duration of the task to not think about a white bear, but if they did think about a white bear to write it down and try to alter their thoughts away from the forbidden thought. The difference between Hand-grip task times before and after thought suppression task was then compared for each time point. The difference between Hand-grip task times before and after the thought suppression task should relate to an individual's capacity for self-control much like an endurance test as previously described.

Questionnaires were administered at each time point. These included an Orthodontic Self-Efficacy Scale (Pitner, 2005), a General Self-Efficacy Scale (Schwarzer and Jerusalem, 1995), and a questionnaire for the parents to evaluate their child's study habits and general regulatory behavior such as doing chores, keeping their room clean, and emotional control (See Appendix A, B, and C, respectively). The results of the self-reported questionnaires (those

completed by the child) and the parental questionnaires were then used in conjunction with the results of the laboratory exercise to evaluate the self-regulating capacity of the subject and its change over time with respect to orthodontic treatment.

### 3.2 **Hand-grip**

A standard steel spring loaded hand-grip with foam cushioned grip was used. It was manufactured by KYTO with the model number HG-2320. Dimensions were 14x10.8x3.6cm and weighed 80g.



Figure 3. Spring loaded hand-grip

### 3.3 **Questionnaires**

#### 3.3.1 **Orthodontic Self-Efficacy Scale (Appendix A)**

The Orthodontic Self-Efficacy Scale is a twenty question scale designed to measure self-efficacy as it pertains to adolescents undergoing orthodontic treatment. Questions focus on areas of oral hygiene, compliance with elastics, headgear, and refraining from destructive foods. Subjects were given a rating scale from 0 (I cannot do this at all) to 10 (I'm sure I can do this). Subjects were instructed to complete the questionnaire at each time point as truthfully as possible, keeping in mind that their answers were strictly confidential.

#### 3.3.2 **General Self-Efficacy Scale (Appendix B)**

The General Self-Efficacy Scale is a ten question scale designed to measure general self-efficacy for an individual. Subjects were given a rating scale from 0 (Not at all true) to 4 (Exactly true). Subjects were instructed to complete the questionnaire at each time point as truthfully as possible, keeping in mind that their answers were strictly confidential.

#### 3.3.3 **Parental Questionnaire (Appendix C)**

The Parental Questionnaire is an eighteen question scale broken into two parts. The first part asks "How often does your child," in order to gain a third party observational view on the subject's (adolescent's) proficiency for tasks requiring self-control. The parental questionnaire asks the parents how many times per week the parent observed the child participating in self-regulatory activities. It focuses on the adolescent's average use of self-control to complete a variety of daily tasks based on the parent's/LAR's observations during that 4-6 week time period. The second part asks "How often do you," in order to gain insight into possible

economic or family dynamics that may have an effect on the self-control capacity plasticity of the subject. Both sections were accompanied with a rating scale from 0 (Never) to 4 (more than once daily). The same parent or LAR was given the questionnaire to complete at each time point, keeping in mind that their answers were strictly confidential.

### 3.4 **Consent and Assent**

Parents were given a consent form outlining the details of the study and an assent form was obtained from the children. Consent and assent forms were distributed at orthodontic records and consultation appointments and were obtained together. Only subjects that completed and signed both the parental consent and children assent forms were enrolled in the study. All participants had the opportunity to ask questions about the study at the time that they signed the consent form, and were also provided with a phone number and email address at which they could contact the principal investigator for further inquiries. Participants were informed both verbally and in the consent form that their participation in this study was completely voluntary and that they may withdraw at any time without jeopardizing their orthodontic treatment. Participants and parents in this study were informed both in the consent/ assent forms and at the beginning of each assessment that they were free to discontinue their participation in the study at any time without penalty.

### 3.5 **Subject Confidentiality**

Confidentiality was maintained by collecting all data using only the randomly generated subject identifier. This data only identified participants using their participant identification number and did not contain any identifying information such as name. A password-protected list



of names and ID numbers was stored separately from other data files in a password protected folder and was destroyed after all data collection was complete.

After the study completion, the principal investigator maintained a copy of the dataset, but all documents containing identifying information of participants was destroyed. Parental permission and subject assent forms were kept in a locked file cabinet during study duration and will be destroyed three years after study completion.

### 3.6 **Statistical Analysis**

Nonparametric statistical testing was used due to the small sample size and subsequent lack of sample normality. The results of the Hand-grip task and other outcome measures pre and post intervention were analyzed by Friedman Test and Wilcoxon Signed Ranks Test.

### 3.7 **Institutional Review Board Approval**

Initial review was approved by Members of the Institutional Review Board (IRB) #2 using the Expedited review process on February 21, 2013 under protocol #2012-1023 (Appendices D, E). IRB approval period expires December 9, 2014.

## 4. RESULTS

### 4.1 Results

#### 4.1.2 Hand-grip Task

Table II displays the descriptive analysis of Hand-grip task time differences before and after thought suppression for each group at each time point. Statistical analysis shows no significant difference for hand-grip task time differences between time points ( $p \leq .05$ ). Statistical testing results are shown in Tables III and IV. The large standard deviation at each time point reflects the degree of variation amongst subjects.

Group		T1	T2	T3
1	Mean	7.328	11.963	5.997
	Standard Deviation	16.126	13.320	12.829
	Median	8.850	7.960	2.060
2	Mean	-7.708	2.722	-2.762
	Standard Deviation	19.905	27.082	25.188
	Median	-5.150	3.980	5.210

<b>TABLE III</b>				
<b>HAND-GRIP FRIEDMAN TEST</b>				
<b>Group</b>	<b>N</b>	<b>Chi-Square</b>	<b>df</b>	<b>p-value</b>
1	12	2.000	2	0.368
2	10	2.600	2	0.273

<b>TABLE IV</b>				
<b>HAND-GRIP WILCOXON SIGNED RANKS TEST</b>				
<b>Group</b>	<b>Test Statistics</b>	<b>T2d - T1d</b>	<b>T3d - T2d</b>	<b>T3d - T1d</b>
1	Z	-0.784	-1.883	-0.078
	p-value	.433	.060	.937
2	Z	-1.478	-0.968	-1.07
	p-value	.139	.333	.285

Figure 4 depicts hand-grip task times before and after thought suppression during the intervention phase of study. There was no significant change in the hand-grip task time differences from the orthodontic bonding appointment through the second appointment in this study at  $p \leq .05$ .

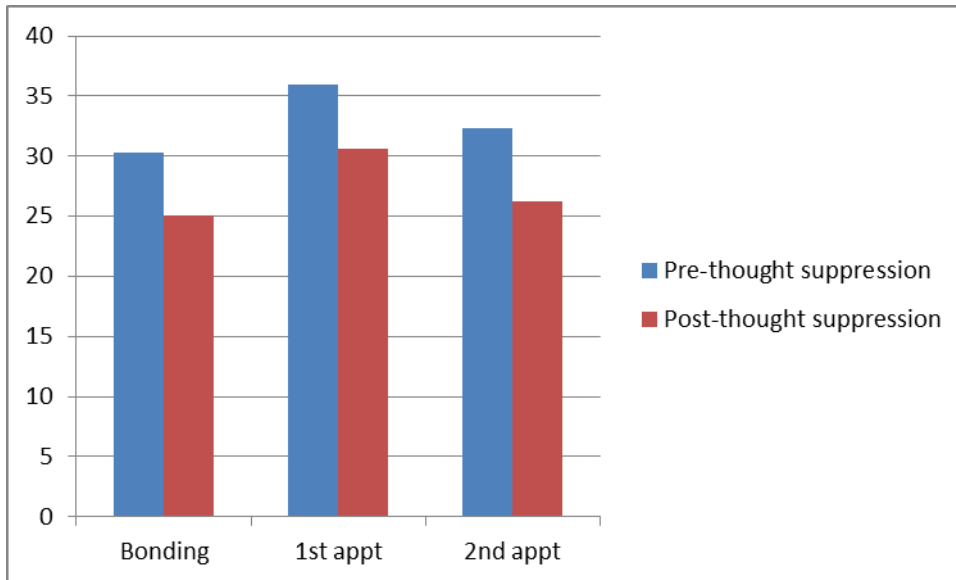


Figure 4. Hand-grip Task Times before and after thought suppression task during orthodontic phase.

#### 4.1.3 Orthodontic Self-Efficacy Scale

Table V shows the descriptive analysis of responses to the Orthodontic Self-Efficacy Scale at each time point for Group 1 and 2.

**TABLE V**  
**ORTHODONTIC SELF-EFFICACY SCALE RESPONSES**

Question	ORTHODONTIC SELF-EFFICACY SCALE RESPONSES													
	Group 1					Group 2					Question			
	T1	T2	T3	T1	T2	T3	T1	T2	T3	T1	T2	T3		
1	Mean	8.833	8.583	9.250	9.100	9.200	9.400	11	Mean	7.417	7.083	7.917	6.200	7.800
	Standard Deviation	1.193	1.443	0.965	1.912	1.619	1.265		Standard	2.575	2.843	2.109	3.584	2.974
	Median	9.000	8.500	10.000	10.000	10.000	10.000		Median	8.500	8.000	8.500	7.500	9.000
2	Mean	8.417	9.167	9.250	9.200	9.400	9.600	12	Mean	5.833	6.167	6.667	5.800	5.600
	Standard Deviation	2.021	1.528	1.712	1.932	1.578	1.265		Standard	3.215	2.443	1.969	3.521	3.239
	Median	9.500	10.000	10.000	10.000	10.000	10.000		Median	7.000	7.000	6.500	7.000	6.000
3	Mean	5.667	6.167	7.333	7.600	7.200	7.800	13	Mean	5.833	6.250	6.083	4.300	6.100
	Standard Deviation	3.367	3.129	2.570	2.716	2.440	1.687		Standard	4.086	4.159	4.033	4.347	4.254
	Median	6.500	6.500	8.000	9.000	8.000	8.500		Median	6.500	8.500	7.500	3.500	7.500
4	Mean	5.917	7.083	7.667	7.300	7.600	8.500	14	Mean	6.083	6.083	5.833	4.300	5.400
	Standard Deviation	2.968	2.937	2.535	3.368	2.591	1.780		Standard	4.166	3.965	3.689	4.322	3.950
	Median	5.500	7.500	8.000	8.500	8.500	9.000		Median	7.500	7.500	7.000	3.000	5.500
5	Mean	7.500	7.333	8.000	8.100	8.000	8.100	15	Mean	8.000	8.333	8.917	8.900	8.100
	Standard Deviation	3.060	2.964	1.907	2.470	2.357	2.283		Standard	2.486	2.270	1.564	1.287	2.685
	Median	9.000	8.000	8.000	9.500	9.000	8.500		Median	9.000	9.000	9.500	9.500	9.000
6	Mean	7.833	8.750	9.250	9.200	8.900	9.200	16	Mean	6.833	7.750	7.917	8.600	7.500
	Standard Deviation	2.082	1.545	1.545	2.201	2.514	1.317		Standard	2.823	2.491	2.193	1.838	3.028
	Median	8.000	9.000	10.000	10.000	10.000	10.000		Median	7.500	8.500	9.000	9.500	8.000
7	Mean	7.000	6.833	7.917	8.000	7.500	8.300	17	Mean	9.000	8.583	8.667	9.500	9.000
	Standard Deviation	3.330	2.949	2.314	2.625	2.718	3.129		Standard	2.000	2.275	1.875	1.080	1.633
	Median	8.500	7.000	8.000	9.000	8.000	10.000		Median	10.000	9.500	9.500	10.000	10.000
8	Mean	7.000	6.750	7.333	6.500	6.900	8.100	18	Mean	8.833	8.667	8.833	9.600	8.900
	Standard Deviation	2.296	2.454	1.723	3.375	3.281	2.132		Standard	2.038	2.309	1.850	0.843	1.912
	Median	7.000	7.000	7.500	8.000	8.000	8.500		Median	10.000	10.000	10.000	10.000	10.000
9	Mean	5.917	6.333	6.583	5.800	6.200	7.400	19	Mean	7.583	7.667	8.167	8.900	8.000
	Standard Deviation	2.503	2.640	2.065	3.910	3.584	2.066		Standard	2.906	2.708	2.406	1.449	2.404
	Median	6.000	6.500	6.500	8.000	8.000	7.500		Median	8.500	8.500	9.500	9.500	8.500
10	Mean	5.833	6.583	6.667	6.000	5.900	6.800	20	Mean	8.000	7.833	8.333	7.600	8.100
	Standard Deviation	2.290	2.906	2.270	3.367	3.281	2.348		Standard	2.216	2.517	2.708	2.836	3.281
	Median	5.500	8.000	7.000	7.500	6.500	7.500		Median	8.500	8.000	10.000	8.500	10.000

Table VI displays the results of the Friedman Test for Group 1 and 2. In Group 1, question 3 (Brush my teeth three times a day), question 4 (Brush my teeth when I am tired), question 6 (Brush my teeth without my parents reminding me), and question 15 (If asked, wear rubber bands all the time) had significant change over the course of the study at  $p \leq .05$ .

**TABLE VI**  
ORTHODONTIC SELF-EFFICACY SCALE GROUP 1 FRIEDMAN TEST

Group 1					Group 2				
Question	N	Chi-Square	df	p-value	Question	N	Chi-Square	df	p-value
1	12	0.800	2	0.670	1	10	1.714	2	0.424
2	12	4.333	2	0.115	2	10	2.600	2	0.273
3	12	9.176	2	0.010*	3	10	2.000	2	0.368
4	12	7.737	2	0.021*	4	10	3.467	2	0.177
5	12	2.786	2	0.248	5	10	0.250	2	0.882
6	12	7.280	2	0.026*	6	10	0.400	2	0.819
7	12	4.471	2	0.107	7	10	4.385	2	0.112
8	12	2.324	2	0.313	8	10	2.690	2	0.261
9	12	0.462	2	0.794	9	10	1.724	2	0.422
10	12	1.850	2	0.397	10	10	0.452	2	0.798
11	12	1.590	2	0.452	11	10	2.480	2	0.289
12	12	0.150	2	0.928	12	10	0.867	2	0.648
13	12	1.182	2	0.554	13	10	1.600	2	0.449
14	12	1.280	2	0.527	14	10	0.091	2	0.956
15	12	6.080	2	0.048*	15	10	1.238	2	0.538
16	12	4.061	2	0.131	16	10	4.095	2	0.129
17	12	1.059	2	0.589	17	10	2.700	2	0.259
18	12	0.125	2	0.939	18	10	4.429	2	0.109
19	12	2.467	2	0.291	19	10	2.667	2	0.264
20	12	1.588	2	0.452	20	10	0.105	2	0.949

\*p ≤ 0.05

Table VII shows the results of the Wilcoxon Signed Ranks Test for Group 1. There was a statistically significant change between T2-T3 and T1-T3 for question 3 (Brush my teeth three times a day), T1-T3 for question 4 (Brush my teeth when I am tired), T1-T3 for question 6 (Brush my teeth without my parents reminding me), T2-T3 for question 7 (Brush my teeth if I am very busy), T2-T3 and T1-T3 for question 15 (If asked, wear rubber bands all the time), and

T1-T3 for question 16 (If asked, wear rubber bands all the time when my teeth are sore) at  $p \leq 0.05$ .

Question	Test Statistics	T2 - T1	T3 - T2	T3 - T1	Question	Test Statistics	T2 - T1	T3 - T2	T3 - T1
1	Z	-0.637	-1.710	-1.289	11	Z	-0.205	-1.445	-0.448
	p-value	0.524	0.087	0.197		p-value	0.837	0.149	0.654
2	Z	-1.625	-0.577	-1.826	12	Z	-0.564	-0.992	-0.671
	p-value	0.104	0.564	0.068		p-value	0.573	0.321	0.502
3	Z	-0.281	-2.203	-2.555	13	Z	-1.186	-0.816	-1.000
	p-value	0.779	0.028*	0.011*		p-value	0.236	0.414	0.317
4	Z	-1.851	-0.838	-2.623	14	Z	0.000	-0.966	-0.520
	p-value	0.064	0.402	0.009*		p-value	1.000	0.334	0.603
5	Z	-0.702	-1.725	-1.084	15	Z	-0.632	-2.070	-2.032
	p-value	0.483	0.084	0.279		p-value	0.527	0.038*	0.042*
6	Z	-1.436	-1.732	-2.207	16	Z	-1.845	-0.574	-2.136
	p-value	0.151	0.083	0.027*		p-value	0.065	0.566	0.033*
7	Z	-0.355	-2.266	-1.770	17	Z	-1.134	-0.272	-0.962
	p-value	0.723	0.023*	0.077		p-value	0.257	0.785	0.336
8	Z	-0.355	-1.144	-0.360	18	Z	-0.535	-0.378	0.000
	p-value	0.723	0.253	0.719		p-value	0.593	0.705	1.000
9	Z	-0.778	-0.543	-0.874	19	Z	-0.302	-1.121	-1.276
	p-value	0.436	0.587	0.382		p-value	0.763	0.262	0.202
10	Z	-0.778	-0.543	-0.874	20	Z	-0.259	-1.511	-0.776
	p-value	0.436	0.587	0.382		p-value	0.796	0.131	0.438

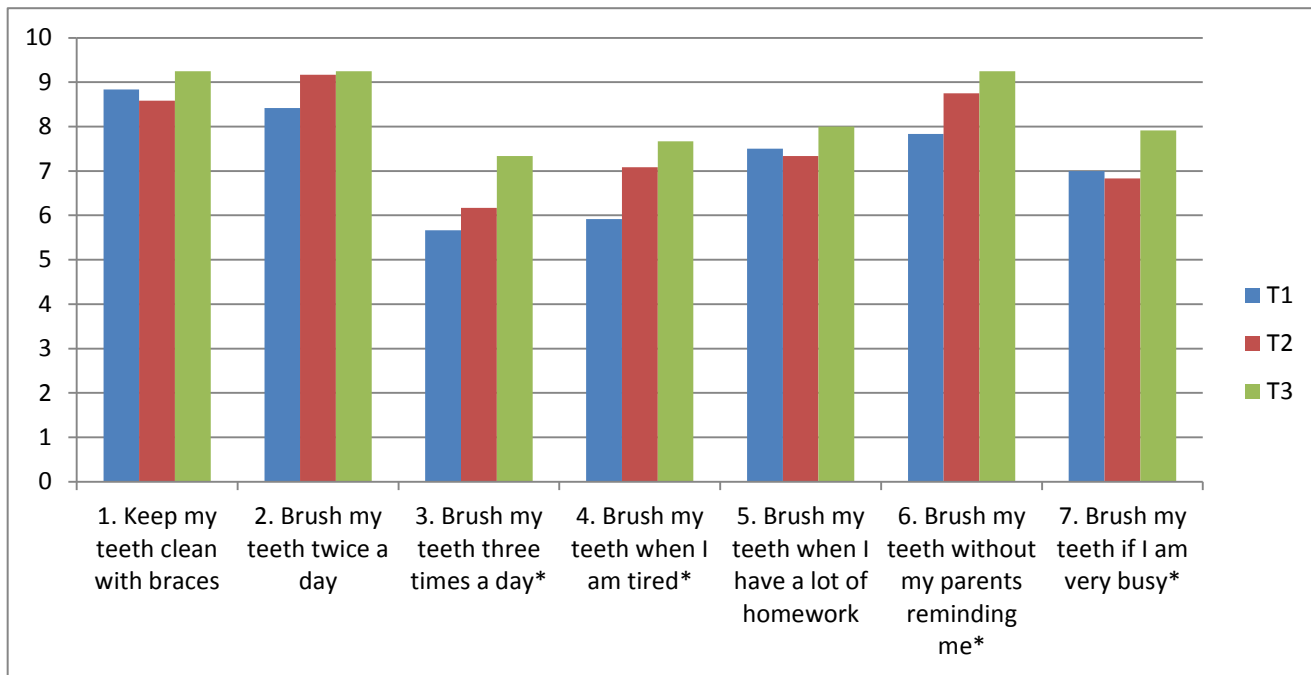
\* $p \leq 0.05$



Table VIII shows the results of the Wilcoxon Signed Ranks Test for the Orthodontic Self-Efficacy for Group 2. Group 2 showed no statistical significance at  $p \leq 0.05$  for any question during the study.

Question	Test Statistics	T2 - T1	T3 - T2	T3 - T1	Question	Test Statistics	T2 - T1	T3 - T2	T3 - T1
1	Z	-0.378	-1.000	-1.342	11	Z	-1.667	-0.412	-0.954
	p-value	0.705	0.317	0.180		p-value	0.096	0.680	0.340
2	Z	-0.816	-1.414	-1.414	12	Z	-0.137	-0.849	-0.791
	p-value	0.414	0.157	0.157		p-value	0.891	0.396	0.429
3	Z	-0.531	-1.276	-0.284	13	Z	-1.461	-0.730	-0.106
	p-value	0.595	0.202	0.776		p-value	0.144	0.465	0.916
4	Z	-0.512	-1.377	-1.022	14	Z	-0.730	-0.184	-0.170
	p-value	0.609	0.168	0.307		p-value	0.465	0.854	0.865
5	Z	-0.378	-0.333	-0.175	15	Z	-1.289	-0.962	-0.755
	p-value	0.705	0.739	0.861		p-value	0.197	0.336	0.450
6	Z	-1.134	0.000	0.000	16	Z	-1.826	-1.633	-0.973
	p-value	0.257	1.000	1.000		p-value	0.068	0.102	0.330
7	Z	-1.035	-1.552	-0.552	17	Z	-0.962	0.000	-1.131
	p-value	0.301	0.121	0.581		p-value	0.336	1.000	0.258
8	Z	-0.497	-1.160	-1.930	18	Z	-1.633	-0.736	-1.633
	p-value	0.619	0.246	0.054		p-value	0.102	0.461	0.102
9	Z	-0.271	-0.851	-1.057	19	Z	-1.625	-0.962	-0.813
	p-value	0.786	0.395	0.291		p-value	0.104	0.336	0.416
10	Z	-0.250	-0.851	-0.954	20	Z	-0.730	-0.542	-0.365
	p-value	0.803	0.395	0.340		p-value	0.465	0.588	0.715

Figures 5-12 graphically display the changes in subject response to each question over time. There was an overall increase in orthodontic self-efficacy responses in Group 1 over the time period from orthodontic appliance placement to the second appointments.



\*Statistically significant;  $p \leq .05$

Figure 5. Group 1 Orthodontic Self-Efficacy Scale results for Questions 1-7 across time points.

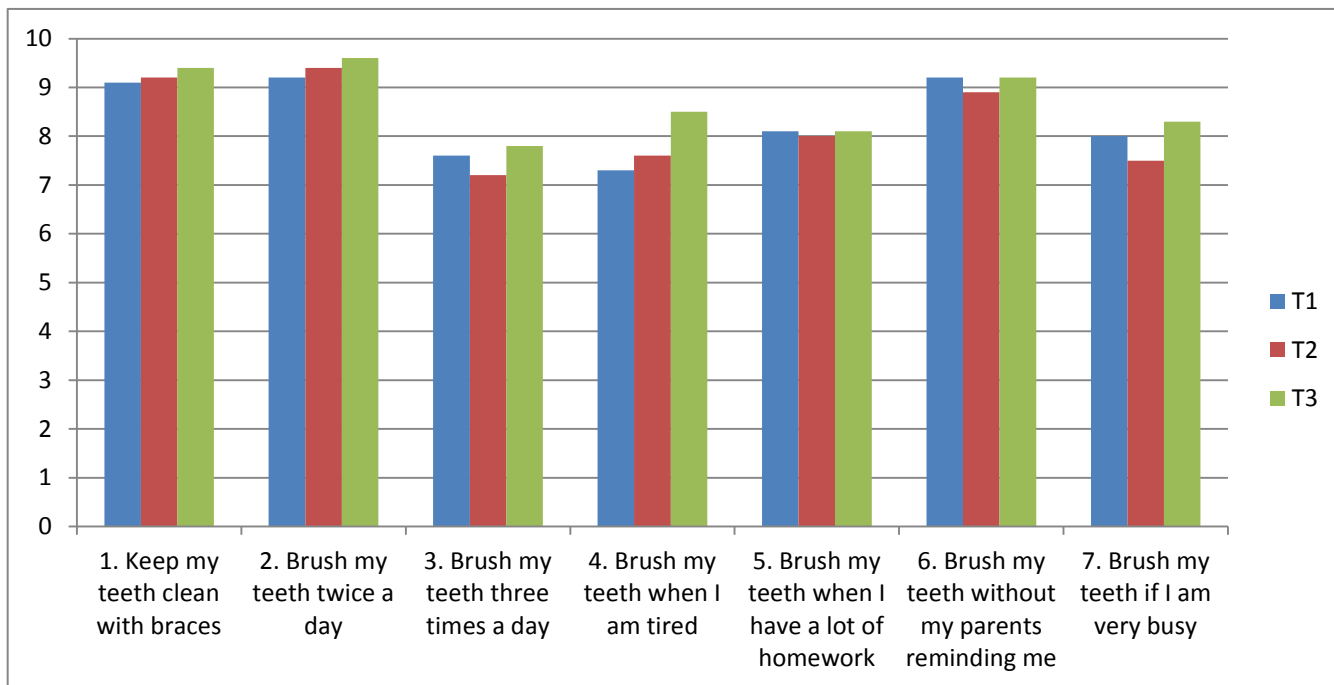


Figure 6. Group 2 Orthodontic Self-Efficacy Scale results for Questions 1-7 across time points.

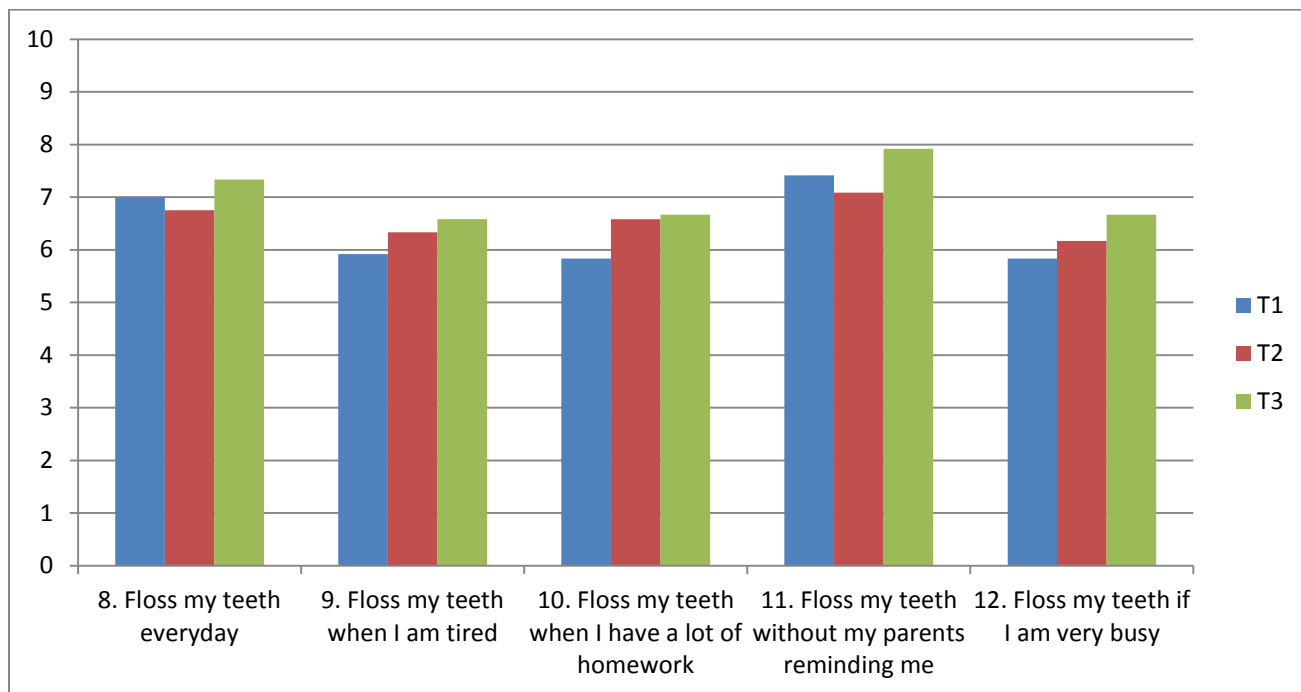


Figure 7. Group 1 Orthodontic Self-Efficacy Scale results for Questions 8-12 across time points.

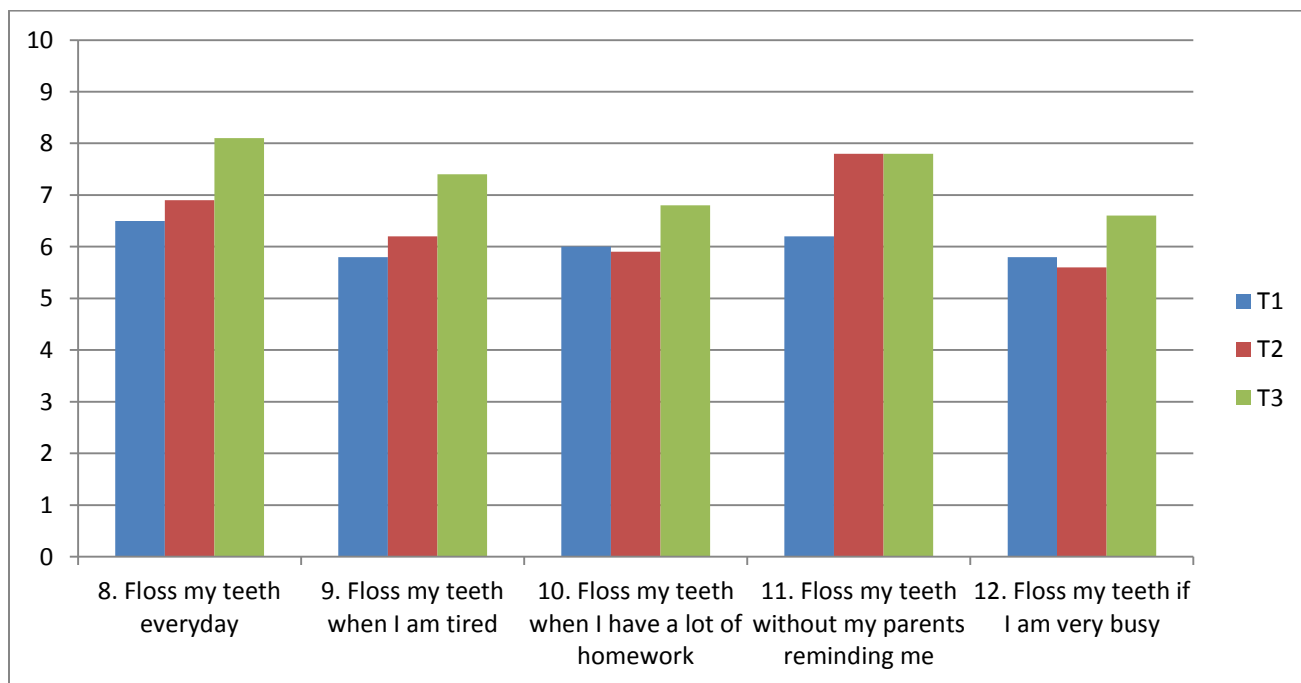
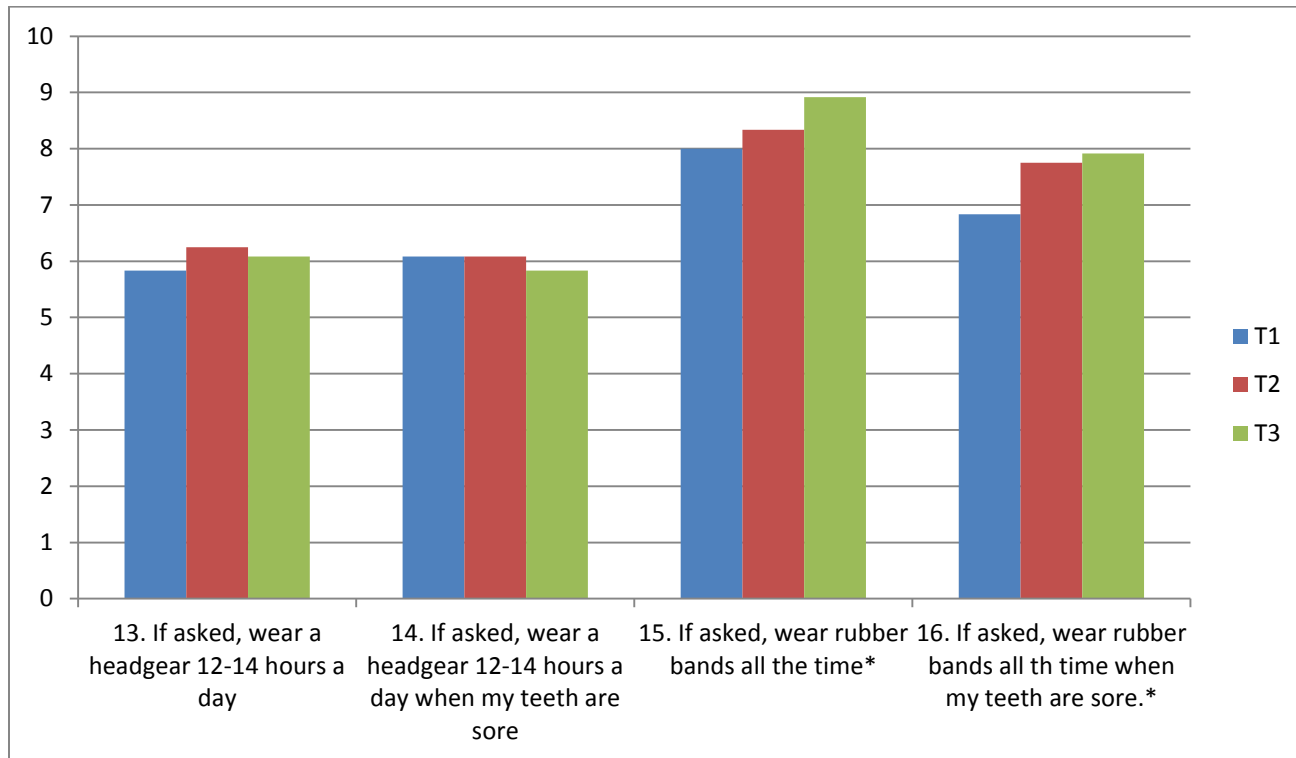


Figure 8. Group 2 Orthodontic Self-Efficacy Scale results for Questions 8-12 across time points.



\*Statistically significant;  $p \leq .05$

Figure 9. Group 1 Orthodontic Self-Efficacy Scale results for Questions 13-16 across time points.

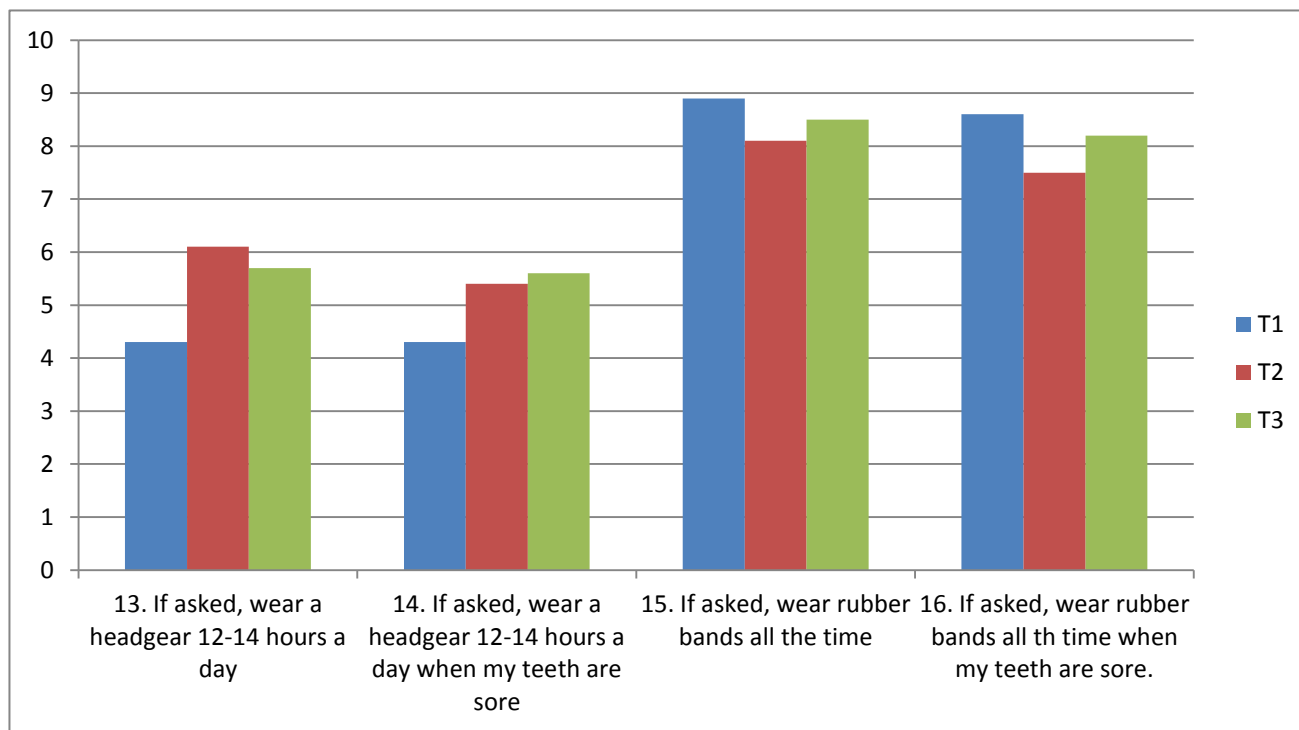


Figure 10. Group 2 Orthodontic Self-Efficacy Scale results for Questions 13-16 across time points.

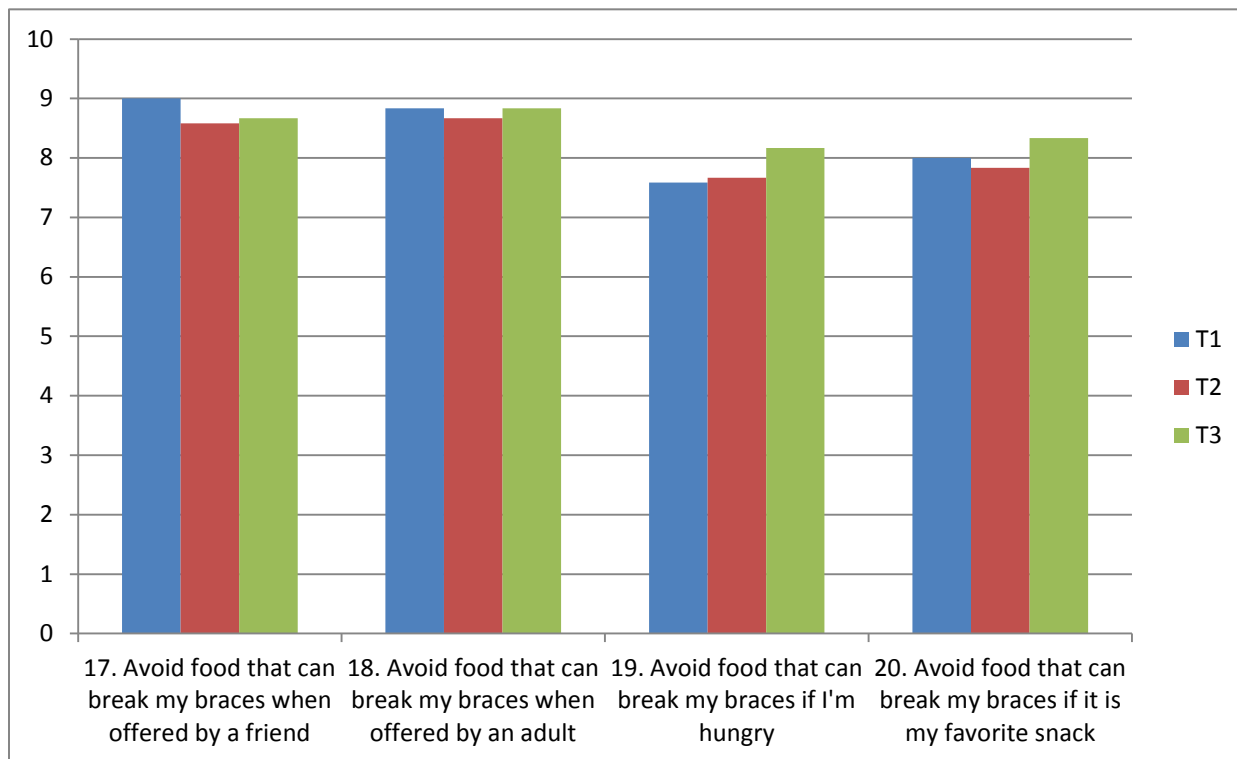


Figure 11. Group 1 Orthodontic Self-Efficacy Scale results for Questions 17-20 across time points.

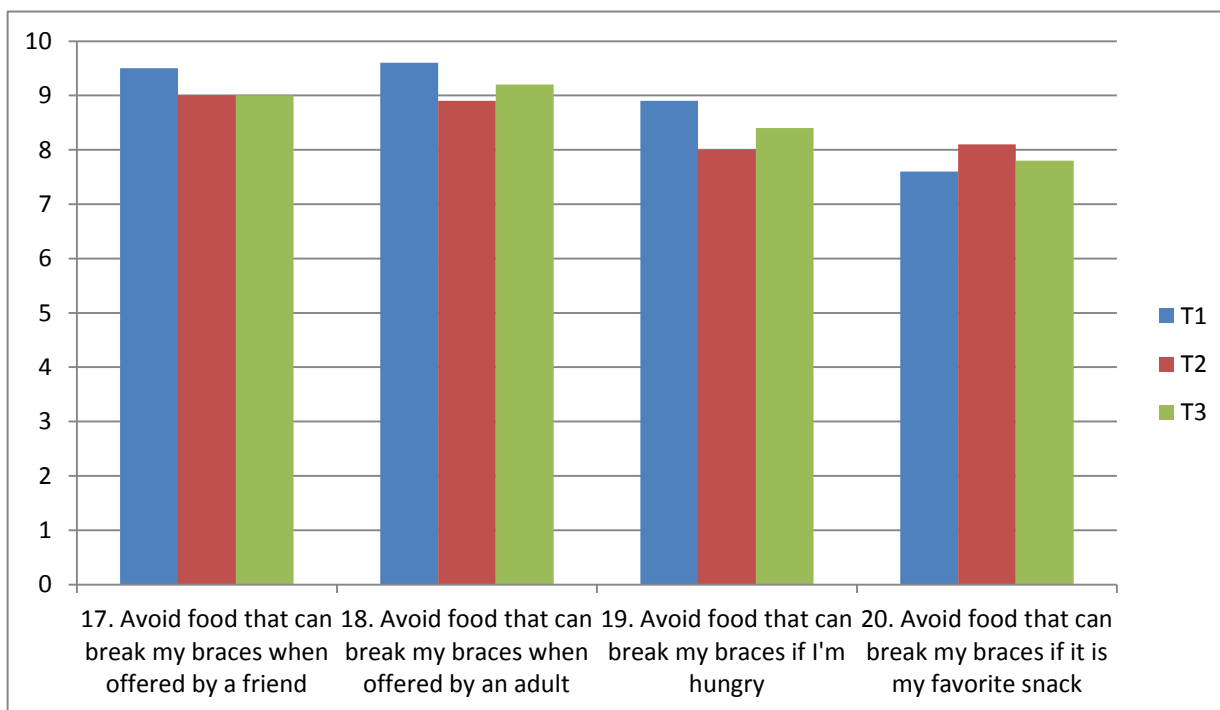


Figure 12. Group 2 Orthodontic Self-Efficacy Scale results for Questions 17-20 across time points.

#### 4.1.4 **General Self-Efficacy Scale**

Table IX contains the descriptive analysis of responses to the General Self-Efficacy Scale at each time point for Group 1 and 2.

**TABLE IX**  
GENERAL SELF-EFFICACY SCALE RESPONSES

		Group 1			Group 2		
Question		T1	T2	T3	T1	T2	T3
1	Mean	3.417	3.333	3.250	3.700	3.300	3.500
	Standard Deviation	0.515	0.492	0.622	0.483	0.675	0.527
	Median	3.000	3.000	3.000	4.000	3.000	3.500
2	Mean	2.818	2.667	2.750	3.000	3.400	3.300
	Standard Deviation	0.874	0.651	0.622	1.155	0.699	0.483
	Median	3.000	3.000	3.000	3.000	3.500	3.000
3	Mean	3.333	3.333	3.333	3.300	3.000	3.100
	Standard Deviation	0.492	0.651	0.492	0.675	0.816	0.876
	Median	3.000	3.000	3.000	3.000	3.000	3.000
4	Mean	3.167	3.083	3.167	3.300	2.900	2.700
	Standard Deviation	0.577	0.515	0.389	0.949	0.876	0.823
	Median	3.000	3.000	3.000	3.500	3.000	3.000
5	Mean	3.083	2.917	3.167	3.111	2.700	2.900
	Standard Deviation	0.793	0.669	0.577	1.054	1.059	0.876
	Median	3.000	3.000	3.000	3.000	3.000	3.000
6	Mean	3.833	3.417	3.417	3.900	3.500	3.600
	Standard Deviation	0.389	0.515	0.793	0.316	0.707	0.516
	Median	4.000	3.000	4.000	4.000	4.000	4.000
7	Mean	3.083	3.250	3.500	2.900	2.900	2.900
	Standard Deviation	0.515	0.866	0.522	0.994	1.101	0.738
	Median	3.000	3.000	3.500	3.000	3.000	3.000
8	Mean	3.583	3.250	3.500	3.200	3.100	3.200
	Standard Deviation	0.515	0.622	0.522	0.789	0.738	0.789
	Median	4.000	3.000	3.500	3.000	3.000	3.000
9	Mean	3.333	3.167	3.583	3.500	3.600	3.400
	Standard Deviation	0.651	0.577	0.669	0.527	0.516	0.843
	Median	3.000	3.000	4.000	3.500	4.000	4.000
10	Mean	3.333	3.167	3.250	3.200	2.900	3.000
	Standard Deviation	0.492	0.577	0.754	1.033	0.994	1.054
	Median	3.000	3.000	3.000	3.500	3.000	3.000





Table XI displays the results of the Wilcoxon Signed Ranks test for Group 1 and 2. There was no statistically significant change in responses for Group 1 over any time point. In Group 2, there was a statistically significant decrease in responses for question 1 (I can always manage to solve difficult problems if I try hard enough.) from T1-T2 at  $p \leq .05$ .

Group 1					Group 2				
Question	Test Statistics	T2 - T1	T3 - T2	T3 - T1	Question	Test Statistics	T2 - T1	T3 - T1	T3 - T2
1	Z	-0.447	-0.577	-0.816	1	Z	-2.000	-1.414	-1.414
	p-value	0.655	0.414	0.564		p-value	0.046*	0.157	0.157
2	Z	-0.447	-0.577	-0.333	2	Z	-1.134	-0.966	-0.447
	p-value	0.655	0.739	0.564		p-value	0.257	0.334	0.655
3	Z	0.000	0.000	0.000	3	Z	-1.134	-0.577	-0.816
	p-value	1.000	1.000	1.000		p-value	0.257	0.564	0.414
4	Z	-0.577	-0.577	0.000	4	Z	-1.633	-1.000	-1.667
	p-value	0.564	0.564	1.000		p-value	0.102	0.317	0.096
5	Z	-0.707	-1.134	-0.333	5	Z	-0.707	-0.557	-0.412
	p-value	0.480	0.257	0.739		p-value	0.480	0.577	0.680
6	Z	-1.890	0.000	-1.667	6	Z	-1.414	-0.577	-1.342
	p-value	0.059	1.000	0.096		p-value	0.157	0.564	0.180
7	Z	-0.541	-0.707	-1.890	7	Z	-0.137	0.000	0.000
	p-value	0.589	0.480	0.059		p-value	0.891	1.000	1.000
8	Z	-1.633	-1.134	-0.378	8	Z	-0.333	-0.378	0.000
	p-value	0.102	0.257	0.705		p-value	0.739	0.705	1.000
9	Z	-0.707	-1.667	-1.342	9	Z	-0.447	-0.707	-0.378
	p-value	0.480	0.096	0.180		p-value	0.655	0.480	0.705
10	Z	-0.816	-0.378	-0.378	10	Z	-1.134	-0.447	-0.816
	p-value	0.414	0.705	0.705		p-value	0.257	0.655	0.414

Figures 13-18 graphically display subject responses for the General Self-Efficacy Scale for Group 1 and 2 over T1-3.

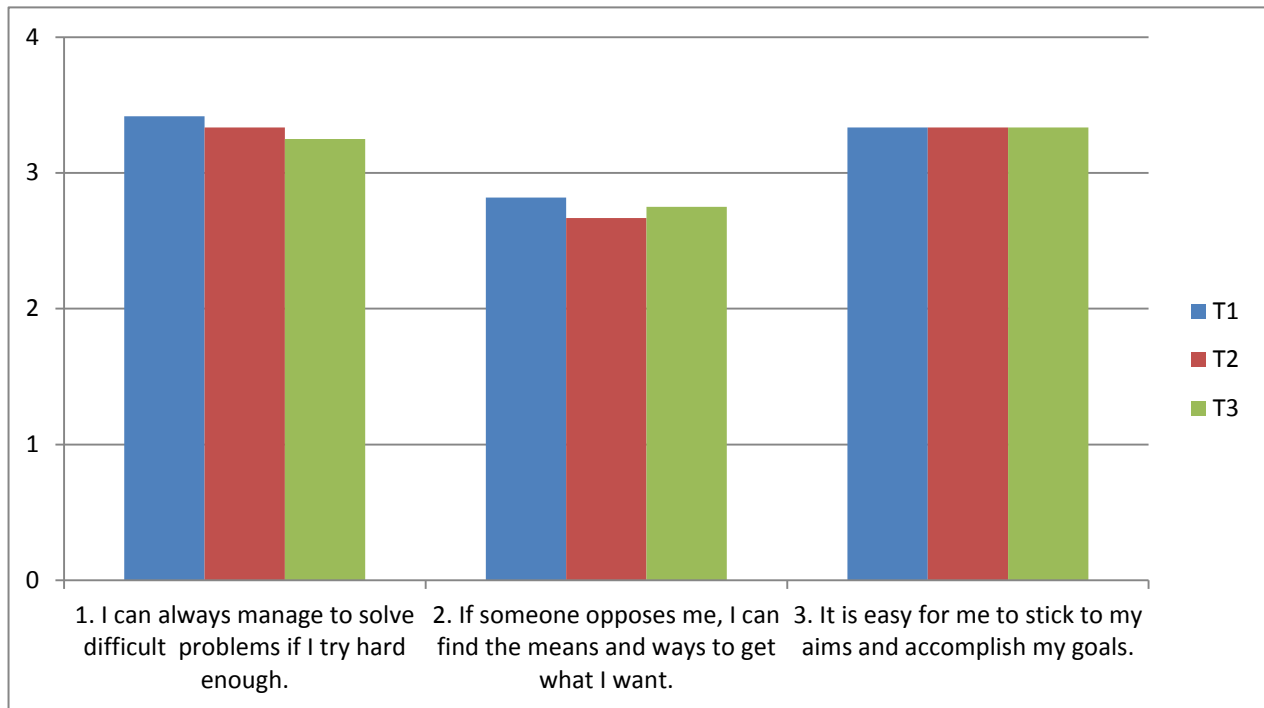
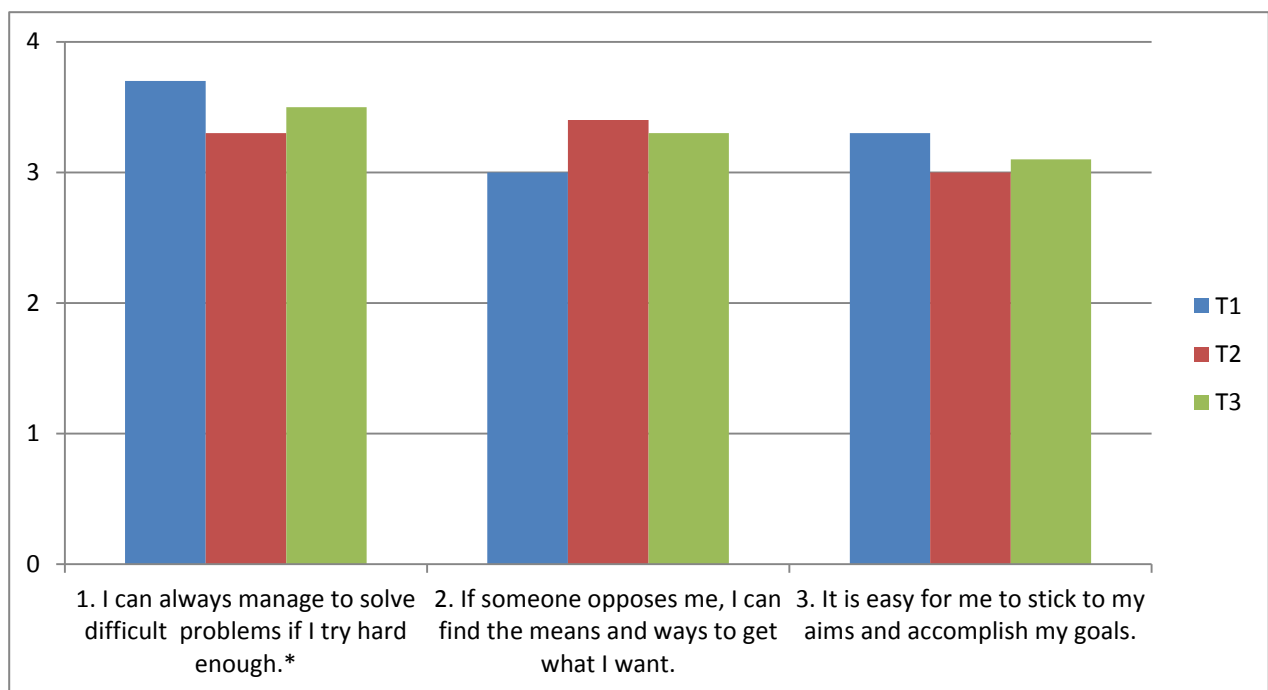


Figure 13. Group 1 General Self-Efficacy Scale results for Questions 1-3 across time points.



\*Statistically significant;  $p \leq 0.05$

Figure 14. Group 2 General Self-Efficacy Scale results for Questions 1-3 across time points.

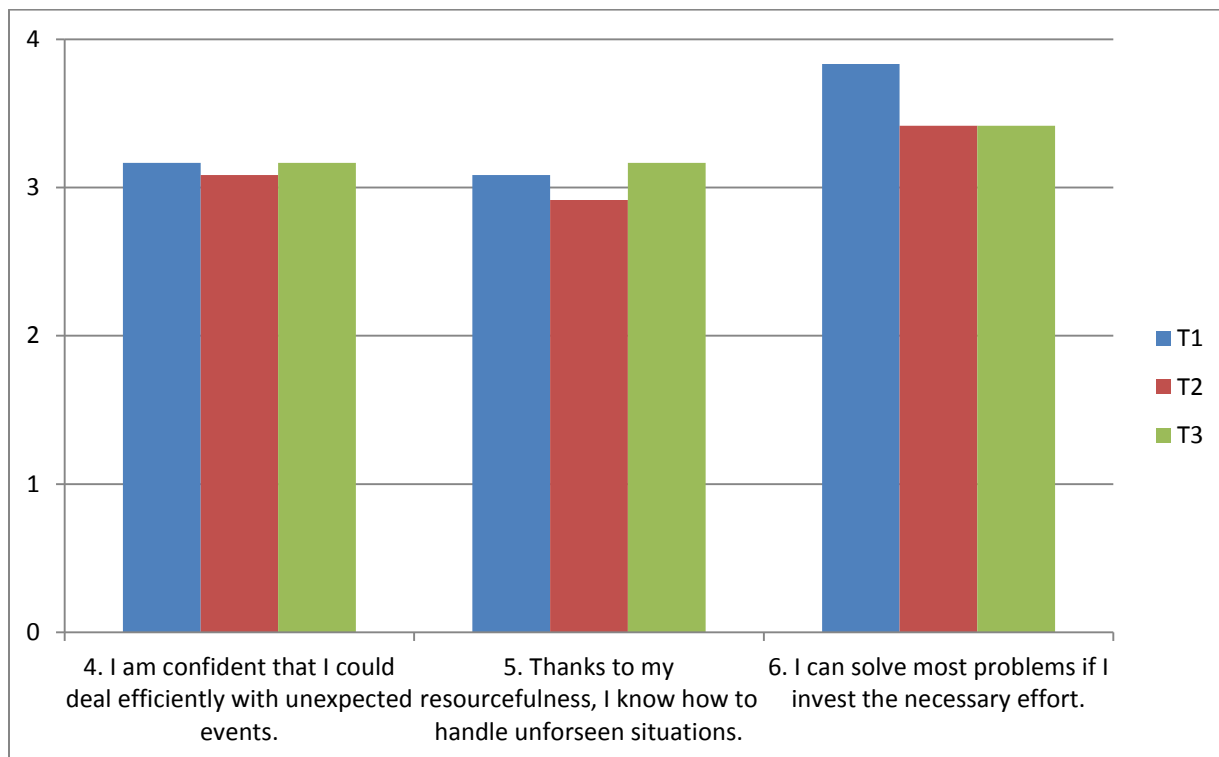


Figure 15. Group 1 General Self-Efficacy Scale results for Questions 4-6 across time points.

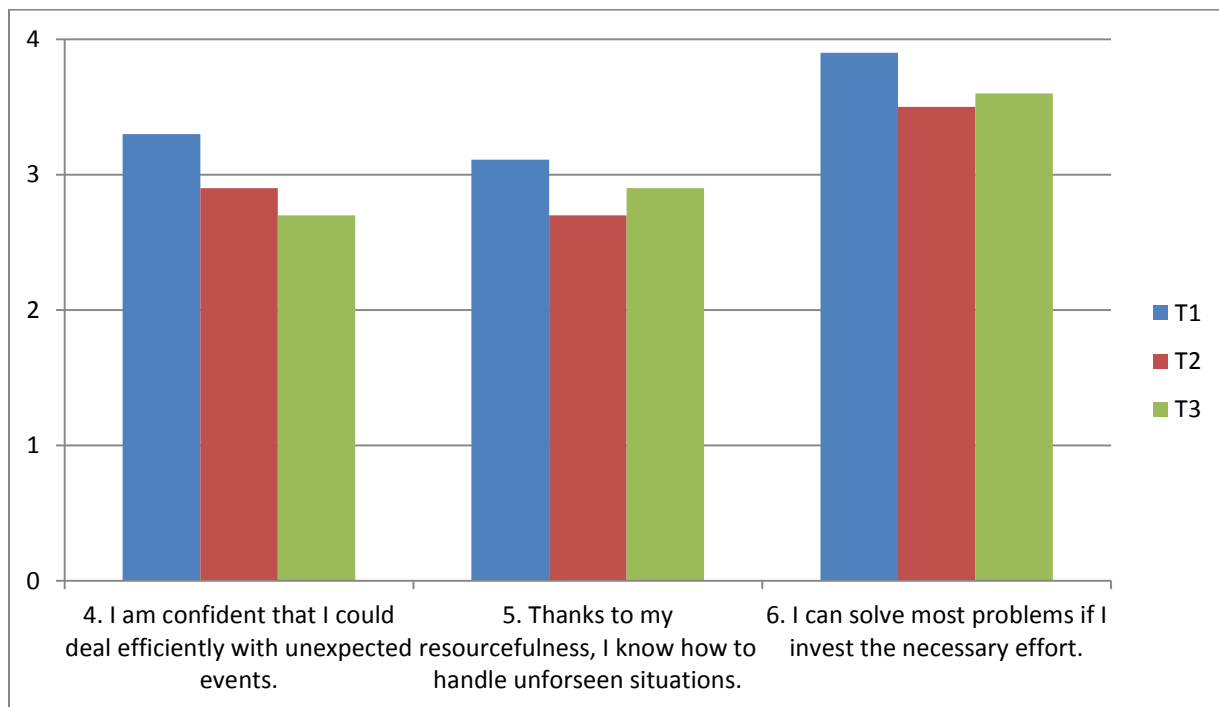


Figure 16. Group 2 General Self-Efficacy Scale results for Questions 4-6 across time points.

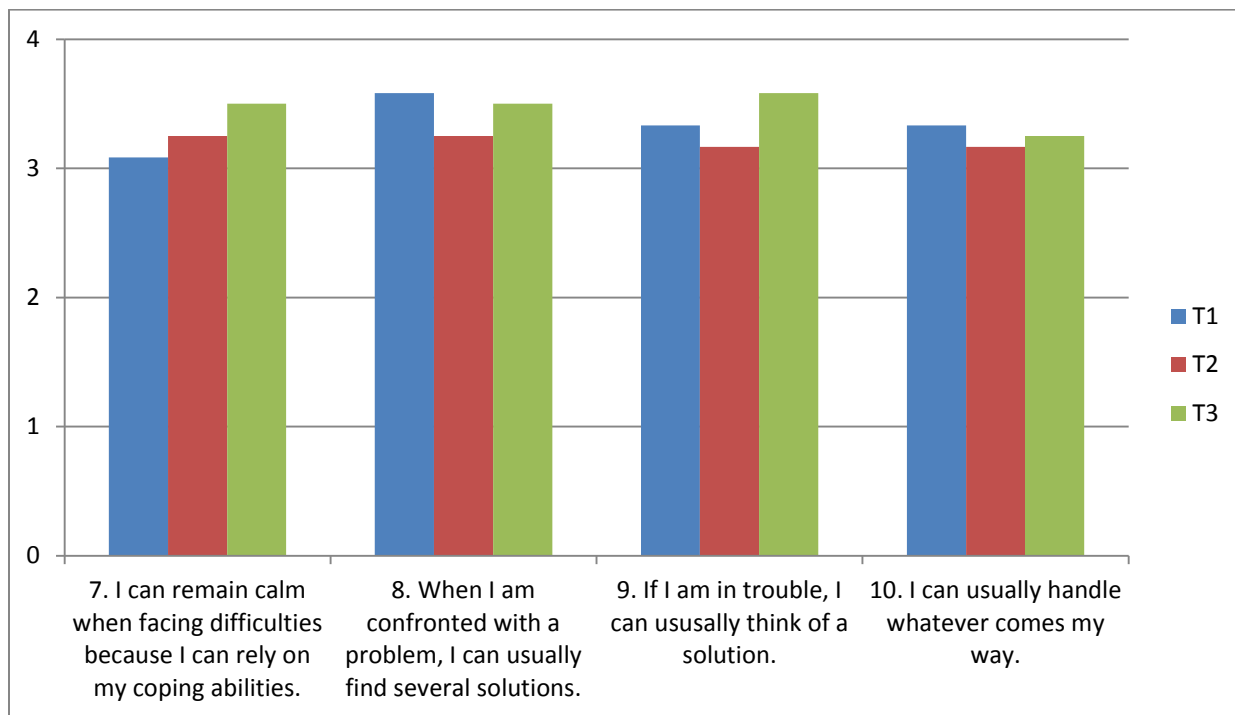


Figure 17. Group 1 General Self-Efficacy Scale results for Questions 7-10 across time points.

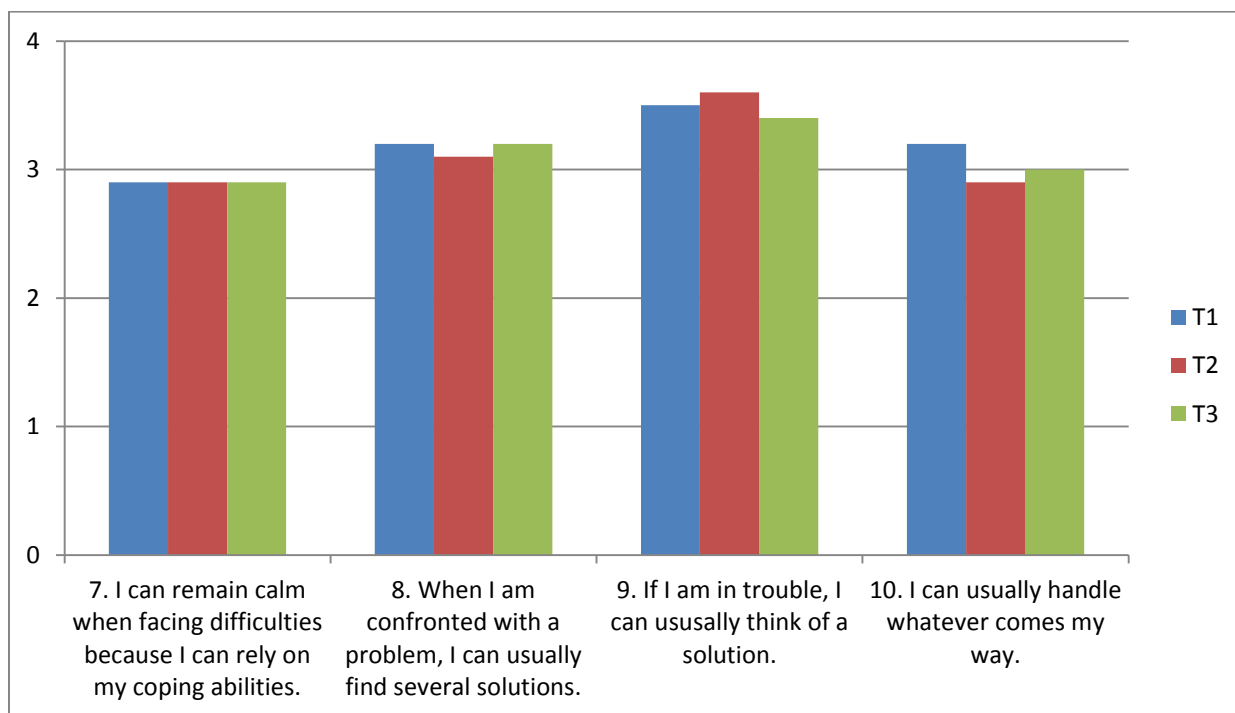


Figure 18. Group 2 General Self-Efficacy Scale results for Questions 7-10 across time points.

#### 4.1.5 **Parental Questionnaire**

Table XII contains the descriptive analysis of responses to the Parental Questionnaire at each time point for Group 1 and 2.

**TABLE XII**  
**PARENTAL QUESTIONNAIRE RESULTS**

		Group 1			Group 2		
Question		T1	T2	T3	T1	T2	T3
1	Mean	2.500	2.250	2.667	2.400	2.100	2.700
	Standard Deviation	0.798	0.965	1.073	0.699	0.738	0.949
	Median	2.500	2.000	3.000	2.500	2.000	3.000
2	Mean	1.583	1.333	1.583	1.800	1.800	1.800
	Standard Deviation	1.240	0.888	0.996	0.919	0.919	0.919
	Median	2.000	1.000	1.500	2.000	2.000	2.000
3	Mean	2.333	2.667	2.333	2.500	2.700	2.800
	Standard Deviation	1.155	1.497	1.557	1.434	1.252	1.033
	Median	3.000	3.000	3.000	3.000	3.000	3.000
4	Mean	1.417	1.250	1.750	1.300	1.400	1.600
	Standard Deviation	0.996	0.754	0.965	1.494	1.350	1.265
	Median	2.000	1.000	2.000	1.000	1.000	1.500
5	Mean	1.083	1.000	0.750	1.000	0.800	1.100
	Standard Deviation	0.793	1.279	0.866	1.054	1.033	1.449
	Median	1.000	0.500	0.500	1.000	0.500	0.500
6	Mean	0.750	0.917	0.417	1.700	1.300	1.400
	Standard Deviation	0.965	0.900	0.793	0.949	0.823	1.265
	Median	0.500	1.000	0.000	2.000	1.500	2.000
7	Mean	0.417	0.333	0.583	0.400	0.500	0.600
	Standard Deviation	0.669	0.651	0.900	0.516	0.707	0.699
	Median	0.000	0.000	0.000	0.000	0.000	0.500
8	Mean	0.667	0.583	0.833	1.200	1.500	1.000
	Standard Deviation	0.651	0.900	0.835	1.229	1.509	1.054
	Median	1.000	0.000	1.000	1.000	1.500	1.000
9	Mean	0.250	0.417	0.667	0.600	0.800	0.900
	Standard Deviation	0.622	0.669	0.778	0.843	0.919	0.876
	Median	0.000	0.000	0.500	0.000	1.000	1.000
10	Mean	1.750	1.583	1.417	1.700	1.100	1.700
	Standard Deviation	1.055	1.084	0.996	1.418	1.287	1.160
	Median	2.000	1.500	1.000	1.500	1.000	1.500



Table XIII displays the result of the Friedman Test for Group 1 and 2. There was no statistically significant change in responses for Group 1 or 2 from T1-T3 ( $p \leq .05$ ).

Group 1					Group 2				
Question	N	Chi-Square	df	p-value	Question	N	Chi-Square	df	p-value
1	12	1.182	2	0.554	1	10	5.120	2	0.077
2	12	0.686	2	0.710	2	10	0.000	2	1.000
3	12	1.000	2	0.607	3	10	0.087	2	0.957
4	12	4.667	2	0.097	4	10	0.087	2	0.957
5	12	1.520	2	0.468	5	10	2.000	2	0.368
6	12	6.000	2	0.050	6	10	2.500	2	0.287
7	12	0.381	2	0.827	7	10	2.000	2	0.368
8	12	1.750	2	0.417	8	10	2.800	2	0.247
9	12	3.429	2	0.180	9	10	2.333	2	0.311
10	12	0.545	2	0.761	10	10	2.700	2	0.259

Table XIV displays the results of the Wilcoxon Signed Ranks Test for Group 1 and 2.

No statistically significant changes were found over any time point for Group 1 or 2 ( $p \leq .05$ ).

Group 1					Group 2				
Question	Test Statistics	T2 - T1	T3 - T2	T3 - T1	Question	Test Statistics	T2 - T1	T3 - T2	T3 - T1
1	Z	-1.089	-1.186	-0.816	1	Z	-1.342	-1.897	-1.342
	p-value	0.276	0.236	0.414		p-value	0.180	0.058	0.180
2	Z	-0.905	-0.832	0.000	2	Z	0.000	0.000	0.000
	p-value	0.366	0.405	1.000		p-value	1.000	1.000	1.000
3	Z	-0.877	-0.680	-0.106	3	Z	0.000	-0.108	-0.412
	p-value	0.380	0.496	0.916		p-value	1.000	0.914	0.680
4	Z	-0.513	-1.459	-1.633	4	Z	-0.378	0.000	-0.351
	p-value	0.608	0.145	0.102		p-value	0.705	1.000	0.726
5	Z	-0.322	-0.750	-1.414	5	Z	-1.000	-1.732	-0.333
	p-value	0.748	0.453	0.157		p-value	0.317	0.083	0.739
6	Z	-0.632	-2.449	-1.414	6	Z	-2.000	-0.276	-0.966
	p-value	0.527	0.014	0.157		p-value	0.046	0.783	0.334
7	Z	-0.447	-0.966	-0.707	7	Z	-1.000	-0.577	-1.414
	p-value	0.655	0.334	0.480		p-value	0.317	0.564	0.157
8	Z	-0.333	-1.732	-0.632	8	Z	-0.816	-1.414	-1.414
	p-value	0.739	0.083	0.527		p-value	0.414	0.157	0.157
9	Z	-1.000	-1.134	-1.667	9	Z	-1.000	-0.577	-1.342
	p-value	0.317	0.257	0.096		p-value	0.317	0.564	0.180
10	Z	-0.541	-0.513	-0.811	10	Z	-1.414	-1.604	0.000
	p-value	0.589	0.608	0.417		p-value	0.157	0.109	1.000

Figures 19-24 graphically display subject responses to the Parental Questionnaire for Group 1 and 2 from T1-T3.

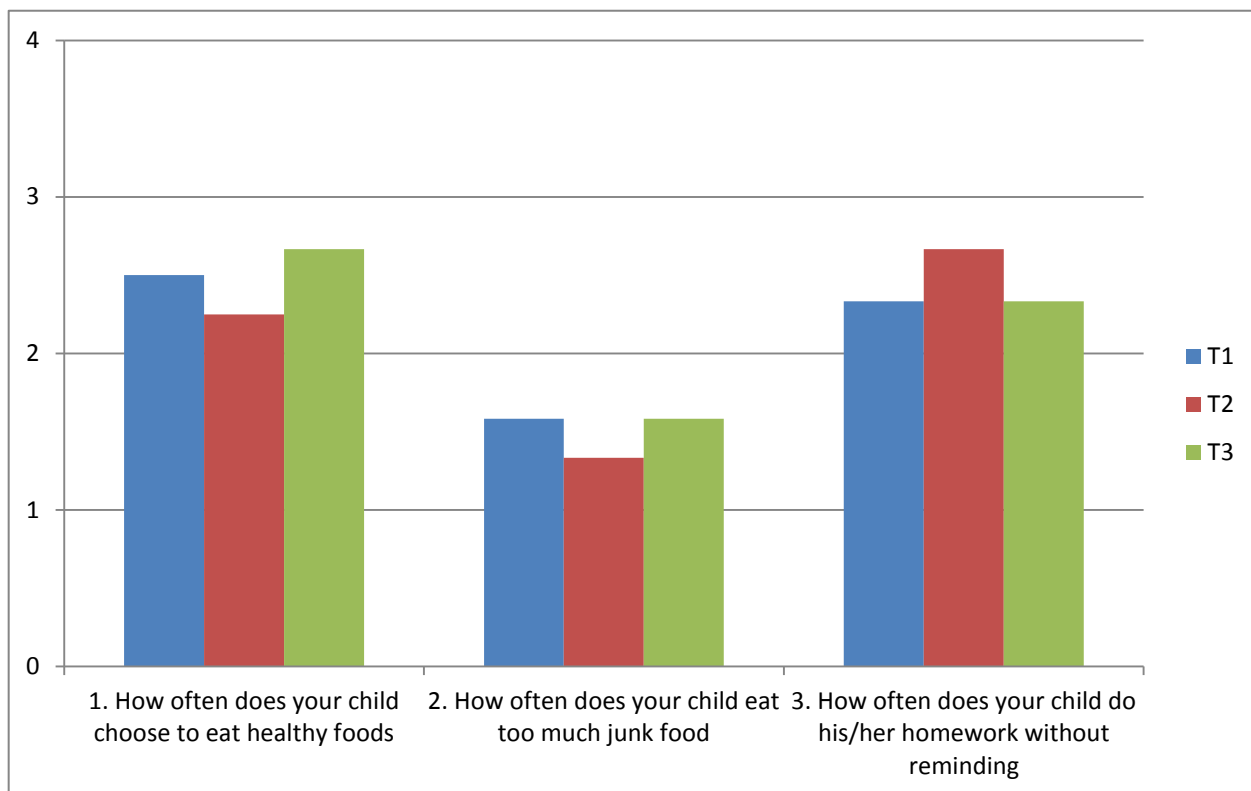


Figure 19. Group 1 Parental Questionnaire results for Questions 1-3 across time points.

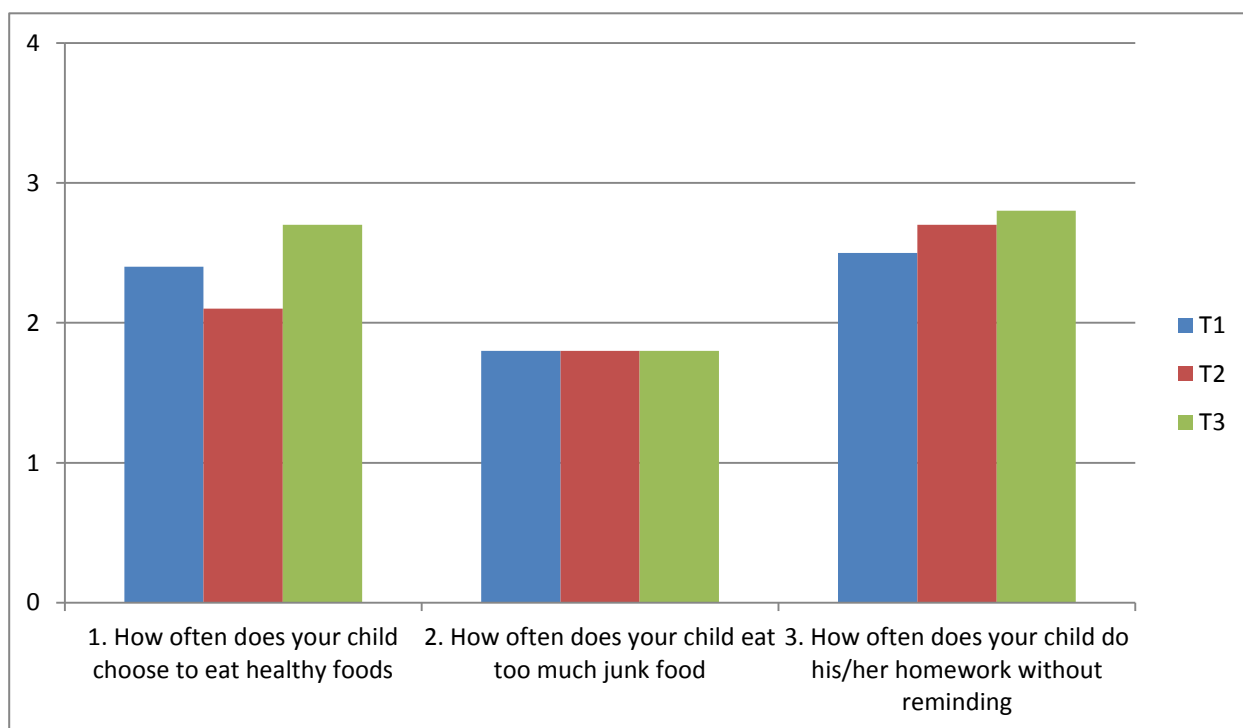


Figure 20. Group 2 Parental Questionnaire results for Questions 1-3 across time points.

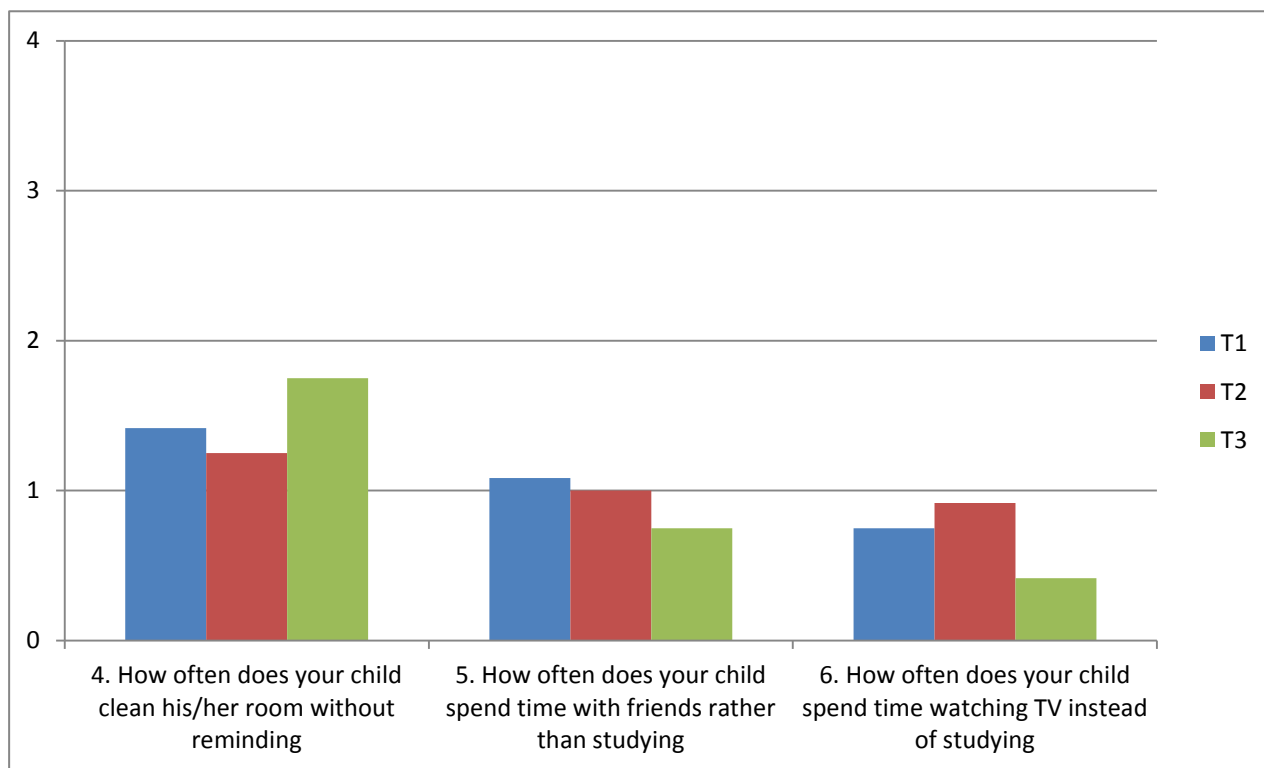


Figure 21. Group 1 Parental Questionnaire results for Questions 4-6 across time points.

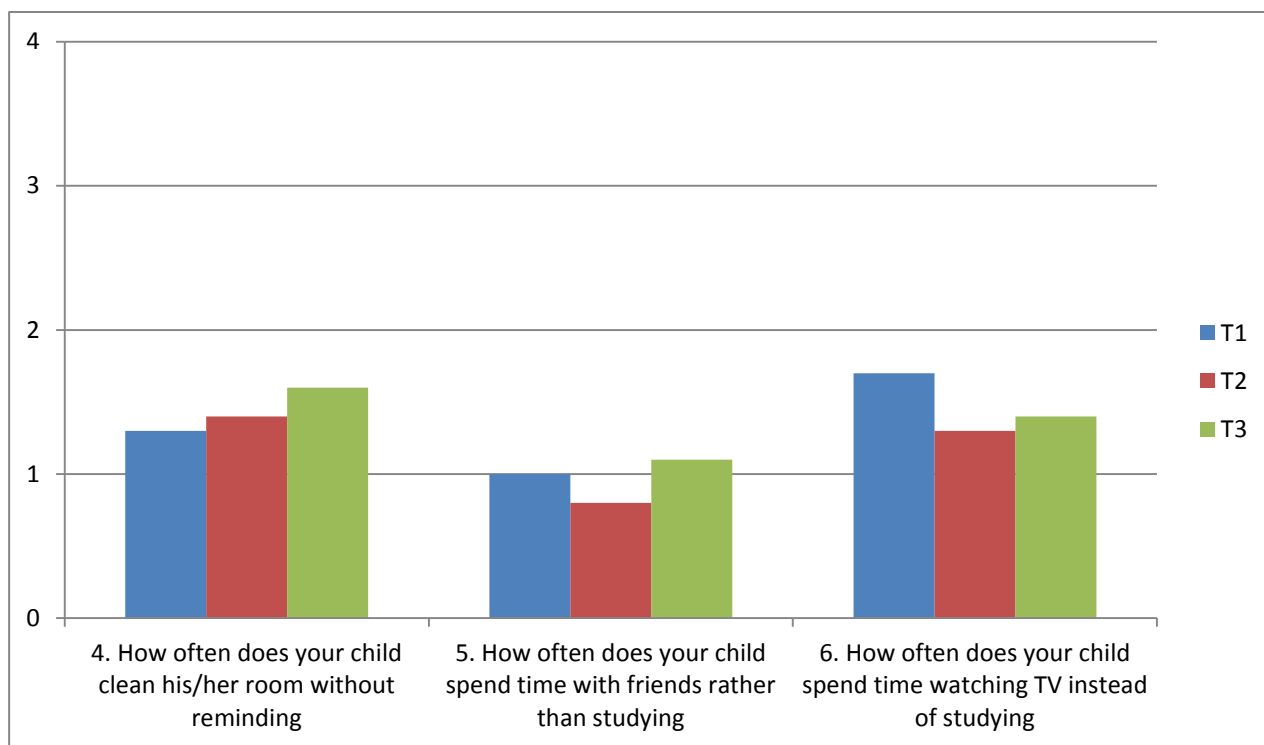


Figure 22. Group 2 Parental Questionnaire results for Questions 4-6 across time points.

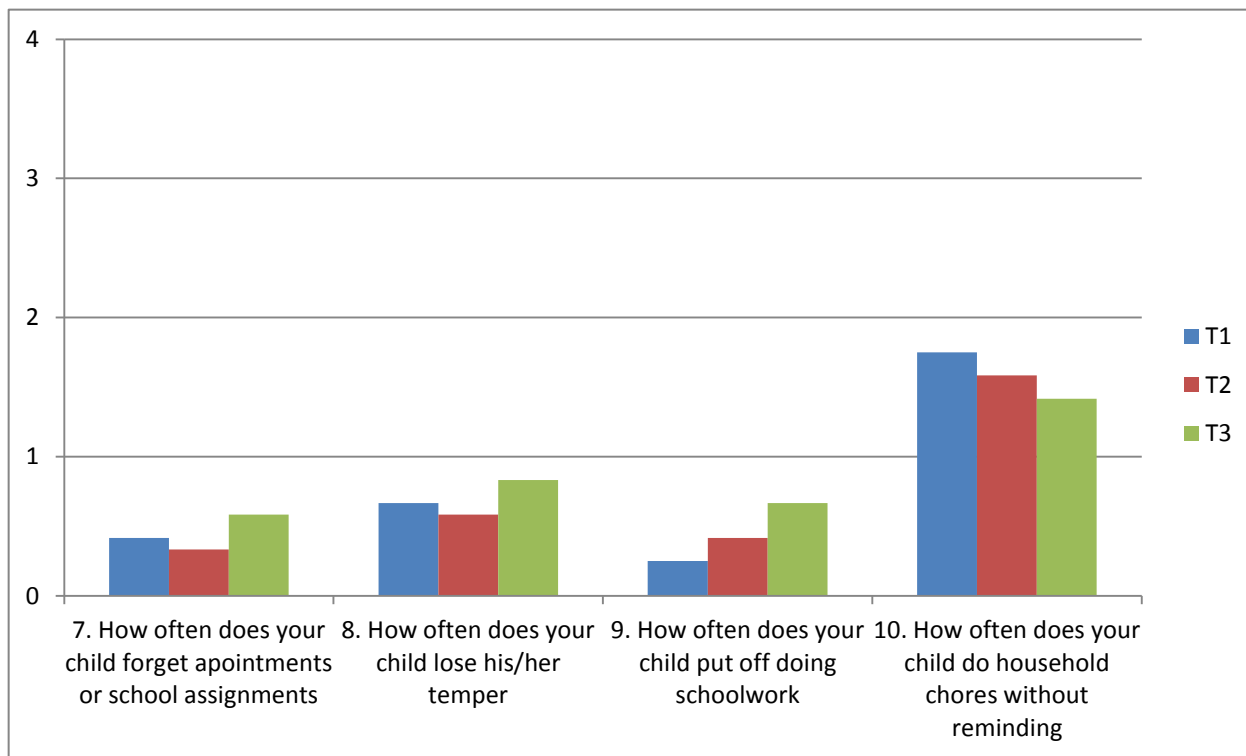


Figure 23. Group 1 Parental Questionnaire results for Questions 7-10 across time points.

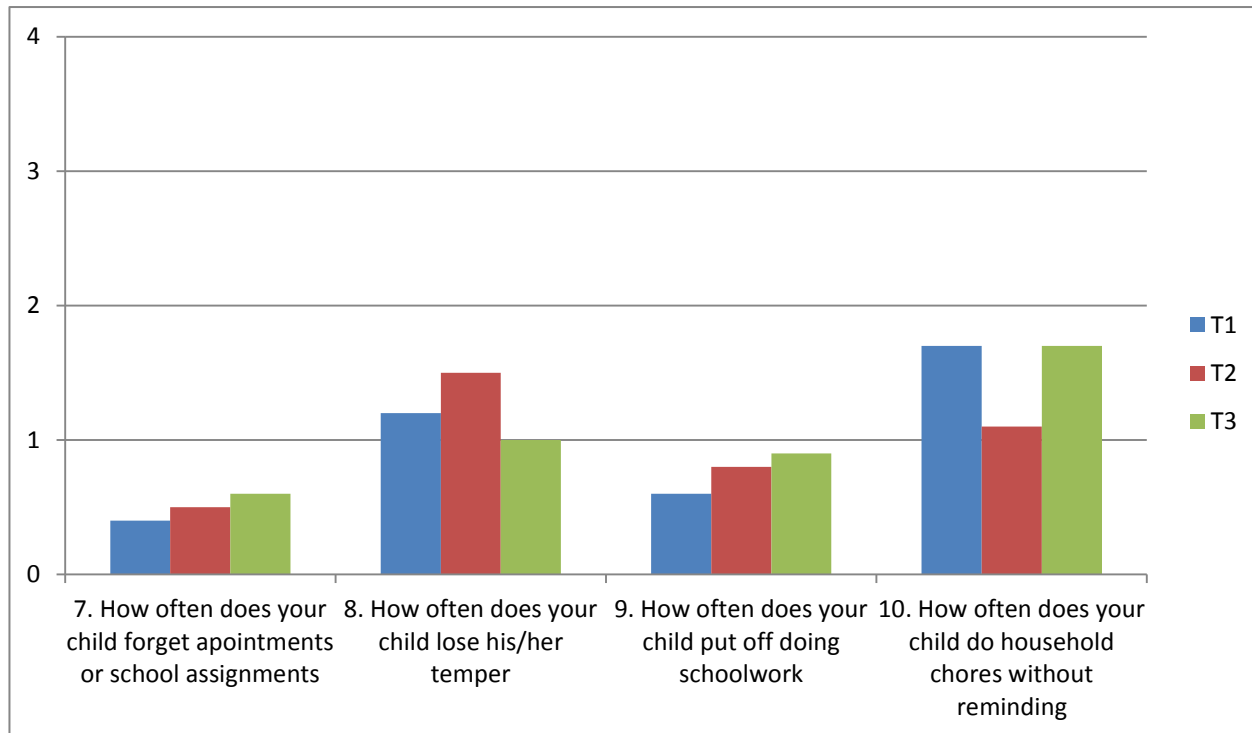


Figure 24. Group 2 Parental Questionnaire results for Questions 7-10 across time points.

Figures 25-26 display parental responses to questions concerning parenting habits and styles in Group 1 and 2, respectively. Both groups had similar responses to all questions.

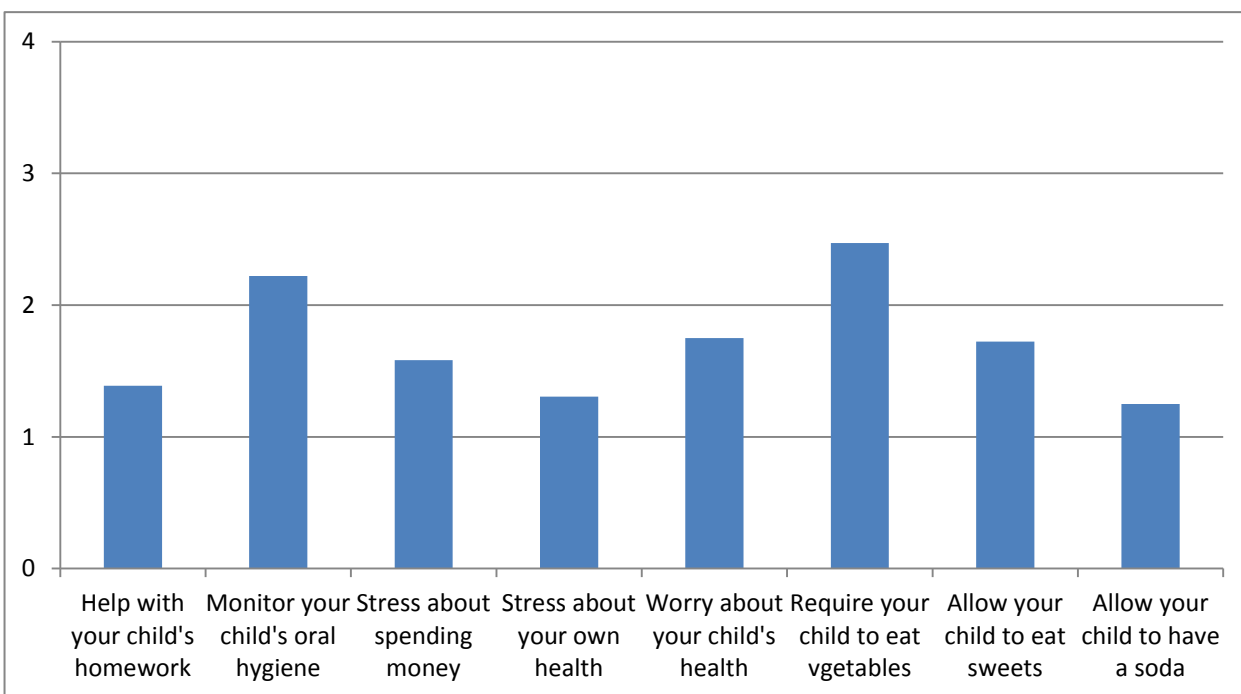


Figure 25. Group 1 Parental response to questions “How often do you...?”

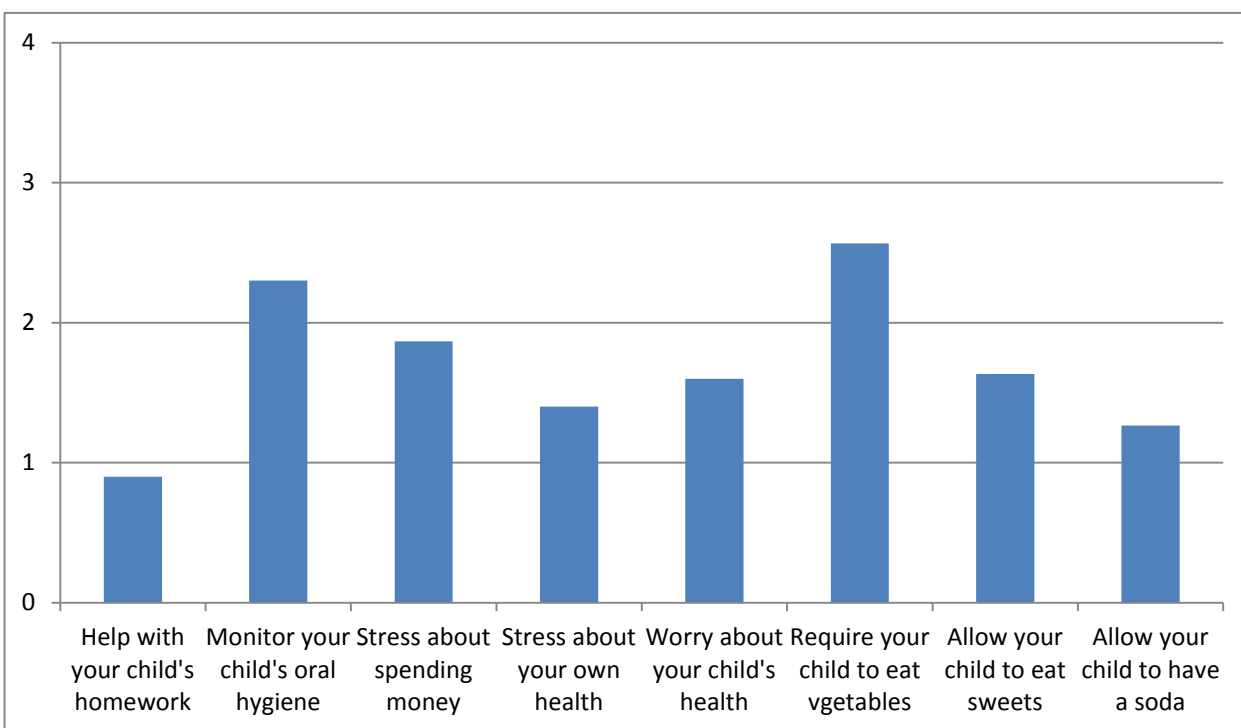


Figure 26. Group 2 Parental response to questions “How often do you...?”



## 5. DISCUSSION

### 5.1 Discussion

Measurement of self-regulation capacity did not show a change with orthodontic treatment from the initial appliance placement to the second adjustment appointment. Although the change in average hand-grip task times before and after thought suppression followed previous study patterns, the adolescent subjects seemed to be more resistant to the depleting effects of thought suppression (Muraven et al., 1998; Oaten and Cheng, 2006a, Oaten and Cheng, 2006b). They seemed better able to multi-task their thought processes to ignore the instructions “Do not think about a white bear” and concentrate on writing down their thoughts. Today, adolescents are constantly dividing their attention between cell phones, television, schoolwork, extracurricular activities, etc. in order to function in modern society. Another test may be necessary to measure self-regulatory capacity in adolescents of the 21<sup>st</sup> century.

Similar to the findings of Murtagh and Todd (2004), subjects often had higher hand-grip task times after thought suppression. It seemed as if they perceived the hand-grip as a game and were motivated to do better after the “break.” Subjects were not able to see their times, but they were aware of being timed. In some instances, subjects far exceeded the average time before thought suppression, and their subsequent post-thought suppression times were markedly less, as if they exhausted self-regulation capacity during the pre-thought suppression task, beyond that which they could recover. Or perhaps they reached their goal of achievement with the first hand-grip task and felt less inclined to reach further with the second hand-grip task.

Orthodontics itself is an ongoing, continuously depleting task. Unlike the exercise regimen used in Oaten and Cheng’s study (2006a, 2006b), there is an innate unfamiliarity with

braces that is not felt with an exercise routine. Although a new regimen at the gym may bring some level of uncertainty, most undergraduate students are somewhat familiar with what to expect. Orthodontic treatment, however, is a completely new experience for patients and brings with it a degree of fear and anxiety. During the initial few months of orthodontic treatment, patients are bombarded with the task of getting accustomed to the appliances invading their mouths. It may be that patients are using self-control resources to not only take care of, but merely tolerate orthodontic treatment. It is possible that over a longer period of time the beneficial self-regulatory effect of the caring for the braces could be more apparent.

Conversely, the more a patient is motivated toward a goal, the less depleting the activity becomes (Muraven and Slessareva, 2003). If the subject is internally motivated to complete a regulatory task, then that task is not depleting, and therefore cannot increase self-regulatory capacity over time. In addition, this internal motivation may give an individual the self-regulatory strength to complete a task even if their stores are depleted from other activities (Muraven and Slessareva, 2003; Martijin et al., 2002). If the orthodontist is able to motivate a patient in a way that orthodontic appliance maintenance becomes part of their autonomous regulation system, the patient's self-regulatory stores may not be depleted and can be used for other activities. The motivational difference amongst subjects may be reflected in the large variation seen in subject responses, thus confounding our ability to see any concrete results in regard to change in self-regulatory capacity.

Patients may associate braces with parental goals instead of their own goals, placing treatment responsibility with their parents or doctor in lieu of themselves. Although parental attitude toward braces was found to be associated with compliance early in treatment, long term compliance was correlated with patient's locus of control (Albino et al., 1991). It is the

perception of responsibility, whether internally or externally prescribed, that most closely predicts treatment compliance. In the study by Albino et al. (1991), patients that possessed an external locus of control regarded their orthodontic treatment as *not* being their responsibility and displayed poorer compliance over the course of treatment. In these cases, more self-regulation is required to comply with treatment due to their lack of motivation. This depleting self-regulation, if successfully employed, may result in a positive change in global self-regulation capacity as described by Baumeister (2002, 2006).

Self-regulation is controlled primarily by the prefrontal region of the brain (Baumeister and Vohs, 2011; Dahm et al., 2011). This area of the brain does not reach full maturity until approximately 25 years of age (Sowell et al., 1999). With the knowledge that brain maturity develops in the mid-twenties, a recent study by Dahm et al. (2011) asked the question ‘How does age affect self-regulation depletion?’ Although the theory of ego-depletion has been well documented in undergraduate students, the authors point out that the brain has not fully completed maturation during this age range. In their study, they found that adults between the ages of 40-65 experienced less self-regulatory depletion than adults below the age of 25, suggesting that the degree of brain maturation affects ego-depletion.

But how far does the relevancy of brain maturity extend to the concept of self-regulation depletion? If the brain’s level of maturation in undergraduates versus middle-aged adults affects its ability to undergo self-regulatory depletion, perhaps the degree of brain maturation in adolescents affects this phenomenon as well. Adolescence is an incredibly complex time that encompasses a new understanding of the abstract world around them, a crisis of identity, and a strong sense of sexuality in addition to the physical changes in their bodies. Rebellion against authority, in varying degrees, is common, and is often associated with risky behaviors (Proffit,

2000). An adolescent is constantly required to meet obstacles in a variety of forms and overcome them, largely on their own. During this complex period of cognitive development, these experiences may help shape self-efficacy ideals available for future endeavors, but are perhaps less likely to evoke self-regulatory depletion necessary for changes in self-regulatory capacity.

Orthodontic Self-Efficacy Scale responses show an increase in self-efficacy with orthodontic treatment suggesting that there is in fact a change in this belief system. After being challenged with orthodontic appliance placement, they seemed to develop a stronger sense that they can overcome future challenges--- that they will be able to wear rubber bands when asked, or brush their teeth sufficiently. Perhaps during adolescent level of cognitive development, the belief that one can employ self-control to overcome obstacles precedes a physical change in the self-regulatory reservoir.

The idea that the challenge presented by orthodontic therapy may increase one's self-efficacy is extremely encouraging. It may reflect an increase in self-efficacy specifically in regard to challenges presented by orthodontic appliances. The nature of orthodontics and subsequent compliance motivation presents a nurturing environment for self-efficacy. First, it presents a challenge that the patient must overcome. These challenges are difficult and must be tackled over a long period of time in order to attain a clearly set goal. Second, the orthodontist acts to continually encourage the patient towards achievement of their goals and ideally provides an environment in which they can succeed. Lastly, patients are surrounded by other individuals that are working toward similar goals or have succeeded in achieving those goals.

The orthodontist has the opportunity to employ techniques to not only improve patient compliance, but help provide an interactive experience to enhance the self-efficacy of the

orthodontic patient. Nanda and Kierl (1992) found that the perceived orthodontist-patient relationship was the only factor tested that correlated with treatment compliance. Although a patient's own internal motivation enhances treatment compliance, the orthodontist can help by setting clear goals, and properly explaining these goals to the patient. The relationship between orthodontist and patient could potentially mimic that of a coach or a mentor. Their encouragement towards progress and redirection of poor compliance may aid in increasing self-efficacy and compliance, potentially boosting their ability to cope with future challenges. This new role may empower the orthodontist to expend additional efforts to increase adolescent investment in their own treatment as a new approach to compliance management.

## 5.2 **Limitations of the study**

Subject recruitment was an extremely limiting factor in achieving adequate sample size. Subjects were not compensated for participation. Motivating factors may have been introduced by calling on patient's willingness to comply without a monetary reward. The *reward* for participation called on internal motivation to help a stranger finish a research project and may have confounded results.

Patients were treated by a variety of practitioners. All practitioners were asked to provide standard information regarding braces care and oral hygiene instructions. The variability in the chosen language and tone of each practitioner may have altered the understanding and compliance of the subject, subsequently contributing to the large variation. Utilizing a single practitioner and providing a detailed script may alleviate future issues. The factor of patient and doctor relationship, however, is a more difficult thing to control.

The time of day that the test was administered was not controlled. A subject may have been tested before school for one test or after school for another. School is an enormously depleting activity of assignments, demands of location, and activity. Adolescents differ from previously studied undergraduate students in the fact that they are not in control of their environment. Cohorts of university students often follow a similar schedule of exams and events. These subjects attended different schools and thus had differing schedules. Various factors such as summer vacation, parental environment (particularly in divorced homes), control over diet, etc. affect the depletion state of an adolescent's self-regulatory capacity.

All but two subjects had their orthodontic treatment covered by the Illinois Department of Public Aid. This means that the majority of the subjects were from a lower socioeconomic background, and had a malocclusion severe enough to qualify for public aid coverage of their treatment. The severity of their preexisting malocclusion may affect subject's self-esteem prior to beginning orthodontic treatment.

### 5.3 **Future research**

A longer study that evaluates self-regulatory capacity after completion of orthodontic treatment may show different conclusions. A patient may experience pride and feelings of self-efficacy by participating in treatment and being rewarded by a successful outcome, making effects in orthodontic self-efficacy or even general self-efficacy more dramatic. It would be interesting to see if there are any global changes to self-efficacy due orthodontic treatment over time.

## 6. CONCLUSION

### 6.1 Conclusion

Change in self-regulatory capacity with orthodontic treatment was not found to be significant in our study. Study results do suggest that patient self-efficacy may increase in adolescents undergoing orthodontic treatment between initial appliance placement and the second adjustment appointment.

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## APPENDICES

### APPENDIX A

#### ORTHODONTIC SELF-EFFICACY SCALE

This questionnaire is designed to help us get a better understanding of the kinds of things that patients may find hard to do while they have braces on.

Please rate how sure you are that you can do each of the things listed below to take care of your braces. Your answers will be kept strictly confidential. No one will be told how you answer these questions, not even your parents or doctor.

0	1	2	3	4	5	6	7	8	9	10
I cannot				I'm moderately			I'm sure I			
do this at all				sure I can do this			can do this			

Keep my teeth clean with braces \_\_\_\_\_

Brush my teeth twice a day \_\_\_\_\_

Brush my teeth three times a day \_\_\_\_\_

Brush my teeth when I am tired \_\_\_\_\_

Brush my teeth when I have a lot of homework \_\_\_\_\_

Brush my teeth without my parents reminding me \_\_\_\_\_

Brush my teeth if I am very busy \_\_\_\_\_

Floss my teeth every day \_\_\_\_\_

Floss my teeth when I am tired \_\_\_\_\_

Floss my teeth when I have a lot of homework \_\_\_\_\_

Floss my teeth without my parents reminding me \_\_\_\_\_

Floss my teeth if I am very busy \_\_\_\_\_

If asked, wear a headgear 12-14 hours a day \_\_\_\_\_

If asked, wear a headgear 12-14 hours a day when my teeth are sore \_\_\_\_\_

If asked, wear rubber bands all the time \_\_\_\_\_

**APPENDIX A** (continued)

If asked, wear rubber bands all the time when my teeth are sore \_\_\_\_\_

Avoid food that can break my braces when offered by a friend \_\_\_\_\_

Avoid food that can break my braces when offered by an adult \_\_\_\_\_

Avoid food that can break my braces if I'm hungry \_\_\_\_\_

Avoid food that can break my braces if it is my favorite snack \_\_\_\_\_

## APPENDIX B

### General Self-Efficacy Scale

#### Response Format

1 = Not at all true 2 = Hardly true 3 = Moderately true 4 = Exactly true

I can always manage to solve difficult problems if I try hard enough.

If someone opposes me, I can find the means and ways to get what I want.

It is easy for me to stick to my aims and accomplish my goals.

I am confident that I could deal efficiently with unexpected events.

Thanks to my resourcefulness, I know how to handle unforeseen situations.

I can solve most problems if I invest the necessary effort.

I can remain calm when facing difficulties because I can rely on my coping abilities.

When I am confronted with a problem, I can usually find several solutions.

If I am in trouble, I can usually think of a solution.

I can usually handle whatever comes my way.

## APPENDIX C

### PARENTAL QUESTIONNAIRE

0 – Never   1- Once a week   2 – 2-3 times a week   3 – daily   4- more than once daily

#### **How often does your child:**

Choose to eat healthy foods

Eat too much junk food

Do his/her homework without reminding

Clean his/her room without reminding

Spend time with friends rather than studying

Spend time watching TV instead of studying

Forget appointments or school assignments

Lose his/her temper

Put off doing schoolwork

Do household chores without reminding

#### **How often do you:**

Help with your child's homework

Monitor your child's oral hygiene

Stress about spending money

Stress about your own health

Worry about your child's health

Require your child to eat vegetables

**APPENDIX C** (continued)

Allow your child to eat sweets

Allow your child to have soda

## APPENDIX D

### Approval Notice Initial Review (Response To Modifications)

February 26, 2013

Kathryn Bullwinkel, DMD  
Orthodontics  
801 S Paulina St Rm 131, M/C 841  
Chicago, IL 60612  
Phone: (312) 508-3963 / Fax: (312) 996-0873

**RE: Protocol # 2012-1023**  
**“Longitudinal Measurement of Self Control in Children Undergoing Orthodontic Treatment”**

Dear Dr. Bullwinkel:

Your Initial Review (Response To Modifications) was reviewed and approved by Members of IRB #2 by the Expedited review process on February 21, 2013. You may now begin your research

Please note the following information about your approved research protocol:

**Protocol Approval Period:** February 21, 2013 - February 21, 2014

**Approved Subject Enrollment #:** 60

**Additional Determinations for Research Involving Minors:** The Board determined that this research satisfies 45CFR46.404, research not involving greater than minimal risk. Therefore, in accordance with 45CFR46.408, the IRB determined that only one parent's/legal guardian's permission/signature is needed. Wards of the State may not be enrolled unless the IRB grants specific approval and assures inclusion of additional protections in the research required under 45CFR46.409. If you wish to enroll Wards of the State contact OPRS and refer to the tip sheet.

**Performance Sites:** UIC

**Sponsor:** None

**Research Protocol(s):**

- a) Longitudinal Measurement of Self Control in Children Undergoing Orthodontic Treatment; Version #2; 1-28-2013

**Recruitment Material(s):**

- a) Recruitment Script, Version #2, 1-28-13
- b) Recruitment Script for Children, Version #1, 1-28-13
- c) Follow-up Script, Version #1, 1-28-13

**Informed Consent(s):**



**APPENDIX D (continued)**

- a) Waiver of Informed Consent granted under 45 CFR 46.116(d) for Recruitment Purposes Only

**Assent(s):**

- a) Child's Assent, Version #2, 2-6-13

**Parental Permission(s):**

- a) Parental Permission Form and Consent, Version #3, 2-11-13

**HIPAA Authorization(s):**

- a) HIPAA - Waiver of Authorization granted under 45 CFR 164.512(i)(1)(i) for Recruitment Purposes Only

Your research meets the criteria for expedited review as defined in 45 CFR 46.110(b)(1) under the following specific category:

(7) Research on individual or group characteristics or behavior (including but not limited to research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

**Please note the Review History of this submission:**

Receipt Date	Submission Type	Review Process	Review Date	Review Action
11/21/2012	Initial Review	Expedited	11/28/2012	Modifications Required
02/07/2013	Response To Modifications	Expedited	02/11/2013	Modifications Required
02/14/2013	Response To Modifications	Expedited	02/21/2013	Approved

Please remember to:

→ Use your **research protocol number** (2012-1023) on any documents or correspondence with the IRB concerning your research protocol.

→ Review and comply with all requirements on the enclosure,  
**"UIC Investigator Responsibilities, Protection of Human Research Subjects"**  
 (<http://tiger.uic.edu/depts/ovcr/research/protocolreview/irb/policies/0924.pdf>)

**Please note that the UIC IRB has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.**

**Please be aware that if the scope of work in the grant/project changes, the protocol must be amended and approved by the UIC IRB before the initiation of the change.**

**APPENDIX D** (continued)

We wish you the best as you conduct your research. If you have any questions or need further help, please contact OPRS at (312) 996-1711 or me at (312) 355-2939. Please send any correspondence about this protocol to OPRS at 203 AOB, M/C 672.

Sincerely,

Jewell Hamilton, MSW  
IRB Coordinator, IRB # 2  
Office for the Protection of Research

Subjects

Enclosure(s):

- 1. Assent Document(s):**
  - a) Child's Assent, Version #2, 2-6-13
- 2. Parental Permission(s):**
  - a) Parental Permission Form and Consent, Version #3, 2-11-13
- 3. HIPAA Authorization(s):**
  - a) HIPAA - Waiver of Authorization Certificate
  - a) Recruitment Script, Version #2, 1-28-13
  - b) Recruitment Script for Children, Version #1, 1-28-13
  - c) Follow-up Script, Version #1, 1-28-13

cc: Carlotta A. Evans, Orthodontics, M/C 841  
Ellen A. BeGole, Faculty Sponsor, Orthodontics, M/C 841

## APPENDIX E

### Approval Notice Continuing Review

December 13, 2013

Kathryn Bullwinkel, DMD  
Orthodontics  
801 S Paulina St Romm 131  
M/C 841  
Chicago, IL 60612  
Phone: (312) 508-3963 / Fax: (312) 996-0873

RE: **Protocol # 2012-1023**  
**“Longitudinal Measurement of Self Control in Children Undergoing Orthodontic Treatment”**

Dear Dr. Bullwinkel:

Your Continuing Review was reviewed and approved by the Expedited review process on December 9, 2013. You may now continue your research.

Please note the following information about your approved research protocol:

**Protocol Approval Period:** December 9, 2013 - December 9, 2014  
**Approved Subject Enrollment #:** 60 (closed to accrual-open for follow-up of 40 subjects)

**Additional Determinations for Research Involving Minors:** The Board determined that this research satisfies 45CFR46.404, research not involving greater than minimal risk. Therefore, in accordance with 45CFR46.408, the IRB determined that only one parent's/legal guardian's permission/signature is needed. Wards of the State may not be enrolled unless the IRB grants specific approval and assures inclusion of additional protections in the research required under 45CFR46.409. If you wish to enroll Wards of the State contact OPRS and refer to the tip sheet.

**Performance Site:** UIC

**Sponsor:** None

**Research Protocol:**

- b) Longitudinal Measurement of Self Control in Children Undergoing Orthodontic Treatment; Version #3, 3/20/2013

**Recruitment Material:**

- d) Follow-up Script, Version #1, 1-28-13

**Informed Consent:**

- b) N/A- Closed to enrollment/accrual

**APPENDIX E (continued)**

Your research meets the criteria for expedited review as defined in 45 CFR 46.110(b)(1) under the following specific category:

(7) Research on individual or group characteristics or behavior (including but not limited to research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

**Please note the Review History of this submission:**

Receipt Date	Submission Type	Review Process	Review Date	Review Action
12/05/2013	Continuing Review	Expedited	12/09/2013	Approved

Please remember to:

→ Use your **research protocol number** (2012-1023) on any documents or correspondence with the IRB concerning your research protocol.

→ Review and comply with all requirements on the enclosure,  
**"UIC Investigator Responsibilities, Protection of Human Research Subjects"**  
*(<http://tiger.uic.edu/depts/ovcr/research/protocolreview/irb/policies/0924.pdf>)*

**Please note that the UIC IRB has the right to seek additional information, require further modifications, or monitor the conduct of your research and the consent process.**

**Please be aware that if the scope of work in the grant/project changes, the protocol must be amended and approved by the UIC IRB before the initiation of the change.**

We wish you the best as you conduct your research. If you have any questions or need further help, please contact OPRS at (312) 996-1711 or me at (312) 355-2764. Please send any correspondence about this protocol to OPRS at 203 AOB, M/C 672.

Sincerely,

Betty Mayberry, B.S.  
 IRB Coordinator, IRB # 2  
 Office for the Protection of Research

Subjects

Enclosure:

**APPENDIX E** (continued)**1. Recruiting Material:**

d) Follow-up Script, Version #1, 1-28-13

cc: Carlotta A. Evans, Orthodontics, M/C 841  
Ellen A. BeGole, Faculty Sponsor, Orthodontics, M/C 841  
Privacy Office, Health Information Management Department, M/C 772

## VITA

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EDUCATION: B.S., Biology, Wofford College, Spartanburg, SC, 2007  
D.M.D., Medical University of South Carolina, Charleston, SC, 2011  
M.S., Oral Sciences, University of Illinois at Chicago, Chicago, IL, 2014  
Certificate, Orthodontics, University of Illinois at Chicago, Chicago, IL, 2014

HONORS: Anna Todd Wofford Scholarship, Wofford College, 2003-2007  
Phi Beta Kappa Honor Society, Wofford College, 2007  
Joseph Cleveland Award, Medical University of South Carolina, 2008  
Thomas P. Hinman Scholar, Medical University of South Carolina, 2010  
Medical University of South Carolina Leadership Society, Medical University of South Carolina, 2010  
Omicron Kappa Upsilon, Medical University of South Carolina, 2011  
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