

An Investigation of Academic Achievement and Achievement Motivation
in Children with Cystic Fibrosis

by

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ABSTRACT

Cystic Fibrosis, one of the most severe childhood life-shortening illnesses, places demands on a child's life conceivably interfering with his or her academic success. It is possible that the medically related activities in which individuals with CF partake interfere with academic activities and the motivation, specifically beliefs, expectancies, and values held, toward those activities. These issues encouraged the investigation of academic achievement and achievement motivation in children with CF through exploration of three research questions. Question one concerns differences in academic achievement between children with CF and a healthy comparison group for 1) reading and 2) math. Question two explored differences in aspects of motivation including ability beliefs, outcome expectancies, and task values between the groups for the two academic subjects. Finally, question three examined the relationship between motivational components and academic achievement. Evidence is provided for differences in math achievement between the two groups. Differences in motivation between children with CF and healthy children remain unsubstantiated.

DEDICATION

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Chapter 1

One of the leading theories of academic achievement motivation is expectancy-value theory. This model of achievement motivation postulates that the effort an individual puts toward the attainment of some goal is accounted for by a) his beliefs about how well he is able to perform the task at hand, and b) the degree of value he has for that goal (Wigfield & Eccles, 2000). Based on this model, motivation to achieve academically may be problematic for subgroups of children for whom the value of an academic task competes with the value of tasks necessary for sustaining one's health. Children with Cystic Fibrosis (CF) are an example of a group at risk for these motivation-decreasing effects.

Cystic fibrosis is a chronic, life-shortening disease that in the past has affected children only. Although historically the life expectancy of children with CF was quite short, enhancements in the medical field have increased the life expectancy of individuals with CF (Davis, 2006). This improved health prognosis has given rise to new issues for individuals living with CF and their quality of life as adults (Coe, 2001). Due to the nature of the disease, it is unlikely that a person with CF will grow to be an individual with physical stamina, thus, realistic goals include careers that limit strenuous labor. Many such careers require more advanced academic training than those relying on physical labor alone. Therefore, the academic success of children with CF is of critical importance for their long-term economic stability. However, considering the seriousness of the disease, the pervasiveness of the treatments, and the traditional expectation of a short life-span, school-work may not always be a priority for a child or adolescent living

with CF (Coe, 2001; Worchel-Prevatt, Heffer, Prevatt, Miner, Young-Salame, Horgan, et al., 1998).

When one considers the academic achievement of children with serious and chronic illnesses from a motivational context, it is plausible that the worries and responsibilities that accompany the illness may interfere with the academic performance in comparison to a healthy child; this is true regardless of the theoretical perspective taken. For example, in Maslow's (1943) theory of hierarchical needs, physiological and safety needs, such as breathing and health, must be met before esteem needs like the endeavor for academic achievement. Since breathing and health are not assured qualities for people with CF, effort must be put forth towards fulfilling those needs before an individual can concentrate on achievement needs. Based on expectancy-value theory of academic motivation, one would expect potentially lowered motivation for academic tasks, assuming a relatively low value as compared to health related tasks (Eccles, 1983). Consider which activity is likely to have higher task value in the daily life of a child with a severe chronic illness: taking medication and undergoing breathing treatments to feel well, or studying for an upcoming test? This study adopts a task-value model of achievement motivation as the foundation of its research questions. Based on this model, we expect that the value of academic achievement for children with severe illnesses differs from that of healthy children.

The current study examines potential threats to the academic achievement motivation of children with CF. It examines the relationship between academic

achievement and motivation for children with CF by comparing them to a sample of healthy peers from the perspective of a task-value model of achievement motivation. Based on this model, we expect that the value of academic achievement for children with severe illnesses differs from that of healthy children. Students' beliefs about self and ability, and their values regarding academic tasks and experiences are examined in relation to academic achievement. Further, this relationship is compared to that of children without a chronic illness. The results of this study will provide evidence regarding the motivational effects of CF on student achievement- an issue that may inhibit many children with the disease from achieving their full academic potential.

Chapter 2

Literature Review

There are many factors that can influence a student's academic achievement, including the presence of a childhood chronic illness (Coe, 2001) and students' achievement motivation (Eccles, 1983). Cystic fibrosis is an example of a chronic illness that may interfere with a child's academic achievement. An understanding of the factors influencing the academic achievement and other life experiences of children with this disease is important in order to predict life outcomes. However, the literature on the relationship between CF and academic achievement is sparse in comparison to literature regarding the achievement of children with other chronic illnesses. Beyond CF, research has been conducted on the experiences of children with other chronic illnesses that could perhaps be generalized to the condition of CF (Worchel-Prevatt, et al, 1998). The purpose of this study is to extend existing research on the effects of chronic illness on academic motivation and achievement to the population of children with CF. A review of the relevant literature is presented, including a discussion of expectancy-value theory of motivation, information about CF, and the effects of chronic illness on education, followed by a description of the study methodology and results.

Expectancy-Value Theory

Achievement motivation is an educational construct that has been described through various theories and models. One cognitive theory of achievement motivation is *expectancy-value theory* (Husman, Derryberry,

Crowso & Lomax, 2004). Expectancy-value theory specifies that three key factors affect student motivation: 1) expectations regarding one's ability to perform a task successfully, 2) expectancies regarding the outcome of related tasks, and 3) the values held for those tasks and their outcomes. These factors have been found to directly influence achievement choices such as task selection, initiation, effort, persistence, and overall performance in academic activities (Wigfield & Eccles, 2000).

Within the expectancy value model, there are two types of expectancies to note. The first is comprised of self-efficacy and thoughts about one's ability, whereas the second regards perceptions of task difficulty and the amount of effort required for successful task completion (Eccles & Wigfield, 1995). In a study by Meece, Wigfield and Eccles (1990), ability beliefs and expectancies were the strongest predictors of later grades in math, even after controlling for prior grades. Subjective task value is a complementary construct within this model aiding the explanation of achievement motivation (Eccles & Wigfield, 1995).

Task value is a person's perception of the incentive for a current activity. It consists of an individual's assessment of benefits, rewards or outcomes of the task at hand (Eccles & Wigfield, 1995). Task value is comprised of multiple values, including *utility value*, *attainment value*, *intrinsic value*, and *cost*. Utility value is the usefulness of an activity in obtaining some future goal, and the task at hand might seem unconnected to the goal itself (Husman, Derryberry, Crowso & Lomax, 2004). Attainment value is the perceived importance of performing well on a particular task. Intrinsic value is the enjoyment one gains from performing

the task. Finally, cost refers to the possibility that performing one task might restrict access to another activity (Wigfield & Eccles, 2000). Meece, Wigfield and Eccles' (1990) study found that task values were the strongest predictor of students' intentions to continue taking math. Hence, the expectancies, ability beliefs and task value constructs that comprise expectancy-value theory are important paradigms to measure when assessing the motivation of students.

Eccles (1983) originally used a collection of items to assess students' ability beliefs, expectancies, and perspectives regarding usefulness, importance and interest in math. Subsequently, the items have been expanded upon to explore these motivation concepts in other domains such as reading, sports, and music (Eccles, 1993). The scale has been used with children from 1st grade through high school graduation (Wigfield & Eccles, 2000). Wigfield, Harold, Freedman-Doan, Eccles, Yoon, Arbreton, and Blumenfeld (1997) have reported the reliabilities for the competency beliefs and subjective values constructs based on the data from a three-year study. The internal consistency reliabilities for the competency belief scales ranged from .74 to .90 across subject domains and times of measurement. Separate scales were used within the subjective task value construct. One scale was used for interest and the other for usefulness and importance. The internal consistency reliabilities for usefulness and importance were low at the time of the first measurement (.36 for math, .43 for reading and .57 for sports), however they were higher at both of the later measurement points ranging from .61 to .88 across domains. For interest the reliabilities ranged from .73 to .92 across domains and times of measurement. Furthermore, children's ability beliefs were found to be

significantly correlated with teachers' perceptions of students' competence for reading, math and sports for grades three through six (with an overall pattern of higher correlations at higher grade levels) in Wigfield et al's 1997 study. For third graders, teacher's perceptions of children's competence and children's perceptions of their own competence had significant correlations of $r = .27$ math and $r = .23$ for reading, but teachers' perceptions of children's competence were not significantly correlated with children's interests. The pattern was similar for fourth graders, teachers' perceptions of children's competence were significantly correlated with children's competence beliefs for math, $r = .37$, and for reading, $r = .33$, but were not significantly correlated with children's interests. Teacher's perceptions of children's competence for fifth graders was also significantly correlated with children's competence beliefs for math $r = .34$ and reading $r = .39$. For sixth graders teachers' perception of children's competence was significantly correlated with children's competence beliefs for math, $r = .50$, and reading, $r = .32$, as well.

Although expectancy and value beliefs are distinct theoretically, empirically they have been found to be highly related (Eccles & Wigfield, 1995). In multiple studies, when confirmatory factor analyses were conducted, ability beliefs and expectancies consistently loaded together for children and adolescents (Eccles et al., 1993; Eccles & Wigfield, 1995). Also, students' ability beliefs and expectancies appear to be domain-specific. That is, a student's ability beliefs and expectancies might vary across subjects like math, reading, music or sports (Eccles et al., 1993).

The field of motivation currently has multiple competing and complimentary theories undergoing research and development. Expectancy-value theory has been incorporated into the current study due to its conceptual fit with issues related to chronic illness, as well as its measurement properties. However, one caveat is that the existing literature in this model of motivation has not addresses health issues and these instruments have not been used with pediatric populations.

Cystic Fibrosis

Among the currently diagnosed childhood chronic illnesses, the symptomology and prognosis of CF make it one of the most severe childhood, life-shortening illnesses. Cystic fibrosis is a disease affecting approximately 1 in 3,400 live births among Caucasian populations and 1 in 12,613 in other populations (Kosorok, Wei & Farrell, 1996). According to the Cystic Fibrosis Foundation, approximately 1,000 cases are diagnosed each year, usually before the age of two. It is an autosomal recessive disease, so in order for it to be present in a child both parents must be carriers. The most common defective gene is $\Delta F508$, but hundreds of mutations can lead to CF. The multitude of genetic causes makes population screening difficult (Quittner, Modi & Roux, 2004). Thus, it will likely continue to occur in the population.

The eventual prognosis for children with CF has evolved since its initial diagnosis. When CF was first distinguished as a disease in 1938, the life expectancy of an inflicted patient was approximately six months (Davis, 2006). Currently, the median survival rate is mixed, ranging from 31 years (Quittner,

Modi & Roux, 2004; Davis, 2005) to 37 years (Cystic Fibrosis Foundation, 2008) and up to 40 (Burker, Sedway, Carone, Trombley & Yeats 2005). Identified factors leading to the increase in life expectancy are early diagnosis, aggressive treatments, pancreatic enzyme replacements, and new antibiotics that are able to treat lung infections (Quittner, Modi & Roux, 2004).

One issue regarding the prognosis of Cystic Fibrosis remaining unchanged is its invasiveness. Individuals with the disease experience symptoms that can inhibit participation in activities and necessitate medical attention. Additionally, CF is a progressive disease, meaning that symptoms become increasingly worse as time passes. However, the development of therapies has resulted in a decreased rate of progression. As one might expect from a disease that was once predictive of morbidity at six months of age, the damage to the body and to one's health begins early in development when CF is present. Although many of the therapies that treat symptoms have a profoundly positive effect on lifespan and quality of life, CF will continue to be a problem until therapies that treat the basic defect become available.

CF symptomology.

Symptom-producing components accompanying CF result from three primary affected organ systems (Quittner et al, 2004): gastrointestinal organs, respiratory organs, and reproductive organs. Many patients with CF have insufficient pancreatic enzymes due to blockage of the pancreas during fetal development (Davis, 2006), which results in a diminished ability to digest food and absorb nutrition. Consequently, poor growth trajectories can be expected. Abdominal pain is another common gastrointestinal related

experience of these individuals. Problems with the respiratory system include bronchoconstriction, airway obstruction (edema) due to excessive mucus and pus, frequent lung infections, and chronic inflammation (hypertrophy), which all give rise to progressive lung disease. The diminished physical growth that an individual with CF experiences compounds the lung disease by impeding the body's ability to combat infection and preserve lung function (Davis, 2006). Finally, defects in the reproductive system are particularly common in males due to congenital bilateral absence of the vas deferens, which makes them azoospermic (Davis, 2006). Reproductive complications resulting from CF are not as universal in women as they are in men. If a woman's lung functioning is ample and she is able to gain weight throughout a pregnancy, full term healthy pregnancies are possible. However, the presence of thick cervical mucus may impair a woman's fertility, and CF can cause irregular hormonal cycles due to being underweight (Davis, 2006).

Though the system-specific symptoms are often discussed, the basic defect at the core of all of the medical issues is a lesion in a cAMP-regulated chloride channel. This defect manifests itself in the epithelial cells that line the affected organ systems (Davis, 2006). The basic defect can be conceptualized as the root of the ensuing health complications.

Treatments for CF.

The treatment of patients with CF is best described as rigorous. As is the case with many chronic illnesses, CF necessitates that those afflicted endure various therapies and treatment regimens. The various medical problems that comprise CF each require different treatments. In order to combat nutritional

repletion many patients take pancreatic enzyme supplements to prevent some of the malnutrition, however they do not completely correct the malabsorption. Vitamin and calorie supplements are also necessary. These might be taken orally or administered through enteral (tube) feedings, the latter of which can be rather obtrusive in a child's life (Davis, 2006). The presence of an underweight condition is predictive of poor pulmonary function and provides the reasoning for vigorous nutritional repletion. However, it has not been thoroughly demonstrated that improving appropriate weight will improve the overall prognosis for individuals living with the illness (Davis, 2006).

There are several methods for treating the various respiratory conditions. One is through vibrating the chest with the use of either a mechanical vest that the child wears or a suctioning tube that the child holds to clear sputum. Controlled breathing and aerobic exercise, which stimulate deep breathing and cough, are approaches that healthier patients can use for this same purpose. There are also drugs that patients can take to aid in clearing sputum or treat other physiological defects. Recently, hypertonic saline aerosols have been shown to improve pulmonary functioning and reduce exacerbation. When typical treatment options for respiratory problems are not sufficient, more drastic measures can be taken. A lung transplant is the most invasive procedure available to treat respiratory problems. However, even if a patient elects to undergo the surgery, organs are not always available for those who need them, and survival is only 80% at the 1-year mark and 50% at the 4-year mark (Davis, 2006).

Davis (2006) describes an additional pharmacological aspect to treating patients with CF. This comes in many forms including antibiotics, steroids, and high dosage ibuprofen, among other medicines. The antibiotics serve the purpose of combating airway infections such as pseudomonas and can be administered intravenously or orally. Steroids and ibuprofen serve the purpose of suppressing inflammation, which is important because inflammation may precede infection. Therefore, treating the inflammation may slow the rate of decline in pulmonary functioning. Unfortunately, both medicines can have adverse effects on the individual. Treatment with steroids comes with the risk of growth failure, cataracts and diabetes, and ibuprofen can be associated with a greater risk for gastrointestinal hemorrhage. One must consider how these forms of treatment will interfere with the day-to-day life of a student with CF. Because of the many components of the disease, and the multiple treatment regimens necessary to combat each one, the health related tasks required to be performed or participated in by an individual with CF quickly accumulate.

Effects of Chronic Illness on Childhood Experiences

To gain insight as to how the medical experiences of children with CF might interfere with their academic achievement, one can consult the literature regarding the experiences of children with chronic illnesses in general. The extant literature suggests that there can be psychological and social effects accompanying the physiological effects of any chronic illness, including CF. The physiological, psychological, and social effects affecting educational experiences are discussed.

Schooling.

Physical effects.

Physiological experiences associated with chronic illness can include damage to vital organs, fatigue, pain and dependence on medication or caretakers. Donnelly (2005) reports that damage to vital organs can affect the child in multiple fashions, including bladder control, motor impairment, level of fatigue, and activity level. Fatigue and decreased activity level will affect the extent to which the child can participate in classroom activities or group work. Other physical effects that could influence schooling are the experiences of pain in the chest, abdomen, and headaches. In addition to these concerns is the possibility of dependence on medications, as well as on caretakers. Dependence on medication is likely to cause interruptions in the child's school day for trips to the nurse's office, and dependence on caretakers can be embarrassing or delay the rate at which the child can complete tasks. It is understandable how the presence of these factors could be distracting, making it difficult to sit in class or actively participate in one's own education.

Psychological effects.

Research on the relationship between chronic illness and education suggests a variety of potential psychological effects on the schooling process (Donnelly, 2005). Although chronic illnesses have greatly varying effects on individual children, the typical issues that may arise can be categorized as cognitive, affective and behavioral in nature. The psychological factors include changes in emotional states, lowered self-esteem and lowered self-efficacy

(Donnelly, 2005). Landon, Rosenfeld, Northcraft, and Lewiston (1980) found that some children with CF were negatively impacted in the areas of impulse control, emotional tone, and body-self image. Chronically ill children are at an increased risk for adjustment and self-concept problems, too (Lavigne & Faier-Routman, 1992). It is possible that the psychological effects associated with a chronic illness, such as CF, may be related to a reduction in positive, autonomy boosting experiences (Stam, Hartmen, Deurloo, Groothoff, & Grootenhuis, 2006) paired with an increase in physically painful or isolating experiences, which have been associated with emotional and behavioral dysfunction (Young, Kane, & Nicholson, 2006).

Social effects.

Research on the relationship between chronic illness and education also suggests a variety of potential social effects (Donnelly, 2005). Family stress, altered expectations of others (such as teachers), and altered peer relations are examples of social issues that may influence a child's experience with school. Examples of family stress might include additional parental responsibilities and strained sibling relationships. It may also be difficult for students with chronic illnesses to maintain relationships with peers while they are away from school for extended periods of time for medical care. Furthermore, teachers may not be familiar with how to manage the child's education and classroom behavior appropriately (Coe, 2001).

Achievement and functioning.

The experiences of children with chronic illnesses vary considerably, which may lead to differences in academic achievement and intellectual functioning. The intellectual functioning and academic achievement of children with CF has been shown by some to be normally distributed (Thompson, Gustafson, Meghdadpour, Harrell, Johndrow, and Spock, 1992). However, academic achievement for children with CF is below grade level for approximately 20% of the sampled children for both reading and mathematics (Thompson et. al., 1992). Factors thought to be related to intellectual and academic functioning in this population were age, socioeconomic status and medical status. Because both the medical prognosis for children with Cystic Fibrosis and the educational management of children with “other health impairments” has changed since the time of Thompson et. al.’s (1992) study, it is possible that the information is outdated (Davis, 2006; Wodrich & Spencer, 2007). For example, if medical treatments have become more efficient and the patients receive better accommodations at school, they might have different experiences with the educational process leading to different outcomes. However, there have been no recent studies exploring this issue.

Attendance.

In the opinion of Clay et al. (2004), reduced participation in school and school absences should be foremost concerns in the lives of children with chronic illnesses; they can greatly affect academic performance and put a child at risk for academic failure. Cook, Schaller, and Krischer (1985) report that children and adolescents with chronic illnesses exhibit more absenteeism than their healthy

peers. Furthermore, Sexson and Madan-Swain (1995) state that the relationship between specific illnesses and absenteeism rates are unclear, but several factors associated with chronic illness influence school attendance. However, they also report that unlike a typical school population, low achievement scores do not seem to correlate with absences for children with chronic illnesses.

Although there are benefits of attending school, in many ways school attendance can be a challenge for children living with chronic or terminal illnesses. In addition to the illness itself, there are other issues that influence school attendance of chronically ill children (Donnelly, 2005). Fear about returning to school after an extended absence is a substantial issue that may affect a child's schooling. Donnelly (2005) and Worchel-Prevatt, Heffer, Prevatt, Miner, Young-Salame, Horgan, et al. (1998), reported that some students feel that returning to school after their hospitalization can be worse than the treatment itself. Many of the reasons for these feelings are based in the child's fear of what may happen in the future. Examples include fear of loss of friendship, fear of rejection, and the fear that their peers, teachers and administrators will misunderstand his or her disease (Donnelly, 2005). Children with chronic illnesses may also fear teasing due to changes in their appearances such as hair loss, or weight loss or gain. Furthermore, they may fear isolation from their peers (Worchel-Prevatt et al., 1998). Healthy peers who do not understand aspects of their friend's illness may reject their friend, leaving the unhealthy child without needed security and support. It is not uncommon for children, especially young ones, to have misconceptions about a classmate's illness, such as whether it is

contagious. Furthermore, the student may feel incompetent compared to peers, and therefore be reluctant to attend school (Worchel-Prevatt, et al., 1998). The ill child may also experience anxiety about being able to keep up with work after extended periods when schoolwork was not a priority (Worchel-Prevatt, et al., 1998). Parents may also have a negative influence on their children's attendance if they are reluctant to send them to school. Parents may act in this way due to a fear of their child catching infections at school, getting teased by peers, or if they have misperceptions about the importance of school in their child's life (Worchel-Prevatt et al., 1998). Worchel-Prevatt et al. (1998) gave the example of a parent's idea that "since my child is going to die, why does he need to waste time in school?" Although children with chronic and life-shortening illnesses like CF face challenges in attending school, factors such as the opportunity for social support and the benefits of academic achievement make attendance valuable.

The benefits of academic achievement for children with Cystic Fibrosis are two-fold. First, success in school can improve the individual's quality of life in psychological and social domains. Included in the possible beneficial outcomes of a positive school experience are a sense of mastery or control over at least one element of his or her life, increased self esteem, fulfillment of peer relationships, decreased emotional trauma, academic success, the opportunity to socialize, and the possibility that the child will identify himself as an important member of society (Worchel-Prevatt et al., 1998). Second, academic success will be imperative in the chances of the individual becoming a productive adult. Although

it may be difficult, school attendance is one of the best ways to promote normalcy in the life of a child with a chronic illness (Worchel-Prevatt et al., 1998).

Other developmental effects.

With pediatric patients who have chronic or terminal illnesses living longer, it is important to consider the implications of those illnesses on their future. Stam, Hartmen, Deurloo, Groothoff, and Grootenhuis (2006) propose that achieving developmental milestones is of great importance in the lives of adolescents with chronic illnesses, but that these individuals may be at risk for a delayed course of life. This is in part due to their decreased participation in school and peer activities (including unsupervised activities with peers) as well as their increased dependence on caretakers. In their study, Stam et al. (2006) found that chronically ill adolescents were less likely to have a driver's license, less likely to attend school full time, less likely to date, less likely to make plans for the future, and more likely to drop out of school. Furthermore, development of autonomy was found to be positively related to health outcomes. Thus, it appears to be important. It is also important to encourage children with chronic illnesses to make friends and to participate in peer activities. Other developmental tasks that should be addressed by adults are encouraging and assisting with the establishment of emotional independence, the development of a comfortable body image, sexual role identity, peer group acceptance, separation from parental value systems, future goal orientation, and career planning (Worchell-Prevatt, 1998). Addressing psychosocial elements of having a chronic illness is important in

improving the developmental outcomes such as socialization, academic success and vocational attainment for these children and adolescents.

Vocational attainment.

Prolonged life expectancies are making it necessary for individuals with CF to plan for the future. Thus vocational attainment needs to be addressed; this may be reliant on academic achievement. According to one source, many individuals with cystic Fibrosis are able to maintain careers after schooling despite their declining health (Burker, Sedway, Carone, Trombley & Yeatts, 2005). Furthermore, individuals with more skilled jobs, which require more education, were more likely to maintain employment in a study by Burker et al (2005). Because skilled jobs require more education, the conclusion can be drawn that the more education a person with CF achieves, the more likely it is that he or she will be able to maintain employment.

Purpose of Study

Children and adolescents with CF face responsibilities vital to their health status. These responsibilities are health related tasks such as completion of treatment options for improving health status and prognosis. There are many treatment options both available and required for individuals with CF, and individuals are likely to participate in a combination of many of these methods in order to sustain relative good health. These responsibilities may interfere with academic values and expectancies because of the time and effort required to complete them. For children with CF, the extent to which these issues interfere with their motivation towards academic achievement is of interest because

academic success will be instrumental in the procurement of a normal, productive future. So, it is important to ask how students' with CF values relate to their academic performance and activity choices and if that relationship varies from children that do not have CF. Cystic fibrosis can be expected to continue in the population because of a) the multitude of genetic mutations, and therefore the difficulty involved in population screening, as well as b) the lack of a treatment for the basic defect of the disorder. Thus, it is important to understand the implications of a diagnosis of CF.

Before health care providers and educators can predict and control the outcomes of individuals with CF, an understanding of the natural history is needed. The purpose of this study is to increase knowledge regarding the educational implications of CF; this is examined in terms of three research questions. Specifically, the possibility that medically related activities in which individuals with CF partake interfere with academically related activities and the motivation, meaning beliefs, expectancies, and values held toward those activities is examined. Three research questions are addressed:

Research Question 1. The first research question under investigation addresses the effect of CF on students' achievement in a) math and b) reading. It is expected that on average children with CF will demonstrate lower levels of achievement ranks on a statewide test than the comparison group for both subjects.

Research Question 2. The second research question considers the effect of CF on students' motivation in a) math and b) reading. It is expected that on

average children with CF will demonstrate lower levels of motivation on measures of ability beliefs, outcome expectancies, and values for the two academic subjects.

Research Question 3. The third research question concerns the relationship between reading and math achievement and belief, expectancy, and value aspects of motivation for the two subjects independently. It is predicted that a relationship exists between academic performance levels and Likert scale scores for motivation, with lower levels of subject specific aspects of motivation associated with lower levels achievement in the related academic domains.

The answers to these questions about the academic achievement and motivation of students with CF can provide information about the nature of the educational implications and risk factors associated with the presence of this disease in a student's life. Knowledge regarding the educational implications of CF may lead to information regarding the kinds of assistance students with CF might require, and indicate whether interventions can be developed to contribute to more positive educational and life outcomes.

Chapter 3

Methods

Participants

Independent samples of children were drawn for participation in the study. First, the population of 4th through 11th grade patients of the Cystic Fibrosis Center at Phoenix Children's Hospital, and Child Rehabilitative Services in Phoenix, Arizona were contacted via mail, resulting in a sample of 15 participants for the CF group. This was a 21% response rate which is similar to response rates reported in studies with similar procedures for recruiting students with chronic illnesses (D. L. Wodrich, personal communication, November 22, 2010). The CF group included 5 boys and 10 girls with a mean age of 13.87 (SD = 2.33). Within the group of children with Cystic Fibrosis 20% of the children received educational services under an Individualized Education Plan (IEP) and an additional 20% of the students received services under a 504 plan. School year absences for this group ranged from 1 to 39, with a mean of 13.31 (SD = 12.35). Participants for the comparison group were recruited from a local community center via consultation with the center's director. Additional control subjects were recruited from retail centers (malls) in the Phoenix metropolitan area as needed for any participants with CF unable to be matched with community center children. An attempt was made to match participants in the control group for grade and gender for the purpose of having comparable samples, however this was not always possible due to exclusionary criteria. Ultimately, 5 boys and 10 girls with a mean age of 14.11 (SD = 2.61) were recruited for the comparison

group. Within the comparison group 7% of the students received educational services under an IEP, and no student received services under a 504 plan. School year absences for this group ranged from 0 to 15.5, with a mean of 7.1 (SD = 3.82). Prior to data collection, a power analysis was conducted based on parametric procedures and indicated 26 participants would be necessary to achieve statistical significance with a large effect size. The data analysis procedures were altered, but the initial sample size was met. Exclusionary criteria for both groups included the presence of blindness, deafness, or mental retardation; additional exclusionary criteria for the control group included the presence of another chronic illness. For the purposes of this study “presence of a chronic illness” included any condition which would qualify a student to receive special education services under the eligibility status “Other Health Impairment.” To be included in the study, the participants and parents were required to read English.

Procedure

The research proposal was evaluated by the institutional review boards of Arizona State University and Phoenix Children’s Hospital. Upon approval, clinic patients’ contact information was obtained and participants were recruited via informational mailings and follow up phone calls. Each participant was mailed a packet that included a parental consent form, an instructional sheet for the parent, a child assent form, a permission to release academic records form, and Eccles’ (1983) expectancy value survey. Patients of the Cystic Fibrosis Clinic and Child Rehabilitative Services also received a HIPPA Authorization for Research form in

their packets. The participants and parents were directed to proceed with the participant parent instructions if they had given assent and consent. First, the parents were to fill out the parent data form. Next, the student was to complete Eccles' survey regarding beliefs and attitudes toward school. The parents were permitted to read the items to the student if necessitated by the student's reading level, however they were directed not to influence the student's response. The parent was also directed to sign the School Record Release Form. Last, the parent was instructed to place these three items in the postage paid envelope and place it in the U.S. mail. Upon receipt of materials, the researcher contacted the participant's school to request records of scores on the Arizona Instrument to Measure Standards and Absenteeism. All participants were assigned an identification number, and records such as the data sheets and the document linking participants' data to identification numbers were stored in a locked office at Arizona State University in a file accessible only to the principle investigator until shredding. The participants were each mailed a \$15 gift card to Target department store as an incentive for their participation within two weeks of the investigator's receipt of completed forms.

Instruments

The data collected included two self-report measures of student's expectancies, beliefs, and values for 1) math and 2) reading and archival data from a high-stakes curriculum assessment. The students' performance levels on Arizona's Instrument to Measure Standards (AIMS) were examined as a measure

of the participants' level of academic achievement. Expectancy-value and belief ratings were collected via a self-report measure developed by Eccles (1983).

Arizona's Instrument to Measure Standards (AIMS). The AIMS test is a criterion-referenced test administered to Arizona public school students with the intent of measuring students' and schools' progress (Arizona Department of Education, 2007). Students in grades three through eight take the Dual Purpose Assessment, which is comprised of criterion-referenced questions developed by Arizona Educators and questions from the CTB/McGraw Hill national norm-referenced test. Student in grades ten through twelve take a version of the assessment. Subjects measured include reading, mathematics, writing, and science. Administration can vary for special education students, who might take the Alternative version, or AIMS-A. Scores on the AIMS test are reported in four categories: "falls far below standards," "approaches standards," "meets standards" and "exceeds standards" (Arizona Department of Education, 2007). Achievement data was not available for three students from each group (total of six students) because students in that grade, 10th grade, do not take the AIMS test the previous year.

Beliefs and Values measures. Because previous studies have shown through confirmatory factor analysis that ability beliefs and expectancies can vary across subject areas, it seemed ideal to measure math and reading separately in this study (Eccles et al., 1993). Eccles' (1983) self-report scale, which consists of items to assess children's ability beliefs, expectancies, and subjective task values, were used to assess the participants' achievement motivation. The scale includes a

total of six items per subject area (reading and math) divided into three subscales: 1) Ability Beliefs Items, 2) Expectancy Items, and 3) Usefulness, Importance, and Interest Items (see Appendix A for items). Therefore, the values for these three dependent variables will equal the average of the items on each subscale. For information regarding the reliability and validity of this scale see page 6 of this document.

Other measures included on the participant data form include socio-economic status of the household, gender of the child, and mother's educational attainment.

Data Analysis

Descriptive statistics of data were calculated for the entire sample as well as for the CF and sibling groups separately. Means, medians, and interquartile ranges are reported for outcomes on Eccles' self report scale. Frequency tables, modes, and medians are reported for AIMS achievement categories.

Subsequently, multiple inferential statistical procedures were conducted to evaluate the three research questions regarding differences between the two groups (students with CF and healthy students) on the AIMS measures of academic achievement for reading and math, and on Eccles's items used to assess children's ability beliefs and subjective task values motivation measure.

To address research question one, Mann-Whitney U tests were conducted to evaluate mean performance levels of student achievement to determine whether differences exist for 1) math and 2) reading in the proportion of students in the PL

categories: “falls far below standards,” “approaches standards,” “meets standards” and “exceeds standards.”

To address the second research question, Mann-Whitney U tests were conducted to evaluate the relationship between the presence of CF and motivation (Beliefs, Expectancies, and Values) towards math and reading. Separate Mann-Whitney U tests were conducted with averaged scores for each motivational subscale (beliefs, expectancies, and values) on Eccles’ self-report measure as dependent variables resulting in a total of six analyses.

The third research question is in regard to the relationship between achievement scores and the multiple motivation subscales. Spearman rho correlation coefficients were computed among the reading achievement and math achievement performance levels and their three respective motivation subscales: Expectancies, Beliefs, and Usefulness for those academic subjects resulting in a coefficient matrix including the scores of the three motivation subscales and two achievement scores.

Chapter 4

Results

Students' achievement levels were evaluated to determine whether differences exist for 1) math and 2) reading in the proportion of students in the PL categories: "falls far below standards," "approaches standards," "meets standards" and "exceeds standards" categories. Table 1 displays frequencies, means, medians and modes for these categories. A Mann-Whitney U test was conducted to evaluate the hypothesis that students with Cystic Fibrosis would score lower, on average, than the comparison group on the reading achievement ranking levels on the Arizona Instrument to Measure Standards. The results of the test for reading were in the expected direction but not significant, $z = -1.35$, $p = .18$. The CF group had an average rank of 11.33, and the comparison group had an average rank of 13.88. Figure 1 shows the distributions of the scores on reading levels on the AIMS measure for the two groups. Similarly, a Mann-Whitney U test was conducted to evaluate the hypotheses that students with Cystic Fibrosis would score lower, on average, than the comparison group on the math achievement ranking levels on the Arizona Instrument to Measure Standards. The CF group had an average rank of 10, and the comparison group had an average rank of 15. The results of the test for math were in the expected direction and significant, $z = -2.01$, $p = .05$. Figure 2 shows the score distributions for the AIMS math levels for the two groups.

To address the second research question, Mann-Whitey U tests were conducted to evaluate the relationship between the presence of CF and motivation

(Beliefs, Expectancies, and Usefulness) towards math and reading resulting in a total of six analyses. Table 2 presents means, medians, and interquartile ranges for these outcomes. Separate Mann-Whitney U tests were conducted with scores for each motivational subscale (beliefs, expectancies, and values) on Eccles' self-report measure as dependent variables. Group membership was the independent variable for all six analyses. The dependent variable for the first analysis was the scale score for children's beliefs about their abilities in reading as assessed by Eccles' questionnaire. The results of the test were not significant, $z = -.17, p = .87$. Participants from both groups had a median score of 4.33. The second analysis evaluated the relationship between the independent variable, with the dependent variable being the scale score for children's expectancies regarding their achievement in reading as assessed by Eccles' questionnaire. The results of the test were not significant, $z = -.86, p = .39$. Participants with CF had a median score of 4.5 and children from the comparison group had a median score of 4. The third analysis evaluated the relationship between group membership and the scale score for children's attitudes about usefulness, interest, and importance of reading. The results of the test were not significant, $z = -.1.88, p = .06$. Participants with CF had a median score of 4.5 and children from the comparison group had a median score of 3.67. The dependent variable for the fourth analysis was the scale score for children's beliefs about their abilities in math as assessed by Eccles' questionnaire. The results of the test were not significant, $z = -.68, p = .50$. Participants with CF had a median score of 3.67 and children from the comparison group had a median score of 4. The fifth analysis evaluated the

relationship between the independent variable, with the dependent variable being the scale score for children's expectancies regarding their achievement in math as assessed by Eccles' questionnaire. The results of the test were not significant, $z = -.02$, $p = .98$. Participants from both groups had a median score of 4. The sixth analysis evaluated the relationship between group membership and the scale score for children's attitudes about usefulness, interest, and importance of math. The results of the test were not significant, $z = -.31$, $p = .76$. Participants from both groups had a median score of 3.83.

The third research question is in regard to the presence of a relationship between achievement performance levels and the multiple motivation subscales. Bivariate Spearman rho correlation coefficients were computed among the reading achievement and math achievement performance levels and scores for each of their three respective motivation subscales: Expectancies, Beliefs, and Values for those academic subjects. None of the correlations between the motivation scores and the reading or math achievement levels were significant. The reading ability beliefs scale was positively correlated with the reading expectancies scale and the reading achievement scale, and the correlations were significant ($p < .01$). Also, the reading values scale was positively correlated with the reading expectancies scale, and the correlation was significant ($p < .01$). The correlations among the reading motivation scales ranged from .50 to .74. These statistics are reported in Table 3. The math ability beliefs scale was positively correlated with the math expectancies scale and the math achievement scale, and the correlations were significant ($p < .01$). Also, the math values scale was

positively correlated with the math expectancies scale, which was significant ($p < .01$). The correlations among the math motivation scales ranged from .52 to .78. These statistics are reported in Table 4.

Chapter 5

Discussion

The current study considered differences in academic achievement between children with CF and healthy peers in the subjects of reading and math. Further exploration was directed at detecting differences in the motivational components of ability beliefs, outcome expectancies, and task values for the two academic domains between the groups.

Summary and Explanation of Results

Academic achievement.

Some evidence for differences in math achievement was present on the Arizona Instrument to Measure Standards (AIMS), as differences were present when looking at math achievement level rankings. There was no evidence to suggest differences in reading achievement. One hypothetical explanation for the presence of possible group differences in math achievement but not reading could be the ease with which a learner can engage in the subject independently. Perhaps it is easier for chronically ill children to engage in reading material when they are out of school, making it less likely that they will fall behind their peers in that subject, whereas engagement in math materials relies more on direct instruction. Additionally, the sample overall performed rather successfully on both subjects of the AIMS test.

Past literature, Thompson et. al.'s (1992) study indicated that approximately 20% of children with CF were achieving below grade level in both reading and math. This differs from the current study in that most students (all but

one of the 12 in the reading domain only) from the CF group were meeting grade level standards for both subjects. An encouraging interpretation of this divergence is that perhaps changes in special education (IDEA 2004) have promoted more academic support for “health impaired” children, including those with CF. Support for this notion from the current study exists in that 20% of the participants from the CF group were reported to be receiving services with an IEP and an additional 20% of the group having a 504 plan in place for services, versus only 7% of the participants from the comparison group having an IEP.

Achievement motivation.

The second research question concerned possible differences in patterns of motivation between children with Cystic Fibrosis and healthy peers, which remains an unsubstantiated notion. No significant differences existed between the groups for children’s beliefs about their abilities, their expectancies for achievement, nor for their subjective values for reading and math tasks. Although children with CF tend to have more responsibilities ensuing from the necessity to engage in daily medical treatment, it would not appear that those responsibilities are interfering significantly with their motivation for academic achievement. Nonsignificant results were also found in a past study investigating the school motivation (including self-concept and locus of control) of children with chronic illnesses (Kehrer, 1998). However, this topic remains a largely unexamined issue. Kehrer’s 1998 study reported psychometric problems with the measure of motivation, and the measure used in the current study was not designed for use with chronically ill children either. To be confident that children with CF and

other chronic illnesses are not at risk for differences in aspects of motivation development of measures designed for that purpose may be necessary.

Academic achievement and motivation.

The hypothesis in research question three regarding the measured aspects of motivation as predictors for actual achievement also remains unclear. This finding was counter to previous literature illustrating correlations and the linear relationship of the motivational constructs with achievement (Eccles, 1983; Wigfield & Eccles, 2000). Methodological issues of the study likely account for this in general. The limited size of the present sample, coupled with the Eccles' scale not having been developed for use with pediatric populations likely interfered with detection of a relationship between academic motivation and achievement in the present study.

Implications

In theory, students with less access to academic learning time because of school absences related to a chronic illness would show lower academic achievement. Furthermore, knowledge of such a disadvantage might reduce motivation if students' perceptions of their abilities or expectations for achievement were jeopardized. Additionally, the obligation to engage in non-academic tasks such as daily medical treatment in the form of breathing treatments, nutritional supplements, and adhering to medication prescriptions could conceivably interfere with students' subjective values for other tasks, such as academic ones. On the other hand, the knowledge that one's occupational options may be limited due to physical and health constraints might make

preparing one's self educationally seem more valuable. Many of these theoretical notions were unsubstantiated by the current study, with the exception of differences found for math achievement. Although variables such as high absenteeism and low motivation are consistently associated with low achievement in the achievement literature, the current study suggests that those relationships may not be as straight forward when applied to situations of pervasive chronic illnesses, such as Cystic Fibrosis. From a theoretical standpoint, questions regarding the academic achievement of pediatric populations necessitate not only incorporation of these variables and constructs into investigations but also consideration regarding the extent to which they confound and interact with one another. In this case, classic predictors of academic achievement like absenteeism and motivation may not be as reliable as they are for the general population.

When studying the relationship between these variables and chronic illnesses, it will be important to operationalize the variables as clearly as possible. For example, absenteeism may not be the best measure of engagement in academic learning for pediatric populations, as it is possible that they receive additional educational instruction when hospitalized or through special education services.

Because many factors may interact in counterintuitive ways for children with diseases like Cystic Fibrosis, it is important to consider each student on an individual basis until patterns between predictors and outcomes can be established. Parents and educators are therefore encouraged to carefully monitor the student's progress. Absenteeism will likely interfere with progress monitoring

on a frequent and consistent basis, making collaboration between parents, educators, and hospital personnel essential.

Limitations

The study was conducted with limitations related to sampling and certain psychometric features. The participants with Cystic Fibrosis were recruited through mailings and follow up phone calls. In accordance with the Institutional Review Board's guidelines, as well as respect for participant's privacy, follow up was limited to two phone calls. The recruiting method resulted in a relatively small sample size. An a priori power analysis informed that a total sample of 26 participants would be necessary to attain significance with large effect sizes for the selected statistical procedures. This quota was met for research question two regarding differences in motivation, but not for research questions one and three regarding differences in academic achievement and the relationship between motivation and achievement respectively because of the missing achievement data due to the 10th graders not having been administered the achievement instrument. The consequence of this occurrence is a lack of power. Furthermore, the sample was not random in that unknown factors could be affecting the patients who chose to respond versus those who did not.

Some psychometric properties of the instruments used represent additional limitations. Because Eccles' (1983) questionnaire for ability beliefs, expectancies, and values was not developed for use with children with chronic illnesses, it is possible that it does not detect aspects of motivation pertinent only to that population. For example, questions related to subjective task value only ask the

student to consider academic tasks. Perhaps if the additional responsibilities related to daily medical treatment facing children with CF were made more salient to the students their responses would reflect a more atypical pattern.

Future Directions

Future research in this area should include an investigation of the degree to which factors such as receiving special education services, support group education, family investment and other resiliency promoting factors mediate the relationship between the presence of a chronic illness in a student's life and academic achievement so that they can be applied efficiently and consistently. Based on the current study, it is unclear what factors are promoting resiliency. Thus, qualitative research investigating the effectiveness of particular services may be warranted. Rigorous standards should be upheld in selection of psychometric instruments to ensure measurement of meaningful constructs is taking place. Educating students with pervasive chronic illnesses such as CF is a complicated issue, and knowledge about factors in isolation may not be useful to educators, families, medical practitioners or students themselves.

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APPENDIX A






ECCLES' ITEMS USED TO ASSESS CHILDREN'S ABILITY BELIEFS

AND SUBJECTIVE TASK VALUES






Math Questions

Ability Beliefs Items






1. How good in math are you?

Not at all Good	A little Good	Okay	Good	Very Good
				

2. If you were to list all the students in your class from the worst to the best in math, where would you put yourself?






One of the Worst	Bottom Half	Right in the Middle	Top Half	One of the Best
				

3. Some kids are better in one subject than in another. For example, you might be better in math than reading. Compared to most of your other school subjects, how good are you in math?






A lot worse in math than other subjects	A little worse in math than other subjects	About the same	A little better in math than other subjects	A lot better in math than other subjects
				

Expectancy Items

1. How well do you expect to do in math this year?






Not at all well	Just a little well	Okay	Pretty well	Very well
				

2. How good would you be at learning something new in math?






Not at all good	Just a little good	Okay	Pretty good	Very good
				

Usefulness, Importance, and Interest Items






1. Some things that you learn in school help you do things better outside of class, that is, they are useful. For example, learning about plants might help you grow a garden. In general, how useful is what you learn in math?

Not at all useful	Just a little useful	Somewhat useful	Pretty useful	Very useful
				






2. Compared to most of your other activities, how important is it for you to be good at math?

Not at all important	Just a little important	Somewhat important	Pretty important	Very important
				






3. For me, being good in math is

Not at all important	Just a little important	Somewhat important	Pretty important	Very important
				





4. Compared to most of your other activities, how important is it for you to be good at math?

Not at all important	Just a little important	Somewhat important	Pretty important	Very important
				

5. In general, I find working on math

Very boring	A little boring	Okay	Somewhat fun	Very fun
				






6. How much do you like doing math?

Dislike it	Dislike it a little	Neither like nor dislike	Somewhat like it	Like it very much
				






Reading Questions

Ability Beliefs Items






1. How good in reading are you?

Not at all Good	A little Good	Okay	Good	Very Good
				

2. If you were to list all the students in your class from the worst to the best in reading, where would you put yourself?






One of the Worst	Bottom Half	Right in the Middle	Top Half	One of the Best
				

3. Some kids are better in one subject than in another. For example, you might be better in math than reading. Compared to most of your other school subjects, how good are you in reading?






A lot worse in reading than other subjects	A little worse in reading than other subjects	About the same	A little better in reading than other subjects	A lot better in reading than other subjects
				

Expectancy Items

1. How well do you expect to do in reading this year?






Not at all well	Just a little well	Okay	Pretty well	Very well
				

2. How good would you be at learning something new in reading?






Not at all good	Just a little good	Okay	Pretty good	Very good
				

Usefulness, Importance, and Interest Items






1. Some things that you learn in school help you do things better outside of class, that is, they are useful. For example, learning about plants might help you grow a garden. In general, how useful is what you learn in reading?

Not at all useful	Just a little useful	Somewhat useful	Pretty useful	Very useful
				






2. Compared to most of your other activities, how important is it for you to be good at reading?

Not at all important	Just a little important	Somewhat important	Pretty important	Very important
				






3. For me, being good in reading is

Not at all important	Just a little important	Somewhat important	Pretty important	Very important
				






4. Compared to most of your other activities, how important is it for you to be good at reading?

Not at all important	Just a little important	Somewhat important	Pretty important	Very important
				

5. In general, I find working on reading

Very boring	A little boring	Okay	Somewhat fun	Very fun
				

6. How much do you like doing reading?

Dislike it	Dislike it a little	Neither like nor dislike	Somewhat like it	Like it very much
				

APPENDIX B
TABLES AND FIGURES

Figure 1. AIMS Reading Achievement Ranks Box Plot

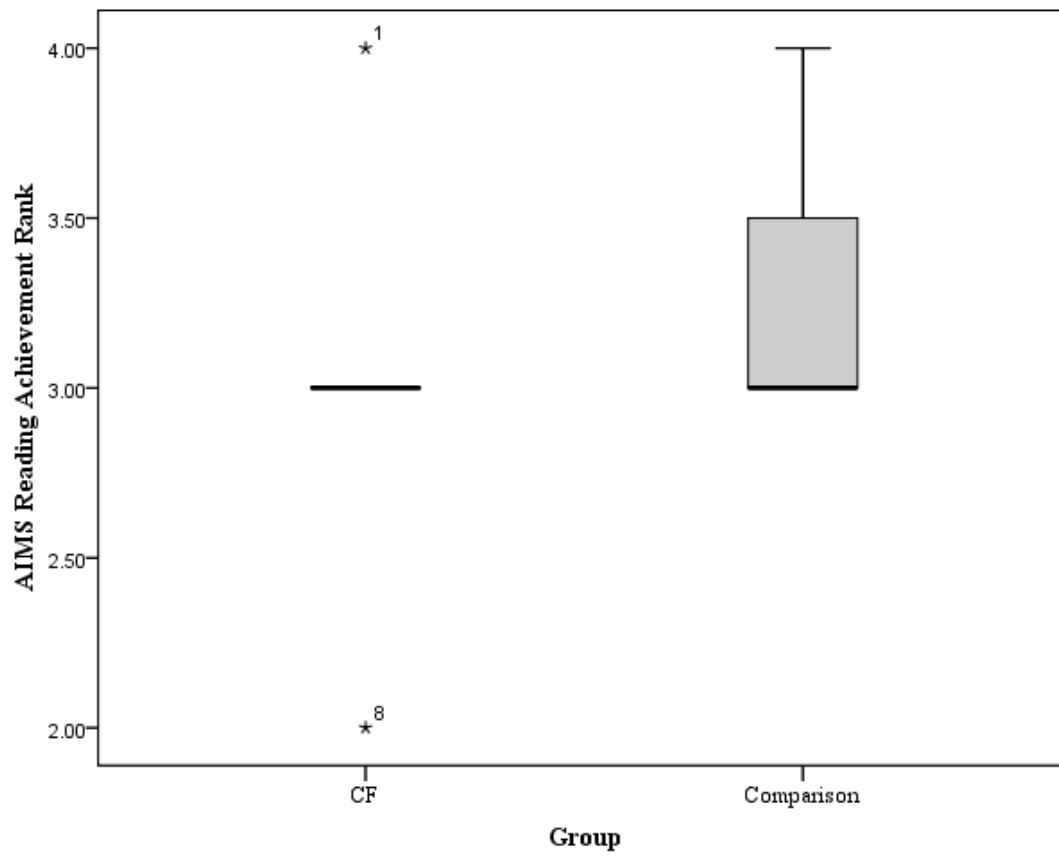


Figure 2. AIMS Math Achievement Ranks Box Plot

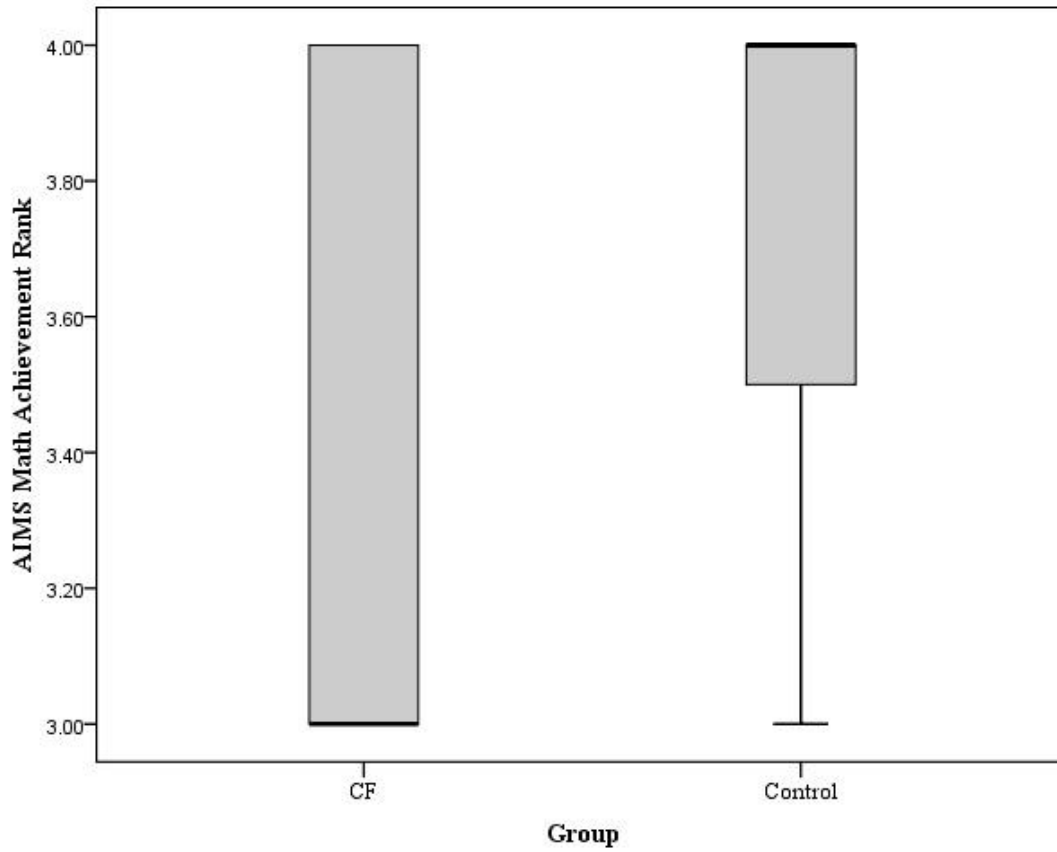


Table 1

<i>AIMS Reading and Math Achievement Performance Level Descriptive Statistics</i>						
Frequencies	Falls Far Below	Approaches	Meets	Exceeds	Median	Mode
CF Group						
Reading	0	1	10	1	Meets	Meets
Math	0	0	8	4	Meets	Meets
Comparison Group						
Reading	0	0	9	3	Meets	Meets
Math	0	0	3	9	Exceeds	Exceeds

Table 2

Outcome Means for CF and Comparison Groups

Eccles' Scale	CF				Comparison				Total			
	<i>n</i>	<i>M (SD)</i>	Median	IQR	<i>n</i>	<i>M (SD)</i>	Median	IQR	<i>n</i>	<i>M (SD)</i>	Median	IQR
Reading												
Ability beliefs	15	4.02 (.87)	4.33	1.33	15	4.09 (.64)	4.33	.67	30	4.06 (.75)	4.33	1.08
Expectancies	15	4.27 (.88)	4.50	1.50	15	4.13 (.55)	4.00	1.00	30	4.20 (.73)	4.00	1.50
Values	15	4.28 (.73)	4.50	1.33	15	3.80 (.66)	3.67	1.00	30	4.04 (.73)	3.83	1.25
Math												
Ability beliefs	15	3.64 (.87)	3.67	1.00	15	3.84 (.69)	4.00	1.00	30	3.74 (.77)	3.83	1.00
Expectancies	15	3.93 (.98)	4.00	1.00	15	4.07 (.50)	4.00	1.00	30	4.00 (.77)	4.00	1.00
Values	15	3.80 (.72)	3.83	1.33	15	3.59 (.97)	3.83	1.33	30	3.69 (.85)	3.83	1.21

Table 3

Correlations for Scores on the AIMS Reading and Reading Motivation Scales

Measure	AIMS Reading	Reading Ability Beliefs	Reading Expectancies
Reading Ability Beliefs	.27		
Reading Expectancies	.00	.77*	
Reading Values	-.15	.50*	.63*

* $p < .01$.

Table 4

Correlations for Scores on the AIMS Math and Math Motivation Scales

Measure	AIMS Math	Math Ability Beliefs	Math Expectancies
Math Ability Beliefs	.35		
Math Expectancies	.31	.78*	
Math Values	.05	.52*	.52*

* $p < .01$.

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