

**Parental Attitudes and the Effects of Ethnicity: How they Influence  
Children's Attitudes toward Science Education**

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**Abstract**

The purpose of this study was to explore the manner in which parents' attitudes toward science learning influences their children's attitudes and the effect of ethnicity on attitudes toward science learning. The results of this study show that parental attitudes toward science learning were influenced by both parents' early life experiences and their own early science learning experiences in school. Also in this study, even though the parents' attitudes, as seen across ethnicities, were found to be positive toward science learning, their attitudes failed to be transformed into serious actions taken to influence their children's attitudes toward science learning. In the absence of real parental involvement, parents' attitudes, displayed as beliefs and intentions, have been found to be of limited importance in influencing either student attitudes or attainments. Cultural, ethnic and social effects were found difficult to measure. In sum, this study concluded that there are three major factors that could heavily influence student academic success in science across cultures and ethnicities: (a) parental attitudes toward science education (b) parental involvement in science education and (c) parents' social stratification. Parents' subculture and social construction block or promote many opportunities for individual performance.

## Introduction

It is not surprising that many other nations' students are scoring better than American students in math and science. In 2007, the Trends in International Mathematics and Science Study (TIMSS) results reflect that students the United States (US) do not achieve well when compared with other nations (Martin, Mullis, & Foy, 2008). The decline of American students' scores in math and science was supported by another well respected standardized test, the Programme for International Student Achievement (PISA) according to its 2010 data release (Kerachsky, 2010).

At the beginning of the current national and global economic crises it is increasingly clear that United States students must become competitive and proficient in science and math. However, there are some important barriers to increased proficiency. US student performance on the 2007 and previous years TIMSS differs across ethnicities, rather than reflecting an even distribution of mathematics and science achievement across the nation's population. Studies have shown an achievement gap among the nation's children that is associated with many factors such as socioeconomic status and ethnicity (De Civita, Pagani, Vitaro, & Tremblay, 2004), as well as parental educational level and parental support (Hakkinen, Kirjavainen, & Uusitalo, 2003).

Enrolment, graduation, and dropout rates in the US identify a long term historical gap in student achievement. These statistics indicate that little progress has been made among minority students. For decades African American, Native American and Latino students have scored lower than Asian American and white students on every measurement scale (USDE,

2009). These continue reports support the idea that social, structural, and cultural changes in US society will not necessarily help to bring the desired academic outcomes because the problem of inequality exists within the educational system itself (Lareau, 2001; Alan & Hood, 2000). Statistical data have shown a continuing educational achievement gap among the student population (Venneman, Hamilton, Baldwin, Anderson & Rehaman, 2009). These statistical data divide the students into lower achievement students: African American and Latino students, and higher achievement students: white and Asian American students (Barton, 2003; Olmedo, 2003; Ramirez & Carpenter, 2005; Lambert, 2009).

Student achievement gaps have become a serious concern, with various studies focusing on achievement related to cultural and parental factors (Stevenson & Chen, 1990; Chen, 2000). Parents' attributes, and how they may affect children's performance, have been investigated from many points of view: parents' involvement (Epstein, 2001; Keith & Lichman, 1994; Hoover-Dempsey & Sander, 1997; Hoover-Dempsey et al., 2005), parents' expectations (Patrikakou, 2004), parents' support and attitudes (Jacobs & Eccles 2000; Bergman & Killen, 1999; Field-Smith, 2004) and parents attitudes functioned as children's perceptions. Parents' educational involvement, as well as attitude towards education, positively influenced students' educational achievement (McWayne et al., 2004; Fantuzzo, 2000, cited by Lee & Bowen, 2006).

Attitude has been defined diversely across the literature. Researchers often define attitude from an individual perspective in order to serve the case being studied. In the academic literature, there is no consensus based definition for the term "attitude" however, it has been functioned to measure cognitive capabilities, or affective behavioural dimensions (Fishbein & Ajzen, 1975). For instance, some researchers have defined attitude from an affective perspective as having a positive or negative feeling toward learning in general and

science learning specifically (Crawley & Koballa, 1985). Other researchers included cognitive aspects in the definition of attitude, thus the definition became associated with terms such as views, opinion, or beliefs (Aikendhead , 1997; Stein & McRobbie, 1997). Based on behaviour perspectives, attitude is defined by Oppenheim (1992) as a tendency to respond to a certain stimulus in certain way. Thus, in the absence of consensus about the definition of attitude, it is up to each individual researcher to decide what his or her definition for "attitude" might be. Applying to this study, attitude means a series of tangible actions (involvements) which are derived by a personal belief; the belief and the sequences actions are able to be evaluated through interviewing individuals (Oppenheim, 1992). Thus, in this study parents' attitudes means a combination of parents' beliefs and involvement where it could be reflected through the parents' actions, and may influence their children's reactions. The reason behind this conservative combination is that there is no way to measure the effectiveness of parents' attitudes on their children's attitudes without having these parents interviewed about their inner beliefs regarding learning science. This would include either asking for evidence that reflects their personal beliefs or having their children interviewed and/or observed in a classroom. There is no guarantee that belief alone, without involvement, is beneficial.

This research targets parents of students and interviewing children of the participants is not part of this study. This researcher believes that parents' beliefs, if matched by their active involvements toward science learning, will influence their children's attitudes toward learning science and as a consequence may influence the children's academic attainment in the science disciplines. In research, attitudes toward science learning are well-documented and have been correlated with parents and students from many different perspectives: (a) students' attitudes toward schooling and different school subjects compared to science; (b)

students' attitudes toward science as a discipline and as a school subject; (c) the relationship between attitudes toward science and different instructional strategies; (d) the relationship between attitudes toward science in general and areas of school science; (e) the relationship between attitudes toward science and student achievement; (f) the influence of teacher behaviour toward students' attitudes; and (g) the relationship between attitudes to science and variables external to the classroom such as age, gender, ethnicity, and grade level (Alsop, 2005). Studies reported that students' attitudes toward science are influenced by their parents' attitudes when associated with parental involvement and expectations (Bregman & Killen, 1999; Jacobs & Eccles, 2000) and as result children's behaviours are changed positively and their learning outcomes are raised (Koballa, 1988; Laforgia, 1988).

In this study, the researcher intends to explore the links between parental attitudes and children's attitudes toward science learning across major ethnicities in the US, in the light of theory of reasoned action and cultural theory along with social structural positions. Thus, this study tried to answer questions such as whether or not parents' attitudes toward science learning influence their children attitudes toward science learning. No matter what the answer for this question, the researcher is also interested in exploring whether the parents' attitudes were associated with active parental involvement, and also whether and how parental attitudes and involvement differed across ethnic groups.

### **Theoretical Framework**

Two theoretical frameworks were used to furnish the conceptual argument for this research. They are: (1) the theory of reasoned action and, (2) a two-in-one theory combining cultural capital theory and the social structural positions model. The theory of reasoned action

somewhat can explain the linkage between parents attitudes and their children's attitudes with exclude to the culture and social structure class factors. Perception can be transmitted to children. Throughout the literature, this mixed-model highlights the barriers that children face starting from their indigenous culture and the social structure by which they are granted advantage or disadvantage related to academic success.

The theory of reasoned action (TRA) was developed by Fishbein and Ajzen in 1975. According to the theory the intention to behave in a certain manner and performing a favourable or non favourable action goes through a formative procedure. The outcome of behaviors can be predicted and evaluated, not just only through the person's expression but also through effective actions. A person's behaviour and performance are influenced by internal and external factors. The internal factors, things such as confidence and the external factors such as culture, ethnic background, parents, peers, teachers, and access to environmental resources work either way; to support or to discourage. Science educators have found that some external variables such as gender, science ability, and academic skills had no influence on the students' intention to enrol in a particular science course, but others such as attitude toward enrolling and social support for doing so were major predictors (Crawley & Coe, 1990 as cited in Alsop, 2005). Furthermore, the researchers also found that parents' beliefs about their children's competency in science were an important factor (Steinberg, 1996; Crockett, 2000; Patton, 2000; Bempechat, 2000). Attitudes are learned; therefore parents can transmit them to their children, as portrayed by Figure1, below.

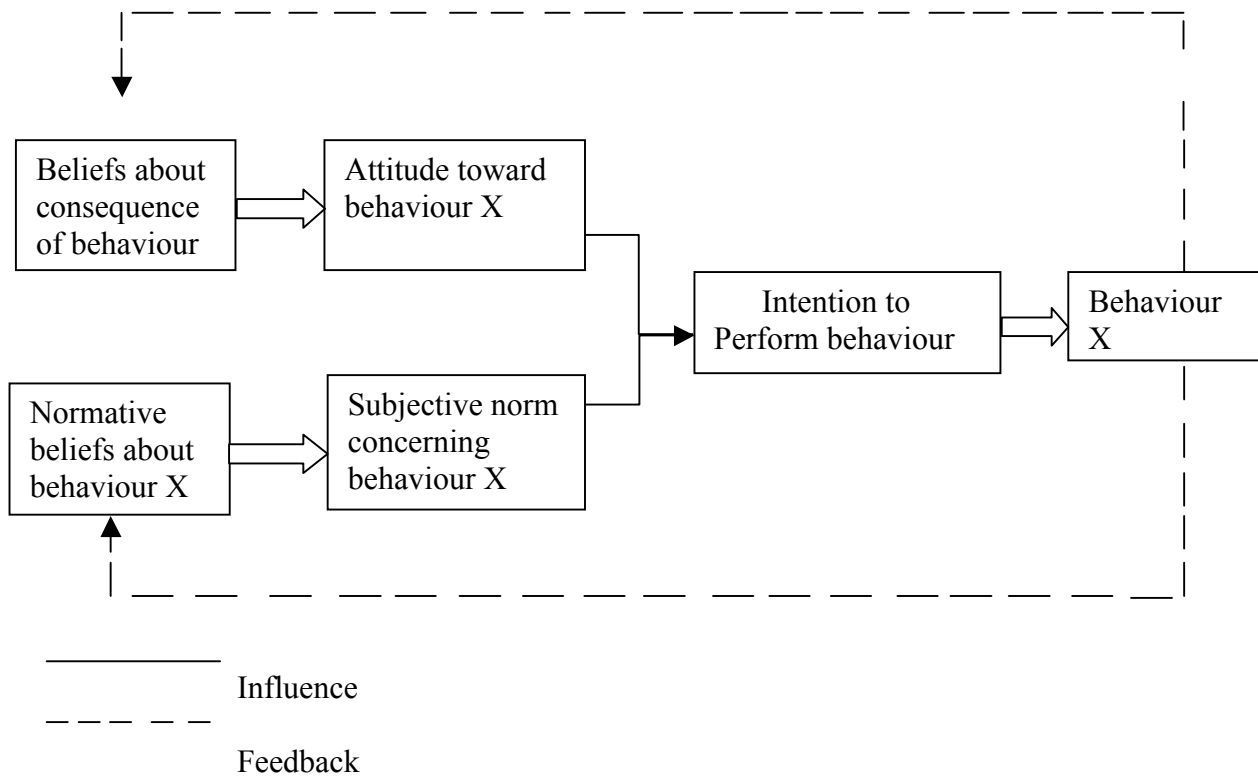


Figure 1. Schematic presentation of concept framework for the prediction of specific intentions and behaviours. (Adapted from Fishbein & Ajzen.1975. p. 17)

Figures 1 (above) and 2 (below) summarize the historic evolution of Ajzen and Fishbein’s framework which was first published in 1975. Through decades of research on the attitudes- behavior relationship these figures have become more complex (Ajzen, 2010). What is being inferred in Figure 1 is that attitude is complexly constructed and yet may be evaluated using verbal or nonverbal responses (Ajzen, 2010). The theory of planned behaviour (TPB) shown in Figure 2 is an evolution of this research on the relationship between attitude and behaviour.



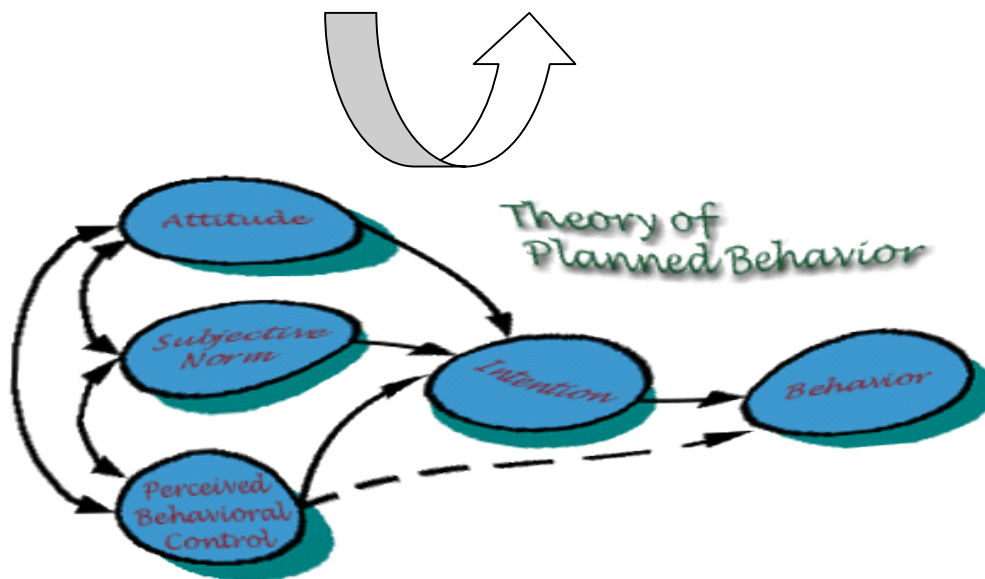


Figure 2. The theory of planned behaviour. Adopted from Ajzen's website, Dec, 25 2010  
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What can be noted here is that the component of behavioural normative belief and control belief were dropped from the first model because it was assumed by the authors as simply a different way to evaluate behavioral intention (Ajzen & Fishbein, 1980 as cited by Manstead, 2009). As applied to this study, parents' attitudes may be evaluated through the residues of their past early life and their educational experiences. In other words participants' early life and educational experiences with science education may pattern their current attitudes towards science education, and as a consequence, influence their children's attitudes toward science as part of their academic curriculum.

As an explicit explanation for these figures is out of the scope this study, presenting the figures here helps illustrate how complex attitudes may be and how other affiliated factors such as subject norm and perceived behavioural control may skew expressed attitudes about desired actions. Besides that, these two frameworks have been used widely to produce scales to measure the attitude –behaviour relationship. For this current study, a scale to measure

targeted behaviours was alternated with taped digitally recorded interviews. A qualitative methodology technique, face - to -face interviews could easily be more valuable to the research than handing out a survey designed to capture hypothetical value as attitudes.

Cultural capital theory and social structure explanations were developed by Pierre Bourdieu (1973) and Steinberg (1981) respectively. In the later segment of this mixed-model project the researcher will not go through the historical approach of evolving human ethnic social structures, but will instead focus on Steinberg's positions (1981) that explain differences in achievement outcomes. Reviewing literatures indicates that both cultural capital and social structure perspective have been used in isolation to explain academic success across minority immigrants groups. Despite the separation, both approaches have been used to explain academic attainment gaps among minorities and both concluded that dominant culture and social class system privileges explained all of the differences in educational attainment. Because of the similarity of results the combination between both approaches in this study has been chosen.

According to Bourdieu's theory schools structure different levels of a social class system. This hierarchical differentiation between socio-economic class levels will virtually grant the dominant groups' cultural capital reproduction (Bourdieu & Passeron, 1977). Bourdieu's notion of cultural capital also involves social structure relationships that provide access to institutional resources (Lareau, 2001). The terms used to explain the social structure were "habitus" and "field". (Lareau, 2001). Researchers have identified "habitus" as "a mental structure of dispositions" that results from social training and early institutional experiences (Brubaker, 2004; Lareau, 2001; Reed-Danahay, 2005). The term "field" is identified as a "network of social relations" (Grenfell & James, 1998; Horvat, Weininger, & Lareau, 2003; Council of Europe, 2001). Thus, whoever is familiar with and understands

the structure of the network or “field” will gain social privilege (Grenfell & James, 1998; Lareau & Horvat, 1999). As applied to this study, one would expect that parent’s educational involvement (e.g. communicating with teachers, visiting schools, involvement in school science activity), will lead to a network relationship between an individual parent (or both parents) and school teachers, principals, board members, and science teachers (school system). This kind of network relationship will be understood by the child; it will influence the child’s attitude and his or her academic achievement. Hence, we can understand how positive parental attitudes toward science learning, along with their involvement in the educational system network, create advantages that flow to their children.

In the light of the cultural capital explanation, Lee and Bowen (2006) reported that parents can maintain this kind of network relationship with the educational system through three forms: personal dispositions, attitudes, and knowledge gained from experience (also cited in Grenfell & James, 1998; Robbins, 2005; Olneck, 2000; Ngo, 2008). Because cultural capital involves a collection of “cultural dispositions” (Brubaker, 2004, p.41) it may be difficult to distinguish it from “habitus” (Robbins, 2000). Thus culture capital, as a set of characteristics, can be inherited by an individual family member and relate the individual to the school system. Although cultural capital is possessed by an individual, it is more influenced by the relationship between the school system and the family’s disposition through the values and practices of the educational system with which the family interacts. Thus, cultural theory connects the student’s academic achievement outcomes to the beliefs values, and practices taught and learned at home, at school, and in the community. In other words, through these shared values and beliefs members of a group form their identity. It is clear that values and beliefs (Cultural elements) may either enhance or limit academic achievement.

Steinberg's notion of culture social structure corresponds with Bourdieu's (1977) proposition of social structure which is that students with higher levels of cultural capital are more likely to succeed academically (Berger, 2000). Steinberg claims that poverty occurs across generations because children met the same structural conditions that their parents faced (Steinberg, 1981). Lieberman (1980) underlined that a culture of poverty born from social structure feeds upon itself. Social structural factors are those elements that may either slow down or enhance academic achievement. The notion of class stratification is often inherited; from parents to their offspring. This means that the access to institutional sources of privilege and social advantage may remain at the same level for different ethnic groups. This concept is hard to measure; therefore the researcher presumed that the early life and science education experiences of parents would shape their attitudes toward science learning. Early life experiences and early science experiences are virtually fed by culture and social structure components. Connecting parents' early childhood experiences to their children's current experiences based on reasoned theory, which says that attitudes are learned is also important in predicting how parents, across ethnicities, interact and communicate with their children and their children teachers (McNeal, 1999; Desimone, 1999).

This research explores how parents in different sub-culture groups influence their children's academic achievements in science. The questions that the study tries to answer are: Do parents' attitudes toward science education influence their children science learning? Is attitude alone enough or does need to be functioned as parent involvement? Is the result of parental attitude and involvement consistent across different ethnic groups? What is the role of subculture capital and social structure play roles on science learning?

As the research on student academic achievement evolves, it is obvious that both cultural and social structural factors must be taken to account in order to give us a deep

understanding of how belonging to certain cluster of people corresponds to success. Such a task helps us to analyze a particular ethnicity and makes a useful comparison among and between groups. Thus, as an example, if we wanted to compare Mexican Americans as a subgroup of Latino Americans to other subgroups, first we have to understand the culture and social structure of Mexican Americans, and how their particular social structure and culture can contribute to the group's success, and more importantly, we must distinguish between Mexican Americans as a subculture and other Latino subgroups such as Cuban Americans.

### **Melting Pot: The Culture Achievement Gap**

The United States, as a nation of immigrants, has many diverse ethnicities – White, African, Hispanic, Asian, and others. These immigrants came to America bringing their original heritages, cultures, and beliefs to live the American dream. Where these immigrants provide America with many diverse heritages and add richness to the national landscape, they also bring with them various levels of education and certain cultural perceptions related to education which may lead to achievement gaps between students from different ethnic backgrounds.

Achievement gaps among American students from different subcultures are obvious and have been the subject of many studies (Williams, 2004; Haycock, Jerald, & Huang, 2001; Lubienski, 2001; National Centre for Education Statistics, 1999). Some of these studies correlate student achievement gaps to culture and social structural propositions that already existed in American society. Consequently, several immigrant groups have received attention in studies that draw on both cultural and social structural arguments. For instance, Waters (2000) compares West Indians as a model of socially successful African Americans. Chen (1998) compares a minority subculture group to its original culture overseas – Asian

American students to Asian students (see also Madigan, 2006). In the US, what has been found is that Asian Americans routinely outperform whites in terms of test scores in math and science (Jose & Huntsinger, 2005; Kao, 1995; Kao & Thompson, 2003; Okagaki & Frensch, 1998). African American and Latino American students consistently achieve lower scores on standardized tests compared to both white and Asian American students (Grigg & Dino, USDE, 2009)

While white students and Asian American students' score at or above average on national math and science tests, African and Hispanic students remain below average. In the academic literature, African American student outcomes have been examined using variables such as family, peer groups, and community. Recent reports have found as many as 47% of black male students graduate from high school on time (Barboza, et al., 2008). By many indications, social variables play a critical role in the under achievement and lack of achievement motivation among black students. Black children learn at an early age the stereotypes associated with living in a non-color blind society. Many, if not most, black students are aware of their race, and their cultural beliefs and values are often already set (Spencer, Kim, & Marshall, 1987). The literature suggests that black children are at risk of being neglected in educational settings, and closing the achievement gap needs both social and educational commitment (Lesley & Bainbarga, 2001).

Latino students, like black students, are much less successful in enrolling and achieving in higher education, as 22-25% of Latino and African American students register in pre-college courses at their high school (Wilkins, et al., 2006). Furthermore, Hispanic and black student populations are less likely to remain in college compared to White American students (Bailey, Jenkins, & Leinbach, 2005; Cook & Cordova, 2006). According to the 2000 NAEP report, by the end of grade level 4, African American and Latino students are already

about two years behind other students. The National Centre for Education Statistics (NCES) reported in 2006 that the overall dropout rate for Hispanic high school students was very high (Abigail, 2003; Hernandez & Nesman, 2004). These studies neglected to distinguish whether the students were born abroad and may have completed some of their education there, or were born and educated entirely in the United States. Indeed, the longer Hispanics families stay in America, the better their children perform in school. Success depends on acquiring English (Steinberg, 1996). Thus, fixing that gap needs not only work on students' potential but also includes many other forces, such as social structural factors and psychological and cultural variables that have been found to slow down achievement and achievement motivation among black and Latino students. Parents are critical to influencing their children's academic achievement (Epstein; 2001; Grolinck, & Slowiaczek, 1994)

### **Melting Pot Culture: The Effects of Parent Involvement**

Although the impact of parent involvement in their children's academic endeavours is beneficial among children from all ethnic groups (Epstein, 2001; Henderson & Mapp, 2002; Jeynes, 2003), some studies suggest that positive or negative effects are controlled or heavily influenced by demographic characteristics (Desimone, 1999; McNeal, 1999). Desimone (1999) reported a significant relationship between many types of parental involvement and students from different ethnic and economic status groups. For example, frequent discussions between parents and students about education were significantly more predictive of gains in achievement among white American students than among other groups. Jeynes (2003) presented evidence that parent involvement (e.g., communicating with the school, checking homework, encouraging outside reading) among Latinos had more influence upon their children than it did for Asian Americans. The author's explanation was that parent

involvement may have the greatest impact in the absence of other cultural factors that promote academic achievement, such as the strong emphasis on education found in many Asian American cultures (Jeynes, 2003).

As parents' socioeconomic status and educational levels are typical examples of social structural aspects and as education is associated with cost, limited financial resources can substantially slow or retard academic achievement. Parents' education level also may present different types of involvement because involvement may differ in regard to parent disposition. The differences in "habitus" or disposition vis-a-vis parent involvement may derive from differences in income, educational level, and confidence in the educational system (Grenfell & James, 1998). According to their habitus, parents from a particular group may show different levels of parent involvement at home and at school. Parents with low levels of education, for example, may be less involved at school because they feel less confident about communicating with school teachers and administrators for a variety of reasons, which may include lack of language skills, lack of knowledge about the school system, or reluctance to approach authority figures. Additionally, parents from some cultures may value home educational involvement more than involvement at school.

These different levels of parental involvement will lead to cultural capital across groups. While some researchers reported that, in general, parents across all social classes highly value education, even if they had negative early experiences with the educational system (Grenfell & James, 1998). However, finding variations in the levels of involvement will support Bourdieu's (1977) claim that families vary in terms of educational habitus. Variations in parents' habitus may shrink the ability of their children obtaining social capital even when parents are able to communicate with the school community. In the literature, minority group parents are reported to have less desire to visit their children's' schools



compared to dominant group parents. They may feel less comfortable and welcome than mainstream (dominant group) parents or they may feel less potential to overcome the barriers that lead to access for their children to the school's social and facility resources (Page, Whitting & Maclean, 2007) . As parents from minority groups possess less cultural capital, they may need to make more efforts to ensure their children's academic success by redeeming what is missed in schools by extensive educational support in home environment (Lee & Bowen, 2006).

This study assumes that there are three major factors that heavily influence student academic success and accumulated achievement in general, and specifically in science, across cultures and ethnicities. These are: (a) parents' attitudes toward science education which can be transmitted to children according to reasoned action theory, (b) parental involvement, which is a natural reflection of parental attitudes based on the reasoned action theory and (c) parents' social stratification which is proposed by the culture and social structural model, in which students who meet certain social structural conditions will gain a positive academic advantage to experience academic success, and vice versa. Thus, elements like parents' socioeconomic conditions, parents' attitudes, parents' perceptions, parents' expectations, parents' support, parents' involvement, parents practices and style, and the home environment are included under these factors. Also parents' culture and ethnic group will influence achievement because these particular social elements construct obstacles or increase opportunities for individual performance.

### **Methodology**

This research was an ethnographic study with interpretive design in which seven males and females who work at a south-eastern university, who have children in junior or

senior high schools, and who are from diverse ethnic backgrounds were interviewed. The researcher was interested in exploring attitudes toward science education among parents from diverse background. By selecting candidates from diverse ethnic backgrounds it is possible to identify the impact of those backgrounds on student success. The participants described their feelings or perceptions about science disciplines. The parents expressed their positive attitudes toward science education in action, and the participants connected their attitudes to their children's attitudes about science learning. Also by choosing parents from diverse ethnicities the researcher was able to look at several "across the border" subcultures. In other words, does parental ethnicity influence their children's academic achievement in science? Seven people participated for this study. Each individual was interviewed for about 40 minutes, except the Chinese American interview was an hour long. The only reason for that length is the American Chinese was interviewed after the business day and away from the work place. The rest of the interviewees were burning their offices hours. The researcher's intention was to find a set of parents-husband and wife-with each one to be interviewed separately, if necessary, in order to serve several purposes. First, the researcher knew that each interviewee would be available only once, so there would be no other opportunity to meet the interviewee again in order to ask him or her about what was missed on the first occasion. Thus, having a set of parents, especially if these couples live in one household, could help to verify and ensure the accuracy of the information. Next, interviewing one parent is one weakness of this study. The weakness was not having the child or children of parents to be interviewed. In other words, if both parents were separately interviewed and had corresponding or similar views about their child's attitude toward science, that might reflect an authentic image of their child's behavior. Third, having a set of parents expands the richness of this study. Finally, interviewing two different genders is help in evaluating the

differences across gender in term of how males and female value science education and how they rationalize their judgments toward their child's attitudes about science. However, measuring the affect of gender attitudes and the connection to their children's achievement in science is beyond this study, but it may be a subject for future study.

Table 1  
*Participant, parents' member and ethnicity*

Participants	parents' member status	ethnicity
G, and G's husband	mother, father	Whites European American
N	single mother	African American
L	father	Asian Chinese American
C and C's husband	mother, father	Latino Bolivian American
E	single mother	Latino Mexican American

Having a set of parents happened twice during this project. Once, the set of participants were white Americans (G and G's husband), who were interviewed separately. In the second set, the participants were jointly interviewed (group interview) – they were a Bolivian American couple (C and C's husband). The group interview has the advantage of expanding the richness of the participants' arguments. In contrast, it also has a disadvantage. For example, having couples (husband and wife) interviewed together may influence the credibility of their responses. Additionally, the structure of the interview may lead to many corresponding answers as the participants respond to the same questions. The researcher did his best to control for these disadvantages; indeed he most often asked each participant to

answer different a question. For instance, can you tell me a little bit about your science experiences in high school? This was C's question. And this was C's husband's question: In junior and senior high school how were your science classes instructed? (C's husband was taught science in two different private schools). In some cases, the researcher recreated the targeted question to give each participant an opportunity to respond freely without repetition of the first parson's response. For example a question for C would be "How was science taught in your high school?" For C's husband the question would be" how was your science classroom structured in high school?"

### **Data collection**

#### **Organizing the Transcriptions**

The digital-recordings were transcribed immediately after each interview since this gives a greater likelihood of remembering the discussion where the tape was indistinct. First the date, number, time and venue of each interview were recorded at the top of each transcript. Then the transcript page was divided into three columns. The left hand column denoted line numbers as well as the identity of the different speakers (e.g. G for Genet "not a participant name"). The middle section contained the transcribed dialogue. The margin on the right was reserved for comments about the transcript when the analysis was concluded. Each transcript page was numbered. Short pauses in the dialogue were indicated by three periods (...) and longer pauses were noted in parentheses as (long pause). In some instances, comments from the researcher were incorporated into the transcript. These were enclosed in square brackets [ ] and placed on a separate line immediately following the relevant part of the dialogue. Once the transcript was completed, the data were analyzed.

The technique of ethnographic interviews is widely used in qualitative research (Spradley, 1979). After collecting the data, the researcher has to decide the way the data should be analyzed (Spradley, 1979; Mahrer, 1988). One way is thematic analysis which can be applied to this study better than any other method of analyzing the data, since it assumes that one's living experiences and behavior contain regularities which can be rationally analyzed. Thematic analysis allows any type of living experiences and personal behavior to be identified as long as it is consistently repeated or explicitly discussed over a period of time, and forms a pattern.

An interviewee's digital recording was kept through this study as an ongoing analysis of data (Lincoln & Guba, 1985), and also for recall of other information discussed by the subjects at other times when they were not being interviewed. The information in this recording was used to construct a future visit and identify where additional information should be added. Interviewees were informed of the possible need for the researcher to revisit particular interviewing sessions for future clarification. While one of the weaknesses of this study is that there was no follow up interviews, the researcher offered feedback to participants by sharing with each individual a copy of his or her transcribed data before using it, and asked them to reflect on what they had said.

To ensure that the research was fairly conducted, and that the conclusions reflected the interviewees experiences, strategies maintaining trustworthiness were used (Lincoln & Guba, 1985). The strategy of prolonged engagement is used throughout the entire study period. The researcher spent sufficient time try to understand the cultural dimension for each individual participant through reading numerous articles about black and Latino communities. The researcher also asked each individual participant about their early life and neighbourhoods in order to have a visual picture of each participant's childhood social

setting. Data were triangulated from different sources including digital-recorded interviews, informal discussion, and sharing transcriptions through email. Data were also discussed with a peer who is a native English speaker, has previous experiences in qualitative research, and has no idea about the participants.

### **Thematic Analysis**

The ethnographic interview is always stated in explicit descriptive language to get a better understanding of participants' experiences. The interviews must be audio-taped for future reference and to ensure reliability (Spradley, 1979). After transcribing the participants' interviews themes or patterns about each individual's experiences can be determined. Data were analyzed to provide meaning and interpretation to find a connection between parents' attitudes toward science education and their children attitudes. Children's attitudes were analyzed based on parents' responses to questions regarding their children. Additionally, the researcher tested to identify whether ethnicity factored, or played a role in participant responses. To accomplish this task, data from this study were coded and organized into categories to develop emerging themes. Categories were taken from the transcribed interviews. Links were identified between the categories and used to establish themes.

In the coding process, transcribed dialogues were read carefully, more than once, to become thoroughly familiar with the data. Then the researcher carefully studied each interview in order to identify explicitly any patterns relevant to the investigation. Once detected, the researcher recorded them in a marginal note, which also includes descriptive language for interpretation in the final phase of the analysis. From the readings of the transcripts a scheme for coding the data was developed, beginning with the first interview.

For instance, G's husbands' (a white American male) discussion of travelling when he was the child of an American soldier who worked on an American military base in Germany was coded as an example of "childhood experiences overseas." All other accounts of early experiences that were shared by participants were coded accordingly.

Data were then organized under the categories according to their similarities (Goetz & Le Compte, 1984). All statements were posted under the name of the individual to whom they belonged. The same technique was used for the categories and statements for the latter periods of collection. Participants' experiences were further coded into subcategories. For example, if the experiences were considered positive or negative, they were coded as such and placed under the proper heading denoting the time period at which they occurred. This was done so that the discussions could be examined sequentially, for this research focused on experiences and beliefs as they occurred over a period of time. Ongoing data analysis enabled the researcher to extrapolate meanings associated with life experiences as the interviewees told the stories. Analysis of information within categories led to the development of themes. These themes reflected the effect of the experiences for each individual as they related to the research questions. From this thematic analysis, a vignette was developed for all participants under a theme to provide a rich description of each individual's attitude toward science education.

During the interviewees, the participants talked about their science experiences as children and as parents of children. They also spoke about their early childhood experience in their parents' homes and their neighbourhoods. In addition, participants were asked to compare their attitudes as children to their attitude as parents of children. Comparing participants' attitude toward science learning as children and as parents may grasp the transition between attitude and practice toward science education in both positions. The three

themes analyzed were: (a) Early life experiences, (b) Childhood education and science education experiences and (c) subculture pattern effect.

The following table (Table 2) illustrates the participants perceptions related to these three thematic categories. Three themes illustrating the influence of ethnic subculture on the parents' attitude toward science education emerged during this study: (a) the early life experiences that shaped these parents through their life journey since they were kids in their sub-culture community; b) early educational experiences and science education specifically; and (c) parents' attitudes toward science learning as an analysis of two different positions. Analysis of two different positions means that the participants were asked to compare their attitude toward science learning when they were children to their current attitudes as a parent of a child. Each of these three themes will be presented in vignettes followed by interpretations for each theme.



Table 2

*A table summary of the themes across ethnicities*

The participants'	Early life experiences	Science education experiences as a child	Attitude as a parent and subculture affect
<u>White American</u>			
G	Parents not interested in science	avoid science courses	positive attitude but not involved
G's husband	divorced- parents lived with his Mother	minimum science courses	science important without involvement
<u>Asian American</u>			
L (M)	in China with couple Scientist-parents	like physics teacher and science courses	support my child but not force him
<u>Black American</u>			
N (F)	lives with st. mother in black Community	dislike science teacher and courses	discuss education issues-not Science
<u>Latino American</u>			
E (F)	Mexico and USA Illiterate parents	minimum science in college	support my daughter education but not science projects
C	in Bolivia with educated parents	like science teachers	my daughter has bad science teacher
C's husband	in Bolivia with educated parents	like science courses in high school	help my daughter in science projects
M= male F= female			

**Parents: Early Life Experiences**

Parents' early life experiences affect their children differently, and yet they are crucial in determining parents' attitudes toward their children's academic success and the way they are involved in their children's learning, and as a consequence influence their children's academic attainment. Participants in this study have had different life experiences that

influence the eye glass that they see the life through. For decades, parents' educational level and socio-economic status (SES) have been connected to their children's educational achievements and were viewed as typical examples of social factors (Fantuzzo, 2000). Thus participants were asked about their parents' educational level and SES. For example, G, who is a white female from a small community, was raised in two-parent home. Her father was an engineer and passed away when she was a high school student. Her mother is an English teacher. G introduced herself as "a shy, pretty girl, who lived in a nice little neighbourhood environment" where not much trouble ever went on except her father's death. She explained her early influence from her father's major (engineering) and the transition to her mother's major (English) after her father's death:

... he was interested in science, and we did talk about it when I was a little girl. I've forgotten all about this. This is like therapy. Um; we did talk about it when I was a little girl, a lot, about things like that, and about math, and about, and you know...and I'd went into it really early, and did advanced math. And, and, and then when he passed away, my mother was an English teacher, and I moved over...

G says straightforwardly that having a major in the humanities was influenced by her Mother's major in part and in part by her admired older sister who majored in English also:

...I imagine that's exactly what happened. Uh, I,... that's probably exactly what happened, because, um... yeah, there wasn't really, there wasn't really anybody to bounce ideas like that off of anymore. She didn't really talk about science that much,... My sister was an English teacher, and she's um, she's retired now. Um, and that was probably also a big influence, because I always wanted to be like my sister.

G's husband is also white, and the son of a divorced mother, but he is also the son of a military soldier. He talked about his early life as a child where he was moving every three years to another place, so he used to live in more than one neighbourhood. As a child of a divorced couple with a military soldier dad he started his elementary school in Germany and

stayed there until fourth grade. His mother was divorced when he was in sixth grade, then he opted to live with his mother. He explained his early life experiences living with his single, divorced mother with a lower income:

She was working, yes. She was working as a secretary at that time. She, she'd never been to college. And so, she just finished a high school education, and so when my parents got divorced, she had to get out on the job market. She didn't have any training to do much of anything, so, uh, she went to night school, to Business College, learned how to do shorthand, and improved her typing, and then got a job as a secretary. You know, so, we never really had much money.

Both G and G's husband had limited sources of income as children (lower to lower middle class income), and both of them faced losing a parent, although for different reasons. In G's case she lost her father to death. However, in G's husband's case the shock was the separation between his parents. For G's husband, being alone with a low-income divorced mother who had no interest in science learning shaped his childhood attitude toward education in general, and science learning in particular. He explained:

She, she pretty much left me alone. It was very much a hands-off approach. She, you know... she had never been to college. And so, she wasn't terribly educated. And, education isn't something that she pushed very hard. It wasn't necessarily something that she valued very much. Um, she assumed that I would go to college, but as far as getting involved in my education, I'm not sure that had ever really occurred to her.

L is an Asian American who was born in China to well-educated parents. His parents were very poor. They started from nothing and worked their way up. Later, both of his parents earned PhDs. He explained that his father struggled very hard until he earned his PhD:

Uh, um, my parents, uh, they, uh, they're retired, right now, retired. You know what the professors... is, my father's life was quite complex. And, uh, he, uh, he started, uh, his career in con-, uh, construction, uh, company, uh, construction worker. And, uh, he got chance to study in, [unintelligible], in, university. Then, he worked, he worked, uh, in, uh, uh, in uh, county government, uh, in the animal, uh, animal science field... later time, they both got jobs, uh, worked in, in university as a teacher and researcher, uh, extension, uh, agricultural e

L earned his PhD in poultry science (agriculture extension). L's father's instructions and major directed L to pursue his graduate major in the United States and he chose the same major that his father had. When I asked him why he chose agricultural extension as a major, he said:

My father, I think, tell me, oh, go to college. I just followed his instruction: "go to college, that's good for you". And, uh, after I graduated, uh, like he said, if, uh, uh, to study here, and he said, "oh, that's good for you, come, come to the U.S.", because he visit here, and he was [in] the U.S., and he know a, uh, a little bit. He said, "oh, go to the U.S. to study". Um, he support me, supported me. I think that's so I don't, I don't did something on my own.

E, C, and C's husband are Latino Americans. E is a Mexican American female. C and her husband are Bolivian Americans. They talk about their early life experience and how it influenced their entire life and their view of science education. E is the single mother of a fourteen- year old daughter. E was born in the U.S and her family promptly moved to Mexico. She was in elementary school there until she moved back to the United States at the age of six. E states that a female is referred as a "Latina." When I called her as a Latino, she said "No Latina, I like to call myself Latina – when you're Latina, it shows born in a... [country], raised in a different [country]." When she asked about her parents, her early childhood experiences, her neighborhood, and how those influenced her life later she said:

Well, um, my parents never completed, my, my mom never went to school, ever. Um, she's illiterate, and my father stopped school when he was in ninth grade. So, I'm the first person to graduate from high school, um, and the first person to ever go to college in my family... I grew up in a neighborhood where drugs, violence ... We lived in public housing. It was called, um, the projects, where, um, middle class people would not want to go through. Um, there was just so much, if you got involved.....

In this climate E was expected to just merely finish high school. Her parents never stopped providing all the necessary tools, such as pencils, papers, and the like; taking care of her and making sure that she had food in her stomach so that she could concentrate on her

classroom assignments. So she had direct parental support, but the expectation and attitude that school was important to them was almost absent. C and C's husband were born in Bolivia. Unlike E, C's parents were educated. Her mother was a teacher. C's husband's parents were educated as well. He described them as "professionals". Both C and her husband were taught in a private Catholic school until high school in Bolivia and science was a part of the school curriculum. After high school, they moved to the United States to pursue higher education. Right now, both of them are naturalized American citizens. Also, C has a PhD and her husband is working on his dissertation in environmental policy. When they were asked about how their early life experiences relate to their current academic majors, C said:

I went to a private Catholic school, and science and math and all those things were really important, because we had, like, the, the, um, regular classes in the morning, and, uh, like, kind of labs in the afternoon, that we have to...that were required for our education.

Her husband said:

They did, also, think that education is very important for the child as they grow up, and, to get an education after, uh, high school.

It seems that C and C' husband belong to upper-class income family because when asked to compare their parents' attitude toward education in general to the neighborhood families. Both of them emphasized that it was common within the same class level. C explained:

I think, uh, yes. Amongst our, our class, social class, and, uh, friends, uh, that live, uh, you know, that are part of our social environment, yes. Parents are very supportive of education, in, in, not only in high school, but beyond high school. Getting a college... uh, education as well. Uh, but that is just, you know, within our circle of friends. Um, that, uh, we see that there's a lot of support for education.

C's husband added

I think this depends on your social class. Like, if they are, um, in the rural areas, and if those people don't have education, they don't support that much, you know. They said, "oh, no, you don't need math", or whatever, whatever to raise cows, or to raise their children. You know, just basic knowledge. And maybe there's just kids that went through, maybe, just elementary education, like they, their parents did. But, like she said, in our, in our group, and our friends, and things like that, yeah, they support education, and they like for us to go farther.

N is an African American widow whose husband passed away two years ago and left her with no child of her own. However, she adopted a girl after her husband's death. Her daughter is fourteen years old. N was raised in her parents' home in a small neighborhood. N was asked about her early life experience when she was at her parents' house. She described her life along with her two brothers and a sister living in a stepmother's house. Her parents' low expectations and her interaction with only the black community influenced her attitude toward education negatively. She expressed it as:

Um, I lived with my mother and father, and, um, went to school with the same kids all throughout. You know, I lived in the same neighborhood, never moved around much, and, so I knew all the kids in elementary school... Neither of my parents have, uh, college. They only have high school degrees. They always wanted us to do better, but they just never got higher degree, because, you know, family, money, all those things, so many children, and couldn't send them to school.

When she was asked about her friends, the diversity among her neighborhood, and her life experiences in general when she was a little girl, she said:

Um, maybe a little bit diverse with race, but, um, I just mainly hung out with the black kids. You know, I knew white kids, and played, you know, played with them, but, you know, my close friends were always, you know, black kids ...

N and two other brothers and one sister lived with their step mother because their birth mother died when they were young children. This kind of situation added more challenges for

her. N's parents' expectations in terms of her education and achievement were no more than high school or similar.

### **Parents: Early Education and Science Learning Experiences**

After asking participants about their parents at home, their educational level and getting a glimpse of the SES that participants grew up in, it was important to connect childhood experiences at home to schooling experiences. Doing so could explain how children's attitudes toward learning, specifically science learning, evolved. G and her husband were asked about their educational experiences in general and science in particular in public school (elementary up to high school). While G had an early positive attitude toward science learning that was influenced by her dad, she quit thinking about science after his death. As she lived and interacted with her mother and older sister in the home she was positively influenced by their attitude toward the humanities. Evaluating what was taught in school, in particular in science classrooms, may help us to explain what occurred to develop a negative or positive attitude toward science learning by the participant.

As a comparison between the past as a child and present as a mother of child G said that she likes science and claimed that she talks with her friends about it and hears a few science lectures on NPR. However, as a child, she tried to avoid it in public schools and currently, she has no interest in going back to school to study science. She explained:

I am interested in that, and I will -- if I hear something on NPR...I'm real interested in the whole idea of, uh, stem cell research, you know. That seems very interesting to me, and uh, um, and I'm - you know -- I'm interested in all kinds of medical breakthroughs

But when she was asked about her experience with science as a student, she said:

um ok... ok I don't have a great sense of science background, I'm a liberal arts person ...um I took biology, chemistry in high school and in college I had biology and physics for non- majors and I'm kind of thinking that may be all science that I have had uh uh I had a lot of math but I don't have a lot of science. I just took the minimum,

G's husband also tried to avoid science when he was high school student. He took the minimum number of classes necessary and had no interest in either education in general or in science; however he succeeded in going to college. He said about science courses in college:

No. In fact, I avoided it. Um, I took science in the ninth grade, and uh, in Austin public schools at the time, you didn't have to take any more science than that, so I took the minimum requirement in ninth grade. I didn't have any more science the next three years I was there.

L went through elementary and middle school levels almost without any real science courses. His first experience with science courses was in high school. He explained his impressive love of science as a student:

Honestly, their meaning of really science, science part in, in, in, uh, our, uh, education system at that time, and, uh, we don't have that. We just have, let's see, uh, uh, Chinese, English, math, chemistry, physics. I think physics class, uh, quite, it was quite interesting at that time for me. And, uh, I enjoyed, I enjoyed that class a lot, uh, because, in that class, uh, uh, our subjects quite different from other class. And ... I, I, studied that very well, and, uh, I, I was in the top in my class, Physics. Um, uh, all kind of, uh, objects I know, you know, [laughs] ... building, uh, engineering, you know, and, uh, [unintelligible], that kind of thing. We can see, we can often, so we started our own class. Quite visible, you know, and, uh, I believe that, that class, and also chemical, chemical class, but I, um, I think, I handled physical better than chemical.

L gave a high credit to his physics teacher and the way that he taught physics (class structure). In fact, this physics course was taught in China.

E moved back from Mexico to the United States when she was six years old. So, she was taught science in the US. She evaluated her exposure and experience with science courses thus:



My first science came in high school...At high school, I had biology, and I had chemistry, and I do remember those classes, I'm, uh, we dissected, I believe, a frog, so that was my first real actual experience into the science world. Um, we didn't have to do projects, but, uh, like, uh, uh, science fairs or anything like that. Those were options, and there was a club, but that was my first real taste into the science world, is in high school.

And then she was asked to evaluate her experience with a science course in high school:

Um, I wasn't good at it. I couldn't understand it. It was really, really hard, especially chemistry. I had to, to, take chemistry twice, because it was really, I didn't, yes, that table was not my friend, making, you know, making the [unintelligible] and all that, you know, trying to make molecules of, um, H<sub>2</sub>O and carbon. You gotta shake them with, um, sticks and, um, gummy balls, you know. How was this, how would it, um, how would this equation look? And it was really, really, really difficult. I did not, I couldn't grasp it. I passed with a C, but that was, that was such a weak, weak part, um, weak part, um, of my educational career, is science.

C and C's husband went to high school in Bolivia. C and her husband started with basic science in Bolivia, some biology and a little botany, until high school, when science was split up into several subjects: biology, chemistry, and physics. C's impressive experience with science courses and science teachers was explained:

chemistry was, like, "oh, I love chemistry". It was the best, uh, because the teacher was an awesome [unintelligible] since the beginning. And, uh, the physics, uh, I struggled a little bit, and the teacher was awesome.

Responding to the same question C's husband said:

Yes, actually, I, I really enjoy sciences. I liked them so much that I went to, to med school for three years. And, uh, then, you know, because of uh, circumstances, I had to switch over. And, uh, here, my specialization is actually in, um, public policy education. It's based in, um, environmental public policy, which has to do, I had to take some biology classes here at the university, and, uh, I really do enjoy science a lot.

N tried to avoid science courses and she blamed her teachers for that negative attitude:

yeah, some science classes, but I just didn't, I don't think I did very well in science, cuz ... Because they, I don't they did a lot of hands-on. It was more lecture. Talk, talk, talk, talk. And so, sometimes it was hard to relate, understand... sometimes, teachers love it in their head so much that they don't understand that maybe everybody don't like science, and so they didn't do different ways to help me really like it, so I always didn't like science.

### **Parents' attitude as influenced by the past:**

The effectiveness of parents' attitudes toward and involvement in science education was evaluated through participant responses to questions regarding their children's behaviors and achievement in science courses. The children themselves were not involved in this study so the researcher chose to investigate parents' attitudes through an analysis of two different positions. Analysis of two different positions means that the researcher asks participants about their early life experiences, early science learning experiences, their response to their parents' attitudes toward education in general and specifically to learning science, their early experiences with science courses, and science teachers in school, and finally, how their early experience effect the manner in which they handle their children right now. In other words, participants (parents) were asked to be in two different positions and asked to analyze their life twice: when they were children, and as the parents of children right now. Thus, the interview was structured to ask the participants (sets of parents or single parents) about their early life experiences (e.g. home, parents, neighborhood, and school), to evaluate their attitudes toward science learning when they were children. Also the interview questions were built in such a way as to give the participants an opportunity to make an evaluation of their own parents' attitudes and involvement during a childhood era. This will allow the researcher to measure the transition that may occur for each participant from childhood to maturity. The interview also, was designed to ask the parents about their attitudes toward science education and to ask them questions regarding the way that they exercise that "attitude" and how their

attitude influences their children's attitude toward science learning. Finally, the researcher will analyze holistically how each subculture's parents acted based on his or her "attitude".

G was influenced by her sister's and mother's majors, but she never indicated that she had a direct support from her mother and her sister when she was a child. G's husband also said that he did not get any specific educational or science support from his mother:

She, she pretty much left me alone. It was very much a hands-off approach. She, you know, she had never been to college. And so, she wasn't terribly educated. And, education isn't something that she pushed very hard. It wasn't necessarily something that she valued very much. Um, she assumed that I would go to college, but as far as getting involved in my education, I'm not sure that had ever really occurred to her.

G's lack of interest in going back to school to study science did not prevent the couple from being supportive parents of their children's science learning. Indeed, G's husband indicated a regret that he did not have more science education. He said:

Yes. We worked on a couple of projects together whenever the teacher said that it's ok for parents to become involved, and sort of do something together. We did physics assignments together in the ninth grade. We worked on, it was a motion study...

G's husband's late interest in becoming a meteorologist is amazing because even though he wasn't interested in science as a child, he developed an interest later in life.

I was never one of the kids that was interested in being in (popular). I just wasn't interested in science, the honors, or being necessarily more of a top student... I just wasn't interested in science.

L believes that his attitudes when he was a child were influenced by his parents, his older brother, and his science teacher (physics teacher)

I kind of followed the example of my brother. You know, he did that, and I follow him. Uh, also, uh, our school system, at that time, teacher control us, uh,

strictly... also I believe my parents tried to train me at that time. They, they, they, they want me to do something on my own, but they control big things [laughs].

Also he admits that he wants to continue his parents' tradition with his only son:

Um, I believe my parents influenced me a lot... I believe that. And, uh, uh, my parents also, uh, uh, was influenced a lot by the, uh, culture,...they have [his parents] a unique character, which is different from, uh, their friends and neighborhood. Uh, for example, uh, uh, my parents, uh, uh, they, they think a criminal thing is, uh, is not good at all. Uh, stealing, and, uh, lying [unintelligible] and, uh, uh, my parents, uh, uh, uh...they [unintelligible] good work, and, uh, try to make people happy. They, they, they, they are very honest. They living this way, they, they speak out, uh, like, kind of thing, uh, uh, so, so my family's kind of a little bit, maybe, maybe,...I'll do that with my little...

E thinks that her attitude toward education is her own, and she was never influenced by someone else, even her parents. She did everything on her own without having educational support from her parents. So her parents' help did not exceed feeding and taking care of her necessary school stuff (e.g. paper, pencil, clothes). But she understands that her parents' support may help her with her attitude and account for her educational level and income potential. She also understands the social structure gaps between Mexico and the US, so she gives her parents a credit for moving to the United States to give their children the opportunity to have a better educational future:

they sacrificed so much [her parents] for us to be here, um, they expect us to take advantage of the opportunities we have, and that's the reason they came, for the American dream. They wanted their kids to do better.

However, she believes that teachers could do more than parents in influencing students' attitudes toward science. She gave the example of one of her science teachers at the college level:

... she was, and she was from India. Uh, she was just an amazing person. She, she was tough, really, really tough. People didn't like her, because she was just so strict. But I really liked her, cuz, I don't know, she just gave me, like, the guidance that I needed, and I failed her class, but I retook it. And, I really, I think I, what I learned, because I, in college, our classes were separated between, like,

sure, we had a lecture, and then we had a lab. And I really liked the lab more than I liked the lecture

In contrast, although her daughter has no interest in science, E asserts that she has been trying her best to change the negative attitude toward science that her daughter has. Her strategies are taking two approaches: involvement at home (e.g. science books, science channels, talking to her) and involvement at school (e.g. contacting her teachers, conferences).

we talked about the importance of math, English, and science. She wants to be, um, right now she's contemplating being a veterinarian or a nurse. And, I told her: "You have to know science. You have to go in their liking science... sit down and watch operations, people getting and performing operations". We would watch the, um, we would watch animals, and how the different animals.... I emailed the teacher.

C and C's husband were talking about their parents' expectations toward education in general and science in specific. They were not tolerant of a low- grade or a delay in graduation. Their parents' awareness about the importance of education, they said, influenced their science achievements. So when they came here C went to medical school for three years and then changed to marketing. C's husband started in the school of biological science for while, and then he changed to environmental science policy. C said regarding her parents' expectations:

if I had a bad grade, I was grounded until the next report card. Like, no phone, no friends, no nothing, because I didn't achieve my dad's or my mom's standards, you know. They were like: "No, if you flunked this, no friends, no nothing, for you," until, you know, I proved to them otherwise..

C's husband added

our parents were saying...it's going to be a shame for us...I saw that their demands and their, uh, requirements, their standards were a little bit higher...

C said that the effort to pass that positive attitude toward science to your children in high school is not easy at all. "All that we have done at home is interrupted by my daughter's science teacher. My son has a good science teacher, but my daughter does not."

They had, like, a really new crazy teacher. That's the way they, she describes this teacher. Then she didn't have enough, enough patience, or she was yelling too.

C said about her son's science teacher:

... but the teacher plays a big role in this... my son had a good teacher since the beginning – he loves science.

N wasn't supported by her parents so she lost her love for science when she was a junior high school student. She took "very minimal science courses," but she didn't link lack of interest in science to her parents' level of education (high school level), socioeconomic status, or her own racial identity. She did blame her science teacher:

I think, sometimes, teachers love it in their head so much that they don't understand that maybe everybody don't like science, and so they didn't do different ways to help me really like it, so I always didn't like science.

Also, N added that the science classroom (science structure) in these days is different from her days in a science classroom (when she was a little girl) so this may make science more interesting.

I think the teacher, because the teacher did, um, did things like have them work in groups, and then the groups would pick different things, and then they would make posters and, you know, make a search in the internet, and, you know. So, they did a lot of activities so it wasn't just lecture all the time. She (her daughter) would tell me that.

Also she concluded that even though she has a vague attitude toward science as a learner, she has to admit that learning science is important. She still has positive attitude

toward education in general; for these reasons she said that she is a big supporter for her daughter.

She wants to be a fashion designer. So, I don't know. It may change. Cuz I told her she can't draw. So, I said, fashion designers, they need to draw. But, you know, I think she's just, she knows she wants to go to college, but I always encourage college, but I don't think she really understands what she could really do in college.

### **Across ethnic groups: Early educational experience and attitudes**

Social structure elements predict that what happened for parents will highly shape their children's future. Steinberg (1981) applied cultural explanations by asserting that intergenerational poverty is the result of subsequent generations facing the same structural conditions as their parents, not the result of their inheriting a culture of poverty. G's father's death, G's husband's parents' separation, L's obedience to his father's instructions, E's parent's lack of education and life in a criminal and violent neighbourhood, C and her husband's families social economic status, N's life in homogenous and close-knit sub-culture are shaped and influenced by their parents' early life experience. As a consequence these factors also influenced their parents' attitudes toward science learning and their involvement with their children's science learning.

G, L, C, and N- a white American, an Asian American, a Hispanic American, and an African American- indicated that science teachers, science structure, parental attitudes, and parental involvement are critical factors that influenced their attitudes toward science learning, and as a result account for their academic achievement. C's husband explained why he enjoyed science as a kid (science teacher and class structured in Bolivia):

It came very naturally for me, because of the way the classroom was set up...the reason that it was easy for me, makes it enjoyable, uh, the way she designed the course was enjoyable for me, and that's why I liked it very much. And, uh, yeah, that's probably the, one of the reasons that I enjoyed the sciences.

Further illustrating the importance of structure, L talked about his science teacher's classroom structure (In China):

Great teacher,[physics teacher] and, uh, uh, he, uh, he can simplify things, you know. And, uh, I can, uh, he taught you, you know, uh, step-by-step, and can reach higher level, you understand that, you know... I was in the top in my physics class

But N presents a negative opinion about her teacher and the way that her science class was structured.

I think sometimes the teacher just went too fast... We had some teachers that make it boring, because all they do is talk. They had some teachers that wanted to do activities with you, so it made you want to know more, and learn, and do stuff.

### **Across ethnic groups: Involvement**

All participants were asked to discuss what they had done to support their children's science education. Some of them were able to give some examples regarding what they had done. Follow up questions were asked about how they evaluate their children progress in science classrooms. Analyzing what they said about their children's performances in science, failed to find any connection between the participants' attitudes and their children's academic achievement in science.

It is clear that some children succeed without clear parental involvement. The academic success achieved by E is an example. In general, a positive parental attitude toward education alone is not enough. A positive parental attitude combined with action (involvement) is more likely to lead to academic success. For example, L's parents allowed him to do many things on his own, but they not only provided him with books and expected



that he go to a college, they took him to their work to work in the computer lab, shoeing hime what scientists actually do.

All of the participants in this study have earned a higher degree (Master or PhD); however some of them had no interest in science as children. Now, the question is whether they will transmit their childhood negative attitude toward science as parents or whether they will change it to a positive and active attitude in order to influence their own children's attitude toward science learning as they claim.

### **Discussion**

The results of this study cannot be generalized to the larger population, thus the findings will be only analyzed for the group that was interviewed. The discussion will be divided to two different segments. The first section is a holistic discussion about the participants and the second section will explicitly discuss the themes that were mentioned previously: the early life experiences of the participants, the early science experiences of the participants, and a comparison of participants' attitudes when they were children to their attitudes currently as parents of children (an analysis of two different positions).

There is no doubt that the early life experiences of the participants were influenced by their parents' educational levels and the community in which they lived as children. For example, E has illiterate parents who provided her with the things necessary to survive and go to school. There was no discussion of science in her house. There was no communication between her parents and her science teacher. G's major area of study is identical with her mother' major which is the humanities, and her mother showed no interest in science education. Living in her step mother's house, playing with her friends in a small subculture

community, and having a negative experience with a science teacher in school influenced N's attitude toward science education. It is obvious that parent level of education and early experiences with science in classrooms will influence attitude toward learning science either negative or positive. For instance, L, C, and C's husband have well educated parents. In L's case both parents are scientists. They had high expectations for their children; college was expected.

In this study there was no consistent connection between participants' attitudes as children toward science education and their attitudes as parents of children. Thus for this study only, the researcher found that what happened for these participants when they were children is did not necessarily shape their attitude as a parent of children. In case of N, her negative attitude toward science as a child is still influencing her attitude as the mother of a child. In other words she has no interest in knowing any more about science, and she does not feel comfortable in discussing science with her daughter. On the other hand, G's husband who had almost no interest as a child in science would like to learn more metrology as a parent, and he likes to join his children in their science projects and activities.

The participants in this study were all influenced by their science teachers in one way or another. L likes physics, and he attributes a great deal of that liking to his physics teacher when he was a child. C and her husband talked positively about how their science classes were instructed when they were in Bolivia. In contrast, N's negative experience with science teachers influenced her lack of interest in learning science. All participants were asked to outline what they had done to support their children's science education. Some of them succeeded in giving examples regarding what they had done to support their children's science education. Follow up questions were asked about how they evaluate their children's progress in science classrooms. Analyzing what they had said about their children's

performances in science, failed to find a connection between the participants' attitudes and their children's academic achievement in science. In general, attitude alone is not enough; attitude with action (involvement) is more secure and leads to academic success.

Cultural capital gives an individual an advantage in obtaining additional capital that will benefit children of parents who gain symbolic capital (Grenfell & James, 1998). As a matter of fact, in this study C and C's husband inherited cultural capital as seen in the "habitus" formation present in their families, which makes them more successful players than others in their educational peer group (Grenfell & James, 1998). In contrast, individuals with less cultural capital, like N, battle with pressures that result in unequal access to institutional resources (Lareau, 2001). There are few differences among the participants regarding their views of science education and their expectations of their children's science academic achievement. However, the Chinese American participant (L) believes that his child has been influenced by both cultural heritages (Chinese and American). But the researcher cannot generalize from this case that Chinese immigrants are gradually moving away from their original orientation due to assimilation. The question that may better to ask is how long it takes second or third generation Chinese to lose their original culture and become completely American.

Unlike when they were children, all participants expressed positive attitudes toward science education for their children, however, how they are going to exercise their "attitude" with their children to help them to accomplish in school is different. For instance, G stated that she is very concerned about her children's grades in all disciplines, but she never mentioned how she helped them earn higher grades. G's husband, who had a negative attitude toward science education as a child, gave some examples of his involvement to help

his children to achieve their best in science. These examples included working along with his children on science projects, and talking them to children's science museums.

Participants, in this study, are good examples of the ambiguity in defining parents' involvement in education. For instance for G parental involvement means asking about her children grades and then making decisions regarding holding or releasing her children's privileges. N also never spoke about communication between herself and her daughter's school or gave any evidence of supporting her daughter, except talking to her sometimes about what is going on in school. In contrast, E, C, and C's husband were very successful in acting on their "attitudes" toward education in general and science in particular. E's attitude toward education is translated as involvement at home (e.g. science books, science activities, watching a science channel) and at school (e.g. communicating, conferences, emailing teachers). C and her husband are active concerning communication with their daughter's science teacher, and they provide her with science books and work with her on science projects. Without exception all participants talked about the impact of science teachers and science classroom structure on their attitudes, and their children's attitudes toward science and science education.

### **Parental Attitude**

Attitudes are learned (Fisher & Jazan, 1975), however, attitude formation may be influenced by early childhood and educational experiences. Thus a positive attitude toward learning science alone is not enough to garner successful transition between two consecutive generations; from parents to their children. In this study, although all participants verbally expressed positive attitudes toward science, they expressed (with one exception) no interest in going back to school to major in science and make no serious attempts to improve their

science knowledge. Having no interest in science can be understandable from many different perspectives. For instance, participants who have an interest in their current academic majors have no time to be invested in learning other enterprises. Nevertheless, beginning this study with participants' early life experiences and their early science learning experiences raises a very important question, which is whether the reason behind a limited or nonexistent interest in science is because of events that happened during parents' early life and early learning experiences.

During the interviews, all participants indicated some events influenced their attitudes toward science education. For instance, the African American female participants (N) spoke about her science teachers in elementary and high schools who were moving rapidly through science concepts with the expectation that all students understood the concepts. This indicates a supposition on the part of teachers that all students share the same cultural habitus or perspective. N indicated that her lack of interest in science was influenced by this early science instruction. In another example, The Mexican American female (E) mentioned struggling in her chemistry classroom

“Um, I wasn't good at it. I couldn't understand it. It was really, really hard, especially chemistry. I had to, to, took chemistry twice-- I did not, I couldn't grasp it. I passed with a C, but that was, that was such a weak, weak part, um, weak part, um, of my educational career, is science”.

The white American couple G, and her husband tried to avoid science courses. “In fact, I took the minimum requirement” G's husband said. These participants clearly indicated that they had no interest in science courses because of either one or more than one of the following reasons: science teacher, science classroom instruction, their parents' attitudes, their socio-economic status, or their parents' level of education. In contrast, some participants, such as the Chinese male (L), and the Bolivian American couple, C, and C's husband have an interest in science courses because they have not met the same conditions as the first group. They

have highly educated parents, they had good science teachers, and their parents' attitudes toward education are very positive. For example, L loves physics because of the teacher that he had in high school.

The teacher is good also. Of course, uh, that's, uh, that teacher is a great teacher, and, uh, he can simplify things, you know. And, uh, I can, uh, he taught you, you know, uh, step-by-step, and can reach higher level."

The Bolivian couple, C and her husband talk about their parents' expectations and that they did not tolerate bad grades. C spoke thus about her chemistry and physics teachers:

oh, I love chemistry. It was the best, uh, because the teacher was an awesome-- since the beginning. And, uh, the physics, uh, I struggled a little bit, and the teacher was awesome also. I think...all the teachers that I liked, and all the teachers that were there, like, loved teaching, and they did, uh, create a good environment, and they teach well...".

These are messages to parents and science teachers. These messages tell us that the attitudes of parents, science teachers' behaviors, and science classroom instructions play a big role in the participants' later life experiences and in their enjoyment and support of science and science education. In other words, participant's interest or non-interest in science was influenced by science teachers and parents' attitudes.

### **Parental Responsibilities**

The study has shown that all of the parent participants have general positive attitudes toward science education. However for most of them their attitudes toward science value does not extend beyond oral appreciation. For example one E's response to the question of whether science is important or not was positive, however when she was asked about what she has done to support her children's education in terms of learning science her answer was

very broad. She said that “in school conference, I ask the science teacher about my child’s performance” but there was no indication of more extensive educational involvement.

For most of the participants such activities as discussing science issues with a child, visiting science museums, involvement in a science activity, involvement in the science classroom, or communicating often with science teachers did not happen. Furthermore, when the participants were asked if they would like to go back to school to major in science or if they talk about science with their friends the answers were almost always “No”. G said:

No I’m interested about what I’m doing right now. You know, talking to a friend means talking about socially shared issues, so talking about science is seldom...it never goes beyond a big event in the media.

It seems that parents’ attitudes toward science do not go beyond positive oral support, because participants recognize science as a possible college major for their children, but not as a way of knowing or learning things that are important. For a half century, it has been a perennial goal of science education in the US to achieve scientifically literate citizens (AAAS, 1990; NRC, 1996; Bybee, 1997; DeBoer, 1991). Thus science is no longer for scientists alone, but every citizen should know enough science to enable them to make decisions on issues considered crucial to American society (e.g. using alternative energy sources, climate change, national security, etc.). Science education is not only important for young students who are planning to attend a school of science it is very important for every citizen (AAAS, 1990; NRC, 1996; Bybee, 1997; DeBoer, 1991).

### **Parental Educational Involvement**

Parents’ attitude alone is not enough. Parental involvement in school is an essential part of helping children to make the right decisions about their future. In this study responses to questions like: How do you describe and apply your attitudes toward science? got very

broad answers from the participants. In general the participant responses were positive; however, the participants' failed to give valuable answers for how their attitudes influence their children's academic success. Indeed there were no actions taken to support their children's science learning and academic achievement in science except from the white American couple. While the kind of parental involvement needed to influence children's academic outcomes has changed from study to study (Georgiou & Tourva, 2007), parental involvement has never been seen as non-beneficial when it's linked to children's performance (McNeal, 1999; MPP, 2002).

### **Subculture Parenting Patterns**

Individual differences and the value of freedom of choice are important values shared by most Americans; however, America is a nation of immigrants. European Americans are the numerically and culturally dominant group; the groups that defines the "habitus". However, the percentage of minority groups, African, Hispanic and Asian, is rapidly increasing. All these different ethnics groups came to America to live the American dream, where the European American culture is considered the mainstream culture. Minority groups are going under continues changes to assimilate into the mainstream culture; yet many would like to keep aspects of their indigenous cultures.

American parents across ethnicities have presumed expectations regarding their children's academic achievement. In general parents expect that their children graduate from college and have a job (Kao & Thompson, 2003; Reynolds, et al, 2006). This trend may partly relate to American parents' strong beliefs in innate ability and how it determines their children's performance. They also quite often adhere to the American value of personal freedom of choice (Kao & Thompson, 2003; Reynolds, et al, 2006). However, strategies to



achieve academic success are different across ethnicities. European Americans regularly adopts an authoritative parenting style where children are encouraged to make independent choices, to problem-solve on their own, reasoning through selections and actively exploring their environment (Hamner & Turner, 1990). African and Asian American parents are more often reported to be authoritarian (Steinberg, 2001), and Hispanic parents are reported to be permissive (Julian, McHenry, & McKelvey, 1994). While the authoritative parenting style is linked to positive education outcomes (Steinberg, 2001), the authoritarian and permissive styles are connected to negative academic achievements and lower cognitive development (Dornbusch et al., 1991). However this literature is limited by suggestions of bias and by the use of controversial data. Two things are interesting here. 1) Veja (1990) reported Mexican American parents as authoritative, and 2) the authoritarian style was connected to higher educational achievements when tested in East Asian dominated Confucius culture (Chen & Steinberg, 1994)

Almost all of the participants in this study, when asked whether they would try to convince one of their children to choose a science major if that child had chosen a different major, responded that they preferred to support their child's choice. Here, it should be mentioned that although the Latino (Mexican and Bolivian Americans) and Asian American (Chinese American) participants were born outside the US and had some education overseas, they support assimilating into mainstream US culture.

Participants across ethnicities believe that their children should adopt their college major freely, without any influence from their parents' beliefs. This opens the door widely for questions of whether students at this age (early to mid adolescence) have adequate experience to make crucial decision about their area of interest and their future career without any help from their parents. Culture matters. It is clear that subculture, early rearing and educational

experiences significantly influence parents' involvement in their children academic achievement. It is also clear that the dominant culture also influences those outcomes, both positively and negatively, depending on the culture and background of each student.

### **Implications for the Future**

There are three important factors that should be considered for any further study on student's academic achievement in general and particularly in science. These are: (a) parent and student attitudes, (b) parents' educational involvement, and (c) family's subculture entities and social stratification. Science educators know that education reform efforts will not occur until parents recognize that schools and effective science teachers cannot do the job alone and the parents are an important component in their children's science learning and achievement. Parents should not only show respect for science or positive attitude toward science education, but also show serious involvement with their children in the process of learning science. Thus, we have to not forget that parents are the child's first teachers. Children, at an early age, learn almost everything critical to their academic achievement from their parents, not from their teachers. They learn their attitudes toward school, things such as their motivation to learn and their learning habits, from their parents. If parents understand the value of science and help their children to understand it, if parents set high standards for studying science and math, if parents invest adequate time in evaluating their children's performance not only will the students' academic science achievements improve but also their whole life will be improved.

### **Conclusion**

This study indicates that parents' attitudes toward science education were generally verbally positive with a minimum of actual support and involvement. The participants expected their children to graduate from college, and yet they had no intention of influencing or directing their children's choice in terms of choosing a specific major. The participants have made no serious attempts to be involved in science discussions, projects, and activities with their children. This may be because all participants either have no science major or/and not interested in scientific enquiry. They understand, in a general way, that science is not just for the students in schools, but that science is important for all ages to achieve scientifically literate citizens.

This is important. In a nationwide poll about public perception of the skills that American students need to be able to compete for jobs, 80% of respondents stated that the kind of skills that students need to learn in the 21<sup>st</sup> century is different from those needed two decades ago (Lang, 2007). Achieving such a goal requires a deep understanding that calls for not only parents' attitudes to change, but for parents' to become involved and play a major role in their children's future. Even so, all of these participants support the idea of giving their children a full right to decide their majors of interest without parental restriction. The researcher believes that children in high school still need their parents to help them to make the right decisions about their future, because children in adolescence may lack the skills to make wise decisions, especially about issues that may affect their entire life. Parents are responsible for their children's achievements in general and in science specifically. Now, when economic conditions are unstable and American students' achievement in science and math has declined, parents are responsible for helping schools to fix the gap in achievement

discussed earlier. In the 2008 American presidential election, parents' responsibility toward their children performance in school was addressed. President Obama said "government can inject more money to reform schools but it can't turn TVs off and it can't keep children from playing games".

Global competition, the economic crisis, and domestic and international data are not encouraging. US students have a gap in science and math achievement within and between the groups when they compared to Asian students. Moreover this achievement gap has been existed since the 1990s. The most recent results of a respected standardized exam (PISA) indict that American 15 year old students fall behind East Asian students in science, math and reading. These finding are important in light of the results of this small qualitative study, which concludes that most parents in every subgroup investigated in this study had a positive attitude toward science education; however, there is no evidence that parents' positive attitudes are associated with active involvement to help their children in accomplish more in school. In future research, the most important questions that should be investigated involve how subgroup social stratification and attitude are transmitted, under which conditions students' academic success are granted, and whether the actions of parents in other cultures should be should be considered by American parents and educators.

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