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# The Effects of Social Norms Feedback on Fruit and Vegetable Consumption and Skin Carotenoids Among College Students

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# THE EFFECTS OF SOCIAL NORMS FEEDBACK ON FRUIT AND VEGETABLE CONSUMPTION AND SKIN CAROTENOIDS AMONG COLLEGE STUDENTS

by

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# ABSTRACT

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During college, students establish nutritional habits that may last a lifetime. Fruit and vegetable consumption often decreases during the first few years of college and the vast majority of college-aged students are not meeting current recommendations. Social norms theory has been shown to be an effective method for influencing behaviors in this population. This study was designed to test whether or not providing students with normative and manipulated social norms feedback could influence fruit and vegetable intakes among college-aged students as evidenced by changes in skin carotenoid levels and food frequency questionnaire reports.

Participants (n=244) were randomly assigned to a control group or given either normative feedback or manipulated social norms feedback regarding their skin carotenoid levels in comparison to their peers, with carotenoid levels being an objective measurement of fruit and vegetable intake. Those receiving manipulated

feedback were given an artificially low carotenoid score implying that peer consumption was greater than their own.

Results indicated no significant within-participant changes in fruit and vegetable intakes reported in the FFQ (P=.635). While there was no change in the control groups skin carotenoid levels (P=.996), there was a borderline significant increase among those receiving normative feedback (P=.066) and a significant increase among those receiving manipulated social norms feedback (P<.001). Repeated measures of analysis showed that within-participant increases in carotenoid scores were dependent on group assignment (P=.033) with an effect size of $\eta^2p$=.026 which according to Cohen's guideline is a small effect size. The distribution of carotenoid scores and FFQ results were approximately normal. Comparisons between FFQ results and skin carotenoid levels found Pearson correlation coefficients of .301 (P<.001) and other positive correlations were found between skin carotenoid levels and both exercise and BMI (.111, P=.049; -.253, P<.001).

The results of this study suggest that manipulated social norms feedback can increase skin carotenoid levels. The observed increases may indicate higher carotenoid containing fruit and vegetable consumption. These findings imply that social norms feedback may potentially be used as a strategy to promote and influence greater fruit and vegetable consumption among college students.

(91 pages)

# PUBLIC ABSTRACT

The Effects of Social Norms Feedback on Fruit and Vegetable Consumption and Skin Carotenoids among College Students

Troy Bailey

Fruit and vegetable consumption, which has been shown to have a protective effect against chronic diseases, often decreases during the first few years of college. Implementing public health interventions to improve consumption of these foods may be time-consuming, costly and burdensome. The aim of this study was to determine if a social norms intervention, examining the effects of normative and manipulated feedback of participants' carotenoid scores compared to a no-norm control, could increase fruit and vegetable consumption among college students. Such a strategy could be a cost-effective method for promoting healthy diets in this population.

While self-reported increases in fruit and vegetable intakes were not observed in FFQ reports, increases in skin carotenoid levels were observed among students receiving social norms feedback. Because there was no increase in the control group these increases were likely related to the intervention. In addition, correlations were found between skin carotenoid levels and participants' self-reported fruit and vegetable intakes, BMI, and activity levels.

Because skin carotenoid levels are an objective indicator of fruit and vegetable intakes, the observed increases suggest social norms feedback could be

used as a method for promoting fruit and vegetable consumption among college students. It would be beneficial to continue to explore the use of social norms feedback as a low-cost strategy for promoting healthy diets among college students and examining its effects on other populations as well.

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# CHAPTER 1

# INTRODUCTION AND BACKGROUND

## ABSTRACT

Students in their first few years of college are moving from a phase of parental supervision toward personal independence. At this time, college students begin to make their own food choices and dietary patterns [1]. The choices made are important because diets high in fruits and vegetables decrease risks of chronic diseases [2-5]. However, fruit and vegetable consumption often decreases during the first few years of college and the vast majority of college-aged students are not meeting current recommendations [1,6,7]. The social norms approach to modifying behavior has been shown to decrease high-risk behaviors such as smoking and alcohol use among college students [8-10]. Because behavior of young adults is heavily influenced by their perception of how others think and act, changing students' perception regarding the eating behaviors of their peers may influence their own dietary patterns [11]. The purpose of this study is to evaluate whether or not providing students with information regarding how many fruits and vegetables others within their age range consume will influence their subsequent fruit and vegetable intake. To quantify this, we used changes in students' skin carotenoid levels and food frequency questionnaire reports.

## INTRODUCTION

College students between the ages of 18 and 24 are at a crucial stage in life. During these years students are becoming more independent, most living away from

home, and becoming responsible for their own lives and choices. During this beginning stage of independence, students develop habits and lifestyles that may last a lifetime [12]. Dietary patterns established during this phase of life are likely to carry into adulthood, and healthy patterns, such as following the USDA nutritional recommendations, are more likely to result in improved health and a longer life. Currently the 2010 USDA recommendations for fruit and vegetable intakes for men and women aged 19-30 are 2 cups of fruit/day, 2.5 cups of vegetables/day for women and 3 cup of vegetables/day for men [35]. The combined five cups a day of fruit and vegetables is the recommendation given by the USDA to help maintain overall health, prevent nutritional deficiencies and decrease risk for chronic diseases. Research has consistently shown that diets low in fruits and vegetables are associated with increased risk for cardiovascular disease, hypertension, diabetes and cancer. Diets low in fruit and vegetables have also been associated with low family connectedness, weight dissatisfaction, and poor academic achievement [33]. Because of these associations with both physical and psychosocial health, the development of healthy dietary habits among college students is an important step toward ensuring optimal health and happiness in their adult years [2-5].

**BACKGROUND**

*Health Changes in College Students.* According to the national college health risk behavior survey [15], 73.7% of college students are not meeting the recommended intakes for fruit and vegetables, 21.8% reported eating three or more high fat meals per day, and the majority of college students are not getting enough

exercise [15]. More recent data shows that 35% of college students are overweight or obese [16], increasing their risk for chronic diseases later in life.

Weight gain during the first few years of college is common and often referred to as the "Freshman 15". Though many freshmen do gain weight, most gain less than 15 pounds. Lloyd-Richardson et al. published a two-year study showing that 70% of college freshmen gain an average of 3.5kg (7.7 lbs.) their first year, totaling nearly 10 lbs. by their sophomore year [17]. A similar study by Wengreen found that first year college students gain an average of 1.5kg during their first semester, with 23% of participants gaining 5% or more of their baseline bodyweight and averaging gains of 4.5kg [18].

Butler et al. saw similar weight gains during students' first year of college. They also found that during the first five months of freshman year there was a decrease in fruit and vegetable consumption, with 81.7% of students showing deficient intake. They also saw an increase in the percent of calories from fat along with an average decrease in exercise over the course of the study [7]. It is also important to mention that this study showed a decrease in participants' lean body mass and an increase in fat mass. This is a very unhealthy change in body mass composition and puts individuals at an increased risk for chronic diseases [19].

*Previous Interventions.* A variety of intervention methods have been used to improve the eating patterns of college students by increasing their fruit and vegetable consumption. General nutrition courses were effective in a study done at Kent State University in Ohio. Results from beginning and ending three-day food records showed that by the end of the nutrition course, fruit and vegetable

consumption increased by roughly 0.75 cups/day, while french-fry consumption decreased by nearly 50% [20]. Potential limitations of this study may have included some bias in the self-reporting method. Students in a nutrition class may have been subject to a social-desirability bias, which may have influenced participants to over-report their fruit and vegetable intake.

Online education programs have also been used to improve health among college students. Franko et al. found that the online nutrition and physical activity education tool mystudentbody.com increased students' motivation to improve eating behaviors. This study involved two 45-minute sessions using the website; sessions were done two weeks apart. Following the second session, students were given open access to the site for the next 3-6 months. Participants' readiness and motivation to increase fruit and vegetable intakes was assessed using a validated 14-item questionnaire and found that participants' "self-efficacy to eat fruit and vegetables" scores increased by .71. Fruit and vegetable intake was estimated using a 16 question FFQ with results showing an increase of .33 of fruit and .24 of vegetable servings/day [21]. Because the amount of time individual participants spent on the website during the open access period was unknown, it is likely that participants who chose to return often had the greatest levels of change in both F&V consumption and readiness to change. This may have inflated the efficacy of the website as a whole with the majority of the observed change coming from a subgroup of the study who utilized the website more fully.

In the last decade, the use of social marketing has also become an effective tool to improve healthy eating habits among students. Shrive et al. showed that

social marketing through the use of posters and brochures on campus, table tents in cafeterias, along with bi-monthly online video presentations, helped increase fruit and vegetable consumption among college students. Fruit and vegetable intake were estimated using a FFQ and results showed an increase of 0.3 servings/day of fruits and vegetables [22]. Because of the cross-sectional quasi-experimental design of the study there are several limitations. First, participants taking the pre and post-test were not necessarily the same participants, as no effort was made to monitor or ensure participant follow-up. Furthermore, there was no assessment as to whether or not the participants surveyed observed the intervention. These limitations make it impossible to determine if the results were a direct result of the intervention or due to other factors.

Another study used a multi-interventional model to improve diet patterns. Nitzke et al. found that a combination of education through extension sources, mailed educational materials, and two phone call follow-ups within a six-month period was somewhat effective. Fruit and vegetable intakes were measured using a 5-a-day screener that consisted of seven open ended questions to assess intake. By the end of the study, participants' fruit intake increased from 3.92 to 4.31 servings/ day [23] while vegetable intake was not significantly affected.

Another model by Richards et al. used stage-based newsletters, computer-based communications, and motivational interviewing to increase fruit and vegetable intake among students aged 18-24. This four-month intervention was found to increase fruit and vegetable consumption by 0.4 servings/day [24] and was measured using a 26 question FFQ.

The proposed study will use a social norms intervention comparing normative feedback and manipulated majority norm information to alter participants' perception of their peers' eating habits.

*Rational for a Social Norms Approach.* The use of a social norms approach for behavior modification began in the mid-1980s and was first suggested by Perkins and Berkowitz as a possible intervention for drug and alcohol abuse [8]. The basis of the social norms approach is that one's perception of how their peers think and act (the "perceived norm") significantly influences the choices that individual makes. For example, if one believes their peers drink alcohol excessively then that individual is more likely to drink excessively also. However, providing normative feedback (the "actual norm") showing that one's peers do not drink excessively tends to decrease alcohol consumption. The social norms method has proven effective in decreasing high-risk behaviors such as drug and alcohol consumption [8-10].

While there are currently very few studies using a social norms approach as an intervention to diet-related behaviors, current data does show the potential success for a social norms intervention. Wardle et al. found that adolescents underestimate the amount of fruits and vegetables their peers eat. Furthermore, adolescents who believed that their peers consumed more fruit and vegetable tended to consume more fruits and vegetables themselves [11]. Therefore, an effective intervention could be to increase the perception of how much fruit and vegetables peers consume.

Croker et al. showed that a social norms approach could be used to increase intended food choices. Using trained interviewers to collect data, their 2008 study showed that participants who were told that "80% of the local population tried to eat 5 fruits and veggies/day" showed an increase of intended fruit and vegetable intake by .5 servings/day. This was despite the fact that participants had a very low belief in the impact of social norms. While there was a correlation observed between social norms feedback and increased intent, other factors including food cost and health benefits of fruit and vegetables were not correlated with intended food choices [25]. Because there was no follow-up in this study it is impossible to determine if the observed increase in intent to consume actually lead to an increase in fruit and vegetable intakes.

Stok et al. conducted a similar study involving 102 university students. Students were given fictitious nutritional information in either a "majority norm" or "minority norm" format. The "majority norm" participants were told that 73% of students do get enough fruit in their diet. The "minority norm" group was told that only 23% of students have sufficient fruit intake. Using a questionnaire to evaluate prior food consumption and future intent, students given the majority norm information later showed a higher fruit consumption intent than those given minority norm statistics [26]. However, as with Croker's study there was no evaluation of changes in actual consumption following the intervention.

Preliminary studies by Higgs and Birmingham show that students with a history of low levels of vegetable consumption who were given social norms information prior to a lunchtime buffet increased their vegetable consumption [27].

However, students with an already normal or high vegetable consumption were not affected.

*Evaluating fruit and vegetable consumption.* Each of the previously mentioned studies used either a food frequency questionnaire or a 24-hour recall to estimate fruit and vegetable intakes. Questionnaires are generally accurate for estimating overall intakes of large populations over time but are not usually an accurate enough method for comparing changes between individuals. 24-hour recalls may be more accurate in their specificity but are not always reflective of overall dietary habits. Both of these methods rely on self-reporting, which introduces the potential for personal biases, errors and inaccuracies common with self-reporting methodologies.

This study will use two methods for evaluating fruit and vegetable intakes, the use of a biophotonic scanner to measure skin carotenoid levels, and a food frequency questionnaire. The biophotonic scanner made by Pharmanex uses Raman Resonance Spectroscopy (RRS) to measure levels of carotenoids and is a non-invasive method. The main carotenoids in the skin are lycopene, beta-carotene, alpha-carotene, beta-crypoxanthin, lutein, phytoene and phytofluene with beta-carotene and lycopene making up 70% of total skin carotenoids [28]. Carotenoids are not produced in the body and can only be obtained exogenously thru diet or supplementation. Studies have found a strong correlation between fruit and vegetable intake and skin carotenoid levels. Because of this strong correlation, carotenoid levels can be an effective biomarker of fruit and vegetable intake. This being an objective measurement is not subject to the same personal biases that may

affect self-reported subjective measures such as dietary recalls and food frequency questionnaires [23,24].

In the human body, carotenoids function as antioxidants, protecting cells from oxidative damage caused by free radicals. Free radicals are produced naturally during metabolism, or in response to stress, cigarette smoking, radiation, sunlight or pollutants. Oxidative stress has been linked to a number of chronic diseases including cancer, Alzheimer's, Parkinson's, diabetes, cardiovascular disease and many other diseases [2-5]. Because antioxidants have a protective effect against these chronic diseases, it is important to maintain optimal levels of carotenoids in the body.

Measuring carotenoid levels has previously been done using high-pressure liquid chromatography (HPLC), which requires a blood draw and/or tissue biopsy for analysis [29]. This method has its limitations. Analysis can become costly and time consuming due to the need to obtain blood/tissue samples, store samples properly, and then analyze samples with the proper equipment and trained personnel. In the last few years a new technology using Raman Resonance Spectroscopy (RRS) was developed to measure carotenoid levels in the skin. This has been found to be a quicker and more cost-effective method for studies with a larger sample size where HPLC may not be practical due to a lack of proper equipment or funding [30].

Skin carotenoid levels strongly correlate with carotenoid levels in the serum. Studies in adult populations have shown a significant correlation between skin carotenoid levels measured using RRS compared to blood and tissue samples analyzed by HPLC ($r = 0.74$, P, 0.0001) [31]. Blood carotenoid levels have previously

been viewed as the best biological marker of fruit and vegetable intake, this significant correlation shows that skin carotenoid levels measured by RRS may also be an effective biomarker of fruit and vegetable intake [31].

RRS utilizes light to identify both organic molecules and their concentrations. When a laser is shone on a molecule the light scatters. Part of this scattered light exhibits a change in frequency and is called Raman Scattered Light. When this scattered light has its frequency and intensity plotted on a graph it will form a specific pattern that corresponds to the specific vibrational and rotational energy determined by the molecules structure, allowing for identification of the molecule. By comparing the intensity of the peaks on the graph to those of a known concentration of the organic compound, the amount of the sample can be calculated, with a higher intensity reflecting a larger amount of the compound [34].

Fruit and vegetable intake will also be measured using the NIH's 16-item food frequency questionnaire designed to screen fruit and vegetable intake. While FFQ's are easy to administer, they're not as accurate as multiple 24hr recalls or multiple food records which are the preferred methods when time and resources allow. Each of these methods however are still self-reporting methods and subject to potential personal bias and human error.

This questionnaire consists of portion-size and frequency questions regarding the intake of fruit juice, fruit, lettuce/salad, fried potatoes, other potatoes, dried beans, other vegetables and tomato sauce. This FFQ was validated by the National Cancer Institute in multiple studies, and has been deemed a viable

alternative to 24hr recalls and food records for obtaining approximate average fruit and vegetable intakes of populations [33].

Thompson found that correlations between the true intake and the FFQ estimates were more accurate for men (.68) than for women (.54). A later 2012 study found the overall correlation of this FFQ to be .65 for test/retest reliability [33, 34].

**SUMMARY**

Students in their first few years of college are at risk for developing poor eating habits that may lead to future health problems [1]. Campus food courts are often buffet style promoting high calorie intakes. Grab-and-go options are generally low in fruits and vegetables [6]. Late night snacks are frequent and consist of comfort foods that are often used as a coping mechanism for high stress levels [35]. Poor diets, high stress levels and decreased amounts of activity and exercise often lead to significant weight gains in the first few years of college [35].

Because this population is at high risk for developing poor eating habits that may last a lifetime, it is important to find interventions that can improve eating patterns. The purpose of this study is to determine if a social norms intervention is an effective tool for improving dietary intake of fruits and vegetables as evidenced by skin carotenoid levels and food frequency questionnaire (FFQ) results.

The proposed study will be the first to use skin carotenoid levels as an objective measurement in connection with a social norms intervention. This may help give insights beyond the data collected by the use of FFQ's in previous studies.

**OBJECTIVES**

The purpose of this study is to show whether or not a social norms approach, using both normative feedback and manipulated norm feedback, can influence fruit and vegetable intake among college aged students as evidenced by changes in skin carotenoid levels and food frequency questionnaire reports. The research question and objectives were as follows:

1. Can a social norms intervention utilizing personal skin carotenoid levels and social norms information be used to improve fruit and vegetable consumption and carotenoid levels among college students?
    a. Determine if social norms information can influence eating behaviors to increase fruit and vegetable intakes as evidenced by changes in skin carotenoid levels and self-reported intake assessed by FFQ.
    b. Assess differences between carotenoid levels and FFQ results.
    c. Compare normative feedback with manipulated norm information.
    d. To determine if undergraduate nutrition courses influence fruit and vegetable intake, skin carotenoid levels, and/or the effectiveness of a social norms intervention.

**HYPOTHESIS**

It would be expected that nutrition students would have overall higher fruit and vegetable intakes and higher skin carotenoid scores than non-nutrition students. It is further hypothesized that the greatest increase in carotenoid scores, and fruit and vegetable intakes, would occur in nutrition students with lower initial

skin carotenoid scores/intakes and were assigned to an intervention group. It is also expected that non-nutrition students in the intervention groups will have higher carotenoid scores/intakes compared to the control.

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# CHAPTER 2

# USING SOCIAL NORMS THEORY TO CHANGE DIETARY BEHAVIORS: A LITERATURE REVIEW

**ABSTRACT**

Fruit and vegetable intake among young adults are consistently below the levels recommended by the USDA to maintain optimal health and avoid nutritional deficiencies. Numerous interventions have been utilized to modify college students' dietary behaviors and in this work the potential for a social norms intervention are examined.

The association between perception of peer behavior and individual behavior is well documented and observed in a multitude of human behaviors including alcohol and drug use, bullying, homophobia, gambling, eating disorders, parenting behaviors and others. There is conclusive evidence that college students' choices are influenced by their perception of their peer behavior, and if this perception can be changed their behaviors can be influences as well. Studies have shown that social norms interventions can be utilized to correct misperceptions of peer behavior, and that these interventions have resulted in changes in high-risk behaviors such as alcohol and drug abuse.

Because of the success of social norms interventions to modify high-risk behaviors it may be possible to influence other behaviors as well. Current literature suggests a social norms intervention may successfully increase fruit and vegetable intake. Studies have shown that college students given social norms information

regarding peers' food consumption will increase or decrease their intakes of certain foods to mimic the perceived behavior of their peers. Perception of peer fruit and vegetable intake has been shown to be a predictor of personal fruit and vegetable intake. Social norms information has been shown to increase intended fruit and vegetable consumption and in one study participants receiving social norms information had a higher post-study fruit intake compared to control. Therefore, if an intervention can be designed to influence the perception of peer fruit and vegetable intake it may result in an increase of fruit and vegetable consumption.

**INTRODUCTION**

Students in their first few years of college are in the middle of an important transitory stage of life. They are moving from an area of parental supervision toward their personal independence. As part of their new independence students become entirely responsible for their food choices and dietary patterns [1]. During this time young adults are developing dietary and lifestyle habits that may last their entire adult lives, leading to lifelong benefits or complications [2, 3]. Research supports associations between diets high in fruits and vegetables and decreased risks for chronic diseases [4-7]. However, fruit and vegetable consumption often decreases during the first few years of college and the vast majority of college-aged students are not meeting current recommendations [1,8,9].

The social norms approach to modifying behavior gives correct information regarding normal peer behaviors to a specified group to modify their perception of

what is normal or socially correct behavior. Initially the social norms approach was used as a method to discourage high-risk behaviors such as alcohol abuse and drug use [10-12]. Since its conception in 1986, social norms theory has been associated with a multitude of human behaviors including alcohol and drug use, bullying, gambling, eating disorders and other dietary behaviors, and in many cases interventions using social norms information has been used as to modify these behaviors. Because the behaviors of college-aged students are heavily influenced by their perception of how others think and act, changing students' perception regarding the eating behaviors of their peers may influence their own dietary patterns [13].

This chapter will present the background and significance of social norms theory, review social norms studies with nutritional applications, and discuss the potential use of social norms theory as a nutritional intervention.

**REVIEW OF SOCIAL NORMS THEORY**

The use of a social norms approach for behavior modification was pioneered in 1986 when it was first suggested by Perkins and Berkowitz as a possible intervention for drug and alcohol abuse. Their study consisting of 1,116 participants found that college students consistently overestimate how much their peers approve of/participate in drinking activities; only 35% of college students had a correct perception of normal college student drinking behaviors. Their study also found that participants' overestimation of peer behavior was a predictor of individuals drinking habits r=0.47. Perkins and Berkowitz further showed that the

greater the discrepancy between personal attitudes and perceived norms were, the more accurate their behavior could be predicted ($p<.001$) [14].

Upon the discovery of this association between students' perception of peer behavior and individual choices, Berkowitz and Perkins recommended that drug and alcohol prevention strategies include correct education on peers' drinking attitudes and behaviors. Recognizing that individuals' perception of norms may be easier to influence and change then personal attitudes, they hypothesized that giving normative feedback to correct misperceptions would result in decreased drinking among those with inflated perceptions of normal peer behaviors. They also hypothesized that this could increase drinking behaviors among those who perceived peer behavior to be more conservative than they really were.

Interventions using social norms theory were first applied to college students in 1988 by Haines et al. [15]. Their study was designed to test the hypothesis presented by Perkins and Berkowitz and determine whether a social norms intervention could change the perception of peer behavior and modify participants' drinking habits. This was a five-year study conducted between 1988 and 1992 with nearly 18,000 participating each year and an average 89% return rate from year to year. The first year of the study collected data to establish a baseline for students' actual behaviors and perceived peer behaviors. Phase two the following year implemented a traditional alcohol abuse prevention strategy and phase three occurred during years 3-5 implemented a social norms intervention to correct misperceptions.

Their baseline results were consistent with Perkins and Berkowitz showing that 69.7% of participants believed that "binge" drinking was normal college behavior and this perception remained stable (69.3%) the following year during the traditional prevention strategy. It did however decrease significantly during the social norms interventions over the next three years (1990: 57%, 1991: 51.3%, and 1992: 51.2%, $p<.001$). These results showed that a social norms intervention can change perception of peer behavior and did so by 18.5% over the three-year normative feedback intervention.

Self-reported binge drinking behavior among participants was unchanged following the traditional strategy intervention (baseline: 43%, traditional: 44.8%) but was significantly reduced following the social norms intervention (1990: 37.6%, 1991: 36.7%, and 1992: 34.2% $p<.001$) with a decrease of nearly 10% [15]. These results contributed to a growing body of evidence suggesting that perception of peer behavior influences personal actions and that social norms interventions may be used to change individual's perceptions leading to changes in behavior.

Other early landmark studies confirming the effectiveness of social norms interventions include Hansen and Graham's 1991 study and Hansen's 1993 research. In their 1991 study Hansen and Graham began an 8-year cohort study testing the effectiveness of normative feedback compared to traditional alcohol prevention methods consisting of education and peer pressure resistance training. Their study included 2416 students from 12 different junior high schools in LA and Orange Counties, California. Schools were stratified by size, test scores and ethnic composition and then randomly assigned to one of four intervention groups. The

first group was an "information only" education program that included four 45-minute lessons about the potential health and social consequences of using drugs and alcohol. The second was a "peer pressure resistance training" group that received four lessons about the consequences of using substances and five lessons teaching students to identify and resist pressure from peers to use these substances. The third group used "normative feedback education" which included five lessons that corrected misperceptions about drug and alcohol use and their social acceptability among their peers. The last group was a combined program including three information lessons, three and one-half lessons using normative feedback to establish conservative norms, and three and one-half lessons to develop peer pressure resistance skills.

Their study found that classrooms receiving normative feedback had significantly reduced self-reported rates of alcohol consumption ($p<0.001$), marijuana use ($p<0.001$), and cigarette use ($p<0.05$) compared to programs with no normative education. Further results showed that classrooms receiving normative feedback reported a 62.4% relative rate reduction of drunkenness, a 22.5% relative reduction in incidence of initial drinking, and a 45.1% relative decrease in prevalence of weekly alcohol use followed by a 31.9% relative decrease in previous 30-day use. Results also showed an 87.5% decrease in the rate of disciplinary problems resulting from alcohol use compared to the traditional methods groups [16].

It is interesting to note that the resistance-training program failed completely, with some results showing an increase in alcohol and marijuana prevalence. The researchers speculated that because the program focused

specifically on resisting pressure, this may have actually increased students' perception of peer alcohol and drug use by implying that if there is pressure to use, it must therefore be very common and acceptable to others to use. This may have resulted in an enhanced misperception of social norms.

In Hansen's 1993 study researchers reviewed 35 multi-component school based alcohol intervention programs. Of the 35 programs only 14 were found to be effective in reducing alcohol consumption of participants. While the content of the 14 successful programs varied, Hansen's review found that including a social norms approach and correcting misperceptions was critical to the effectiveness of multi-component alcohol prevention programs among high school teens [17].

Since 1986 there have been numerous studies utilizing social norms theory as an intervention to influence drinking behaviors. Table 2.1 outlines numerous studies and their outcomes after implementing social norms interventions [15,16,18-27].

While most research in social norms theory has primarily studied misperceptions and behaviors related to alcohol and drug use, other researchers have studied social norms associations in other behavioral areas. Bigsby et al. found that both students and parents misperceive the degree and amount of bullying that occurs and that while bullying behaviors are misperceived as normal behavior they are disapproved of by the majority [28]. Researchers hypothesize that correcting this inflated perception of bullying activity may reduce bullying at the elementary school level.

TABLE 2.1 Summaries of social norms interventions and effects on high-risk behaviors.

| Location and Authors | Description | Outcomes |
|---|---|---|
| Northern Illinois Univ.<br>Haines and Spear, 1996[15];<br>Haines, 1996[18];<br>Haines and Barker, 2003[19] | 1989-1998<br>Cluster sampling,<br>Yearly *n* from 550 to 1,052 | From 1989 to 1998 there was a decrease in 6+ drinks when partying (from 45% to 25%), an increase in 1-5 drinks when partying (46% to 56%, and an increase in abstinence (9% to 19%) |
| Univ. of Arizona<br>Glider et al., 2001[20]<br>Johannessen & Glider, 2003[21]<br>Johannessen et al., 1999[22] | 1995-1998,<br>*n* = 300 each year | From 1995 to 1998 there was a decrease of heavy drinking (5+ drinks) by 29%, prior 30-day use rate decreased from 74% to 65%. |
| Western Washington Univ.<br>Fabiano, 2003[23] | 1997-1998<br>*n* = 489 and 1127 | No change in drinking from 1992-1997. From 1997-1998 decrease in 5+ drinks from 34% to 27%, an increase in 1-2 drinks from 34% to 49%. |
| Hobart and William Smith Colleges<br>Perkins and Craig, 2002, 2003[24,25] | 1996-1998<br>*n* = 156,274 | 21% decrease in 5+ drinks, 20% increase in abstaining, 14% decrease in average number of drinks/party |
| | 1995-2000<br>*n* = 232,326 | 18% decrease in days drinking during last 2 weeks, 24% decrease in avg. drinks/party, 50% increase in "rarely or never experience neg. consequences" 46% decrease in liquor law violation arrests. |
| Rowan University<br>Jeffrey et al., 2003[26] | 1998-2001<br>*n* = 483,453 | Decrease in 5+ drinks at a party (from 40% to 30%), decrease in 5+ drinks in last two weeks (from 48% to 37%) |
| Two Midwestern High Schools<br>Haines et al. 2003[27] | 1999-2001<br>*n* = 317 and 380 | Decrease in 5+drinks in a row in last 2 weeks (from 27% to 19%) decrease in "got drunk" in last 30 days from 32% to 26% |

Studying social norms perceptions related to homophobia, Bowen et al. found that students consistently believed themselves to be "less anti-gay" than their friends or the typical college student [29]. Their survey found that students' self-reported personal attitudes towards lesbians, gays and bisexuals were significantly more positive (M=.87, SD=1.95) than they believed their peers to be (M=.52, SD=1.71, p=.01). In their paper, Bowen et al. discuss the potential that social norms interventions could be used to decrease misperceptions of LGB social acceptance and reduce social prejudice against the LGB community.

Similar to Bigsby and Bowens studies, misperceptions of social norms have been found regarding the prevalence and social acceptance of other behaviors including sexual assault, eating disorders, gambling, parenting behaviors, and income tax compliance. In each of these areas there has been found notable misperceptions of normal behavior and the authors discuss the potential to modify behaviors by correcting social misperceptions. Though in many cases research on the application of a social norms intervention are still forthcoming [30-36].

*Nutritional Applications of Social Norms Theory.* Over the last several years there has been a growing interest in the application of social norms theory to the field of nutrition and dietetics. Currently there are only sixteen articles that study the effect of a social norms intervention on nutrition/dietary related intentions and behaviors. Of these studies only four have evaluated outcomes related to improving healthy dietary practices such as intention to purchase and/or consume fruits and vegetables. While there are only a few studies published on the topic, there is

enough evidence to suggest the potential success for social norms interventions to improve diet related behaviors.

Recently the Academy of Nutrition and Dietetics published a systematic review and meta-analysis of the effects of social norms information on eating behaviors. Their review of 339 potential articles found 15 studies that looked at the effect of social norms information on dietary related behaviors. Nine of these studies were eating lab studies enrolling psychology undergraduate females who were given real or manipulated social norms information regarding peers' consumption of cookies, doughnuts, pizza, or other snack foods. In seven of these studies participants were then given a limited amount of time with free access to the food and their consumption was measured. In the remaining two studies participants were given a limited number of food choices and the percentage of unhealthy vs. healthy snacks chosen were recorded.

Three of the fifteen studies assigned participants to read an article regarding the high consumption of junk food by an undesirable social group on campus. In two studies, after reading the article participants were given a pseudo grocery shopping assignment after which the amount of junk foods chosen were evaluated. In the third study, after reading the article participants went to the university cafeteria where their food selections were monitored. The remaining three studies will be described in more detail later.

Overall their meta-analysis of these studies concluded that social norms information can significantly influence dietary choices. When participants were told that social norm intakes were high they tended to eat more than the controls

(Z=3.85; p=.0001). And similarly when participants were told that normal intakes were low they tended to eat less compared to control (Z=2.78; p=.005). While these combined results are quite significant and confirm the influence that social norms can have on behavior, each of these studies examine only short-term immediate effects. None of these studies show any lasting change in behavior over time.

Three studies have previously examined how providing information about a socially undesirable group may impact the behavior of others. In the first study, participants were presented with paired food options (junk food and healthy foods) and asked to select their choice. Participants told that a socially undesirable group ate a lot of junk food selected junk food choices 30% less often than did those told a socially desirable group at a lot of junk food (p-value for the difference between the groups = <0.05). naThe next study, which included a no-norm control found those receiving social norms information about the undesirable social group chose less junk food from the 10 paired choice options compared to control (p<.05). The third study measured percentage of calories from fat in food items chosen from the university cafeteria and found a 20% decrease among those receiving social norms information of the undesirable group compared to no-norm controls (p<.05) [37]. These results imply that the reference peer group the social norms are drawn from may be as important as the social norms information itself. If the social norm is regarding the behavior of a socially undesirable group, participants are more likely to resist instead of conform to the social norm. Whereas the previously mentioned studies have shown participants tend to mimic the social norm when it is a desirable social group.

Lally et al. examined associations between perceived norms and dietary habits in high school seniors aged 16-19 (n=264). Dietary behaviors looked at in this study included the consumption of fruits and vegetables, unhealthy snacks and sugar sweetened-drinks. Using gender specific questionnaires to evaluate individual attitudes and eating behaviors, along with perception of peer attitudes and behaviors, Lally found that adolescents believe their peers eat less fruits and vegetables than they actually do, underestimating peers' intake of fruits and vegetables by 3.2 servings/week. Furthermore, using food frequency questionnaires (FFQ) to estimate food intakes, their regression analysis found that the only predictor of individuals' fruit and vegetable intake was their perception of peer norms, which accounted for 22% of the variance in fruit and vegetable consumption [13]. While FFQ's are useful tools in obtaining general information about dietary changes in large populations over time, most FFQ's are not an accurate method for tracking changes in individuals. Lally gives no information regarding the validation/accuracy of the FFQ used in their study.

Croker et al. showed that a social norms approach may also be used to increase intended food choices. Their 2008 study, consisting of 1083 participants, used trained interviewers to collect data from randomly selected households in Great Britain. After an initial survey collecting data on participants' attitudes towards nutrition and personal fruit and vegetable consumption, participants were assigned to one of four information conditions: information on cost of fruit and vegetables, health value, social normative information, or a control group. Those receiving social norms information were told that 80% of the local population tried

to eat 5 fruits and veggies/day. These participants receiving the social norms condition showed an increase of intended fruit and vegetable intake by .6 servings /day (p=0.001). This increase was despite the fact that participants rated the importance of social norms when choosing fruits and vegetables the lowest on a 1-4 scale (mean=2.1) compared to the cost of healthy food (mean=2.7), and health associations (mean=3.4). This social norms information regarding peers' fruit and vegetable intake was the only intervention to have a positive effect on intended consumption. Other factors including food cost and health benefits of healthy foods had no statistically significant effects on intended food choices [38].

The limitations of Croker's study are that this study has no baseline or follow-up measures evaluating actual fruit and vegetable intakes. Information regarding whether or not the seen increase in "intended fruit and vegetable consumption" lead to an actual increase in intakes would have been useful information regarding the effectiveness of social norms information toward modifying dietary behaviors. Another potential limitation of their study was how they evaluated future intended food choices. According to their publication this was evaluated by a single question asking participants to indicate how many portions of fruits and vegetables a day they intended to eat over the next six months. It is possible that multiple, validated, and more specific questions regarding intended future fruit and vegetable consumption may have yielded a more accurate estimation of future intended intakes.

Stok et al. conducted a similar study involving 102 university students. Students were given manipulated information conditions receiving either a

"majority norm" information or "minority norm" information intervention. The "majority norm" participants were told that 73% of students get enough fruit in their diet, while the "minority norm" group was told that only 23% of students have sufficient fruit intake. Using a questionnaire to evaluate prior food consumption and future intent, students given the majority norm information later showed a statistically significant (p=0.01) higher fruit consumption intent (M=3.89, SD=0.97) compared to those given minority norm statistics (M=3.53, SD=0.72) [39]. Furthermore, preliminary findings by Higgs and Birmingham show that students given social norms information prior to a lunchtime buffet may increase vegetable consumption among students with a history of poor vegetable intake [40]. However, students with an already normal or high vegetable consumption were not affected. This observed ceiling effect is similar to those seen in other types of nutritional interventions in college students [41]. Because there are so few studies utilizing social norms theory to increase fruit and vegetable consumption, it is unknown whether or not this effect is to be expected for future studies.

A later study by Stok examined the difference between descriptive social norms and injunctive norm feedback on influencing fruit intake in high school students. Descriptive norms include information *describing* the behaviors of a given population. Injunctive norms however function by *proscribing* a behavior or indicating what others think a given population "should" do. This study included 96 high school students between the ages of 14 and 17 who were assigned to one of three groups: A control group that didn't receive any social norms feedback; a descriptive norm group who were informed that the "majority of high school

students try to eat sufficient amounts of fruit". And an injunctive norms group that was told the "majority of high school students think other students should eat a sufficient amount of fruit". It is important to note that feedback given in the intervention groups were manipulated for the experimental purposes of this study and were not true or validated statements.

Only 80 participants completed the follow up phase which evaluated future intended fruit consumption and reported two day follow up fruit intake. The results from this study yield interesting implications for the use of social norms interventions in the field of nutrition. The first is that receiving descriptive norm information did not affect future intended fruit consumption compared to control (descriptive norm M=3.87, SD=.77; control M=3.88, SD=.76) [42]. This seems to contradict earlier findings by Croker who found social norms feedback to increase intended consumption [38]. Furthermore, both the descriptive norms group and the control had statistically significantly higher ($p<0.05$) intended fruit consumption than those receiving the injunctive norm condition (M=3.43, SD=.76). These results imply that injunctive norms could actually have a negative effect on adolescents and according to Stok may instill feelings of resistance. Or in other words, adolescents may resist being told what others think they should do.

Another key finding was that participants receiving descriptive norms had a higher two-day post study fruit consumption (M=2.3 daily pieces of fruit, SD=1.6) compared to both injunctive norms (M=1.5, SD=.9) and control (M=1.7, SD=1.0), though this increase was only borderline significant (p=.057) [42]. These results imply that while descriptive norms may not increase intended fruit consumption they may

lead to an increase in actual fruit consumption. According to Stok this suggests that the effects of descriptive norms may be on a heuristic level beneath the conscious processing of the individual requiring no mental exertion in the decision making process. Or in other words, their choices may have been influenced without them consciously noticing the change. It is also important to note that those receiving injunctive norms had the lowest fruit intakes, providing more evidence for the potential negative effects of injunctive norms on adolescents.

Stok's study has both its strengths and limitations. The first limitation is that they examined only intent and intakes of fruit. Stok gives no explanation as to why only fruit was examined in this study compared to most studies that evaluate habits and intentions relating to both fruit and vegetables. Unlike previous studies using FFQ's to evaluate intakes, Stok used an average of two 24 hour recalls asking participants specifically how many servings of fruit they ate on each of the two days prior to the follow-up. While these results were likely very accurate, there unfortunately was no baseline intake to compare these results to, making it impossible to know whether or not the intervention actually lead to an increase in fruit consumption due to the intervention. Further follow-up longer than three days would be required to determine how long the effects may last. In evaluating intended fruit consumption Stok used a score averaged from four different questions regarding participants' attitudes and intentions for future consumption. This methodology likely yielded a more accurate estimation of intent compared to the single question method employed by Croker. However, Croker's study had a much larger sample size and was examining a different population making a direct

comparison of the results inappropriate. The key contribution Stok's study makes regarding social norms feedback is that interventions in future studies hoping to improve dietary habits should give the context of social norms in a descriptive norms format.

The two studies published by Stok are the first to utilize manipulated information about social norms as a method for influencing fruit and vegetable intakes or intent. Using some form of deception, Stok gave misinformation in the first study regarding the difference between majority and minority norms, and in the second study regarding descriptive and injunctive norms. The purposes of the manipulated information in Stok's two studies were to examine the differences in the presentation of social norms feedback. The different effects when social norms are presented as majority vs. minority norms and in a descriptive or injunctive form. There are currently no studies examining the differences between artificially manipulated feedback and true social norms information, and the effects of each on fruit and vegetable consumption.

**IMPLICATIONS FOR SOCIAL NORMS AS A NUTRITIONAL INTERVENTION**

The results from each of these studies helps to lay the foundation for the possibility of a social norms intervention aimed at improving dietary behaviors by increasing fruit and vegetable intake. Meta-analysis shows that social norms influence the food choices of college students with changes in students' consumptions trending toward what they are told the social norm is. Lally's results imply that students who perceive that their peers eat more fruits and vegetables,

are more likely to eat more fruits and vegetables themselves. Both Croker's study and Stok's 2012 results show that majority social norms education can lead to an increased intent to eat fruit and vegetables. And while Stok's 2014 study did not lead to an increase in intended food choices, their use of descriptive social norms actually did lead to a comparative increase in fruit consumption. Therefore, it is presumable that if an intervention can be developed to change the perception of peer fruit and vegetable intake, it may be possible to both increase one's intended food choices and lead to an actual increase in fruit and vegetable consumption.

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# CHAPTER 3

# THE EFFECT OF SOCIAL NORMS FEEDBACK ON FRUIT AND VEGETABLE CONSUMPTION AND SKIN CAROTENOIDS AMONG COLLEGE STUDENTS


## ABSTRACT

The object of this study was to determine if a social norms intervention using normative and manipulated feedback could influence fruit and vegetable intake and skin carotenoid levels in college students. Participants' baseline and follow-up F&V intakes and carotenoid levels were evaluated using a 16-item FFQ and Pharmanex's biophotonic scanner.

There were 344 participants enrolled at the beginning of the study with 244 returning for follow-up evaluation (70.9% completion rate) including 75 males and 169 females. Participants were randomly assigned to either the control (n=81), normative feedback (n=77) or manipulated feedback (n=86) interventions. Mean age was 21 years, mean fruit intake was 0.922 cup/day, mean vegetable intake was 1.95 cup/day, and mean carotenoid concentration was 24,575 units.

Skin carotenoid levels were correlated with baseline and follow-up self-reported F&V intakes (R=.29, P<.001 and R=.34, P<.001). No differences between baseline and follow-up F&V intakes were reported (P=.635). However, there was a significant change in carotenoid levels based on group assignment (P=.033). Students in the manipulated feedback group increased carotenoid scores (P<0.001); no significant change was observed in either the normative feedback or control groups.

These results suggest that a social norms intervention may lead to an increase in skin carotenoid levels among college students. And could potentially be a cost-effective strategy for promoting fruit and vegetable consumption on college campuses.

**INTRODUCTION**

College students between the ages of 18 and 24 are establishing habits and lifestyles that may last a lifetime and according to the national college health risk behavior survey they may be putting their future health at risk (Racette & Deusinger, 2005; Douglas & Collins, 1997). 73.7% of college students are not meeting the recommended intakes for fruit and vegetables and studies show a significant decrease in consumption during the first five months of freshman year (Douglas & Collins, 1997; Butler & Black, 2004). 21.8% report eating three or more high fat meals on any given day and the majority of college students are not getting enough exercise (Douglas & Collins, 1997; Butler & Black, 2004).

Weight gain during the first year of college is well documented with students gaining on average between four pounds their first semester and ten pounds by sophomore year (Lloyd-Richardson & Bailey, 2009; Wengreen & Moncur, 2009). This weight gain contributes to the current obesity epidemic with recent data showing that 35% of college students are overweight or obese (Lowry & Galuska, 2000). Weight gain, an unbalanced diet, and limited physical activity all contribute to an unhealthy change in body composition. Butler et al. found that college students exhibit a statistically significant decrease in lean body mass (P=.01) and an increase

in fat mass (P=.001) during freshman year, a change that puts individuals at an increased risk for chronic diseases later in life (Butler & Black, 2004; Baumgartner & Heymsfield, 2012).

A variety of interventions have been used to successfully improve the eating patterns of college students by targeting the behavior of eating recommended amounts of fruits and vegetables. Enrollment in a general nutrition course was shown to increase fruit and vegetable consumption by 0.75 cups/day and help decrease consumption of some fried foods by 50% (Ha & Caine-Bish, 2009). Online education programs including two guided 45-minute sessions followed by free access to the online nutrition and physical activity tools for 3-6 months led to an increase of .33 servings of fruit and .24 servings of vegetable per day (Franko & Cousineau, 2008). Some marketing campaigns utilizing posters, brochures, table tents and bimonthly video presentations similarly resulted in an increase of 0.3 servings/day of fruits and vegetables (Shive & Morris, 2006). One multi-interventional model led to increased fruit intakes from 3.92 to 4.31 servings/day (P<.01)(Nitzke & Kritsch, 2007), while another was found to increase fruit and vegetable consumption by 0.4 servings/day (P<.001)(Richards & Kattelmann, 2006).

In this study we assessed the effectiveness of a social-norms intervention aimed at encouraging college students to eat more fruits and vegetables. Because college students are social creatures that tend to conform to the group standard, social norms have been shown to exert a powerful influence over individual behavior (Reno & Cialdini, 1993; Schultz & Nolan, 2007). Social norms theory is

based on the fact that one's perception of peer behavior (the "perceived norm") significantly influences individual behavior. For example, if one believes their peers drink alcohol excessively, then that individual is more likely to drink excessively also. However, by providing normative feedback (education pertaining to the "actual norm") showing that one's peers do not drink as excessively as they are perceived to, then the individual tends to decrease alcohol consumption (Berkowitz, 2004; Wechsler & Nelson, 2003; Perkins & Craig, 2006).

The social norms method has proven effective in decreasing high-risk behaviors such as drug and alcohol consumption (Berkowitz, 2004; Wechsler & Nelson, 2003; Perkins & Craig, 2006) and may also similarly be able to promote healthy behaviors such as eating fruits and vegetables. There has been a growing interest in the connection between social norms and dietary patterns over the last few years. Recent studies have found that individuals who perceive their peers to eat more fruits and vegetable are more likely to have higher rates of consumption themselves (Lally & Bartle, 2011). Giving social norms information has also been shown to lead to an increase in intended fruit and vegetable consumption (Croker & Whitaker, 2009; Stok & Ridder, 2012). One study has even shown that giving social norms information prior to a buffet may lead to greater vegetable consumption during the event (Robinson & Higgs, 2012). Therefore, since perception of peer fruit and vegetable consumption is associated with personal intakes, social norms information leads to increases in intended consumption and in some cases even actual increases in consumption, it is conceivable that a social norms intervention

could be implemented to increase fruit and vegetable consumption by modifying one's perception of peer fruit and vegetable consumption.

The purpose of this study is to determine whether or not a social norms approach, using both normative feedback and manipulated norms, can influence fruit and vegetable intake among college aged students as evidenced by changes in skin carotenoid levels and food frequency questionnaire reports. This study will also be the first to use skin carotenoid levels as an objective measurement of fruit and vegetable intake in this type of intervention.

**METHODS**

*Subjects.* The Intuitional Review Board at USU reviewed and approved this study to examine the application of a social norms intervention. At the beginning of the 2013 Fall and 2014 Spring semesters, students from each of the sections of the NDFS 1020 "Science and Application of Human Nutrition" were informed of the research project and invited to participate (n=251). Students not receiving nutrition education were recruited via USU's SONA program, which is a research program designed to give students from other disciplines the opportunity to participate in human research. SONA participants were accepted into the study with the qualification that these participants had never enrolled in a nutrition course (n=93). Of these 344 participants who enrolled in the study there was only 181 of the 251 nutrition students who completed the study (72.1% completion rate) and were included in the final analysis. 63 of the 93 (67.7%) non-nutrition students completed the study and were included in the final analysis.

*Qualifications for Study.* All participants enrolling in the study were required to meet the following requirements: over the age of 18, in good health with no known existing chronic conditions, initial biophotonic scanner score > 5,000, and neither pregnant nor anticipating becoming pregnant in the next 9 weeks.

*Study Design.* Participants completed an online FFQ and had their skin carotenoid levels checked at the beginning and at the end of the study. Both nutrition and non-nutrition participants were randomly assigned to one of the following groups: in the control group participants' scanner score was not revealed to them; in the normative feedback group participants were told their obtained scanner score, along with their ranking in comparison to other college students; and in the manipulated feedback group participants were not told their true scanner score, instead they were told the majority of college students (80%) had a higher carotenoid score than they did, even if this statement was false. Participants were not informed that there were different groups to which they might be assigned, and they completed their initial meeting individually, so that they could not hear other forms of post-scanner information being provided. Following completion of the study, participants in the manipulated feedback group were informed of the deception used. Their true scores were revealed to them and they were given the option to withdraw their results from the study, no participants chose to exercise this option.

*Data Collection.* Skin carotenoid levels were measured through the use of a Pharmanex Bio Photonic scanner validated for measuring skin carotenoid levels using Raman Resonance Spectroscopy (Mayne & Cartmel, 2010). Measurements of

skin carotenoid levels were taken on the inside of the palm roughly one inch beneath the knuckle of the little finger between the first and second lines on the palms as per the instruments instructions. Participants wearing lotion were instructed to wash their hands vigorously prior to having their carotenoid levels checked. Participants with levels below 5000 or above 60,000 were asked verbally about their dietary habits, nutrition supplementation and use of lotions. If needed they were then instructed to wash their hands and had their carotenoid levels checked a second time with their second score being recorded for analysis.

Dietary intakes were also estimated by using the National Institute of Health's 16-item food frequency questionnaire, which has been validated for evaluating changes in fruit and vegetable consumption of populations (Thompson & Subar, 2002; Yaroch & Tooze, 2012). Other questions regarding participants' age, year in school, multivitamin and alcohol usage, activity levels, nutrition education, gender, ethnicity, and height and weight were added to the questionnaire, which was administered online.

Non-nutrition students enrolling in the study via the SONA program were required to schedule individual appointments for both baseline and follow-up data collections which included taking the survey and having their skin carotenoid levels checked. Nutrition students had the option to schedule individual data collection appointments or attend a data collection session during one of their nutrition classes to have their skin carotenoid levels checked. To ensure that participants were not privy to others scores or feedback each was individually brought to the back of the room away from other students to have their levels checked and scores

given, participants then submitted the survey online following class. Both skin carotenoid levels and FFQ results were collected at the beginning and end of the study to estimate changes in fruit and vegetable consumption.

*Statistical Analysis.* Statistical analysis was done using statistical software IBM SPSS (version 21 SPSS Inc., Chicago, IL, 2012). An examination of the data's distribution appeared to be approximately normal. Paired t-tests were conducted for all pre and post evaluations to assess significant changes. A repeated measure of analysis (ANOVA) was applied using a general linear model to assess if there were any significant changes dependent on group assignment. Because skin carotenoid levels may be effected by age, BMI, gender, multivitamin use, baseline fruit and vegetable intake and exercise, each of these were included as covariates in the analysis. Statistical significance for this study was defined as $P< 0.05$.

**RESULTS**

*Demographics.* Data was collected from 344 participants during the 2013 Fall semester and 2014 Spring semesters. Of the 344 participants 249 completed both parts of the study, 5 of these participants had results that were determined to be outliers and were therefore removed from the data set leaving 244 participants for the final analysis. There were 75 males and 169 females (see Table 3.1). 93.8% identified themselves as white, with 2.5% identifying as Hispanic. Black, Native American, Asian, middle-eastern, and pacific islanders made up the remainder of the population. The average age was 20.7 years old with first year students making up

Table 3.1 Participant demographics

| | Control | Normative feedback | Manipulated feedback | Total | Chi sq. p-value |
|---|---|---|---|---|---|
| N[a] | 81 | 77 | 86 | 244 | 0.607 |
| Male | 23 | 27 | 25 | 75 | |
| Female | 58 | 50 | 61 | 169 | |
| | | | | | |
| White | 74 | 70 | 84 | 8 | 0.123 |
| Hispanic | 3 | 3 | | 6 | |
| Black | | 1 | | 1 | |
| Native American | 1 | | | 1 | |
| Asian | 2 | 1 | | 3 | |
| Middle Eastern | | | 2 | 2 | |
| Pacific Islands | | 2 | | 2 | |
| no response | 1 | | | 1 | |
| | | | | | |
| Freshman | 41 | 37 | 42 | 120 | 0.725 |
| Sophomore | 13 | 16 | 20 | 49 | |
| Junior | 18 | 12 | 13 | 43 | |
| Senior+ | 9 | 12 | 11 | 32 | |

[a] Only those completing the entire study were included

49.4% of the sample, 20.1% were second year, 17.7% were third year, and 12.8% were in their fourth year or more.

*FFQ and Carotenoid Scores.* The study was administered over the course of 7-9 weeks. Participants completed an online FFQ and had their skin carotenoid levels measured to establish baseline and follow-up levels. Participants were randomly assigned to a control, normative feedback or manipulated feedback group. Analysis of variance for initial dietary intakes, carotenoid scores, and BMI confirmed that there were no significant differences initially between the groups confirming that the randomization was successful with P>.05 for all variables. The means and

Table 3.2 Baseline and follow-up means

| | Group[a] | N | Mean | Std. Dev | Std. Error | *f*-test | p value |
|---|---|---|---|---|---|---|---|
| Baseline Fruit and Veg. Cups/day | 1 | 80 | 2.64 | 1.846 | 0.206 | 0.059 | 0.943 |
| | 2 | 77 | 2.60 | 1.964 | 0.224 | | |
| | 3 | 86 | 2.54 | 1.987 | 0.214 | | |
| | Total | 243 | 2.59 | 1.927 | 0.124 | | |
| Followup Fruit and Veg Cups/day | 1 | 80 | 2.70 | 2.054 | 0.247 | 1.033 | 0.358 |
| | 2 | 77 | 2.64 | 2.005 | 0.257 | | |
| | 3 | 86 | 2.30 | 1.329 | 0.156 | | |
| | Total | 243 | 2.54 | 1.810 | 0.127 | | |
| Baseline Carotenoid Score | 1 | 81 | 24875.53 | 8893.106 | 988.123 | 0.411 | 0.663 |
| | 2 | 77 | 23796.75 | 9451.863 | 1077.140 | | |
| | 3 | 86 | 24991.14 | 9117.475 | 983.163 | | |
| | Total | 244 | 24575.84 | 9129.027 | 584.426 | | |
| Follow up Carotenoid Score | 1 | 81 | 24872.31 | 9788.671 | 1087.630 | 1.815 | 0.165 |
| | 2 | 77 | 24972.99 | 9708.566 | 1106.394 | | |
| | 3 | 86 | 27341.35 | 8973.167 | 967.602 | | |
| | Total | 244 | 25774.32 | 9514.870 | 609.127 | | |
| Age | 1 | 79 | 20.85 | 4.032 | 0.454 | 3.194 | 0.043[b] |
| | 2 | 77 | 21.44 | 4.667 | 0.532 | | |
| | 3 | 86 | 19.98 | 2.175 | 0.235 | | |
| | Total | 242 | 20.73 | 3.764 | 0.242 | | |
| BMI | 1 | 80 | 23.82 | 4.796 | 0.536 | 0.338 | 0.713 |
| | 2 | 77 | 23.30 | 3.380 | 0.385 | | |
| | 3 | 86 | 23.55 | 3.551 | 0.383 | | |
| | Total | 243 | 23.56 | 3.946 | 0.253 | | |
| Minutes of exercise per week | 1 | 80 | 104.63 | 66.183 | 7.400 | 0.652 | 0.522 |
| | 2 | 77 | 97.01 | 61.635 | 7.024 | | |
| | 3 | 86 | 108.14 | 61.444 | 6.626 | | |
| | Total | 243 | 103.46 | 63.011 | 4.042 | | |

[a] 1=Control, 2=Normative feedback, 3=Manipulated feedback
[b] $p<0.05$

standard deviations for dietary intake estimates and skin carotenoid levels along with age, BMI, minutes of exercise and GPA are presented in Table 3.2.

*Dietary Intakes and Skin Carotenoids.* While there was no difference between beginning and ending self-reported F&V intake by group assignment (P=.635), there was a significant correlation between baseline and follow up F&V intakes and carotenoid levels (R=.271, P<.001; R=.338, P<.001) (Table 3.3). Fruit and vegetable intakes were also correlated with exercise (R=.227, P<.001). Other significant correlations included, exercise and carotenoid levels (R=.111, P=.049), BMI and carotenoid levels (R=-.253, P<.001), and BMI and exercise (R=-.139, P=.011).

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Paired t-test showed that there was no significant difference within the control group's baseline and follow-up carotenoid levels P=.996. There was a significant difference seen in the manipulated feedback group P<.001 with an average increase in carotenoid levels of 3439.55 , and a moderate difference in the

Table 3.3 Pearson correlation table

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1. Baseline F&V | _____ | | | | | |
| 2. Follow up F&V | .483** | _____ | | | | |
| 3. Baseline Carotenoid Score | .271** | .301** | _____ | | | |
| 4. Follow up Carotenoid Score | .297** | .338** | .821** | _____ | | |
| 5. Minutes of exercise per week | .227** | .146* | .111* | 0.1 | _____ | |
| 6. BMI | 0.013 | -0.121 | -.253** | -.262** | -.139* | _____ |

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

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

normative feedback group with an average increase of carotenoid score of 1058.28, P=.066.

When comparing male and female participants there appeared to be no difference in the effects of social norms between genders with nearly identical changes in both the normative and manipulated feedback groups. There was no overall difference in carotenoid levels between males and females P=.471. Furthermore, there were no differences based on gender within each the group assignments P=.945.

Using repeated measures of analysis we examined differences in average skin carotenoid scores by group over time. We observed a significant group*time interaction (df=2, F=3.78, P=.024) indicating that skin carotenoids scores increased among those in the normative and manipulated feedback groups, but not for those in the control (Figure 3.1). In a post-hoc multiple comparisons analysis we found

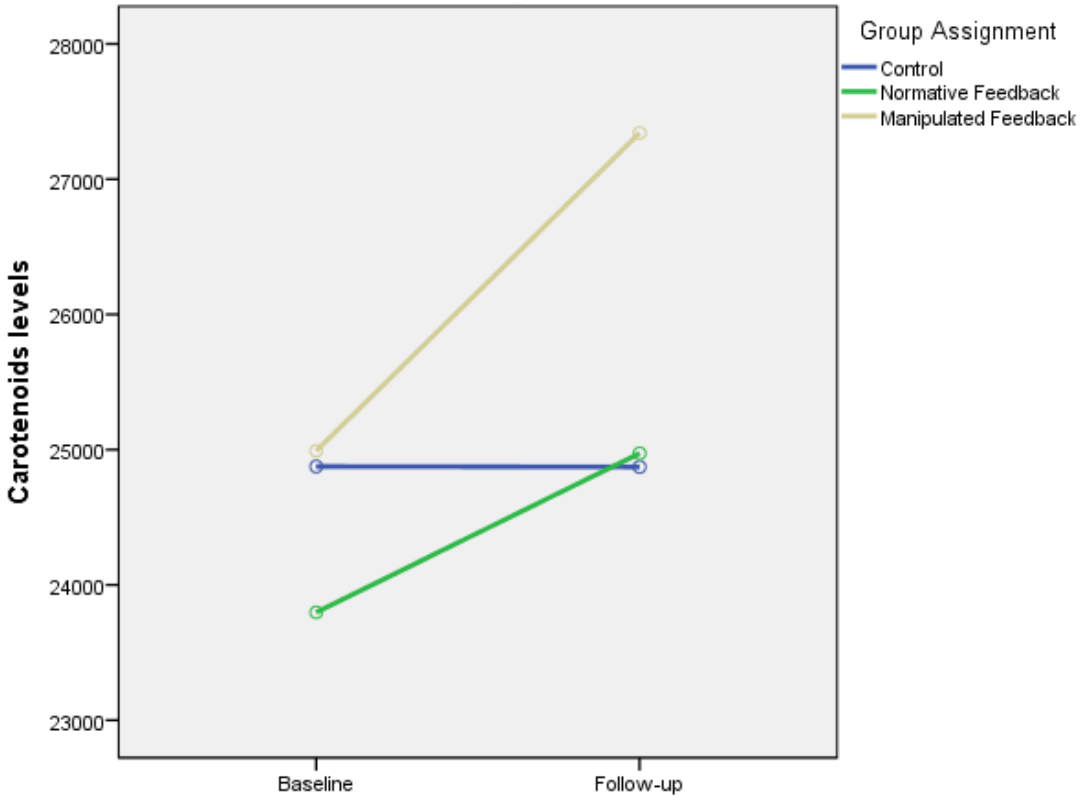


Figure 3.1 Changes in skin carotenoid levels by group

the most significant difference among those in the manipulated feedback group compared to both the normative (P=.016) and control groups (P=.075). The group effect remained significant in a model that included age, BMI, initial FFQ results, multivitamin use, and minutes of exercise as covariates (P=.033, Figure 3.2).

Baseline fruits and vegetable intake was categorized into quartiles of the study population. Those in the lowest quartile reported consuming M=.90 (SD=.231) servings of F&V per day, those in the highest quartile reported consuming M=5.6 (SD=1.77) servings of F&V per day. To examine whether or not baseline fruits and

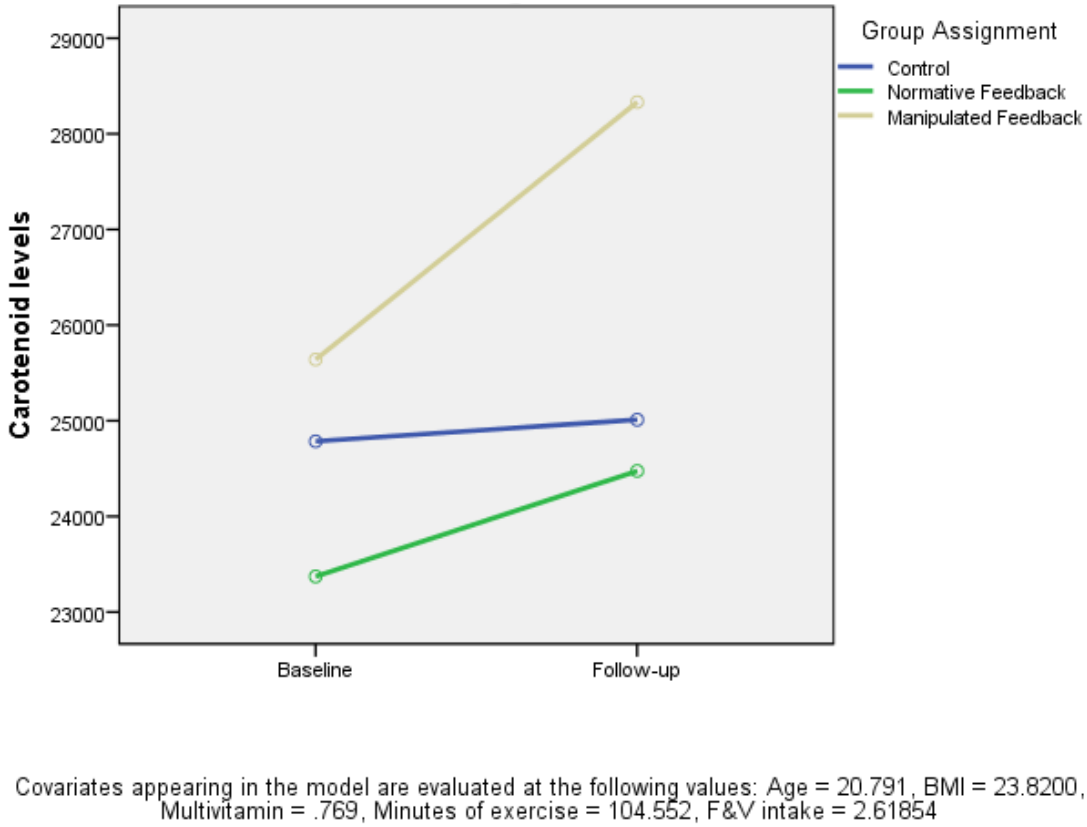


Figure 3.2 Changes in skin carotenoid levels adjusted for covariates

vegetable intake moderated the observed group effect, we used repeated measures analysis to examine change in skin carotenoid score by group, stratified by baseline consumption (in quartiles). We observed an overall increase in carotenoid levels across groups among those in the first and second quartiles that did not vary by group assignment (P>.05), this change being a regression towards the mean is consistent with what social norms theory would predict. We observed an increase in both the normative feedback and manipulated norm groups among those in the third quartile of intake (P<.05) (Figure 3.3).

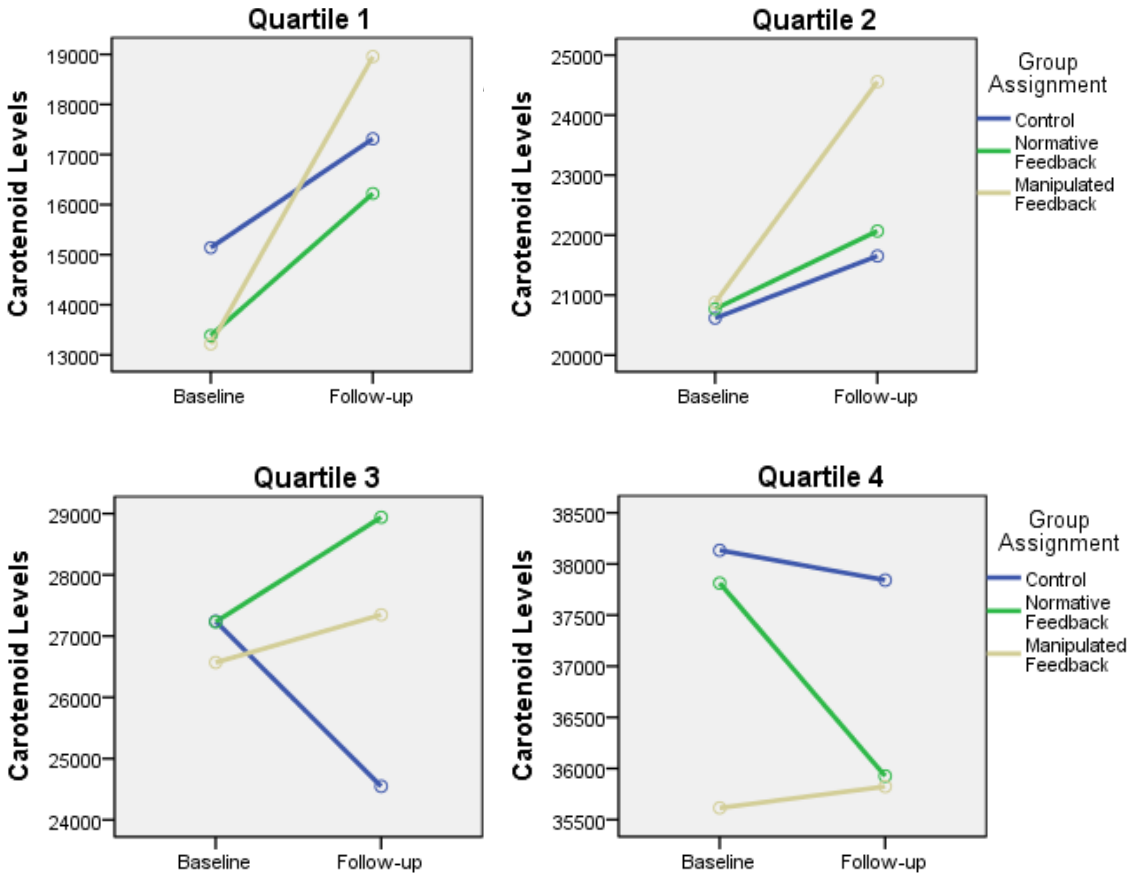


Figure 3.3 Changes in skin carotenoids levels by quartile of fruit and vegetable consumption

The interaction terms for quartile of baseline fruit and vegetable intake and group assignment, and baseline fruit and vegetable intake, group assignment, and time were not significant (P=.312, P=.259, respectively).

In comparing students enrolled in the general nutrition class to students who had never enrolled in a nutrition class there appeared to be no differences in baseline F&V consumption (P=.211) or carotenoid levels (P=.331). However, non-nutrition students did have a higher follow-up carotenoid level (P.006) than those

enrolled in the nutrition class that was not dependent on group assignment (P=.883).

**DISCUSSION**

Because this is the first study utilizing skin carotenoids levels as a method for evaluating the effects of a social norms intervention, the results yield some interesting observations beyond what other studies have looked at. First, there were statistically significant changes in the normative and manipulated feedbacks skin carotenoid levels, which are an objective indicator of greater carotenoid containing fruit and vegetable consumption, while there were no change in dietary intake as evaluated by the FFQ. The changes in skin carotenoids were specific to group assignment supporting the possibility that this observed change was due to the intervention. The lack of sensitivity of FFQ's to observe small changes in individual fruit and vegetable consumption may explain this discrepancy, because the magnitude of the increases in carotenoid levels though statistically significant, were small (an increase of 3400 in manipulated, and 1050 in normative groups). S. Aguilar et al. found that an increase of a cup of fruit/vegetables was associated with a RRS intensity increase of 3,504 (P=0.001) in children aged 5-17 (Aguilar & Wengreen, 2014). It is unknown whether or not a similar dose response would be expected in adults due to the differences is body size, weight and composition between children and adults.

Proceeding under the assumption that changes in carotenoid levels in this study were the result of increases in fruit and vegetable consumption beyond the

ability of the FFQ to detect continues to yield unique insights. While the correlation between fruit and vegetable intakes and skin carotenoid levels was expected and consistent with previous studies (Mayne & Cartmel, 2010), it is worth mentioning that exercise was associated with higher carotenoid levels (R=.111, P=.049). While it is not a strong association it is noteworthy because carotenoids function as antioxidants in the body (Krinsky, 1989) and vigorous exercise is known to increase metabolic stress producing higher levels of free radicals (Cooper & Vollaard, 2001). It would seem logical that individuals with higher levels of activity would have lower levels of skin carotenoids, as the carotenoids would be utilized as antioxidants instead of being stored as pigments in the skin. This was likely not seen in this study because higher levels of activity were also associated with higher fruit and vegetable intakes (R=.215, P<.001). This indicates that those with higher activity levels were also likely to have an overall healthier diet/lifestyle leading to higher carotenoid levels. Another contributing factor would be that BMI, which was negatively associated with carotenoid levels (R=-.253, P<.001) (Smidt & Shieh, 2003), was also inversely associated with exercise in this study (R=-.139, P=.011). A future study may look at the effect of exercise alone on skin carotenoid levels, looking at changes in carotenoid levels between those with high and low activity levels with similar dietary intakes.

Overall the changes in carotenoid levels for this study were as expected. There was no change in the control group reflecting no overall changes in behavior or dietary patterns, as there was no intervention in this group. Repeated measures of analysis showed that there were differences in the changes of carotenoid levels

due to group assignment. There was a marked increase in the normative group suggesting that normative feedback may be a method for encouraging healthy changes leading to increases in carotenoid levels. There was nearly three times the effect in those receiving the manipulated feedback. This implies that those who are informed that their levels are substandard may be more motivated to change than those who are told their levels are normal or above average. While future community or campus interventions using deception and false information may not be an ethical method for increasing fruit and vegetable consumption, these results do add to body of literature increasing to our understanding of the effects social norms feedback may have.

Looking at the change in skin carotenoids by group and quartile of baseline fruit and vegetable intake revealed that the manipulated feedback group was the only one to have a consistent increase thru each of the quartiles. This is the result we would expect if those in this group were striving to mimic what they had been informed was "normal behavior". In those already consuming high amounts of fruits and vegetables, we observed a slight decrease in the control and a notable decrease in those receiving normative feedback. This once again is in agreement with social norms theory with the participants receiving normative feedback moving towards what they had been informed was their peer norm, which was in this case, a lower amount than what they regularly consume. Because this effect appears to discourage fruit and vegetable consumption among those with initially high intakes, it may be wise to use this method with some caution.

One previous study found that social norms feedback only affected men with no change observed in women. In evaluating the effects of social norms information on intended food choice, Croker found that men exhibited an increase in intended fruit and vegetable consumption by .63 servings (P=.005) after receiving social norms information while women's intent remained identical to control (Croker & Whitaker, 2009). While this current study did not evaluate intended food choices, no differences in the effects of social norms between genders were observed, with nearly identical results occurring between males and females in both the normative and manipulated feedback groups.

When comparing the changes in carotenoid levels between nutrition students and non-nutrition students we found that greater follow-up carotenoid levels were observed among the non-nutrition students. While this contradicts both our hypothesis and observations in previous studies (Ha & Caine-Bish, 2009), it is likely explained by a greater self-selection bias among the non-nutrition students in actively choosing to participate in this nutrition study compared to nutrition students that were able to conveniently participate as part of the class. Furthermore, while there were greater overall follow-up carotenoid levels among the non-nutrition students, this did not significantly influence the overall results of the social norms intervention when this factor was included as a covariate in the analysis.

*Limitations.* Since the population used in this study was a convenience sample of USU students, these results are not reflective of college students as a whole. With 70% of the participants being female (which was due to the higher

female enrollment in the general nutrition courses) and 93.8% being white, a larger study with a more equal gender ratio and a much more racially diverse population would be required to give an indication of how social norms may influence skin carotenoid levels for college students outside the population studied.

Another limitation was the FFQ, which was likely not a precise enough method for observing absolute changes in dietary intakes. Because the FFQ used is only effective for observing dietary changes in large populations it is likely that a larger sample, or a different tool precise enough to observe accurate changes within individuals would have been necessary to observe the changes in dietary patterns indicated by the changes in carotenoid levels. It must also be acknowledged that changes in skin carotenoid levels could be the result of some unknown confounding factor not controlled for in this study.

Other potential limitations would have been attributed to the methodology. Participants only had their carotenoid levels measured once during both baseline and follow-up measures. Because there can be some small variance between test/retest scores, had measurements been taken in triplicate and the scores averaged this may have been a more accurate measurement. However, while the results may have been more accurate it is unlikely they would have been significantly different.

The instruments used to measure carotenoid levels may have had some slight variability between each other, with one scanner producing a slightly different score than another. To ensure this did not affect the results of this study all

participants were measured with the same instrument they had their baseline carotenoid score measure with.

Furthermore, midpoint measures throughout the study versus just baseline and ending measurements would give a better perspective of the changes overtime. Continued follow-up would also determine how long the effects might last before returning to baseline. Because this study only lasted 7-9 weeks for each of the participants involved it is impossible to tell whether or not there was a seasonal effect on carotenoid scores as well. Also, effects of the social norms intervention may have been enhanced had the interventions included an educational component and been repeated on a regular basis, versus participants being given only background information at the beginning of the study.

*Strengths.* One of the strengths of this study is that it is the first study to evaluate the effects of social norms feedback objectively using skin carotenoid levels as a measurement of fruit and vegetable intake. All previous studies have used self-reporting methods such as food frequency questionnaires. Because skin carotenoid levels are an objective measurement they is not subject to the same self-reporting errors found in other dietary assessments methods and cannot be affected by personal biases. Another strength is that this study has a moderate sample size. Similar studies examining social norms effect on fruit and vegetable intakes have only included between 80 and 104 participants. Having a sample size over twice that yields a greater power of analysis.

## CONCLUSION

The results observed indicate that a social norms intervention may be effective in increasing skin carotenoid levels. While the magnitude of the increase was not large, it potentially could be effective as part of a multicomponent strategy aimed at improving dietary habits of college students. It will require future studies compensating for the limitations of this study to fully explore how large of an effect a social norms intervention can have on improving fruit and vegetable intake in college students.

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# CHAPTER 4

# SUMMARY AND CONCLUSION

## ABSTRACT

This study explores the use of social norms theory as a nutritional intervention. Previous studies have concluded that social norms feedback can influence one's behavior and perception of peer behavior. With perception of peer fruit and vegetable intakes being a predictor of personal F&V consumption, social norms feedback may result in increased intent and possibly increased intakes of fruit and vegetables.

The results of this study found that changes in skin carotenoid levels were determined by which intervention group participants were assigned to (P=.033). With normative and manipulated social norms feedback leading to increases in skin carotenoid levels while no change was observed in control. These results suggest a social norms intervention could lead to an increased consumption of carotenoid containing fruits and vegetables. A healthy change that would be beneficial to college students whose intakes tend to decrease after enrolling in school and are historically well below the recommended levels.

While this study implies the potential success social norms feedback could have as a nutritional intervention, future studies are required to determine how useful and effective this strategy may be compared to other methods.

**SUMMARY**

The purpose of this thesis study was to gain a greater understanding of the application of social norms theory on increasing fruit and vegetable intakes among college students, using skin carotenoids as an objective measure of consumption. Current literature confirms that college students' fruit and vegetable intakes decrease following university enrollment and dietary habits established during these years may last a lifetime [1,2]. Decreases in fruit and vegetables consumption have been associated with increased risk for chronic diseases including cardiovascular disease, hypertension, diabetes and cancer [3-7]. Interventions aimed at increasing fruit and vegetable intakes may help address both the current obesity epidemic and other diet related diseases. The use of social norms feedback as an intervention or as part of a multicomponent model may be an effective method toward increasing fruit and vegetable intakes and improving overall health.

A literature review of social norms theory and nutritional applications concluded that college students' choices are heavily influenced by their perception of peer behavior [8]. Social norms interventions can be used to modify this perception of peer behavior [9] and in turn result in a modification of the individuals' actions [9,10,11]. Nutritional applications of social norms information have found that college students generally conform to social norms presented [12]. Perception of peer fruit and vegetable intake is a predictor of individual consumption levels [13]. Social norms feedback can be used to increase intended fruit and vegetable consumption, and may result in increases of actual intake levels as well [14,15,16]. The objective of this study was to determine whether or not an intervention using both normative and

manipulated feedback of social norms could influence fruit and vegetable intake and skin carotenoid levels among college students.

Participants enrolled in this study (n=344) completed the NIH's 16-item food frequency questionnaire and had baseline skin carotenoid levels checked using a Pharmanex Biophotonic scanner. Participants were then given either no information regarding their skin carotenoid levels, Normative information including their score and ranking among peers. Or a Manipulated score below the 20$^{th}$ percentile of their peers, implying that their peers had a much higher fruit and vegetable intake than the participant.

Only 70.9% of the initial participants completed the study n=244. Results showed no change in skin carotenoid levels among the control group p=.996. A moderate increase of near significance among those receiving normative feedback p=.066. And a larger significant increase among those receiving manipulated feedback p<.001. Repeated measures of analysis controlling for baseline F&V intake, multivitamin use, age, amount of exercise and BMI showed that changes between baseline and follow-up skin carotenoid levels were dependent on group assignment p=.033. These results confirm the successful effects of the social norms intervention in increasing skin carotenoid levels, which are an objective biomarker of fruit and vegetable intake [17].

**FUTURE STUDIES**

The results of this study show the potential success of social norms intervention to improve dietary behaviors among college students. While increases

were only observed in skin carotenoid levels, future studies using more sensitive tools to estimate changes in fruit and vegetable intakes may observe increases not seen in the FFQ results of this study. Studies using multi-component models may find the inclusion of social norms feedback may also enhance the results observed in other methods. Future studies comparing the effects of social norms feedback to other nutritional interventions may determine how useful social norms may be compared to other methodologies. Studies in different age groups and locations may find that different populations or subgroups of people may be more susceptible to influence by social norms information.

Other potential studies could include protocols to evaluate misperceptions regarding peer dietary behaviors, and determine whether or not social norms interventions improve eating behaviors on a conscious level by correcting misperceptions and increasing conscious fruit and vegetable intent. Or if they function on a heuristic level beneath conscious processing, improving intakes without subjects being aware of their increased consumption. This would increase our understanding of how and why social norms can be used to in the field of nutrition. Furthermore, future studies using social norms feedback to improve dietary behaviors will expand the limited body of literature on the subject and enhance our understanding of its usefulness and applications.

**CONCLUSION**

Fruit and vegetable intakes among college students are continually below recommended levels, and improving these dietary behaviors may be critical in

maintaining optimal health and preventing chronic diseases. The use of social norms feedback may be a potential method for improving fruit and vegetable consumption among college students as evidenced by increases in skin carotenoid scores. Both normative and manipulated social norms feedback appear to improve carotenoid levels, with manipulated feedback having a significantly larger effect. Future studies further exploring the use of social norms theory as a nutritional intervention are needed to determine how beneficial it can be in comparison to other methods, what levels of improvements can be expected, and how best to use social norms as part of a multicomponent model.

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# APPENDICES

Appendix A. Final Version of Food Frequency Questionnaire

# NDFS 1020 Survey

* Required

1. **1a. Each time you drank 100% juice, how much did you usually drink?** *
   *Mark only one oval.*

   - ◯ less than 6 oz.
   - ◯ 6-10 oz.
   - ◯ 10-16 oz.
   - ◯ More than 16 oz.
   - ◯ Never

2. **1. Over the last month, how many times per month, week or day did you drink 100% juice such as orange, apple, grape, or grapefruit juice?** *
   Do not count fruit drinks such as Kool-aid, lemonade, Hi-C, cranberry juice drink, Tang, and Twister. Include juice you drank at all mealtimes and between meals.
   *Mark only one oval.*

   - ◯ Never
   - ◯ 1-3 times last month
   - ◯ 1-2 times per week
   - ◯ 3-4 times per week
   - ◯ 5-6 times per week
   - ◯ 1 time per day
   - ◯ 2 times per day
   - ◯ 3 times per day
   - ◯ 4 times per day
   - ◯ 5 or more times per day

3. **2. Over the last month, how many times per month, week or day did you eat fruit?** *
   Count any kind of fruit-fresh, canned, and frozen. Do not count juices. Include fruit you ate at all mealtimes and for snacks.
   *Mark only one oval.*

   - ◯ Never
   - ◯ 1-3 times last month
   - ◯ 1-2 times per week
   - ◯ 3-4 times per week
   - ◯ 5-6 times per week
   - ◯ 1 time per day
   - ◯ 2 times per day
   - ◯ 3 times per day
   - ◯ 4 times per day
   - ◯ 5 or more times per day

4. **2a. Each time you ate fruit, how much did you usually eat?** *
   *Mark only one oval.*

   - ◯ less than 1/2 cup
   - ◯ about 1/2 cup
   - ◯ about 1 cup
   - ◯ more than 1 cup
   - ◯ Never

5. **3. Over the last month, how often did you eat lettuce salad (with or without other vegetables?** *
   *Mark only one oval.*

   - ◯ Never
   - ◯ 1-3 times last month
   - ◯ 1-2 times per week
   - ◯ 3-4 times per week
   - ◯ 5-6 times per week
   - ◯ 1 time per day
   - ◯ 2 times per day
   - ◯ 3 times per day
   - ◯ 4 times per day
   - ◯ 5 or more times per day

6. **3a. Each time you ate lettuce salad, how much did you usually eat?** *
*Mark only one oval.*

- ◯ about 1/2 cup
- ◯ about 1 cup
- ◯ about 2 cups
- ◯ more than 2 cups
- ◯ Never

7. **4. Over the last month, how often did you eat french fries or fried potatoes?** *
*Mark only one oval.*

- ◯ Never
- ◯ 1-3 times last month
- ◯ 1-2 times per week
- ◯ 3-4 times per week
- ◯ 5-6 times per week
- ◯ 1 time per day
- ◯ 2 times per day
- ◯ 3 times per day
- ◯ 4 times per day
- ◯ 5 or more times per day

8. **4a. Each time you ate french fries or fried potatoes, how much did you usually eat?** *
*Mark only one oval.*

- ◯ about 1 cup or less (small order)
- ◯ about 1 and 1/2 cups (medium order)
- ◯ about 2 cups (large order)
- ◯ about 3 cups or more (super size order)
- ◯ Never

9. **5. Over the last month, how often did you eat other white potatoes?** *
count baked, boiled, and mashed potatoes, potato salad, and white potatoes that were not fried.
*Mark only one oval.*

- ◯ Never
- ◯ 1-3 times last month
- ◯ 1-2 times per week
- ◯ 3-4 times per week
- ◯ 5-6 times per week
- ◯ 1 time per day
- ◯ 2 times per day
- ◯ 3 times per day
- ◯ 4 times per day
- ◯ 5 or more times per day

10. **5a. Each time you ate the potatoes, how much did you usually eat?** *
*Mark only one oval.*

- ◯ 1 small potato or less (1/2 cup or less)
- ◯ 1 medium potato (1/2 to 1 cup)
- ◯ 1 large potato (1 to 1 and 1/2 cups)
- ◯ 2 medium potatoes or more (1 and 1/2 cups or more)
- ◯ Never

11. **6. Over the last month, how often did you eat other vegetables?** *
Do not count: Lettuce salads, white potatoes, vegetables in mixtures (such as sandwiches, omelets, casseroles, mexican dishes, stews, stir-fry, or soups) or rice. Do count all other vegetables-raw, cooked, canned and frozen
*Mark only one oval.*

- ◯ Never
- ◯ 1-3 times last month
- ◯ 1-2 times per week
- ◯ 3-4 times per week
- ◯ 5-6 times per week
- ◯ 1 time per day
- ◯ 2 times per day
- ◯ 3 times per day
- ◯ 4 times per day
- ◯ 5 or more times per day

12. **6a. Each of these times that you ate other vegetables, how much did you usually eat?** *
*Mark only one oval.*

- ◯ less than 1/2 cup
- ◯ 1/2 to 1 cup
- ◯ 1 to 2 cups
- ◯ more than 2 cups
- ◯ Never

13. **7. Over the last month, how often did you eat tomato sauce?** *
Include tomato sauce on pasta or macaroni, rice, pizza and other dishes
*Mark only one oval.*

- ◯ Never
- ◯ 1-3 times last month
- ◯ 1-2 times per week
- ◯ 3-4 times per week
- ◯ 5-6 times per week
- ◯ 1 time per day
- ◯ 2 times per day
- ◯ 3 times per day
- ◯ 4 times per day
- ◯ 5 or more times per day

14. **7a. Each time you ate tomato sauce, how much did you usually eat?** *
*Mark only one oval.*

- ◯ about 1/4 cup
- ◯ about 1/2 cup
- ◯ about 1 cup
- ◯ more than 1 cup
- ◯ Never

15. **8. Over the last month, how often did you eat vegetable soups?** *
include tomato soup, gazpacho, beef with vegetable soup, minestrone soup, and other soups made with vegetables.
*Mark only one oval.*

- ◯ Never
- ◯ 1-3 times last month
- ◯ 1-2 times per week
- ◯ 3-4 times per week
- ◯ 5-6 times per week
- ◯ 1 time per day
- ◯ 2 times per day
- ◯ 3 times per day
- ◯ 4 times per day
- ◯ 5 or more times per day

16. **8a. Each time you ate vegetable soup, how much did you usually eat?** *
*Mark only one oval.*

- ◯ less than 1 cup
- ◯ 1-2 cups
- ◯ 2-3 cups
- ◯ more than 3 cups
- ◯ Never

17. **9. Over the last month, how often did you eat mixtures that included vegetables?** *
count such foods as sandwiches, casseroles, stews, stir-fry, omelets, and mexican dishes.
*Mark only one oval.*

- ◯ Never
- ◯ 1-3 times last month
- ◯ 1-2 times per week
- ◯ 3-4 times per week
- ◯ 5-6 times per week
- ◯ 1 time per day
- ◯ 2 times per day
- ◯ 3 times per day
- ◯ 4 times per day
- ◯ 5 or more times per day

18. **What are the last 4 digits of you A-Number? Or your 5 digit SONA ID number?** *
If your participation is part of a SONA requirement use your SONA ID. If you are part of NDFS 1020 use the last 4 of your A-Number

19. **What year are you in school?** *
*Mark only one oval.*

- ◯ Freshman
- ◯ Sophomore
- ◯ Junior
- ◯ Senior
- ◯ Other

20. **What is your age?**

21. **What is your gender?**
*Mark only one oval.*

- ◯ Male
- ◯ Female

22. **What is your ethnicity**

23. **What is your current GPA?**

24. **Do you use alcohol?**
*Mark only one oval.*

- ◯ yes
- ◯ no

25. **How often do you exercise and for what duration** *
*Check all that apply.*

- [ ] less than 30 minutes
- [ ] 30 to 60 minutes
- [ ] more than 60 minutes
- [ ] less than once per week
- [ ] 1-3 times per week
- [ ] more than 3 times per week

26. **What is your current height**
please answer in inches. example: 5 foot 7 inches = 67

.....

27. **What is your current body weight**
please answer in pounds. example: 165lbs = 165

.....

28. **Do you take a multivitamin**
*Mark only one oval.*

- ◯ never
- ◯ occasionally
- ◯ 1-3 times per week
- ◯ 4 or more times per week

29. **What is your email address?** *
Your results and all information regarding this study will be sent to this address.

.....

## Informed Concent

Introduction/ Purpose Dr. Heidi Wengreen and master's degree candidate Troy Bailey in the Department of Nutrition, Dietetics, and Food Sciences at Utah State University are conducting a research study to evaluate factors influencing skin carotenoid levels in undergraduate students. You have been asked to take part because you are enrolled in either NDFS 1020 or PSY 1010. There will be approximately 250 participants in this study.

Procedures As a participant, you will be asked to complete an online questionnaire at the beginning and end of this study. You can take this survey at any computer, but they must be completed between the dates of Sept 16 and Sept 21, 2013 and the second between the dates of Nov 19 and Nov 26 2013. This survey will include questions regarding your diet, physical activity, and other health-related issues including smoking, alcohol use, etc and will take approximately 5 minutes to complete. You will also be asked to visit the room 118A on the first floor of the NDFS building (Aggie Ice Cream building)

to have your skin carotenoid levels measured during the same.

New Findings If new information is obtained that is relevant or useful to you, or if the procedures and/or methods change at any time throughout this study, your consent to continue participating in this study will be obtained again.

Risks There is minimal risk in participating in this study. However, you may feel psychological discomfort from revealing information about eating habits or learning your skin carotenoid level.

Benefits There may or may not be any direct benefit to you from participating in this study. The investigator, however, may learn more about concepts that may influence skin carotenoid levels and fruit and vegetable intake. Insight gained from this study may impact future programs at Utah State University.

Explanation & offer to answer questions A research assistant has explained this research study to you and answered your questions. If you have any questions about the study you can contact Dr, Heidi Wengreen at (435) 797-1806.

If you have questions about your right as a research subject or if problems arise that you do not feel you can discuss with Dr. Wengreen, please contact the Institutional Review Board of USU at (435) 797-1821.

Extra Cost(s)
There will be no costs for participating.

Voluntary nature of participation and right to withdraw without consequence
Participation in this research is entirely voluntary. You may refuse to participate or withdraw at any time without consequence.

Confidentiality
All information you provide will remain confidential. The web-based survey url is safety secured (https://). Answers will be stored on a locked server which is password protected. Participants will be identified only by their email addresses and the last four digits of their student ID number. Email address information will be deleted before Fall 2013. No publications resulting from this study will disclose any information that could identify you personally.

IRB Approval Statement The Institutional Review Board for the protection of human participants at USU has approved this research study. If you have any pertinent questions or concerns about your rights or a research-related injury, you may contact the IRB Administrator at (435) 797-0567 or email irb@usu.edu. If you have a concern or complaint about the research and you would like to contact someone other than the research team, you may contact the IRB Administrator to obtain information or to offer input.

Copy of consent By printing this webpage you will have a copy of this informed consent. If for some reason would like to print a copy but are unable, email Dr. Wengreen at hwengreen@usu.edu for an electronic version.
Investigator Statement “I certify that the research study has been explained to the individual, by me or my research staff, and that the individual understands the nature and purpose, the possible risks and benefits associated with taking part in this research study. Any questions that have been raised have been answered.”

Signature of PI & student or Co-PI

Heidi Wengreen, RD, PhD
Principal Investigator
(435-797-1806)

Troy Bailey
Student Researcher
(435-764-1363)

30. **Signature of Participant By selecting the "Submit" button at the bottom of this page I agree to participate to the following terms:** *
*Check all that apply.*

- [ ] I have read and concent to the terms above
- [ ] I certify that I am 18 years of age or older
- [ ] I certify that I am not currently pregnant
- [ ] I may be contacted via email as needed only for the purposes of this study

31. **Are you currently in the NFS 1020 Class or have previously taken a nutrition class?** *
*Mark only one oval.*

- ◯ Yes
- ◯ No

32. **What is your full A Number?**
Please enter your full A number to receive extra credit for your NDFS 1020 Class