

Abstract

We are pelted with thousands of advertisements per day, and it is in our best interest to understand their effects on us. The question of the effects of subliminal advertising is primarily interesting due to its presence every-day life and the abundance of contradictory evidence available on this topic. The purpose of this experiment was to examine the effects of subliminal advertising on consumer choice and behavior. To conduct this blind experiment, 150 participants were asked to watch a video in which an image of one of two types of water bottles from different brands was flashed for .03 seconds 3 times or 9 times throughout the video. Subjects then completed a survey that asked them which of the two water bottle brands they preferred. Of the 91 participants, 66 responses were usable and conclusions about the effect of subliminal advertising were made from this sample. From this data, we were able to conclude that there is a significant difference between the behavior of subjects who viewed subliminal messages 9 times and subjects who viewed them 3 times; the subjects who had seen the image 9 times were more likely to choose the brand of the water bottle shown in the subliminal messages when asked a preference question after viewing the video. Those subjects were also more likely to change their preference to match the brand in the subliminal messages after watching the video than those who had only seen the subliminal image 3 times.

The Effects of Subliminal Messaging on Subject Behavior

According to a 2006 article by CBS News, we are exposed to as many as 5,000 ads daily (Johnson). That is a staggering number of advertisements, and this fact inevitably leads to the question of how much we truly are influenced by ads - are we really able to live life without ads significantly affecting us, or are our minds actually infiltrated by them? Some experiments in the past have stated that ads have no impact on our judgement, while others posit the complete opposite sentiment. In response to the uncertainty regarding this issue, we are conducting an experiment in an attempt to set the record straight. Our purpose is to discover to what extent advertisements, specifically subliminal advertisements, affect our decisions.

There are many different types of advertisements, including explicit advertising (such as advertisements that appear during television commercial breaks), product placement, and subliminal advertisements. Explicit advertising and product placement both rely heavily on viewer attention to the advertisements and most often include the viewer consciously receiving the desired information of the advertisers (Law & Braun, 2000). Subliminal advertising, on the other hand, depends on the subconscious recognition of the intended message by the viewer. As this type of advertising is received subconsciously, it is more difficult to assess its effects as opposed to assessing the effects of advertising received consciously. For this reason, research has proved and it is widely accepted that explicit advertising and product placement significantly affect viewers' likelihood of buying the advertised product. Meanwhile, research on subliminal advertising has led to contradictory results that do not clearly

illustrate the effects of such advertising. Further research is desirable in this area, making it a topic of interest to us.

To answer our research question of the effects of subliminal advertising on subject opinion of the advertised product, we had subjects answer and complete an online survey in which they were shown different videos with subliminal advertising of images of either Dasani water bottles or Arrowhead water bottles shown 0, 3, or 9 times depending on each subjects' randomly assigned treatment. We conjectured that subject opinion of bottle brand would be most frequently in line with the brand subliminally advertised in the treatment in which the image was flashed subliminally in the video 9 times, second most frequently in the treatment in which the image was flashed subliminally in the video 3 times, and least in the treatment in which the image was flashed subliminally in the video 0 times.

Background

In this background, we will be focusing on the following areas: how the conductors of the experiments tested the effects of advertisement on their subjects, the level of knowledge subjects had about the purpose of the experiment, and how, if at all, bias was avoided. We used the methods in these experiments to inform how we conducted our own.

According to Yoo in her 2008 study, exposure to web advertisements (a type of product placement) primes consumers through implicit memory (memory that is aided by previous life experiences) to build up a preference for the advertised brand. This experiment was structured to answer the question of whether or not the amount attention the consumer pays to the ad determines its effectiveness, and it was found

that preference for the product built up regardless of how much attention was paid. Unfortunately, we do not know exactly how aware participants were to the actual purpose of this experiment. These results are also subject for debate, as a different experiment conducted in 2002 by Naccache, Blandin, and Dehaene found that, in terms of top-down brain processing, unconscious priming depends on temporal attention (Naccache, Blandin, & Dehaene, 2002).

A different experiment of 74 undergraduates by Monahan, Murphy, and Zajonc of the University of Georgia randomly divided students into two groups. The first group had 25 distinct stimuli subliminally presented to them while the second had 5 stimuli subliminally presented, where each of the stimuli was presented five times. All stimuli were images of Chinese characters (a neutral stimulus, as none of the subjects could read the characters). Before viewing the images, participants were only told to watch the screen, even though they wouldn't be able to tell what was being flashed at them. Participant mood was evaluated by having each subject choose from five faces, ranging from sad to happy. Results showed that the second group tended to select more positive facial expressions, suggesting that repeated subliminal exposure did in fact increase subject favorability.

In a 2000 study on product placement by Law and Braun, 111 undergraduate students were randomly assigned to one of two groups, both of which watched a different ten-minute-long *Seinfeld* clip that contained six or more products placed in the show. Before viewing, subjects were told that they were in an experiment to rate *Seinfeld*. After viewing the clip, participants were given information about a certain person and told to check off any items on a list of products that they think one should

buy as a gift for that person. Then, they were asked to list as many products or brands they could remember seeing from the video clip. The results were that recognition of a product in the clip led to an easier recall of that product, and that seeing the products in the clip did significantly increase the frequency with which participants chose those items as suitable gifts.

One study with a purpose more similar to ours is the 2006 study in which Karremans, Stoebe, and Claus found that there was a significant positive association between amount of thirst of participants and their likelihood to choose a specific drink only if participants had been “primed” to choose that particular drink. In this experiment, “priming” referred to the text of the name of the beverage that was shown subliminally to the subjects in the “primed” group. The participants and test administrators were blind to the actual purpose of the study; they were informed that they would be participating in two unrelated studies. To choose a drink to prefer, participants chose from one of two drinks, one on the left half of the computer screen, one on the right half. This study used sixty-one students (who were given 1€), 20 men and 41 women, presumably from Radboud University, Nijmegen, the Netherlands.

The methods used in these last two studies appear to have been carefully constructed and provide insight as to how to conduct this present study. They were both, for example, conducted with subjects participating blind to the purpose of the experiments. In the former study, by Law and Braun, all students in this experiment were, presumably, from the same location, which may have affected the results. And, since *Seinfeld* is a relatively well-known show, previous knowledge of the clips may have had an impact as well; we will be careful to either create our own clips or make

sure none of the subjects have previously seen the ads we will show them. In the latter study (by Karremans, Stoebe, and Claus), which is closely mirrored by our plans for our experiment, when participants chose between images of drinks on their computer screen, the position of the images on the screen was randomly assigned. This is a measure that would be useful in avoiding right-side and left-side bias (the idea that subjects might always choose the option on one side of the screen simply because they are biased to click on that particular side more often) in our present study.

Capturing data about participant likelihood to drink particular beverages through an online survey rather than through observation of behavior as was done Karremans et. al's study is preferable; it creates quantitative data that is easier to analyze. The study also used Lipton Ice as the "primed" brand and Spa Rood as the unprimed brand. As these are both actual drinks out on the market, drink preference could be affected by previously held beliefs about the two drinks, and this was an aspect of the experiment the investigators had to take care in dealing with. Additionally, while the study included both men and women, no analysis of the effects of subliminal messaging by gender was performed; effect by gender would be an interesting variable to analyze in future research (Karremans, Stoebe & Claus, 2006).

Of all the ways the experiments informed the subjects about the purpose of the experiment, we most closely imitated this last one; we made our subjects completely blind to the purpose of our experiment, yielding results that are not biased by what the subjects think we want to hear.

Methodology

To determine the effects of subliminal advertising on subject preference, stress, hunger, and attention levels, we designed a SurveyMonkey survey, created videos with subliminal images of Dasani and Arrowhead brand water bottles spliced in, and took a random sample of 150 Castilleja students.

Selection of Subjects

To gather participants, we used a school roster to randomly select 150 Castilleja students. We used Castilleja students as our subjects in this experiment because we felt most confidence that a random sample from this community would yield results inferable to the entire Castilleja student population and to similar populations of all-girls 6-12 grade schools. We used student email addresses to send the survey out to 30 students in each of five treatments, however not all students that were emailed responded. In total, we received 91 responses, but 25 of those responses had to be excluded as the student taking the survey did not finish it or indicated that she did not watch the included video only once without interruption. After excluding the unusable 25 responses, we had 13 group 1 responses (control group), 15 group 2 responses (Dasani subliminal image viewed 3 times), 10 group 3 responses (Arrowhead subliminal image viewed 3 times), 16 group 4 responses (Dasani subliminal image viewed 9 times), and 12 group 5 responses (Aasani subliminal image viewed 9 times).

Design of Experiment

After we randomly assigned the 150 randomly chosen Castilleja students into the five treatment groups with 30 students per group, the students took an online survey emailed to them. The survey included questions about subject thirst level, hunger level,

stress level, attention level, and preference between Dasani and Arrowhead water bottles (both after and before watching of the treatment video). To see subjects' initial bottle brand preference and any opinion change in this preference after viewing the subliminal images, we asked them about their brand preferences both before and immediately following their watching of the treatment video. We included many other preference questions to keep the experiment blind.

To make our experiment as unbiased and as blind as possible, we field tested our survey before taking a random sample of Castilleja students. We achieved this by asking 10 Castilleja students to take our survey and give us feedback on what they believed the purpose of the survey was, on possibly leading questions, and of the effectiveness of the treatment videos. These 10 students were then excluded from the random sample used in our experiment.

Through the process of field testing, we learned that although our survey questions appeared in the correct order when we designed the survey, the actual survey somehow mixed up that order. To fix this issue (as the order of the questions is critical for our data collection process), we re-designed the order once more, and that order remained accurate during all further testing. Although we meticulously combed through our word choices before field testing, fresh pairs of eyes found several typos and grammatical errors, which we corrected. We also found that asking, "Of the following water bottle brands, which do you prefer?" is more of a leading question than "Of the following water bottle brands, is there one you prefer?" and changed all questions of this type to the latter.

When they were watching the video, our field testing participants also noticed the subliminal images and, being curious, rewound the video to see exactly what the image was, thus making the viewing of the images a conscious, rather than an unconscious activity. This was due to the fact that the subliminal bottle brand images were shown for too long, at about 0.1 seconds. As a result, we shortened the duration of the subliminal images in the videos to 0.03 seconds, so that the field testing participants did not notice the images and thus did not have any reason to scroll back and look for them; the images no longer compromised the blindness of the experiment. We originally chose to show images for 0.1 seconds due to the fact that that duration is the shortest length of time we could show a spliced-in picture in a clip in iMovie. 0.03 seconds, however, is the duration suggested by Karremans et. al's 2006 experiment, which we reviewed in our background research as this time is thought of as the longest duration that is still safe to consider "subliminal." Luckily, this shorter time was can be achieved using technical video software.

We additionally decided based on the field testing results to add the same images of the water bottles to the survey questions about preference as are subliminally in the video. We believe subjects' choice of a preferred brand is a more accurate representation of the effects of subliminal advertisements if the survey question about brand preference after subject viewing of the treatment video includes images of the bottles subliminally advertised in the video; this method more closely resembles the way advertising and other subliminal messages interact with shopping experiences today.

Administration of Experiment

This experiment was administered through school emails and SurveyMonkey without our physical presence; everything was completed through an online survey response by our subjects.

Addressed issues

Issues were posed by the voluntary response nature of the way we sent surveys out to participants, but subject blindness to the purpose of the experiment reduced the bias that might otherwise be caused by this. We also did not get a response from every randomly selected student, and as a result we did not always have enough responses to conduct the analysis we would have liked to.

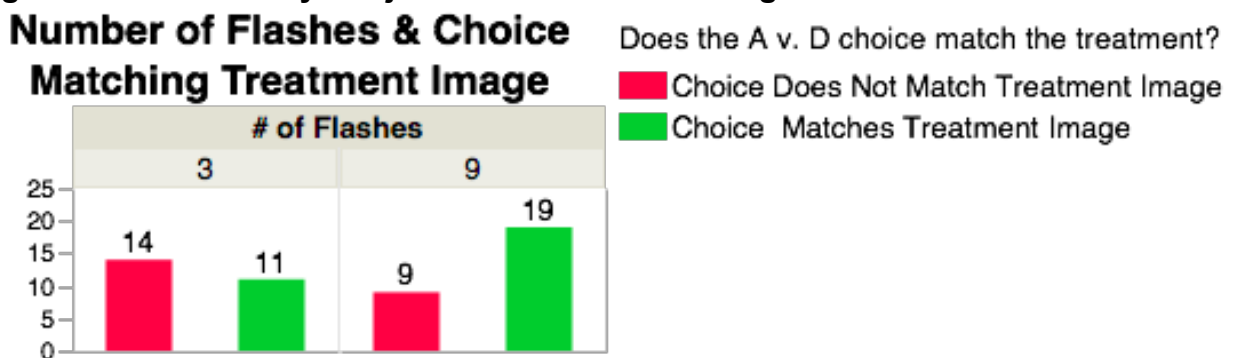
We also ran into technical difficulties in the process of creating our treatment videos. There wasn't any video software readily available to us that could insert a frame 0.03 seconds long into a video, and after a lot of valuable time wasted with failed attempts to create a useful product with different software, we finally found a program that could put an image $\frac{2}{60}$ of a second (or .0333 seconds) long into our video and we ended up with treatments videos we were very happy with.

Findings

First, we decided to look at the subject's final water bottle brand preference choice (this preference was asked after subject viewing of the treatment video) to see if the brand choice was the same brand as that shown in the subliminal "flashes" of the image of the brand bottle during the treatment video. For Figure 1, we combined the data for the Dasani and Arrowhead treatments by number of flashes to see if the number of times a subject was exposed to the image made a difference in her likelihood to for her preference choice to match that treatment image. We excluded the subjects

in the control group for this figure as they were not exposed to any treatment image, and thus we could not group them in a “yes” or “no” category for the variable “Choice Matching Treatment Image.” The “# of Flashes” variable refers to the number of times the treatment video showed, or “flashed,” the subliminal image of the bottle (either 0, 3, or 9 times).

Figure 1: Treatment by Subject Choice Matches Image

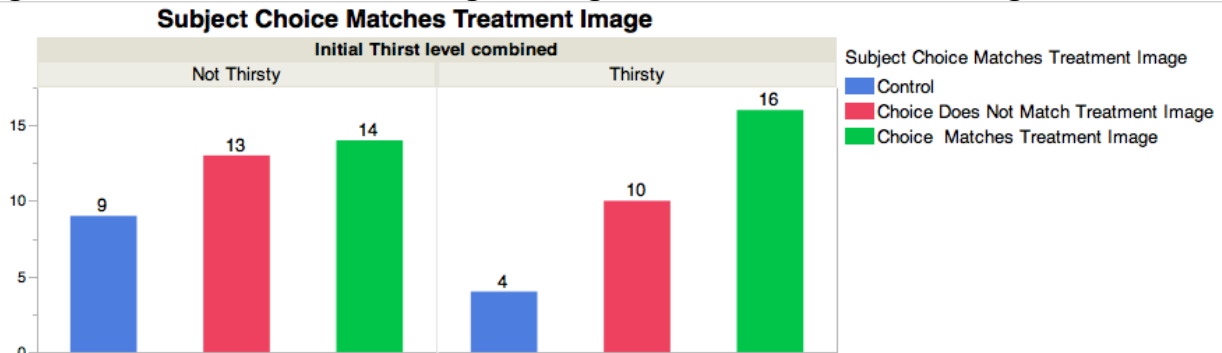


We performed a Chi Square Test of Homogeneity for this data with a 10% significance level, as this is an experiment performed on subjects, and even with an alpha level of .1, our results would be significant. This test yielded a p-value of .0802; there is a significant difference between the behavior of subjects who viewed subliminal messages 9 times and subjects who viewed them 3 times; the subjects who had seen the image flashes 9 times were more likely to prefer the brand of the water bottle shown in the subliminal messages after the video.

Next, we looked at whether the subject’s thirst level prior to watching the treatment video was related to how whether or not her image preference after watching the video matched her treatment image. As in Figure 1, we excluded the subjects in the control group for this figure as they were not exposed to any treatment image, and thus we could not group them in a “yes” or “no” category for the variable “Choice Matching

Treatment Image.” On the survey our subjects took, our subjects indicated their thirst level was “none,” “a little,” “fairly,” “moderately,” or “very.” For Figure 2 below, we grouped the responses “none,” “a little,” and fairly as “Not Thirsty” and the responses “moderately” and “very” as “Thirsty.”

Figure 2: Thirst Level & Matching of Image Choice to Treatment Image



We performed a Chi Square Test of Homogeneity for this data with a 10% significance level, which yielded a p-value of .477; there is no significant difference in the subjects’ preference choice of the treatment image brand between the “thirsty” and “not thirsty” groups.

To determine whether or not the number of times the treatment image was subliminally flashed influenced the subjects’ thirst level, we asked them to once again rate their thirst on the same scale they used to rate their thirst prior to watching the treatment video. We numerically coded the scale, with “none” = 1, “a little” = 2, “fairly” = 3, “moderately” = 4, and “very” = 5 and then subtracted the second thirst rating (taken after each subject watched the treatment video) from the first thirst rating (taken before each subjects’ viewing of the treatment video) to create the variable “Numbered Difference in Thirst Levels.” Figure 3 below shows this variable by the number of

flashes of the treatment image each subject was exposed to. In this figure, the control group is included (as the 0 number of flashes group)

Figure 3: Difference in Thirst Levels by Treatment

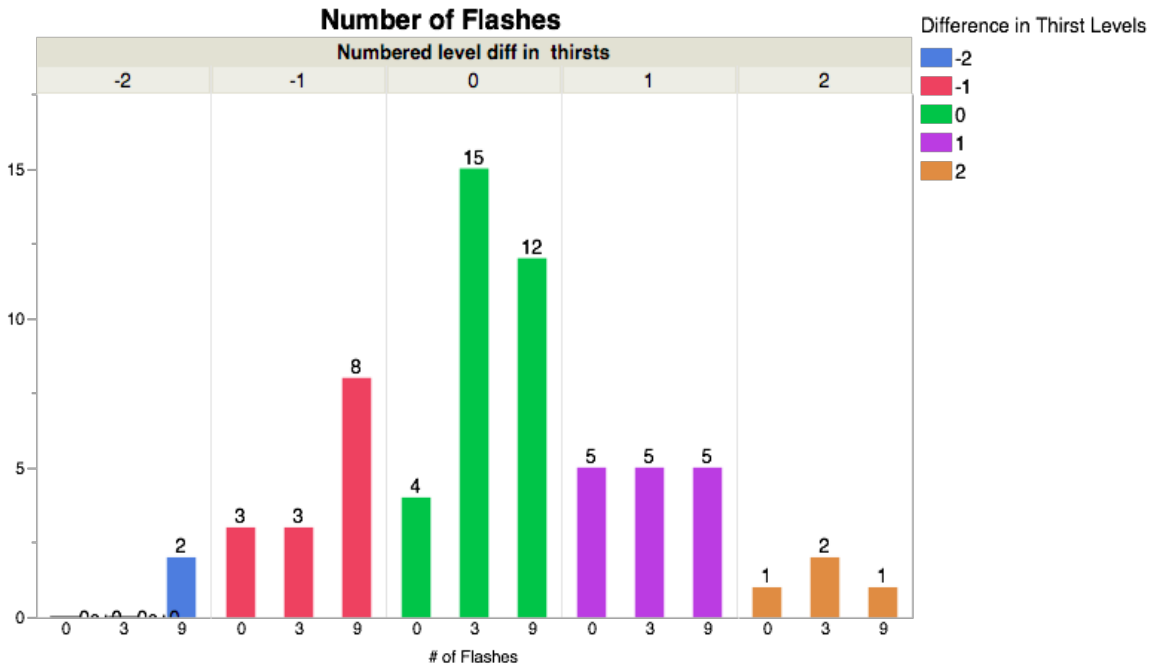
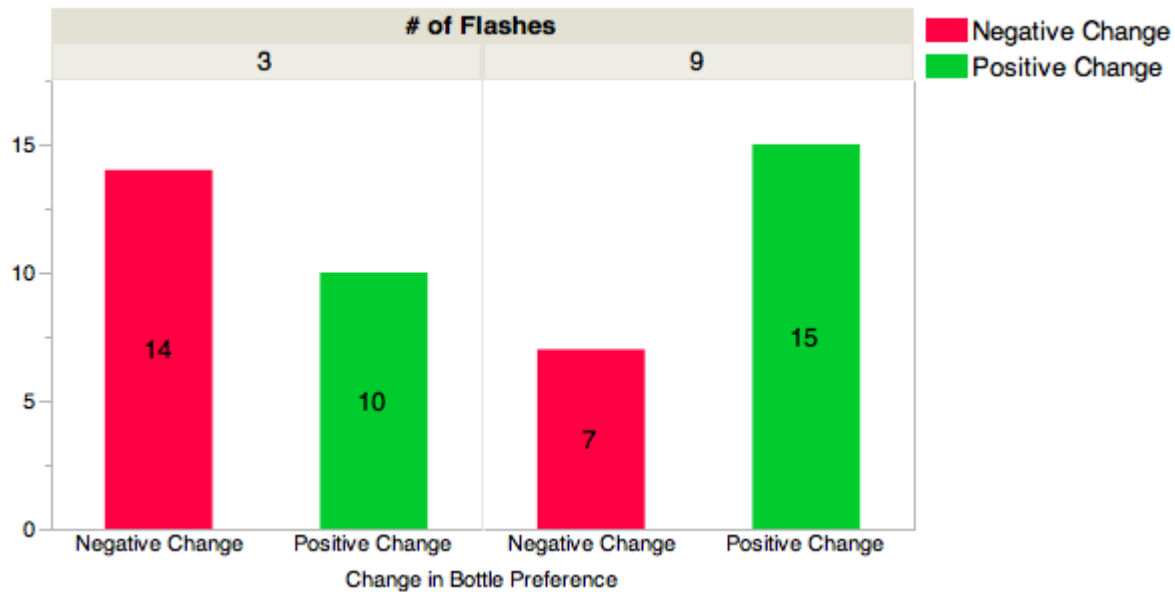


Figure 3 shows that while some subjects experienced a difference in as many as two thirst levels, the majority of subjects experienced no change in thirst level, regardless of the number subliminal images they viewed in their treatment video. Similar graphs of the Number of Flashes (the treatment) by the variables of hunger, stress, or tiredness level yielded similar results; most subjects had a numbered difference of 0 and there were no remarkable differences between the groups who saw no flashed images, 3 flashed images, and 9 flashed images.

We also examined the subjects' change in water bottle opinion in Figure 4. If the change was from a different water bottle brand to the bottle brand on the treatment image, we labelled it "Positive Change," while if the change was from a different water

bottle brand or the bottle brand on the treatment image to a different water bottle brand, we labelled it “Negative Change.” In this graph, the control group is excluded due to the fact that there was no subject preference change of opinion in that group. Figure 4 also excludes those whose preferences did not change, as those numbers were too small for Chi Square analysis.

Figure 4: Change in Opinion of Water Bottles by Treatment



A Chi Square Test of Homogeneity performed on this data with a 0.1 significance level yielded a p-value of .071, allowing us to conclude that subjects in the treatment group who viewed a subliminal bottle brand image 9 times during their treatment video were significantly more likely to experience a positive change in opinion of water bottle brand preference than those who viewed a subliminal bottle brand image 3 times.

Discussion

Data Analysis

Our data brought to light some interesting results; the data in Figure 1: Treatment by Subject Choice Matches Image, yielded a p-value of 0.08, allowing us to conclude

that the subjects who had seen the image flashes 9 times were more likely to prefer the brand of the water bottle shown in the subliminal messages after the video than those who had seen the image 3 times. Similarly, the data in Figure 4: Change in Opinion of Water Bottles by Treatment yielded a p-value of 0.071; subjects who viewed the subliminal image 9 times during their treatment video were significantly more likely to experience a positive change in opinion of water bottle brand. These results show an interesting trend in the data: subjects who viewed the subliminal images 9 times were more affected by the images than those who only saw them 3 times; the number of exposures or the duration of time subjects were exposed to the subliminal images affected their influence on subjects. The greater the number of times the subjects viewed the subliminal images, the more influenced they were by the images.

Figure 2: Thirst Level & Matching of Image Choice to Treatment Image shows data which yields a p-value of .477; we concluded that there is no association between the subject's initial thirst level and the subject's response choice. Additionally, we concluded that the variables of hunger, stress, boredom, and tiredness levels by the variable of the subject's image preference matching their treatment image also yielded no associations that were statistically significant; the p-values were far higher than the 10% significance level in each case.

The distribution in Figure 3: Difference in Thirst Levels by Treatment allows us to conclude that thirst levels were essentially the same before and after the treatment video; there is no association between the change in thirst levels and the number of flashes of the treatment image each subject saw. Similar graphs of the number of

flashes (the treatment) by the variables of hunger, stress, and tiredness level yielded similar results.

Limitations

We would have liked a larger sample size to reduce the influence of an potential biases and to make relationships in the data easier to recognize. While we had a large enough total sample in our experiment, our five treatment groups only had roughly 15 people each in them, which made us cautious of putting too much stock into any patterns we saw. The limitation of our small sample size in this experiment forced us to combine variables in order to perform Chi Square analysis, leading to us possibly missing some of the more nuanced characteristics of the effects of subliminal image messages on viewers. We believe a contributing factor to the small sample size was the technical difficulties we had creating the videos; as a result we had to ask our participants to download the video file from an email containing the video and survey rather than the videos being embedded in the actual survey itself. This extra step may have been the reason some subjects had an unfinished survey; a decent number of responses had to be excluded because their survey was incomplete after our instruction to watch the video. We also had to exclude results in which the participant watched the video incorrectly, either watching it with interruptions, watching it multiple times, or watching it at wrong time. If the video had been embedded in the survey itself rather than a separate part of it, more people probably would have completed the survey or have been less likely to watch it incorrectly.

The problems we ran into concerning technical difficulties might have been avoided had we chosen to examine other types of advertising such as explicit

advertising and product placement. However, we also recognize that it would be interesting to conduct a similar experiment only this time with another type like product placement to compare the effectiveness of the two types and subliminal advertising.

Additionally, our scope of inference for the findings of this experiment are limited. Since we sampled only from the Castilleja students, our results are only representative of that population, which is fairly small. In the future, we would attempt to randomly sample from a broader population to make our results as useful as possible.

Conclusion

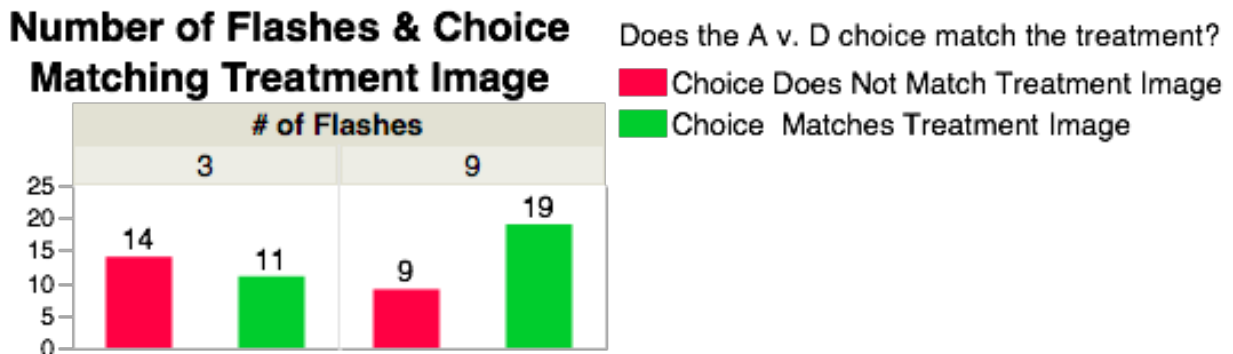
Based on the significance differences between the magnitude of the effects on subjects viewed a subliminal image 9 times and those who viewed a subliminal image 3 times, we conclude that the more frequently a subliminal image is flashed for a duration of 0.03 seconds, the more effect it has on viewer preference and change of preference. Additionally, we conclude that subliminal images of water bottles for a duration of 0.03 seconds have no significant effect on thirst, hunger, tiredness, or stress levels, even when the image is subconsciously seen by the viewer 9 times (or every 16 seconds) in a video.

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Technical Appendix

Figure 1



Actual

Treatment (# of times the image appeared in the video)	Successes (Choice Matches Treatment Image)	Failures (Choice Does Not Match Treatment Image)
3	11	14
9	19	9

Expected

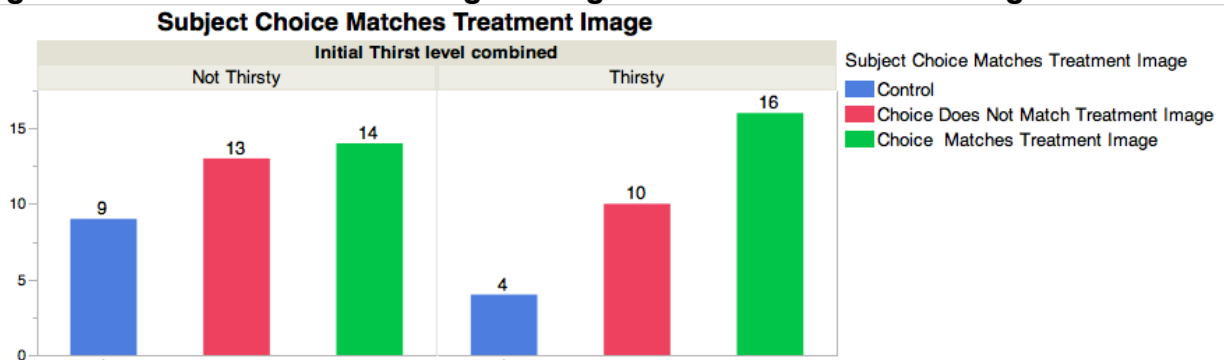
Treatment (# of times the image appeared in the video)	Successes (Choice Matches Treatment Image)	Failures (Choice Does Not Match Treatment Image)
3	14.15	10.85
9	15.85	12.15

Test of Homogeneity

State: Alpha level = .1. Null Hypothesis: there is no association between the number of times the image was flashed and the subject's response choice. Alternate Hypothesis: there is an association between the number of times the image was flashed and the subject's response choice

- Plan: Random: treatments were randomly assigned to participants and participants were randomly selected. Independent: as the treatments are randomly assigned, treatment groups are independent of each other. Participants within groups can also be assumed to be independent of each other due to the nature of the topic at hand (a survey). Large sample size: the lowest expected value (for the Failures when the image is shown 9 times) is $10.85 > 5$. I will conduct a chi-square test for association.
- Do: chi-square test statistic = 3.06, df = 1, p-value = .0802.
- Conclude: as the p-value .0802 is less than the significance level .1, we reject the null hypothesis; there is a significant difference between the behavior of subjects who viewed subliminal messages 9 times and subjects who viewed them 3 times; the subjects who had seen the image flashes 9 times were more likely to prefer the brand of the water bottle shown in the subliminal messages after the video.

Figure 2: Thirst Level & Matching of Image Choice to Treatment Image



Actual (not including control group depicted in Figure 2)

Thirst Level	Successes (Choice Matches Treatment Image)	Failures (Choice Does Not Match Treatment Image)
Not Thirsty	14	13
Thirsty	16	10

Expected (not including control group depicted in Figure 2)

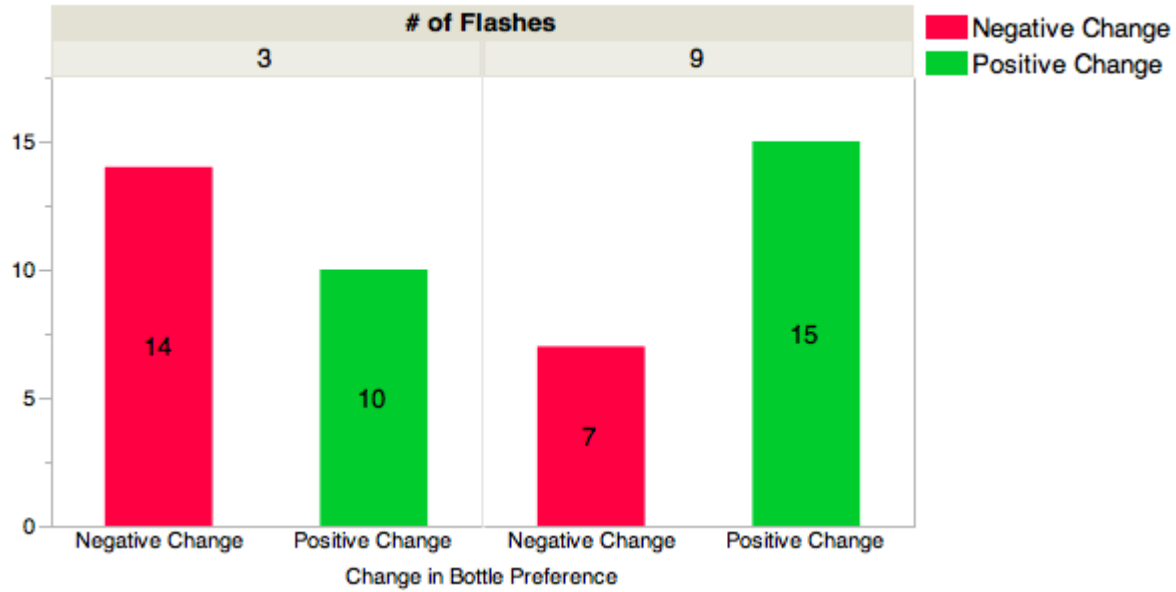
Thirst Level	Successes (Choice Matches Treatment Image)	Failures (Choice Does Not Match Treatment Image)
Not Thirsty		
Thirsty		

	Treatment Image)	Treatment Image)
Not Thirsty	15.283	11.717
Thirsty	14.717	11.283

Chi Square Test of Homogeneity

- State: Alpha level = .1. Null Hypothesis: there is no association between the thirst level of the subject and her response choice. Alternate Hypothesis: there is an association between the thirst level of the subject and her response choice.
- Plan: Random: treatments were randomly assigned to participants and participants were randomly selected. Independent: as the treatments are randomly assigned, treatment groups are independent of each other. Participants within groups can also be assumed to be independent of each other due to the nature of the topic at hand (a survey). Large sample size: unfortunately, all thirst categories except for the “A Little” category and the “Moderately” category have expected values less than 5. Therefore, I will only use these two categories in my chi-square test for association.
- Do: chi-square test statistic = .506, df = 1, p-value = .477.
- Conclude: as the p-value .477 is far more than the significance level .1, we fail to reject the null hypothesis; there is no association between the number of times the image was flashed and the subject’s response choice. This is a fairly obvious conclusion based on the data presented, however.

Figure 4: Change in Opinion of Water Bottles by Treatment



Actual

Number of Flashes	Successes (Positive Change)	Failures (Negative Change)
3	10	14
9	15	7

Expected

Number of Flashes	Successes (Positive Change)	Failures (Negative Change)
3	10	14
9	15	7

Chi Square Test of Homogeneity

- State: Alpha level = .1. Null Hypothesis: there is no association between the treatment and the change in preference of subjects. Alternate Hypothesis: there

is an association between the treatment and the change in preference of subjects.

- Plan: Random: treatments were randomly assigned to participants and participants were randomly selected. Independent: as the treatments are randomly assigned, treatment groups are independent of each other. Participants within groups can also be assumed to be independent of each other due to the nature of the topic at hand (a survey). Large sample size: unfortunately, all thirst categories except for the “A Little” category and the “Moderately” category have expected values less than 5. Therefore, I will only use these two categories in my chi-square test for association.
- Do: chi-square test statistic = 3.25, $df = 1$, $p\text{-value} = .071$.
- Conclude: as the $p\text{-value} .071$ is less than the significance level $.1$, so we reject the null hypothesis; subjects in the treatment group who viewed a subliminal bottle brand image 9 times during their treatment video were significantly more likely to experience a positive change in opinion of water bottle brand preference than those who viewed a subliminal bottle brand image 3 times.