



Information and Decoy Attractiveness

Can Information Downplay Decoy Effect?

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With appreciation from,

Eric Liu

Abstract

A decoy is a powerful tool that influences consumer behavior. By introducing an inferior choice, the decoy can significantly alter consumers' preference. Decoys are a prevalent practice employed by businesses across various fields, but the use of decoys can lead to overconsumption and ultimately causes health concerns including obesity, as a typical example. Are there any tools can decrease the attractiveness of a decoy and help consumers build resilience? If so, what are effective tools? This research examines the correlation between decoy attractiveness and relevant information by experimentally surveying consumer preferences regarding a high calorie food item – ice cream. The objective is to test how people's choice preferences deviate with two types of additional information that relates to the intake of calories. The experiments found that introducing relevant information can decrease the effectiveness of a decoy. Policy makers such as governments can use this strategy to prevent overconsumption.

Keywords: *decoy effect, obesity, pricing strategy, Asymmetric effect, preference, information*

Introduction

Obesity is a serious health concern across the world. In the U.S. before the COVID-19 pandemic, obesity prevalence in 2017 among children and adolescents between aged two to nineteen, and adults aged twenty and above was 19.7% and 41.9%, respectively (Stierman, et al., 2021, p. 4). Obesity can cause numerous health complications, such as hypertension, diabetes, tooth loss and chronic heart diseases. Simply put, the underlying reason for obesity is a persistent calorie surplus. In marketing, a successfully well-designed decoy alters consumer's choice and

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makes people consume more than necessary. Businesses that sell high calorie food (junk food) may contribute to obesity prevalence by manipulating consumer's preference using decoy effect. Why is decoy effect manipulative and how is it used as a pricing strategy? This paper takes a further look in the literature review section.

Literature Review

Since decoy effect was first presented in "*Adding Asymmetrically Dominated Alternatives: Violation of Regularity and the Similarity Hypothesis*"¹ (Joel, H, et al., 1981), the application of decoy became a common pricing strategy in an effort to attract greater sales. How does a decoy work? The 1981 paper demonstrates that an asymmetrically dominated option (the one that is never or rarely chosen) presented to customers changes the proportion of choices

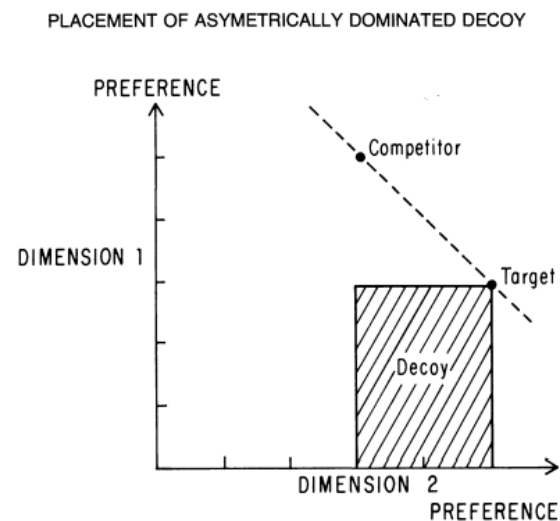


Figure A. Source: Paper 1

preferences between the pre-existing choices.

Figure A illustrates the placement of a decoy. Prior to introducing a decoy, consumers choose between a menu that contains a target and a competitor. The decoy is an asymmetrically dominated choice that hypothetically increases the proportion of customers choosing the targeted option. The shaded area indicates the place where it can be

effective to locate a decoy. Decoy effect is a cognitive bias, it shows a pattern of deviation of individuals from a rational judgement and makes people misperceive the value of their choices. Ostensibly, it makes the targeted option more attractive.

¹ Source for figure A

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There has been extensive research to examine and inspect its attractiveness. A well-known case study is the experiment on the subscription of The Economist magazine (Cui, 2022) conducted by Dan Ariely, a professor of psychology and behavioral economics at Duke University. The experiment separated MBA students at MIT into two groups. Group one was offered two subscription choices, namely web subscription for \$59 and web plus print subscription for \$125. Group two had the same choices as group one and a third option of print only for the same price (\$125) as web plus print is introduced to the choice set (see *Figure B*).

Choice and Price	% chosen between 2 choices	% chosen between 3 choices
Web: \$59	68%	16%
Print: \$125	N/A	0%
Web + Print: \$125	32%	84%

Figure B: the Economists Subscription Outcome

From *Figure A*, we can tell that the third option (print only) is asymmetrically dominated by the targeted option, in this case, the web plus print subscription. The decoy is located in the same price dimension (dimension two) but provides much lower value of the service (dimension one). It exemplifies the difference of value provided by the targeted choice and the decoy, and physiologically makes the targeted choice more attractive. As a result, none of the respondents chose the decoy option (print), a majority (84%) of group two chose the targeted option (web plus print), and merely 16% went with the competitor choice (web). In contrast, when the decoy was not presented in group one, the majority (68%) subscribed to the web service and only 32% chose web and print subscription. In this case study, the decoy not only altered the proportion of the choice preference, it also increased the subscription revenue.

Decoy effect manipulates consumers' behavior. The food industry uses similar practices to the above subscription example. Ever wondered why when we go to a movie theater that a

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large size popcorn nearly doubles in the volume compared to the medium size yet only has a small price increase; a large sugar-filled soda is merely 50 cents more than the smaller one; a double steak burger with double sized fries cost just a couple more dollars as opposed to the regular size. While these offers are seemingly attractive, extensive overconsumption is unhealthy and causes obesity. The objective of this paper is to probe effective information that can decrease the attractiveness of decoy.

Experiment

E.1: Design

We hypothesize that “relevant information” can decrease the attractiveness of a decoy and designed an experiment to test this hypothesis. The experiment consisted of a survey with multiple versions that asked participants to choose between a menu of ice cream options. Some versions included relevant information designed to decrease the attractiveness of the decoy. The relevant information in this study is determined as:

- the equivalent number of calories of the chosen ice cream, and
- the equivalent number of steps (as a proxy for required cardiovascular activity) to burn the calories.

The experiment separated all participants into one of the following four control groups:

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Groups	Menu		
Group 1	Small	N/A	Large
Group 2	Small	Medium	Large
Group 3	Small + Calorie information	Medium + Calorie information	Large + Calorie information
Group 4	Small + Step information	Medium + Step information	Large + Step information

Figure C: Experiment control groups and information available

In group one, survey participants are asked to choose from either a small or large ice cream with only price information available. Group two has the same price information, but a decoy (medium) is introduced to the menu. The large size is the targeted option. As opposed to the decoy, the large ice cream is double the volume but only with a small increase in price. The calorie information and step information are made available and displayed side-by-side with the price for group three and group four, respectively. See price and relevant information in *Figure D*.

Size	Price	Calorie Equivalent	Steps Equivalent
Small	\$5.49	380	9,500
Medium	\$8.49	760	19,000
Large	\$8.99	1140	28,500

Figure D: Information provided accordingly to each control group

E.2 Hypothesis

The objective of this experiment is to evaluate the decoy effect and discover if the relevant information can decrease the attractiveness of the decoy. The study focuses on the large ice cream and analyzes the deviation of the proportion of the large size in each control group.

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The method was designed with multiple survey versions to test several hypotheses that follow from the objective.

To detect the decoy effect, a comparison analysis will be conducted between group one and group two. To scrutinize the impact of the relevant information on the decoy attractiveness, the study will compare group two to group three, and group two to group four, separately.

Formally, the experiment and analysis evaluated three hypotheses.

H_1 : there is significant evidence to indicate the decoy effect,

$$H_{O,1}: \%Large_1 = \%Large_2, \quad H_{A,1}: \%Large_1 \neq \%Large_2$$

The test is $\Delta \%Large_{2,1} > 0$, *decoy effect*. Compare group one to group two, if the percentage of preference on the large ice cream is positive, there should be a decoy effect.

H_2 : providing relevant information will significantly decrease the attractiveness of decoy,

$$H_{O,2}: \%Large_2 = \%Large_{3 \text{ or } 4}, \quad H_{A,2}: \%Large_2 \neq \%Large_{3 \text{ or } 4}$$

The test is $\Delta \%Large_{3 \text{ or } 4,2} < 0$, *relevant information decreases decoy attractiveness*.

Compare group two to group three, group two to group four separately, if the percentage of preference on the large ice cream is negative, it indicates the information decreases the decoy attractiveness.

H_3 : step information is significantly more effective compared to calorie information.

$$H_{O,3}: \%Large_3 = \%Large_4, \quad H_{A,2}: \%Large_3 \neq \%Large_4$$

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The test is $\Delta\%Large_{4,3} > 0$, *step information is more effective*. Compare group four to group three, if the percentage of preference on large is positive, it shows cardio information is more effective relative to cardio information, vice versa.

The second (H_2) and third (H_3) hypotheses depend on the presence of a decoy. That is, the interpretation of the second and third hypotheses assume that they are mitigating the effect of a decoy and whether if the additional relevant information would decrease the attractiveness of decoy (H_2) and inspect the effectiveness of different types of the relevant information (H_3).

There is also a reasonable possibility that the experiment would not discover a significant decoy effect.

Hypothesis tests are performed in the later section. If the tests value is significant, we fail to reject the null and it indicates the difference of preference on the large ice creams are statistically indifferent. In other words, it does not have strong statistical evidence to support the above hypothesis. Otherwise, the hypothesis is supported by statistical analysis.

E.4: Results

The experiment in total collected 163 random samples based on availability of willing participants. The locations where the data collected are from gyms, Front Runner NY (running club), coffee shops, Baruch College library, friends, and family. Participants were asked to answer a 4-question survey presented on a cellular phone or computer tablet. Biases that may be present in the data are discussed in a later section.

In group one, where the decoy option was not provided, an overwhelming majority (70.6%) of the participants chose size small. When the inferior choice is added in the second

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group, decoy effect started to show, the majority (59.5%) of the sample size deviated to the large ice cream. However, when the information of calorie and step equivalent were added for people in group three and group four, 65.6% and 80% of the respondents in the respective groups preferred the small size over the large size (*Figure E*).

Group	Small % (number)	Medium % (number)	Large % (number)	Total % (number)
Group 1	70.60% (24)	N/A	29.4% (10)	100% (34)
Group 2	33.3% (14)	7.1% (3)	59.5% (25)	100% (42)
Group 3	65.6% (21)	31.3% (10)	3.1% (1)	100% (32)
Group 4	80% (44)	10.9% (6)	9.1% (5)	100% (55)

Figure E: survey results. Number = number of respondents

The survey results have shown a visible pattern of choice behavior. In group two, the medium size is asymmetrically dominated by the large size. As opposed to the large ice cream, the medium one has similar price but only has half of the volume. That creates a sense of the large ice cream is more valuable and it is a “hard-to-miss” choice. As a result, the most popular option is the large size in contrast to the small size in group one. While decoy effect was able to manipulate consumers’ behavior, adding relevant information to make consumers aware of the possible impact of their choices can decrease the attractiveness of decoy. As shown in group three and group four, although the targeted option is the large ice cream, it is the least popular choice when more information is displayed on the menu, and most survey participants prefer the small ice cream again.

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Nonetheless, are these preferences deviations statistically significant or merely due to chance? The study uses Z-test² to determine whether if the changes are significant at $\alpha = 0.05$, the test values as follow:

Hypothesis	Z-Score	P-value	Decision
H_1	-2.62	= 0.0044	Reject the null
$H_2^{2 \text{ to } 3, 2 \text{ to } 4}$	5.03 (2 to 3) 5.32 (2 to 4)	< 0.00001	Reject the null
H_3	-1.06	= 0.289145	Failed to reject the null

Figure F: Hypothesis testing

Both the first and the second hypothesis have a significant p value, and the third one has an insignificant p value. Which concludes that:

H_1 : The change of the percentage of the large ice cream between group one and group two is statistically significant, and there is significant evidence to show a decoy effect.

H_2 : The deviation of the proportion of the large size between group two and group three, group two and group four are significantly different. When relevant information is available to consumers, it is likely to decrease the decoy attractiveness.

H_3 : although more people chose the small ice cream in group four (80%) than group three (65.6%), there is no significant statistical evidence to suggest that step information is more effective than the calorie information in order to decrease the decoy attractiveness.

$$^2 Z = \frac{(\hat{p}_1 - \hat{p}_2) - (p_1 - p_2)}{\sqrt{p \times (1-p) \times \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

Discussion

The menus presented to groups one and two were designed to be similar to The Economist subscriptions experiment. The responses produced similar findings demonstrating that the menu presented to group two contained a decoy as intended. That is, the fact that the deviation of preference between the two groups is attributed to the attractiveness of decoy. The medium ice cream option was an asymmetrically dominated alternative, that significantly changed survey responses and the choices of the participants. Although ice cream contains high calories, most survey respondents choose the large ice cream in group two when the medium size is available, while most of the respondents in group one prefers the small one. The change of the proportion of the choice is an example of juxtaposition that decoy is an effective pricing strategy to generate higher sales revenue and unconsciously lead to overconsumption and other health concerns, obesity, as mentioned in this paper.

In terms of developing effective tools to mitigate the attractiveness of decoy effect, calorie information and step information were added to group three and group four in this study, respectively. The empirical results of the study show a significant difference in preference deviations. Relevant information provided next to the price of the item influenced the participant choices. Thus, the small ice cream is the most frequently chosen option in group three and group four.

Results presented are from several groups that may introduce biases. For instance, the responses that were collected from gyms and the running group may be more likely to focus on the calorie intake as the respondents may have a relatively a more active lifestyle and they may have a better understanding step equivalent as they may more closely track steps. Respondents from the school library may be more sensitive to the price of the ice cream. Furthermore,

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different control variables, such as gender, age groups and exercise frequency, may also have a subjective impact on their preferences. Finally, the survey is asking participants to make a choice in a hypothetical scenario – there was no ice cream. The circumstances may influence choice behavior. However, this paper is concerning the correlation between information and the attractiveness of decoy, the study is focused on demonstrating the relationship between the selected information and decoy effect, rather than analyzing the possible sensitivities that mentioned above.

Although displaying the calories per serving is a part of the menu labeling requirements for some categories by the FDA, merchants may manipulate the serving size in order to present a desired caloric quantity that is to the benefit of the merchant. Some unhealthy food is still able to display a low number of calories because the arbitrarily self-defined serving size is relatively small. The findings in this study conclude that showing the relevant information can be an effective tool that impacts consumer behavior, even when there is a decoy to attract consumers to consume more. This finding may help the regulatory bodies to pass regulations and better address obesity.

One hypothesis evaluated was that step information may be more successful to reduce the decoy effect, the empirical results suggest that it is indifferent to the calorie information. It is true that more people choose the small size when step information (group four) is made available than group three where the relevant information is the number of calories, how the preference on the large size deviates is not statistically significant. The results suggest that there might be another type of more effective information to decrease decoy attractiveness, or it may be that the added alternative (decoy) take a substantial share from the change and distorted the hypothesis testing result. Nevertheless, the study shows the power of decoy effect. Providing relevant

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information to consumers, whether it is calorie information or step information, can help substantially decrease the attractiveness of decoy.

Appendix A: Descriptors of Z-test

$$Z = \frac{(\hat{p}_1 - \hat{p}_2) - (p_1 - p_2)}{\sqrt{p \times (1 - p) \times \left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

\hat{p}_i : proportion i in group i .

p_i : common value between the two comparing groups.

n_i : sample size i .

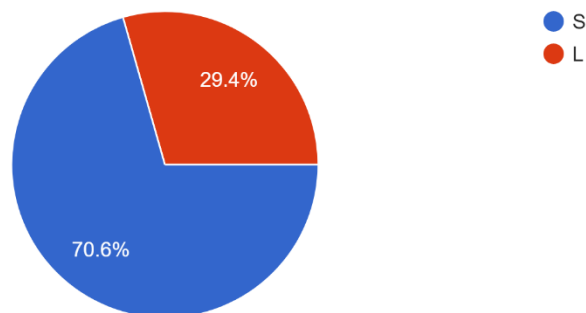
$p_1 - p_2 = 0$, under the assumption of the null hypothesis.

Appendix B: Descriptors of the surveys

Group one:

Imagine you are in an ice cream shop and deciding to buy an ice cream from the following options, which one would you choose?

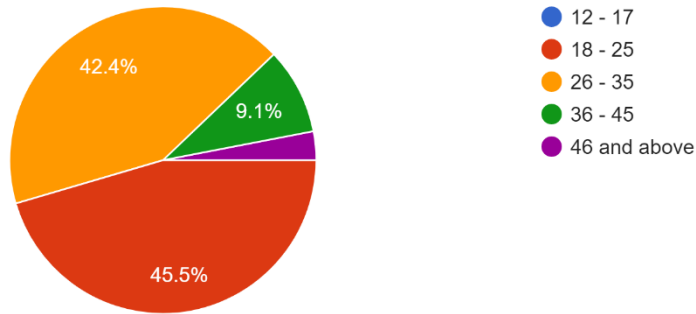
34 responses



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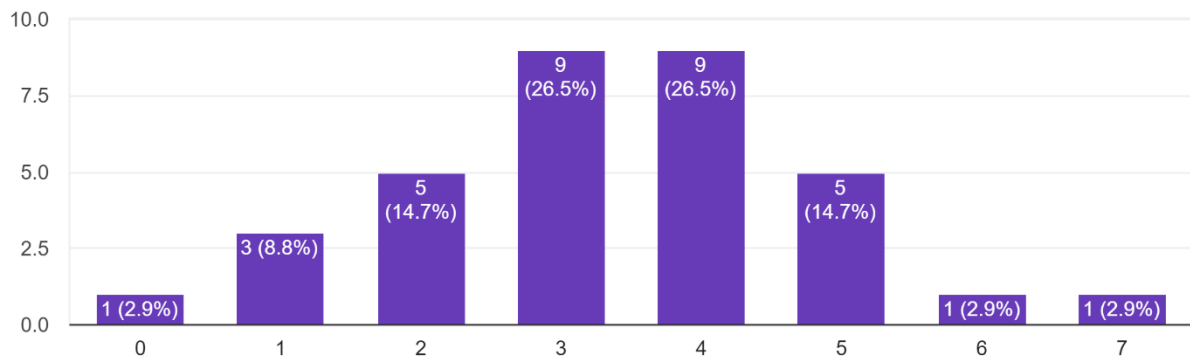
What is your age?

33 responses



How many days do you exercise each week?

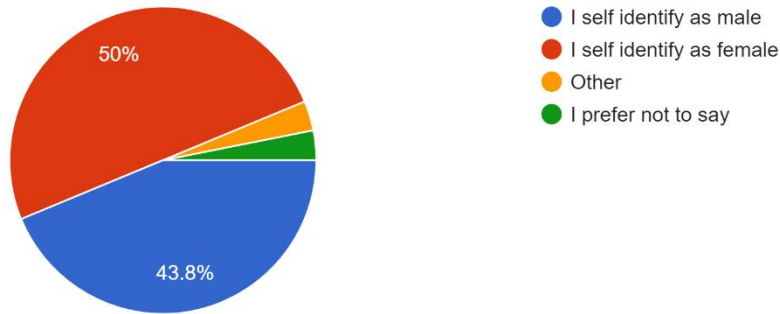
34 responses



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What is your gender?

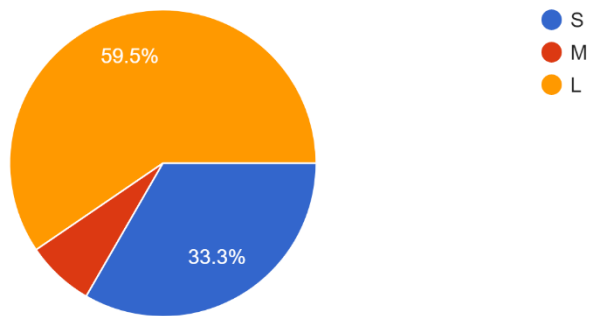
32 responses



Group two:

Imagine you are in an ice cream shop and deciding to buy an ice cream from the following options, which one would you choose?

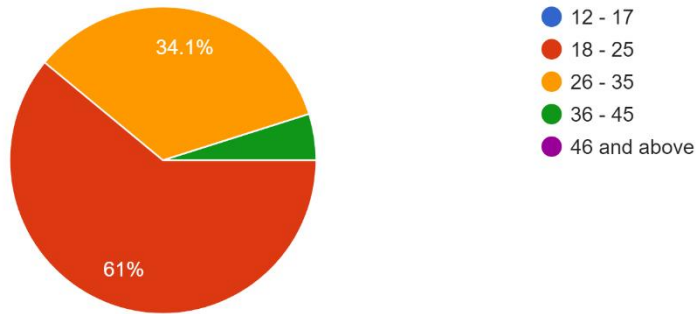
42 responses



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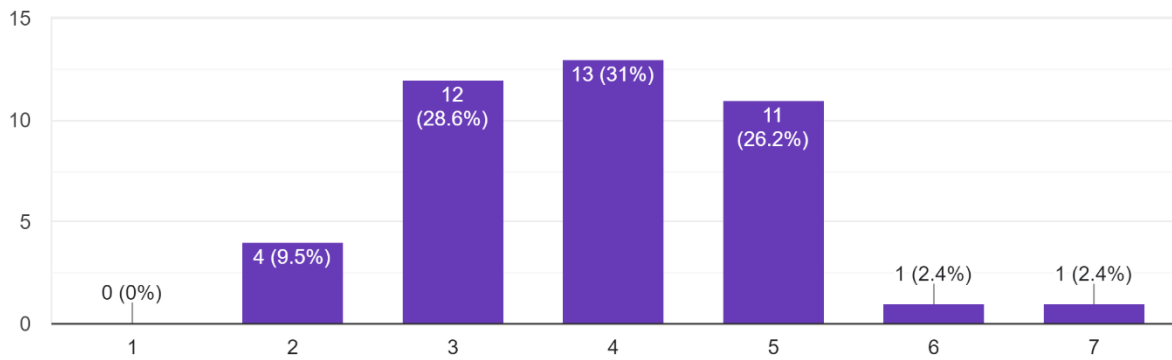
What is your age?

41 responses



How many days do you exercise each week?

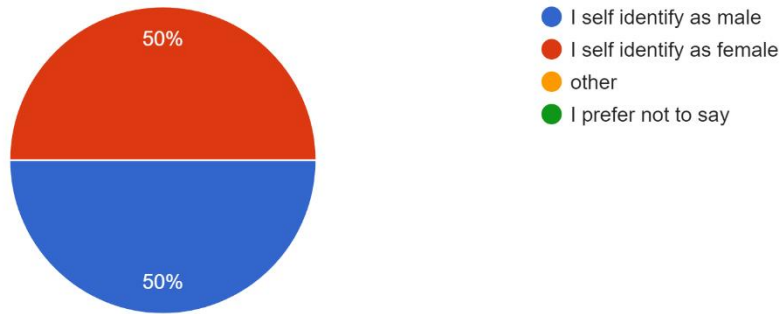
42 responses



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What is your gender?

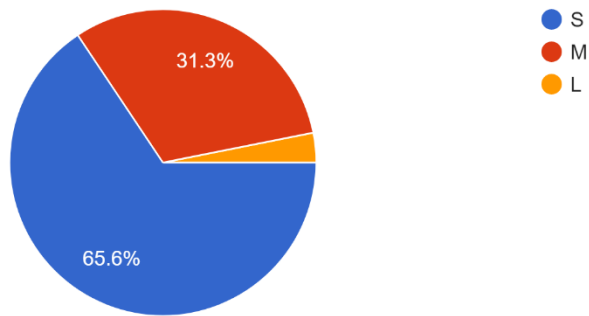
42 responses



Group three:

Daily recommendation is 2000 calories. Imagine you are in an ice cream shop and deciding to by an ice cream from the following options. Which one would you choose?

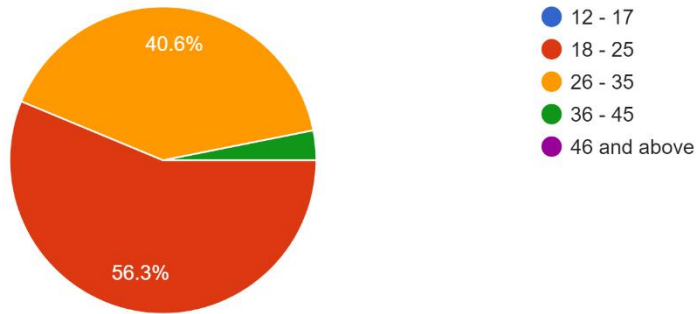
32 responses



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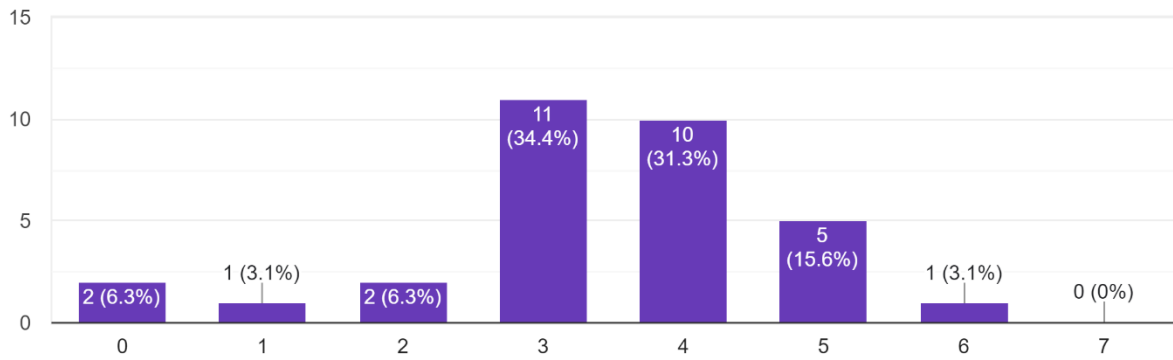
What is your age?

32 responses



How many days do you exercise each week?

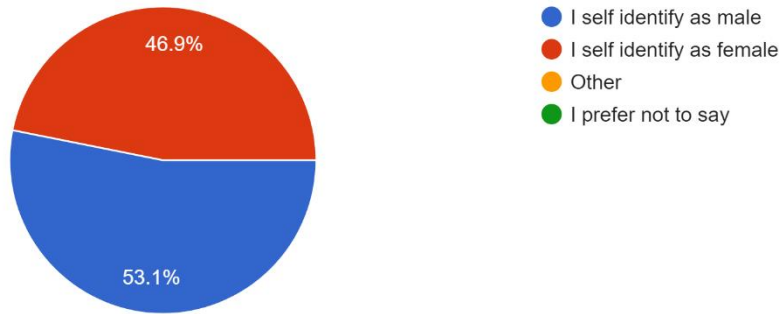
32 responses



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What is your gender?

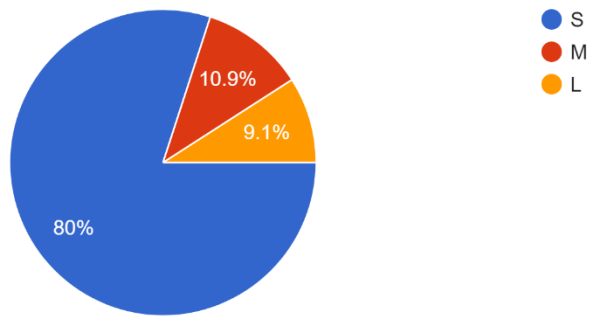
32 responses



Group four:

In order to burn the calorie each ice cream contains, we display the equivalent steps needed. In NYC, people on average walk 7000 steps daily. Which size would you choose?

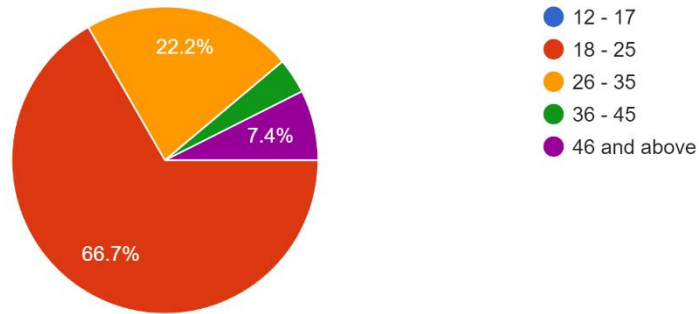
55 responses



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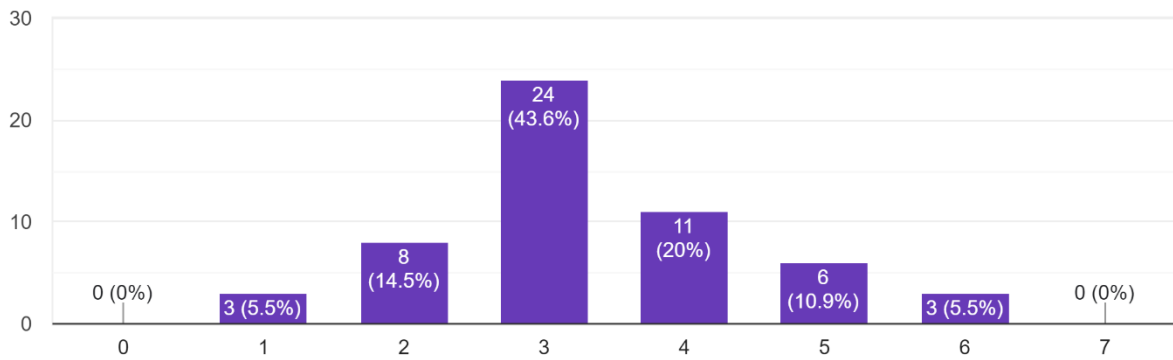
What is your age?

54 responses



How many days do you exercise each week?

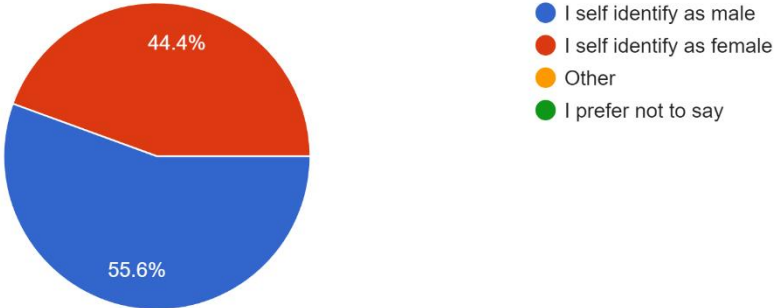
55 responses



Research Paper

What is your gender?

54 responses



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