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The Effects of the Plastic Bag Ban on Consumer Bag Choice at Santa Monica Grocery Stores

Research Report by Team Marine (www.teammarine.org), Santa Monica High School

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Background

To date, 71 cities or counties within California have adopted ordinances to ban single-use plastic bags¹ with Los Angeles City's upcoming implementation to bring the total affected to 25% of the state population². Ban proponents have emphasized the negative environmental and economic impacts of plastic bags, noting that volunteer recycling efforts recover less than 5% of the produced material^{3,4,5}. The plastics industry and pro-plastic affiliates have responded that recycling rates are rising, and that bans exacerbate environmental and economic impacts by increasing paper bag usage (i.e., problem shifting)^{6,7,8}. Meanwhile, few comprehensive studies have quantitatively assessed: (1) the effectiveness of bag bans in eliminating plastic bags, (2) pre- and post-ban trends in carryout bag choice, (3) potential problem shifting to paper bags, and (4) the effects of age and gender on bag selection. Such data are needed for municipalities to make informed decisions about implementing ban ordinances and are critical to the success or failure of future bans at all levels of government.

Summary

We conducted a 19-month study over two years to examine the effects of the City of Santa Monica's plastic bag ban (implemented September 1, 2011 with a ten cent fee per paper bag) on consumer bag choice. Spanning ten months prior to the bag ban and 12 months after, we observed a total of 50,400 grocery store patrons exiting five Santa Monica grocery stores to visually estimate their age, gender, and carryout bag type (plastic, reusable, paper, or no bag). We performed separate analyses for both "eco-friendly" stores (Whole Foods and Trader Joes), which used few if any plastic bags prior to the ban, and "regular" stores, which used primarily plastic bags prior to the ban. The results show that at regular grocery stores, mean plastic bag usage went from 69% pre-ban to 0% post-ban, with reusable, paper, and no bag usage increasing from 10%, 5%, and 15% pre-ban to 41%, 23%, and 36% post-ban, respectively. At eco-friendly grocery stores, the ban not only eliminated plastic bags and increased reusable and no bag options, paper bag usage dropped by 23 percentage points. Our results also indicate the oldest age group was the most inclined to use plastic bags pre-ban and reusable bags post-ban, while the youngest patrons used more paper bags and no bags. Furthermore, at both eco-friendly and regular stores, a higher percentage of females used reusable bags than males, while males were inclined to use more paper bags or no bag than females.

Methods and Materials

We posed five questions before conducting our investigation:

1. Will the ban be effective in getting rid of plastic bags?
2. Will the ban be effective in increasing reusable bag usage?
3. Will the post-ban 10-cent fee on paper bags¹ be effective in decreasing paper bag usage?
4. Does patron age affect bag choice? Which age group is more eco-friendly/unfriendly?
5. Does patron gender affect bag choice? Which sex is more eco-friendly/unfriendly?

To answer these questions, we placed observers at five grocery stores in Santa Monica. For each store, we attempted to collect data eight times per month. During each round of data collection, we observed a minimum



of 100 patrons exiting the store. On a data sheet, each patron was placed into age, gender, and bag type categories. As much as possible, we sought to perform observations during the middle two weeks of every month to provide a gap between months. Peer training and group calibration tests were conducted for age and bag type variables to help reduce observer bias.

To test the null hypothesis that the plastic bag ban would have no effect on consumer bag choice, a multivariable analysis of variance (MANOVA) for both eco- and regular stores was performed after rescaling the pre-ban data to exclude the plastic bag category from the analysis¹⁰. To test the null hypotheses that age and gender variables would have no effects on consumer bag choice, we compared mean values using a series of T-tests. For all analyses, the p-value for significance was set at $p \leq 0.05$.

Results and Discussion

The results indicate that the ban was effective in getting rid of plastic bags at regular stores, reducing plastic bag use from ~70% to 0% (Fig. 1). Contrary to statements by pro-plastic bag groups⁷, paper bags did not replace plastic bags as the predominant bag type. Rather, between pre- and post-ban, the mean percentage of patrons using reusable bags increased by 31 percentage points (MANOVA, $p = 0.0252$), followed by no bag (21 points, $p = 0.0003$), and paper (18 points, $p = 0.0153$) (Fig. 1). At eco-stores, the mean percentage of patrons using reusable bags and no bag rose 24 and 2 percentage points ($p < 0.001$ and $p = 0.0036$), respectively, while the percentage using paper bags decreased by 23 points ($p < 0.001$, Fig. 2). Accordingly, given the plastic bag ban's targets were regular stores, there was thus a notable "spillover effect" at eco-stores. These combined results suggest that the post-ban 10-cent fee per paper bag was an effective incentive to increase reusable and no bag selections. Furthermore, while this study did not assess patron volume per store or the number of bags used per customer, it is conceivable that the increased use of paper bags at regular stores is being countered by the decreased use of paper bags at eco-stores. A more comprehensive answer to this question could arise from subtracting a store's surplus of paper bags from a known purchase order volume within a particular time period to determine the true number of bags distributed.

Figures 2 and 3 indicate the city's plastic bag ban with 10-cent fee has been effective overall, further supported by the time graph for eco-stores (Fig. 3). Here, one year after the ban, the mean percentage of patrons using reusable bags remained steady around 47%. Conversely, at regular stores (Fig. 4), reusable bag use appears to be waning while paper bag use increasing. The upward drift in patrons using paper bags at regular stores in 2012 warrants further investigation. Specifically, it would be of interest to ensure grocery stores, one year after the ban, are following the law; are they continuing to disincentivize paper bag use by charging 10 cents per paper bag? Other variables could be contributing as well, including patron apathy, regular stores undercharging for the number of paper bags used, and stores prematurely removing strategic parking lot and store signage reminding customers to bring in their reusable bags. A study that could determine a store's paper bag surplus in inventory, its paper bag purchase order volume, and the number of paper bags sold in a given time period should establish if any undercharging is occurring, and ultimately, whether regular stores are obeying the law. If undercharging is not occurring, a steeper fee of more than 10 cents may need to be considered.

The present study found that age affects carryout bag selection (Figs. 5, 6, 7, and 8), although it is difficult to identify the most "eco-friendly/unfriendly" age group. The age graphs for both eco- and regular stores reveal that the youngest generation is more inclined to use no bag than older generations (t-test, $p < 0.0002$), while the oldest generation is more likely to use reusable bags than the youngest generation ($p < 0.0003$). The former result was an expected outcome; the youngest customers presumably use fewer bags since they are



less likely to shop for the entire household. In other words, young people likely purchase fewer items, which can be carried out in their hands. Interestingly, while the oldest age group appeared to use the most plastic bags at regular stores prior to the ban (Fig. 7), it used significantly more reusable bags than the two youngest age groups post-ban ($p = 0.039$, Fig. 8). This apparent flip in behavior is surprising, as stereotypes often portray older generations as resistant to change. Another noteworthy result involves paper bag use at eco-stores (Figs. 5 and 6). Prior to the ban, the youngest age group used significantly fewer paper bags than all age groups ($p < 0.03$), whereas after the ban, it appeared to use more paper bags than any other age group. Overall, the results suggest that more educational outreach to the 0-19, and perhaps the 20-39 age groups, may be needed to encourage an increase in reusable bag use.

The present study found that gender affects bag choice, but establishing a more “eco-friendly/unfriendly” gender is also difficult. The gender graphs (Figs. 9 and 10) show that at both eco- and regular stores, more females used reusable bags than males ($p < 0.000006$), while males used more no bag than females ($p < 0.002$). At eco-stores, males also used significantly more paper bags than females ($p < 0.03$). Thus, more outreach may be needed to encourage males to use reusable bags and decrease their use of paper bags.

It should be noted that during the pre-ban months, we attempted to collect data from a third eco-friendly grocery store (Santa Monica Co-Opportunity) (Table 1), but we had to throw out this data due to short staffing. For some months, we also fell short of our goal of eight observations per store or could not obtain data at all (Table 1), also due to short staffing. Despite these gaps in the data set, a total of 504 visual surveys were conducted, amounting to 50,400 patrons observed in the study (Table 1). It is our hope that these data will not only enhance understanding about the impacts of plastic bag bans, but similar prospective policy changes. As far as we are aware, this is the first comprehensive study to assess bag usage before and after a ban through visual surveys of patron bag choice. While previous studies^{11,12,13,14} in Santa Monica and LA County mainly relied on bag sales data from grocery stores in their Environmental Impact Reports, our study is consistent with their main conclusions – bag bans with paper bag fees are effective. Future research is needed to determine the true number of paper bags consumed by patrons and the greenhouse gas emissions of those bags¹⁴.

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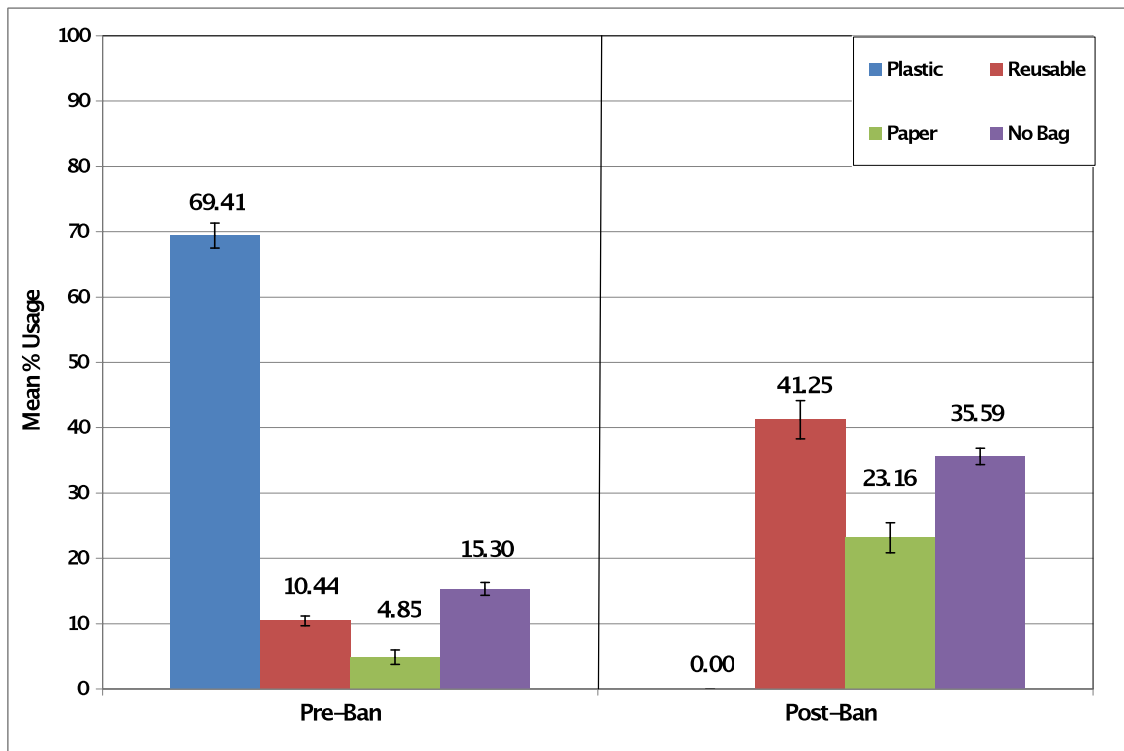


Figure 1. Mean percent usage (\pm SE) of different bag choices (regular stores and months pooled) before and after the plastic bag ban.

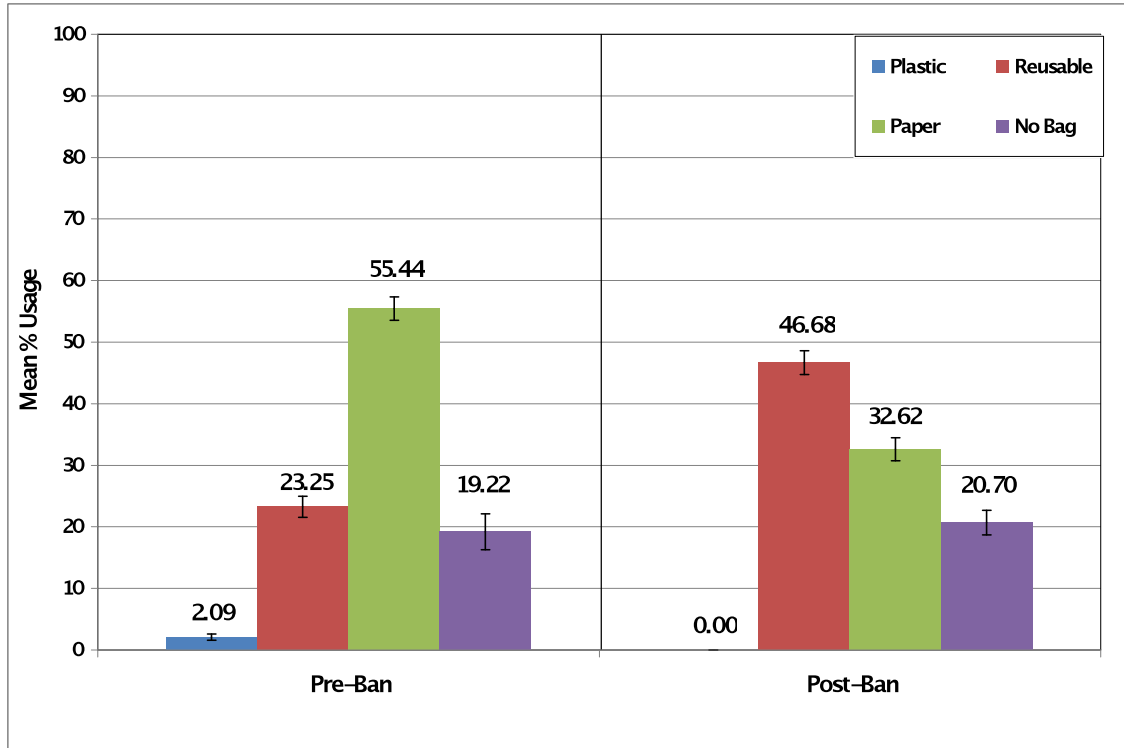


Figure 2. Mean percent usage (\pm SE) of different bag choices (eco-friendly stores and months pooled) before and after the plastic bag ban.

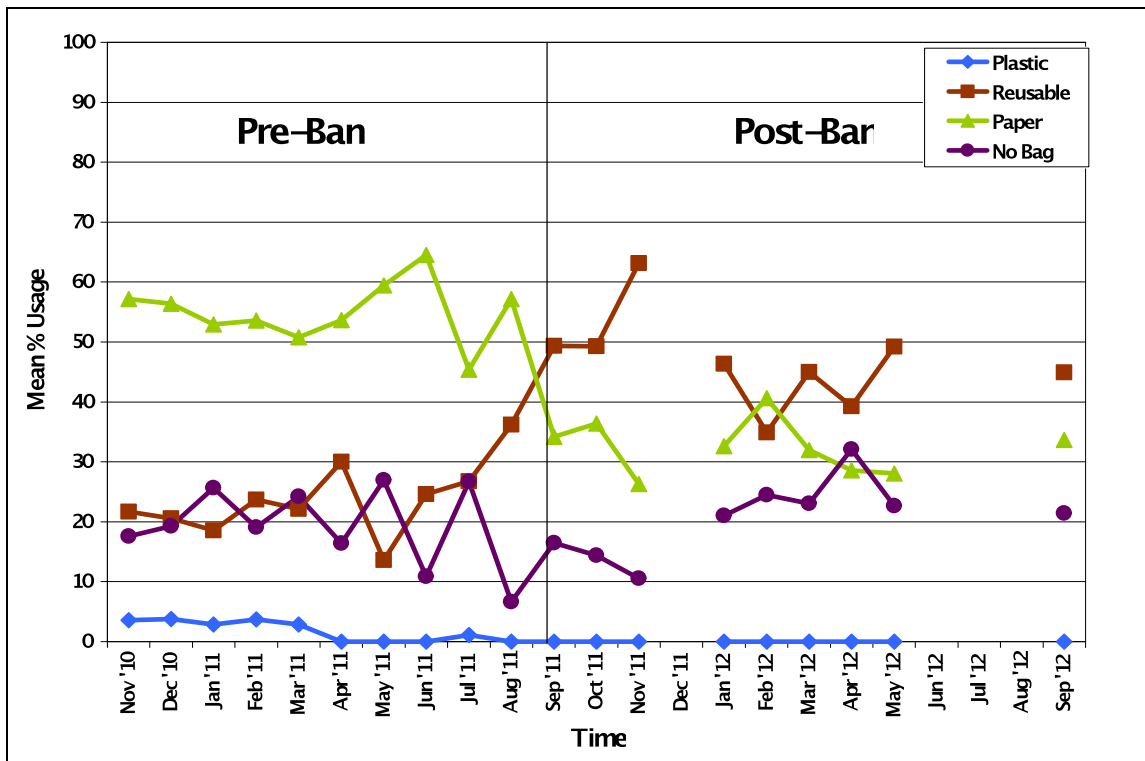


Figure 3. Mean percent usage of different bag choices per month (eco-friendly stores pooled) before and after the plastic bag ban. Gaps represent months no data were collected (see Table 1 below).

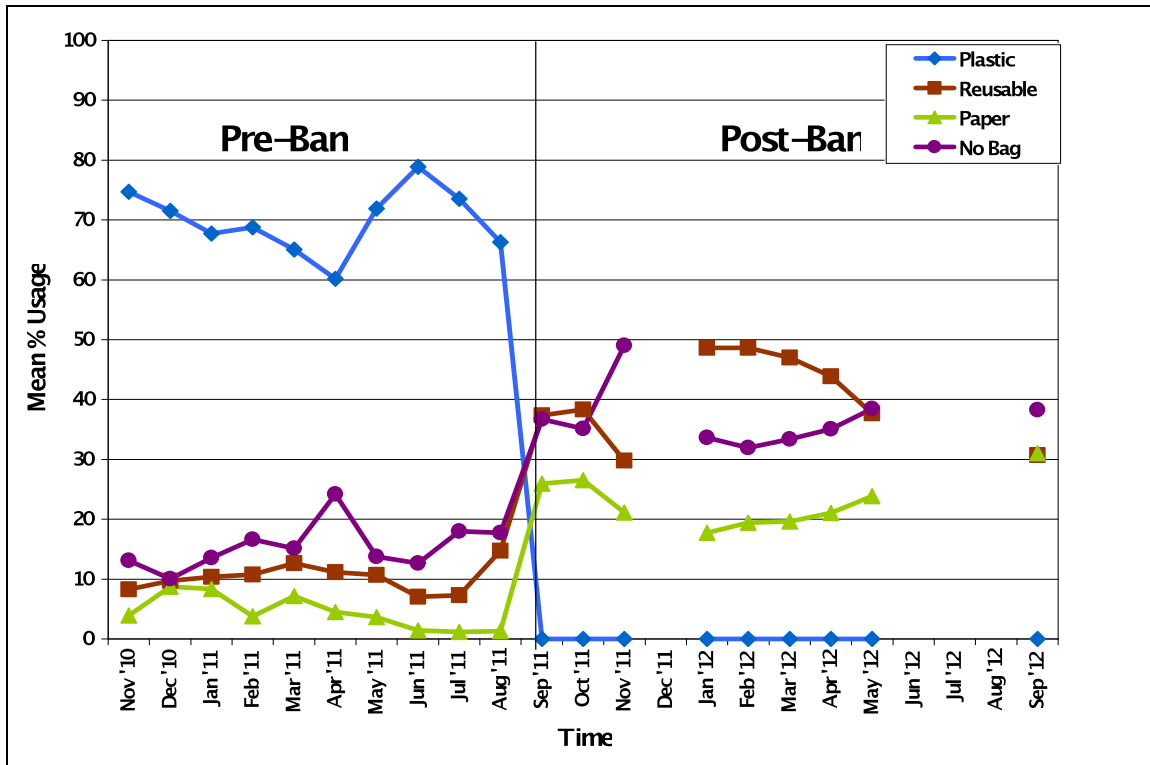


Figure 4. Mean percent usage of different bag choices per month (regular stores pooled) before and after the plastic bag ban. Gaps represent months no data were collected (see Table 1 below).

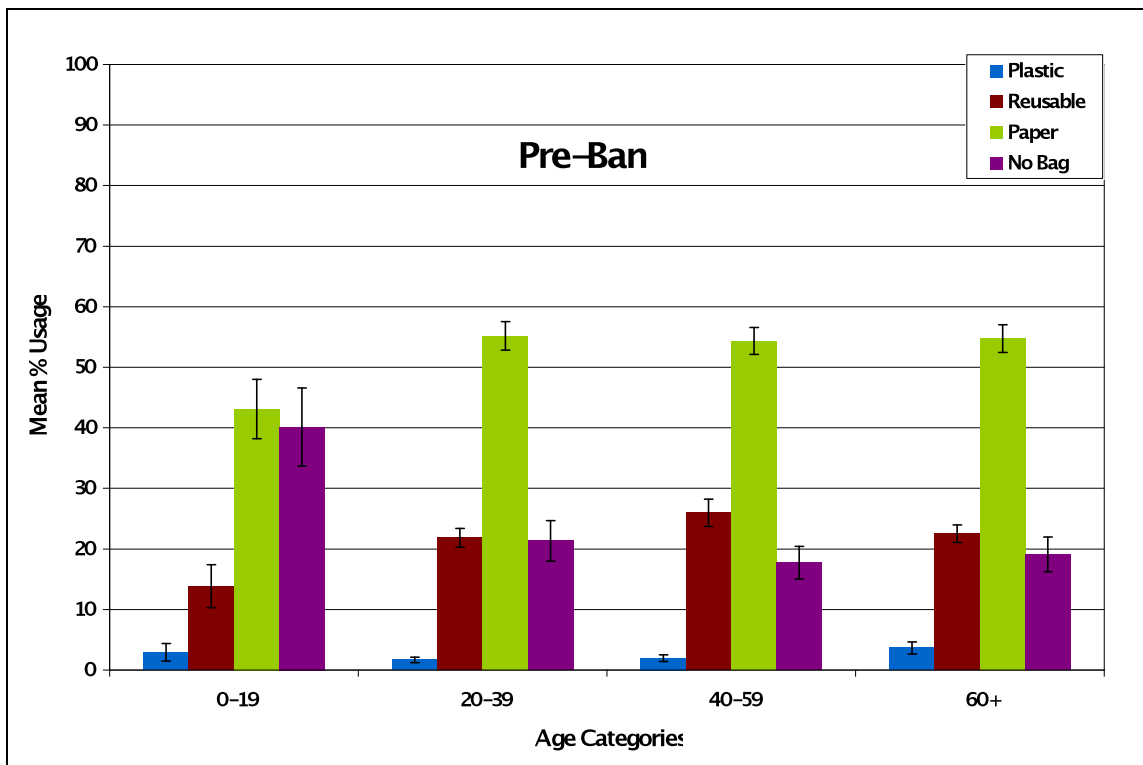


Figure 5. Mean percent usage (\pm SE) of different bag choices in different age categories (eco-friendly stores and months pooled) before the plastic bag ban.

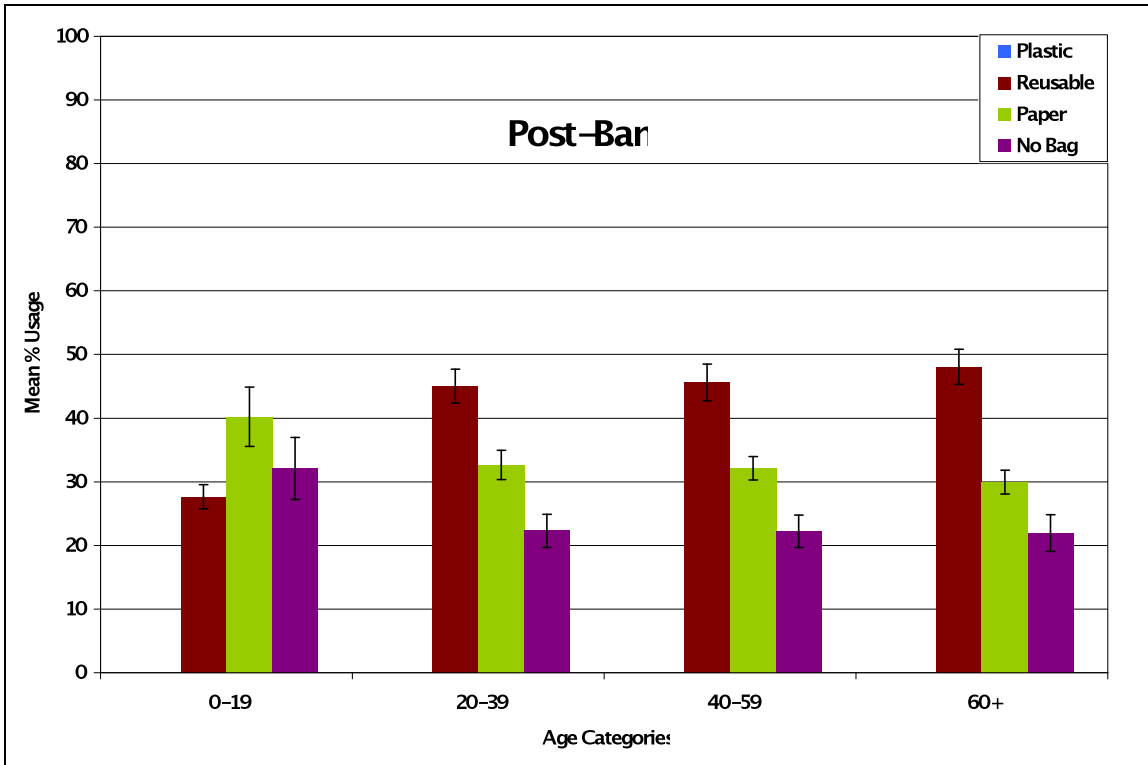


Figure 6. Mean percent usage (\pm SE) of different bag choices in different age categories (eco-friendly stores and months pooled) after the plastic bag ban.

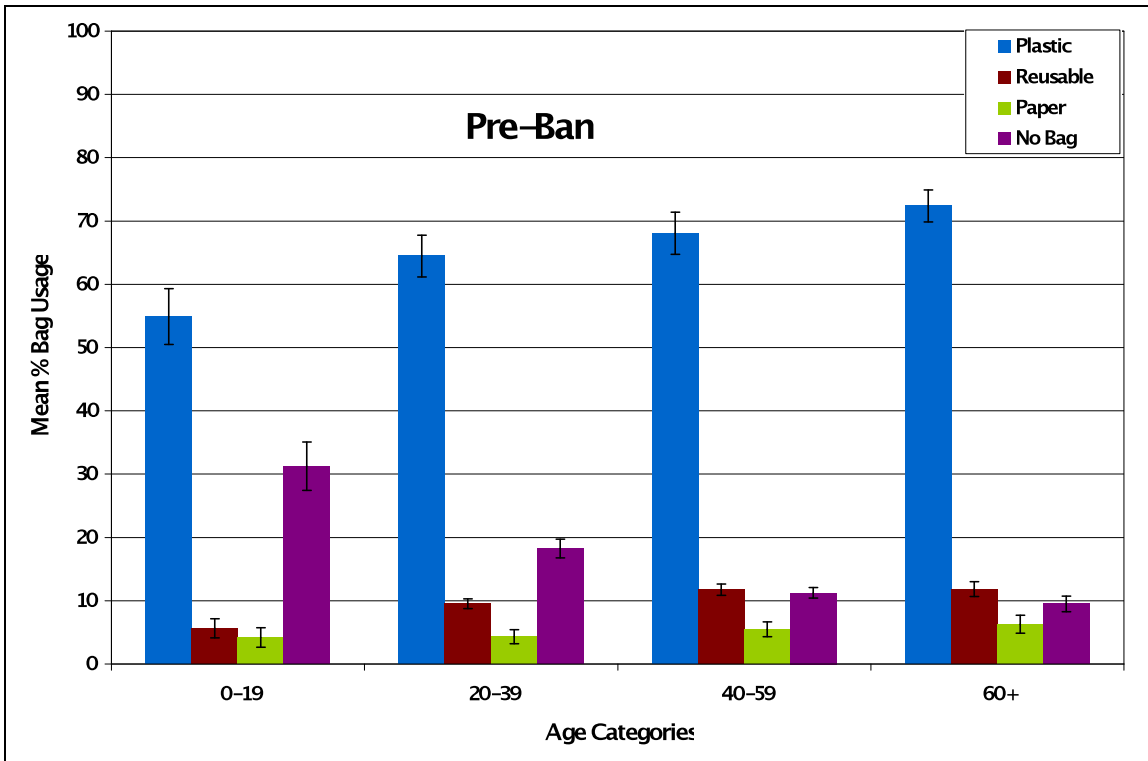


Figure 7. Mean percent usage (\pm SE) of different bag choices in different age categories (regular stores and months pooled) before the plastic bag ban.

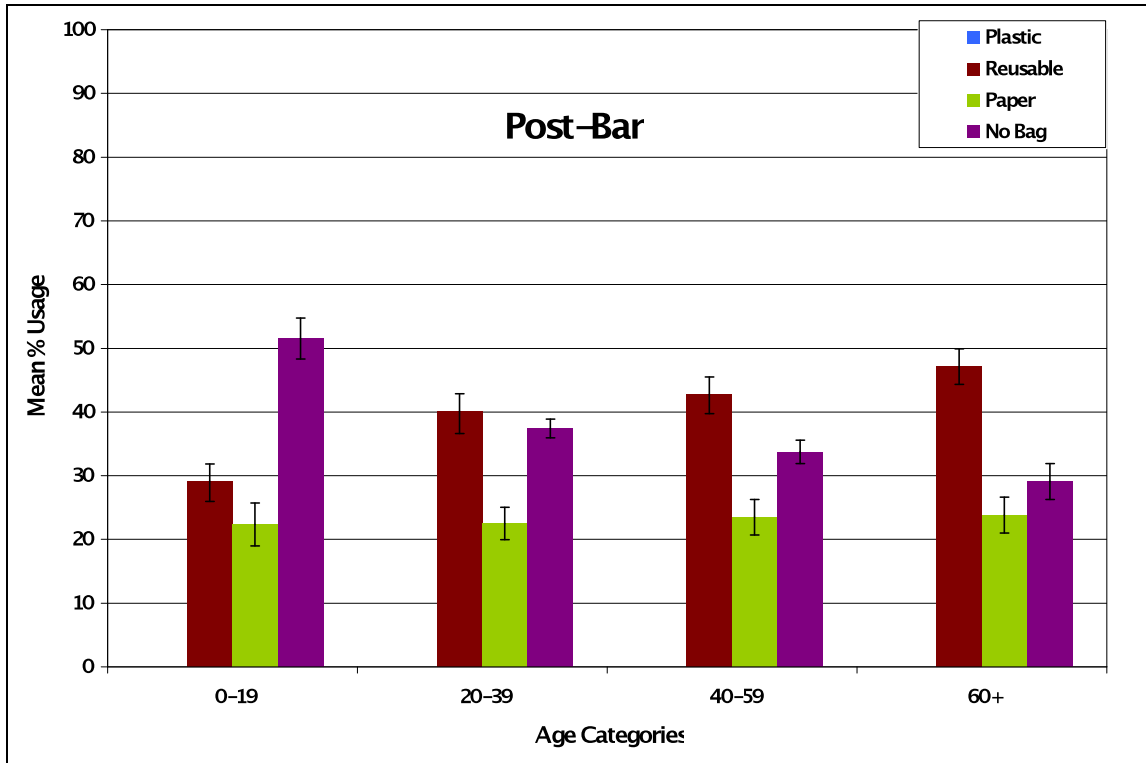


Figure 8. Mean percent usage (\pm SE) of different bag choices in different age categories (regular stores and months pooled) after the plastic bag ban.

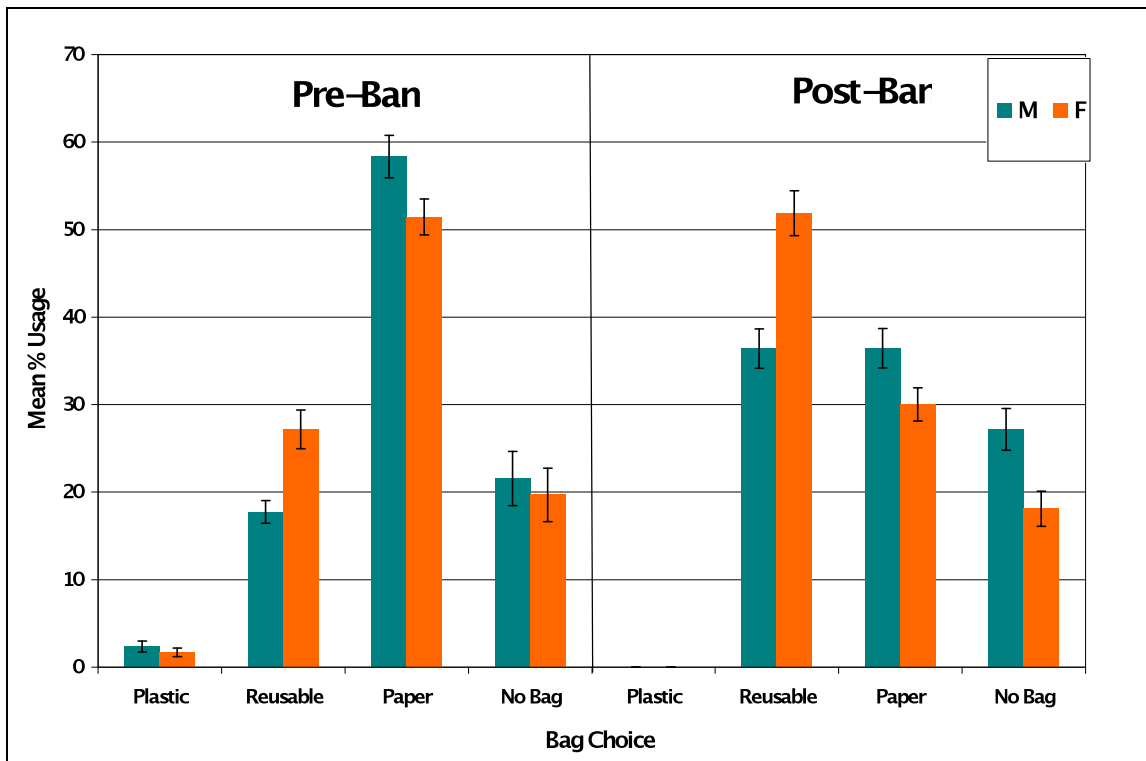


Figure 9. Mean percent usage (\pm SE) of different bag choices in different gender categories (eco-friendly stores and months pooled) before and after the plastic bag ban.

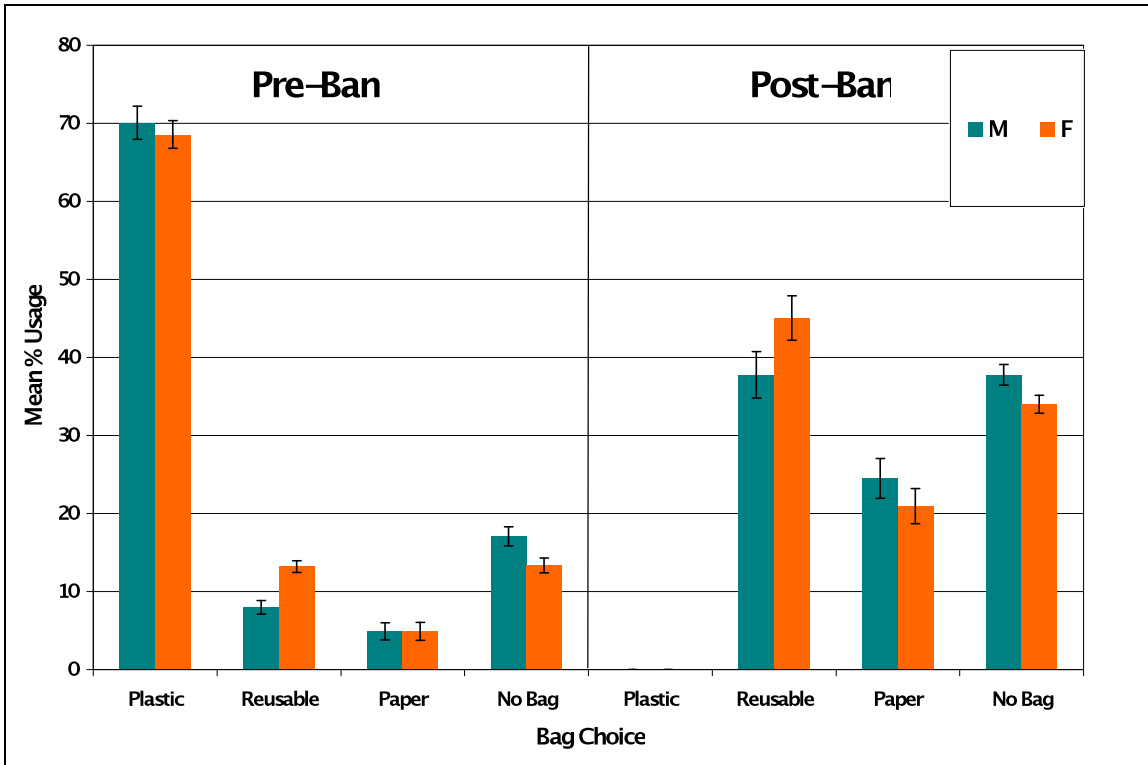


Figure 10. Mean percent usage (\pm SE) of different bag choices in different gender categories (regular stores and months pooled) before and after the plastic bag ban.



Table 1. The number of visual surveys conducted each month at regular and eco-friendly stores before and after the ban. Co-Opportunity data discarded due to short staffing.

Month	"REGULAR STORES"			"ECO-FRIENDLY STORES"		
	Albertsons	Vons	Ralphs	Co-Opportunity	Whole Foods	Trader Joes
Nov 2010	10	10	10	10	10	10
Dec 2010	10	9	10	10	10	10
Jan 2011	10	9	7	10	10	10
Feb 2011	10	7	X	10	10	10
Mar 2011	8	5	6	7	8	6
Apr 2011	10	3	9	8	10	6
May 2011	8	X	6	4	4	8
Jun 2011	10	X	X	X	X	4
Jul 2011	3	X	X	X	1	7
Aug 2011	8	X	X	X	X	1
TOTAL PRE-BAN	87	43	48	59	63	72
		178			135	
Sep 2011	8	X	3	X	X	3
Oct 2011	6	X	3	X	X	2
Nov 2011	X	X	X	X	X	1
Dec 2011	X	X	X	X	X	X
Jan 2012	8	X	6	X	8	4
Feb 2012	5	5	5	X	8	4
Mar 2012	6	6	5	X	7	4
Apr 2012	8	5	5	X	2	4
May 2012	8	5	4	X	3	4
Sep 2012	6	6	8	X	8	8
TOTAL POST-BAN	55	27	39	0	36	34
		121			70	