

# BRUINGO: AN EVALUATION

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## Abstract

In partnership, UCLA and the Santa Monica Municipal Bus Lines offer a transit-pass program that allows 62,700 UCLA students, staff, and faculty to ride any Blue Bus without paying a fare. We conducted an evaluation of the first year of BruinGO, and the results are summarized below.

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### EVALUATION FINDINGS

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Cost of Unlimited Access at UCLA	\$1.61 per person per month
Number of people eligible to ride free	62,700
Increase in faculty/staff daily bus ridership to campus	73 percent
Increase in student daily bus ridership to campus	51 percent
Reduction in faculty/staff daily vehicle trips to campus	6 percent
Reduction in student daily vehicle trips to campus	11 percent
Reduction in daily parking demand	1,380 spaces
Net benefits of Unlimited Access at UCLA	\$ 3.6 million per year
Benefit/cost ratio	5.4 to 1
<u>Reduction in average boarding time per passenger</u>	<u>26 percent</u>

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## **BRUINGO: AN EVALUATION**

In partnership, American universities and transit agencies have created a program that provides fare-free transit for more than a million people. Universities have given this program a variety of names—such as BruinGO, ClassPass, SuperTicket, and UPass. We refer to these programs collectively as Unlimited Access.<sup>1</sup> Unlimited Access programs give all students (and faculty and staff at some universities) the right to ride public transit without paying a fare. The transit agency accepts the university identification cards as public transit passes, and the university pays the transit agency for all university rides. For every student on any day, a bus ride to campus (or anywhere else) is free.

Unlimited Access is spreading rapidly among universities and transit agencies in the United States, but with almost no evaluation of program performance. This paper evaluates the performance of an Unlimited Access program, called BruinGO, at UCLA. The evaluation shows:

- The program served 62,700 people, at a cost of \$1.61 per person per month.
- Faculty and staff made 73 percent more daily bus trips and 6 percent fewer vehicle trips to campus after BruinGO began.
- Students made 51 percent more daily bus trips and 11 percent fewer vehicle trips to campus after BruinGO began.
- The demand for campus parking fell by 1,380 spaces on a typical weekday.
- Use of UCLA's ID as a transit pass reduced the average Blue Bus boarding time by 26 percent.
- The program's benefit/cost ratio is 5.4 to 1.

### **UCLA's BruinGO pilot program**

In September 2000, UCLA Transportation Services and the Santa Monica Municipal Bus Lines (the Blue Bus) launched BruinGO, an Unlimited Access program for UCLA students, staff, and faculty.<sup>2</sup> BruinGO allows UCLA riders to board any Blue Bus without paying a fare when they swipe their university ID card through an electronic card reader, and UCLA pays the Blue Bus 45¢ per ride. The cost of the eight-month pilot program was \$810,000 for 62,700 eligible UCLA riders (36,900 students + 26,800 staff and faculty), or \$1.61 per person per month.

Previous research found that universities and transit agencies create Unlimited Access programs to meet a variety of goals.<sup>3</sup> At UCLA, university officials see three goals as paramount: 1) increase bus ridership to campus, 2) reduce vehicle trips to campus, and 3) reduce parking demand on campus. We have examined UCLA's annual transportation surveys to learn whether BruinGO achieved these goals, and we have also explored how BruinGO affects traffic congestion, air quality, campus welfare, and transit service to campus.<sup>4</sup> In future years we will be able to track BruinGO ridership using the electronic swipe data recorded when UCLA riders board the bus, but these swipe data are not available for the years before BruinGO began.<sup>5</sup>

### **Did BruinGO increase bus ridership to campus?**

To determine whether BruinGO increased bus ridership to campus, we examined the student and faculty/staff transportation surveys UCLA conducted in spring 2000 (before BruinGO) and spring 2001 (with BruinGO). On a typical weekday, faculty and staff made 73 percent more bus trips to campus, and students made 51 percent more bus trips to campus after BruinGO began.

#### *Faculty/staff commuting to UCLA*

The South Coast Air Quality Management District (SCAQMD) requires regulated employers to conduct annual surveys of their employees' commuting behavior.<sup>6</sup> UCLA conducted its employee (faculty and staff) transportation surveys in April 2000 (before BruinGO began) and again in April 2001 (after BruinGO had operated for six months), and we can use the results of these surveys to examine BruinGO's effects on faculty/staff commuting behavior. Figure 1 shows the recent history of faculty/staff bus ridership to UCLA. UCLA's employee transportation surveys show that between 1995 and 2000 the bus share for faculty/staff commuting to campus declined in every year but one, and it fell from 9.2 percent in 1995 to 7.6 percent in 2000. The share of faculty and staff who commute by bus jumped from 7.6 percent in 2000 to 13.1 percent in 2001—a 73-percent increase in bus ridership in just one year.<sup>7</sup>

[Figure 1]

Transit ridership increased only slightly or remained the same at three other nearby universities (see Figure 2). This suggests that regional factors do not explain UCLA's large increase in faculty/staff bus ridership. The large increase in faculty/staff bus ridership to UCLA

during the pilot program is unprecedented, is not explained by trends, and did not occur elsewhere in the region. Therefore, we assume that BruinGO is responsible for the 73-percent increase in faculty/staff bus ridership to UCLA in 2001.<sup>8</sup>

[Figure 2]

How did BruinGO affect faculty/staff commuting to UCLA by other modes? The employee transportation surveys show that the solo-driver share for commuting fell from 60 percent in 2000 to 57 percent in 2001 (see Figure 3). The carpool share also declined but the vanpool and bicycle shares remained steady, and the walk share increased. The net result of these changes was a large shift from private vehicles to public transit for faculty/staff commuting to campus. A chi-square test of statistical significance finds that the probability of finding such large changes in mode shares by chance is approximately one in a million.<sup>9</sup>

[Figure 3]

UCLA Transportation Services initially feared that BruinGO would lure faculty and staff away from walking and cycling to campus, but the cycling share held steady and the walking share increased (see Figure 3). What explains the increase in walking? More than 1,600 students, staff, and faculty sent messages to UCLA Transportation Services to say how BruinGO changed their travel choices, and some people said that BruinGO encouraged them to walk on some days and ride the bus on others, or ride the bus to campus and walk home. For example, one faculty member wrote:

*Both my husband and I work on the UCLA campus. Although we have a parking permit, we 'walk and swipe' to work several times a week. While we have the parking space, we use it less because of the ability to use the bus.<sup>10</sup>*

Others said that they walked in good weather and rode the bus in bad weather, rather than buy a quarterly parking permit and drive every day. Although it may seem surprising, these comments suggest that access to fare-free transit service encouraged some faculty and staff to walk to work more often.

### *Student commuting to UCLA*

UCLA conducted student transportation surveys in May 2000 (before BruinGO began) and May 2001 (after BruinGO had operated for seven months). Figure 4 shows that the share of students who rode the bus to campus increased from 17 percent in 2000 to 26 percent in 2001, a

51-percent increase in bus ridership. The surveys also show that the solo-driver share for commuting fell from 36 percent in 2000 to 32 percent in 2001, an 11-percent decrease. The carpool and motorcycle share held steady, while the walking and bicycling shares declined (see Figure 4).

[Figure 4]

### **Did BruinGO reduce vehicle trips and parking demand?**

UCLA administrators hoped BruinGO would reduce vehicle trips to campus and thereby alleviate a perceived campus parking shortage. On a typical weekday, faculty and staff made 6 percent fewer vehicle trips to campus, students made 11 percent fewer vehicle trips to campus, and campus parking demand fell by 1,380 spaces after BruinGO began.

#### *Faculty/staff bus trips*

We can use UCLA's annual employee transportation surveys to calculate the number of bus trips to campus made by UCLA faculty/staff in 2000 (before BruinGO) and 2001 (with BruinGO). Table 1 shows that 21,419 faculty/staff arrived on campus between 6 am and 10 am on a typical weekday in 2001 (row 4). Thirteen percent of faculty and staff commuted to campus by bus in 2001, and 7.6 percent in 2000 (row 5). If faculty and staff travel behavior in 2001 had remained the same as in 2000, they would have made 1,625 trips (before BruinGO) by bus instead of 2,805 bus trips (with BruinGO). The difference between these two numbers is 1,180 bus trips.<sup>11</sup> This difference suggests that BruinGO increased faculty/staff bus ridership to campus by 1,180 rides—73 percent—on a typical weekday.<sup>12</sup>

[Table 1]

#### *Faculty/staff vehicle trips and parking demand*

We also used the survey data to estimate how BruinGO affected the number of faculty/staff vehicle trips to campus by calculating the Vehicle Trip Rate (VTR) for faculty and staff—the number of *vehicle* trips to work divided by the number of *person* trips to work (vehicles ÷ persons).<sup>13</sup> The VTR fell from 0.66 vehicle trips per commuter in 2000 to 0.62 vehicle trips per commuter in 2001—a 6-percent decline (see row 7 in Table 1). That is, 66

vehicles arrived for every 100 commuters in 2000, and only 62 vehicles arrived for every 100 commuters in 2001.

To determine BruinGO's effect on faculty/staff vehicle trips, we can compare the number of vehicle trips that the surveyed employees made in 2001 (with BruinGO) with the number of trips that these same employees would have made if their VTR had remained 0.66 (before BruinGO). UCLA faculty/staff made 13,359 vehicle trips per day in 2001 *with* BruinGO, and would have made 14,168 trips *without* BruinGO (row 8). The difference between these two numbers is 809 vehicle trips per day (row 8).<sup>14</sup> UCLA's transportation surveys therefore suggest that faculty/staff made 809 fewer vehicle trips per day between 6 a.m. and 10 a.m. with BruinGO. Because BruinGO likely reduced additional vehicle trips after 10 a.m., these data suggest that BruinGO reduced *at least* 809 faculty/staff vehicle trips to campus during an average day.

By reducing the number of faculty/staff vehicle trips to campus, BruinGO also reduced faculty and staff parking demand on campus. It is important to note, however, that BruinGO reduces the demand for campus parking by less than it reduces the number of vehicle trips to campus because some drivers do not remain on campus all day. If one driver leaves campus before another arrives, both can use the same parking space during the day. Because UCLA sells 1.35 parking permits per campus parking space, we will assume that the reduction in campus parking demand is only three-quarters of the reduction in vehicle trips to campus.<sup>15</sup> At this rate, the reduction of 809 faculty/staff vehicle trips will reduce parking demand by 599 spaces ( $809 \times 0.74 = 599$ ). These spaces are made available to other commuters and visitors.

### *Student bus trips*

The estimates presented above refer only to the vehicle trips and parking demand of UCLA *faculty and staff*. BruinGO also increased bus ridership and reduced vehicle trips and parking demand of *UCLA students*. We used the data collected in UCLA's annual student transportation surveys to estimate the increase in student bus ridership and reductions in student vehicle trips and student parking demand after BruinGO began. Table 2 shows that 25,741 off-campus students traveled to campus on a typical weekday in 2001 (row 4). Seventeen percent of these students commuted to campus by bus in 2000, and 26 percent in 2001 (row 5). If students' travel behavior in 2001 had remained the same as in 2000, they would have made 4,427 bus trips (before BruinGO) instead of 6,667 bus trips (with BruinGO). The difference between these two

numbers is 2,239 bus trips. This difference suggests that BruinGO increased student bus ridership to campus by 2,239 rides—51 percent—on a typical weekday.

[Table 2]

### *Student vehicle trips and parking demand*

To determine BruinGO's effects on student vehicle travel and student parking demand, we can compare the number of solo-driver trips that the surveyed students made in 2001 (with BruinGO) with the number of trips these same students would have made if their travel behavior had remained the same as in 2000 (before BruinGO). Thirty-six percent of students drove alone to campus in 2000, and only 32 percent in 2001 (row 7 in Table 2). UCLA students made 8,211 solo-driver trips per day *with* BruinGO, and would have made 9,267 trips *without* BruinGO (row 8). The difference between these two numbers is 1,055 solo driver trips—an 11-percent decrease.<sup>16</sup> Because students made 1,055 fewer solo-driver trips to campus on a typical weekday, their demand for parking fell by 781 spaces ( $1,055 \times 0.74 = 781$ ).<sup>17</sup> When the reduction in student parking demand is added to the reduction in faculty/staff parking demand, we find that the total demand for campus parking fell by 1,380 spaces.

UCLA's wait list for student parking permits also suggests that BruinGO reduced campus parking demand. Students who apply for but do not receive a parking permit are put on a wait list, and UCLA Transportation Services considers the wait list an indicator of the "unmet need" for campus parking.<sup>18</sup> BruinGO can reduce this unmet need in two ways: 1) the parking spaces made available by drivers who shift to public transit can be offered to students who are on the wait list, and 2) the fare-free transit service is a viable alternative to driving for some of those on the wait list for parking.

The wait list declined from 3,969 students in Fall Quarter 1999 (before BruinGO began) to 2,637 students in Fall Quarter 2000 (during BruinGO's first year). Therefore 1,332 students left the parking wait list after BruinGO began. This 34-percent reduction in the parking wait list is consistent with the large increase in bus ridership and large decrease in solo driving after BruinGO began. We would expect some students to shift from driving to the bus, because one-third of students who have parking permits live within five miles of campus.<sup>19</sup> We would also expect some students who are on the wait list to ride the bus because three-fourths of them live near campus.<sup>20</sup> Therefore, BruinGO is a viable alternative to driving for many students who

already have a parking permit and also for many students who are waiting for a permit. There were 2.1 student solo-driver trips to campus for every student bus trip in Spring Quarter 2000 (before BruinGO began) but this ratio had fallen to 1.2 solo-driver trips for every bus trip in Spring Quarter 2001 (during BruinGO's first year, see rows 6 and 8 in Table 2).

### **Are these changes surprising?**

Faculty/staff bus ridership to campus increased by 73 percent during BruinGO's first year, and student ridership increased by 51 percent. These large increases in transit ridership are not surprising, because other universities experienced similar ridership increases when they initiated similar fare-free programs.<sup>21</sup> For example, transit ridership to UC Davis increased by 79 percent in the first year of its program. The large increase in transit ridership to UCLA is also in line with predictions made using fare-elasticity formulas. The fare-elasticity of transit demand implicit in the ridership response at UCLA is  $-0.36$  for faculty/staff, and  $-0.25$  for students, both of which are in the commonly-estimated range of fare elasticities (see Tables 1 and 2).<sup>22</sup>

Faculty/staff vehicle travel to campus decreased by 6 percent during BruinGO's first year, and student vehicle travel to campus decreased by 11 percent. We can use these data to calculate the cross-elasticity between the fare for public transit and the number of private vehicle trips to campus. This cross-elasticity is  $+0.03$  for faculty/staff and  $+0.06$  for students.<sup>23</sup> These cross-elasticities may seem low, but they lead to large absolute changes in the number of vehicle trips because both the fare change and the initial number of vehicle trips are very large. Reducing the transit fare to zero reduced faculty/staff vehicle trips to campus by 809 per day, and reduced student vehicle trips to campus by 1,055 per day.

### **How much did BruinGO cost?**

BruinGO is free to students, staff, and faculty, but it is not free to UCLA. The Blue Bus billed UCLA 45¢ for each BruinGO ride, so UCLA's cost for the 1.4 million rides taken during the pilot program was \$640,000. UCLA Transportation Services also spent \$170,000 to administer the program, so the university's total cost was \$810,000. UCLA Transportation Services had forecast that it would cost between \$1.42 and \$1.6 million to provide BruinGO for students, staff, and faculty during 2000–2001. Therefore, BruinGO's actual cost turned out to be 43 percent below the lower end of the forecast range—a rare event in transportation planning.

## Who paid for BruinGO?

BruinGO is funded entirely from campus parking revenue, which is derived from both daily parking fees and the sale of monthly parking permits. UCLA charges \$2 per hour or \$6 per day for visitor parking, and only \$54 per month for most student, staff, and faculty parking permits. Of the total parking revenue, students pay 17 percent, faculty and staff pay 25 percent, UCLA departments pay 4 percent (for university guests), and campus visitors pay 54 percent.<sup>24</sup> We therefore multiply these percentages times BruinGO's \$810,000 annual cost to allocate this cost to those who paid it. Students paid \$137,000, faculty and staff paid \$206,000, UCLA departments paid \$28,000, and campus visitors paid \$439,000 (which is reported as a non-UCLA cost). The top panel of Table 3 shows the distribution of cost among these groups.

[Table 3]

## What are the benefits of BruinGO?

BruinGO provides a number of benefits, but some of them are hard to quantify. For example, BruinGO helps UCLA recruit and retain employees and students, and it enhances the educational experience of students by providing access to local educational and cultural sites. BruinGO does, however, provide four kinds of benefits to which we *can* assign monetary values: reduced fare payments for UCLA riders, reduced parking demand, reduced vehicle travel, and reduced vehicle emissions. Four groups receive these benefits: UCLA students, UCLA faculty and staff, UCLA departments, and members of the non-UCLA community. The center panel of Table 3 shows the distribution of benefits among these groups. These four categories of benefits are discussed in more detail in the next few pages.

### *Reduced fare payments*

A major benefit of BruinGO is that it saves money for students, staff, and faculty by providing fare-free rides. The program paid \$640,000 in transit fares for the 1.4 million Blue Bus rides taken by members of the university community. From the point of *financing* BruinGO, both the fare payments (\$640,000) and the administrative cost (\$170,000) are the same.: UCLA Transportation Services must cover both costs. From the point of *evaluating* BruinGO, these two costs are utterly different. The administrative costs represent a consumption of resources (mainly Transportation Services' staff time), while the fare payments represent an income transfer to

students, staff, and faculty. UCLA *pays* the Santa Monica Municipal Bus Lines for BruinGO, but UCLA students, staff, and faculty *receive* the money.

For those who were riding the bus before BruinGO began, the fare saving (45¢ a ride) is a pure income gain. For the new rides induced by BruinGO, the value to the riders is presumably less than 45¢ a ride because they were unwilling to pay the fare before the program began. The standard method of valuing the benefit to new riders in this situation is to attribute a value of one-half the fare (22.5 cents per ride) on

Who rides the Blue Bus?	
Students	73%
Faculty & staff	27%

the assumption that the demand curve for transit rides is linear. To be extremely conservative, we have valued *all* riders' income gain at only one-half the fare, or 22.5 cents per ride. This method produces an estimated income gain of \$320,000 for UCLA students, faculty, and staff (1.4 million rides x \$0.225 per ride). This subsidy directly increases the income of riders who would otherwise have paid for the rides, and students wrote many grateful messages to UCLA Transportation Services describing this benefit:

*I love the BruinGO program. I have like 700 bucks total... no kidding, and the BruinGO program is like my lifeline.*

*I save about \$10 weekly, getting back and forth from school. \$40 a month buys a lot of groceries.*

*I know \$1 a day doesn't seem like a lot, but being able to ride free means I can spend the \$25 I save per month on other things . . . like schoolbooks.*

As these comments indicate, many UCLA students, faculty and staff use the money they save for food, housing and other essential expenses. Fare-free transit is thus an important form of direct financial aid for students and a valuable tax-exempt fringe benefit for faculty and staff.

#### *Reduced campus parking demand*

BruinGO riders save money, but they are also led, as if by an invisible hand, to promote the university's goal: reduce parking demand. Paying the fare for a bus rider to campus costs far less than building a parking space on campus, so avoiding the expense of new parking spaces is one of BruinGO's major benefits. BruinGO allows UCLA to satisfy campus parking demand with a smaller parking supply.

We can value the benefit of reducing parking demand by comparing it with the cost of

increasing the parking supply. To estimate the cost of increasing the parking supply, we can examine the cost of a parking structure now being built at UCLA (see Table 4). The 1,500-space IM Field parking structure will cost \$47.3 million, or \$31,500 per space. Because UCLA is willing to pay \$31,500 per space to increase the parking supply, we can use this figure to represent the savings from reducing parking demand. BruinGO reduced the demand for parking by at least 1,380 spaces. At a capital cost of \$31,500 per space, this reduction in parking demand is worth \$43.4 million in avoided capital cost (1,380 spaces x \$31,500 per space).

[Table 4]

The debt service on the capital borrowed to finance the parking structure shows the annual equivalent of the one-time capital cost of a new parking space: \$2,414 per year. When the operating cost is added, the annual capital and operating cost per new parking space is \$2,673 per year (\$223 per month).<sup>25</sup> At this rate, the cost of 1,380 new parking spaces is \$3.7 million per year (1,380 spaces x \$2,673 per space). Because UCLA is willing to pay \$3.7 million per year for 1,380 new parking spaces, we assume that the value of reducing campus parking demand by 1,380 spaces is also \$3.7 million per year. And because UCLA increases campus parking fees to finance new campus parking spaces, we allocate the \$3.7 million avoided cost of new parking spaces to the sources of campus parking revenue. Students save \$623,000, faculty and staff save \$938,000, UCLA departments save \$129,000, and campus visitors save \$1,998,000.

Even those who pay for parking receive a net benefit because BruinGO avoids the high cost of increasing the parking supply. Because BruinGO costs only \$810,000 a year, the benefit/cost ratio for drivers who pay to park is 4.6 to 1. And because BruinGO is financed entirely by parking fees, drivers pay for bus riders, but both drivers and bus riders are better off (see Figure 5).

[Figure 5]

Parking permit holders also use BruinGO. UCLA Transportation Services surveyed a random sample of 2,473 parking permit holders during February 2002 to learn about their BruinGO use. The survey found that 9.6 percent of all parking permit holders used BruinGO for commuting to or from campus during the previous week, and they used BruinGO for an average of 4.0 one-way commute trips per week. Among permit holders who live within any zipcode served by the Blue Bus, 18.7 percent rode the bus to or from campus an average of 3.8 trips per

week.<sup>26</sup> If we assume that these permit holders would have driven to campus if BruinGO did not exist, we can estimate how BruinGO reduced parking demand by permit holders. Approximately 25,000 students, staff, and faculty have campus parking permits, so if 9.6 percent of them ride the Blue Bus to campus an average of two round trips per week, this would reduce vehicle trips to campus and parking on campus by 960 cars per day.<sup>27</sup> The spaces relinquished by these permit holders can be made available for daily sales to visitors (at \$6 per entry), so UCLA is paid twice for the same spaces—by permit holders and by visitors. BruinGO also reduces parking demand by those who choose not to buy a parking permit because of BruinGO, and by those without a permit who would pay for daily parking without BruinGO.

Many students, staff, and faculty members wrote to UCLA Transportation Services to report that BruinGO reduced their demand for parking:

*I LOVE the BruinGO system. I gave up my parking permit because of it.*

*Because of BruinGO, I have mothballed my car and take the bus to school every day, so BruinGO has been a tremendous benefit to me (and has stopped me from applying for a parking permit).*

*I never plan to apply for a parking permit again.*

By reducing the demand for parking, UCLA avoids the high cost of building new parking structures on campus, keeps the cost of parking affordable for those who must commute to campus by car, and can use the land that might have been devoted to new parking spaces for other university facilities—or as open space. Beyond avoiding the high cost of new construction, BruinGO makes more parking available for campus visitors at a lower price. This allows the university to welcome more people to its museums, libraries, concerts, lectures, plays, conferences, and athletic events. BruinGO also helps counter the image of UCLA as an ivory tower with parking as its moat.

### *Reduced vehicle travel*

When compared with building new parking spaces, BruinGO reduces vehicle trips. During its first year, BruinGO eliminated 615,000 vehicle trips to campus by students, staff, and faculty.<sup>28</sup> The 2001 UCLA Student Transportation Survey reports that the average travel distance for students who arrived by the Blue Bus is approximately 3 miles.<sup>29</sup> If this is also the

average commute distance for those motorists who ceased making vehicle trips, BruinGO reduced vehicle travel to and from campus by 1.8 million VMT.

Vehicle travel to and from UCLA increases traffic congestion. Several transportation analysts have estimated the cost of delay imposed by added vehicle travel in Los Angeles, and they report that this cost ranges from 10¢ to 37¢ per VMT.<sup>30</sup> If we value the congestion-relief benefits of the avoided 1.8 million VMT at 10¢ per VMT (the low end of the estimates), the reduced traffic congestion associated with BruinGO is worth \$185,000. These benefits accrue to motorists along all routes to UCLA, including those who are not traveling to and from the university. For simplicity’s sake, we allocate this benefit to the non-UCLA community. Nevertheless, many students wrote that they valued this reduction in vehicle travel:

*It’s about time that LA and its universities started taking some responsibility for the horrendous traffic problems.*

*My car now sits in my driveway for weeks on end because I don’t need to use it.*

By reducing vehicle travel to and from UCLA, BruinGO reduces traffic congestion on local streets and highways, reduces the pressure on local officials to add expensive new capacity to these roads, and improves relations between the university and nearby residents concerned about traffic congestion on streets in their neighborhoods.

*Reduced vehicle emissions*

Reduced vehicle travel leads to reduced vehicle emissions. We found that, compared with adding parking spaces, BruinGO reduced vehicle emissions by 1 ton of particulate matter (PM<sub>10</sub>), 2 tons of nitrous oxide (NO<sub>x</sub>), 2 tons of reactive organic gases (ROG), 22 tons of carbon monoxide (CO), and 1,200 tons of carbon

Vehicle emissions	
1	Fewer ton of PM <sub>10</sub>
2	Fewer tons of NO <sub>x</sub>
2	Fewer tons of ROG
22	Fewer tons of CO
1,200	Fewer tons of CO <sub>2</sub>

dioxide (CO<sub>2</sub>) during its first year.<sup>31</sup> We estimated that the emissions reductions associated with BruinGO are worth \$274,000 when they are valued at the prices paid in California’s emissions trading market.<sup>32</sup> Because this benefit accrues to everyone who lives in Southern California, we allocate this benefit to the non-UCLA community—although members of the campus community also benefit from improved air quality. Many students said they placed a high value on the

environmental benefits of BruinGO:

*Students contribute to a healthier Los Angeles and we aid the community around us with this simple innovation that reduces pollution.*

*BruinGO helps me not waste natural resources by driving to campus, which I feel good about.*

### Comparing the benefits and costs of BruinGO

We can now compare the estimated benefits and costs. Figure 6 shows that the benefits are \$4.3 million a year, and costs are \$810,000 a year. The net benefits of BruinGO are thus \$3.5 million a year. Even with the conservative assumptions made throughout the evaluation, the benefit/cost ratio is 5.4 to 1.

Conservative Assumptions	
\$0.23	Riders' fare savings per bus ride
\$0.10	Congestion reduction benefit per VMT
3	Vehicle miles of travel per one-way trip
0.74	Reduction in parking demand per reduced vehicle trip

[Figure 6]

BruinGO's benefit/cost ratio also exceeds 1.0 for every subgroup considered (see Figure 7). The students' exceptionally high benefit/cost ratio of 6.3 to 1 helps explain the many enthusiastic comments that students have sent to UCLA Transportation Services about BruinGO:

*BruinGO is one of the smartest things UCLA has done in years. With this program, I feel UCLA is finally showing it cares for students.*

*I am a first year graduate student and I do not have the words to adequately describe how wonderful it is to have a free transportation system available to me.*

*BruinGO makes me feel proud to be a Bruin.*

[Figure 7]

### Reducing parking demand versus increasing parking supply

Although BruinGO provides many benefits to UCLA, suppose its only purpose were to reduce parking demand. Given this narrow parking-centered rather than university-centered conception of BruinGO's purpose, how much did it cost per space to reduce parking demand? BruinGO cost \$810,000 for nine months (\$90,000 per month), and it reduced daily parking demand by at least 1,380 spaces. Therefore, BruinGO cost \$65 per month to reduce parking

demand by one space ( $\$90,000 \div 1,380$  spaces). Even when we disregard BruinGO's other benefits, BruinGO's cost to reduce parking demand by one space is only 29 percent of the annualized cost of building one new parking space in the IM Field parking structure ( $\$223$  per space per month).

We can also ask how much BruinGO would have to reduce parking demand for UCLA to recover its cost. Suppose that BruinGO costs  $\$1,000,000$  a year, and that each new parking space costs  $\$2,673$  a year (the cost for the IM Field parking structure). At this cost for parking, BruinGO pays for itself if it reduces parking demand by 374 spaces ( $\$1,000,000 \div \$2,673$ ).<sup>33</sup> Similarly, if BruinGO costs  $\$2,000,000$  a year, it pays for itself if it reduces parking demand by 748 spaces, and so on.

One reason for BruinGO's low cost in comparison with a new parking structure is that UCLA pays for BruinGO only when riders use it. Ridership falls sharply at night, on weekends, and during holidays and vacations, so UCLA pays almost nothing then. In contrast, UCLA pays for parking structures 24 hours a day, 365 days a year, even when they are not used. A parking structure is totally filled for only a few hours each weekday, and the high cost of substantial unused off-peak capacity drives up the average cost per user.

Beyond reducing the demand for parking, BruinGO provides other important benefits. The environmental impact report for the IM Field parking structure provides the data needed to compare BruinGO with building new parking spaces as a campus transportation strategy (see Table 5). BruinGO produces substantial transportation and air quality benefits while new parking spaces degrade the environment.<sup>34</sup>

[Table 5]

Because the parking supply is fixed in the short run, the parking spaces freed by BruinGO are released to provide additional permits for students or daily sales to visitors. And because there is currently an excess demand for both student permits and daily sales, BruinGO does not in the short run reduce vehicle trips to campus. If the parking spaces vacated by permit holders are made available for daily sales, the number of vehicle trips can even increase in the short run because the turnover rate is higher for daily-sale spaces than for permit spaces. Our estimates of BruinGO's transportation and air quality benefits thus refer to the *long run* effects when BruinGO substitutes for increasing the parking supply. In the *short run*, the main effects will be

to reduce the “unmet need” for campus parking, to increase the mobility of students without cars, and to provide additional cash income for students, staff, and faculty who ride public transit.

### **Providing increased income for students, staff, and faculty**

UCLA pays the Blue Bus 45¢ for each BruinGO ride, but all the money goes directly to UCLA students, staff, and faculty. That is, UCLA riders do not reach into their own pockets to pay the fare when they board the bus, but into the UCLA Transportation Services’ pocket. Most of UCLA’s spending for BruinGO thus becomes direct financial aid for students or a tax-exempt fringe benefit for staff and faculty. From a parking-centered view of BruinGO, this spending is money down the drain (because in this view BruinGO’s only purpose is to reduce parking demand). From the university-centered point of view, however, the spending for bus fares becomes additional income for students, staff, and faculty. A survey of student BruinGO riders found that 76 percent of them received financial aid from the university, so their fare subsidy can be considered as an addition to their financial aid packages.

This university-centered point of view is *crucial* in understanding BruinGO’s benefits to UCLA. To show why this is the case, these two policy options: (1) continue BruinGO, which reduces parking demand by 1,380 spaces, or (2) discontinue BruinGO, and instead build 1,380 new parking spaces. First consider BruinGO. UCLA’s spending of \$810,000 a year to pay for BruinGO saves money for members of the UCLA community who ride the bus to campus every day, and who would otherwise have to pay their own bus fares. BruinGO increases the disposable income for these transit riders, and their shifts from driving to public transit make 1,380 additional parking spaces available to commuters and campus visitors.

Next consider building 1,380 new parking spaces. At an annual cost of \$2,671 per space per year (the cost per space in the IM Field Parking structure now under construction), the 1,380 new parking spaces will cost UCLA \$3.7 million every year. Beyond costing almost five times more than BruinGO to provide the same number of parking spaces, a new parking structure provides no benefits beyond the parking spaces themselves—*while BruinGO also provides added income for students, staff, and faculty.*

BruinGO saves some UCLA riders far more than their transit fares. A survey of BruinGO riders found that 56 percent of them own a car. When asked why they did not drive to campus, most of them said that they did not receive a parking permit or that a permit costs too much, but

several volunteered that their spouses had the family car. One said, “BruinGO is our second car.” If BruinGO convinces a family that they can live with only one car, the money saved by forgoing a second car can amount to several thousand dollars a year.

### **Reducing the Blue Bus boarding times**

UCLA riders swipe their ID cards through an electronic fare card reader when boarding the bus, and Blue Bus drivers report that swiping the ID cards is faster than paying by coins or using the operator’s own electronic fare card. To test how BruinGO affects boarding times, we observed Blue Bus boardings outbound from UCLA at the corner of Hilgard Avenue and Westholme Avenue in August and September 2001 *without* BruinGO (before its second year of operation began) and again in October 2001 *with* BruinGO (during its second year of operation). The total boarding time and the number of boarding passengers were recorded for each Blue Bus that arrived at UCLA.<sup>35</sup> Dividing the total boarding time by the number of boardings gives the average boarding time per passenger.

Figure 8 shows a plot of the total boarding time as a function of the number of boarding passengers. Linear regression equations are estimated for the data *with* BruinGO and *without* BruinGO, and fitted curves are added.<sup>36</sup> The *average* boarding time per passenger decreased from 3.7 seconds without BruinGO to 2.7 seconds with BruinGO (see Table 6). The average boarding time per passenger thus fell by 1 second per passenger, or 26 percent.<sup>37</sup> A statistical test of the sample means shows that there is less than a 0.0001 probability that this large a reduction in average boarding time would occur by chance.<sup>38</sup>

[Figure 8]

[Table 6]

We can convert this reduction in boarding time into a time savings for the Blue Bus. If each BruinGO boarding saves one second of boarding time, then the 1.5 million BruinGO rides save 417 vehicle operating hours for the Blue Bus (1.5 million seconds ÷ 3,600 seconds per hour). Because BruinGO also significantly increased the number of Blue Bus boardings the net effect on total boarding time is uncertain. Therefore, we have not attempted to calculate a monetary value for the reduction in average boarding time per passenger.

The added demand created by new UCLA riders has also allowed the Blue Bus to add service. On Line 12, the Blue Bus added 13 new scheduled bus runs per weekday—an 11

percent increase in service. The new service means there are more buses on the streets and more frequent service for all riders.

**Comparing BruinGO with other campus transportation programs**

To put BruinGO’s cost in perspective, we can compare it with the cost of five other UCLA commuter transportation programs: the on-campus shuttle service, the vanpool program, the IM Field parking structure, and two shuttle services to off-campus housing.

- 1) UCLA’s cost to provide BruinGO is 45¢ per boarding, so the subsidy for a student, staff, or faculty member who commutes to campus 22 days a month is \$20 a month ( $0.45 \times 2 \times 22$ ).
- 2) UCLA provides an on-campus shuttle service to transport commuters from their parking spaces to their destinations on campus, and also for other trips around campus. The cost of the Campus Express is \$1.41 per boarding, so the subsidy for someone who parks on campus 22 days a month and then takes the shuttle to and from the final destination is \$62 a month.
- 3) UCLA provides a vanpool program for commuters, and the subsidy per rider is \$65 a month.
- 4) UCLA’s cost for the new IM Field parking structure will be \$223 per space per month (see Table 4), and the price of a Yellow permit to park in it will be \$54 per month. The subsidy for a solo driver who commutes to campus 22 days a month and parks in the IM Field structure will therefore be \$169 a month ( $223 - 54$ ).
- 5) UCLA provides a free shuttle service to off-campus housing for graduate students, and the cost is \$4.38 per boarding, so the subsidy for a student who commutes to campus 22 days a month is \$193 a month.
- 6) UCLA provides a free shuttle service to the off-campus faculty housing in Beverly Glen, and the cost is \$8.95 per boarding, so the subsidy for a faculty member who commutes to campus 22 days a month is \$394 a month.

[Figure 9]

UCLA’s cost for BruinGO is much lower than its cost for other campus transportation programs in part because the government subsidizes

	Annual ridership	Annual cost
BruinGO	1.4 million	\$810,000
Campus Express	1.3 million	\$1.9 million

public transit service. BruinGO carries 1.4 million riders at a cost to UCLA of \$810,000 while the Campus Express carries 1.3 million riders at a cost to UCLA of \$1.9 million. BruinGO

therefore carries 6 percent more riders than the Campus Express, but at 57 percent lower cost. Government subsidies help explain why the cost of a public transit trip all the way from home to campus (45 cents) is only a third of UCLA's cost for a short shuttle trip on campus (\$1.41). The Campus Express often runs empty during vacations, and this also helps explain its higher cost. UCLA pays to operate the Campus Express whether people ride it or not, and also pays for parking structures that are empty at night and on vacations, but it pays for BruinGO only when students, staff, and faculty ride the Blue Bus. UCLA also cancels BruinGO during the summer when there is no shortage of campus parking, and this further reduces BruinGO's cost.

Finally, we can compare the cost of BruinGO with the cost of a buspool program (really a vanpool program in university-owned buses) that UCLA Transportation Services operated for commuters from Fall 1989 through June 1993. In 1992-1993 the program carried 381 commuters per day, and UCLA provided a total subsidy of \$765,100 per year. UCLA's average subsidy was therefore \$167 per commuter per month. BruinGO carries over ten times more commuters than the Transportation Service's buspool program, but at only a slightly higher total cost. In comparison with other campus transportation programs, BruinGO is a spectacular bargain for UCLA.

### **BruinGO serves many non-commute trips**

UCLA riders also use BruinGO for many non-commute trips. For example, UCLA faculty and staff ride the Blue Bus to on-campus and off-campus worksites, saving both their own and the university's time. This option is especially valuable for vanpool commuters who do not have a car available to them during the day. The following comments by staff and faculty suggest that BruinGO serves many UCLA business trips:

*BruinGO is great for trips back and forth between Santa Monica--UCLA Medical Center and Westwood, especially since parking is such a problem at Santa Monica Hospital.*

*My job requires a lot of travel around campus and Westwood in general. Since the BruinGO program started, my job has been made easier.*

*BruinGO has become a great way for our desktop computer support department to travel between the locations to make repairs.*

*When I travel between offices, taking the Blue Bus for free saves my time and*

*UCLA's time.*

*I use the Big Blue Bus for meetings in the Wilshire Center at least 3 days a week. BruinGO saves a lot of time since I don't have to find parking and also saves UCLA money because I don't need validation. Not to mention the Wilshire traffic!!*

Students also use BruinGO for many non-commute trips. Students report that they ride free to the Getty Center, their internships, volunteer work, the beach, or anywhere else they want to go. Whole classes take the bus to museums or public meetings. The following comments suggest that BruinGO gives students access to many valuable social, educational, and job opportunities in Los Angeles:

*BruinGO is especially helpful when professors require students to go to museums or other cultural institutions. I use the bus to visit the Getty.*

*I have visited more places in Los Angeles since the start of BruinGO, especially the Getty Museum, where I do research.*

*I took the Blue Bus to a concert of Middle Eastern music in Santa Monica, a concert I probably wouldn't have attended if I had to worry about driving there and finding a place to park.*

*I am more likely to attend cultural events, concerts, and club meetings since I know that transportation will be so easy. BruinGO allows me to get much more out of my education besides simply taking classes.*

*BruinGO gives me a wider variety of work/internship opportunities since I don't need to figure the cost of taking the bus from school to a job and back again.*

*I feel like the whole city is laid out before me. I use my Bruin Card to go to my internship at Loyola Marymount University.*

*I have started volunteering on the weekends at the UCLA hospital because I don't have to worry about parking or getting a ride to school.*

*As a teaching assistant, I believe that expanding learning outside the classroom (to museums) has always been a worthwhile experience. One difficulty is convincing my students to get there. Another is justifying the extra financial cost to students. Now, with BruinGO, it is a great deal easier for students to expand their horizons beyond campus and Westwood.*

*As an international student at UCLA, I have found it extremely reassuring and welcoming to be able to negotiate the landscape of Los Angeles with the help of*

*BruinGO. I arrived in LA without a car, and BruinGO facilitated the process of getting to know the city and the UCLA campus.*

These comments by students, staff, and faculty show that BruinGO does much more than reduce parking demand. Our evaluation has focused on assessing the benefit of reduced parking demand because this is the primary goal of UCLA Transportation Services, and because the data allow us to measure this benefit. The measured benefit of reduced parking demand is by itself far more than enough to justify the cost of BruinGO, so the additional unmeasured benefits enjoyed by students, staff, and faculty simply provide further evidence that BruinGO's benefits greatly exceed its cost.

## **Conclusion**

The BruinGO pilot program shows that offering free public transit to students, faculty, and staff at UCLA is much cheaper than increasing the parking supply as a way to satisfy parking demand. BruinGO also reduces traffic congestion and vehicle emissions, and it serves many non-commute trips. BruinGO also provides added income for students, staff, and faculty who would otherwise pay their own transit fares. *BruinGO is therefore a successful transportation policy, a creative financial aid program for students, and a new fringe benefit for employees.*

## **Appendix: Predicting BruinGO's ridership and cost**

Until a university offers an Unlimited Access program, most people do not understand how it will work, and predicting both the ridership and the cost is therefore difficult. We can show this difficulty by comparing the predictions made for BruinGO with the results observed in 2000-2001 (see Table 7).

(Table 7)

In 1998, UCLA hired a consultant to predict the ridership and cost of providing a transit-pass program for faculty and staff. The consultant predicted that fare-free transit for faculty and staff would cost \$170,000 per month (exclusive of administrative costs), but in reality BruinGO's cost for faculty and staff amounted to only \$19,200 per month in 2000-2001, or 11 percent of the predicted cost (row 1).<sup>39</sup> The consultant also predicted that fare-free transit would attract only 315 new transit commuters, but in reality BruinGO attracted 1,180 new faculty/staff transit commuters, or 375 percent of the predicted ridership (row 2).<sup>40</sup>

Why did the consultant overestimate BruinGO's cost? One reason is that UCLA is undercharged for BruinGO, because many riders report the bus drivers sometimes allow UCLA riders to board without swiping their BruinCards. A more accurate record of the boardings would therefore increase UCLA's cost for BruinGO. The main reason, however, seems to be a misunderstanding of how a university transit-pass program works, and it will be useful to explain why BruinGO is far cheaper than predicted. The consultant assumed that UCLA would buy a regular transit pass (at a cost of \$42 per month) for every employee who does not have a UCLA parking permit. The consultant also assumed that most employees who receive these transit passes would not use them. This misunderstanding helps to explain why the consultant overestimated BruinGO's actual cost by 885 percent. BruinGO offers free transit only to Blue Bus riders, while the consultant estimated the cost of transit passes for all bus lines to campus, and this also helps to explain the cost overestimate, but the Blue Bus carries most of the transit riders to UCLA, and extending it to the other lines would not greatly increase the cost. BruinGO offers free transit to *all* of UCLA's 31,000 employees, not merely to those without a parking permit, so it is far more generous to faculty and staff than what the consultant proposed.<sup>41</sup>

Why did the consultant underestimate BruinGO's ridership? The consultant assumed that

the fare elasticity of demand for transit ridership would be only  $-0.18$ , which is extremely low. In reality, the fare elasticity for faculty and staff turned out to be  $-0.36$ , twice as high.<sup>42</sup> The consultant also used the *point* elasticity rather than the *arc* elasticity that economists recommend for predicting the effects of large fare changes (in this case a 100-percent reduction); this arithmetic error reduced the predicted ridership by another 50 percent.<sup>43</sup>

These difficulties in predicting the effects of BruinGO show the value of UCLA's decision to offer a pilot program. UCLA, the Big Blue Bus, and the riders themselves could not fully understand how a transit-pass program works without an actual trial run. BruinGO's high ridership and low cost are a welcome departure from many transportation investments that attract fewer riders and cost more than what the consultants predicted.

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## Endnotes

1. University officials report that Unlimited Access reduces the demand for parking, increases students' access to housing and employment, helps universities recruit and retain students, reduces the cost of attending college, and increases transportation equity. Transit agency officials report that Unlimited Access increases transit ridership, provides guaranteed revenue, and improves overall transit service. See Brown, Hess, and Shoup (2001) for a survey of thirty-five Unlimited Access programs.

2. The original pilot program operated from September 2000 until June 2001, but UCLA and the Blue Bus are again offering BruinGO during the 2001-2002 school year.

3. Brown, Hess, and Shoup (2001) discuss the various rationales for offering Unlimited Access.

4. Data used for this evaluation are taken from the Employee Commute Reduction Program Plans that UCLA submitted to the South Coast Air Quality Management District (SCAQMD) in 2000 and 2001 and the Student Transportation Surveys conducted by UCLA Transportation Services in 2000 and 2001.

5. The transportation survey data and swipe data are not directly comparable. The transportation survey data include all transit riders, not just those students, staff, and faculty who ride the Blue Bus. Thus, the transit ridership numbers reported in the surveys are larger than the number of swipes recorded from BruinGO. Many BruinGO riders also report that bus drivers often allow them to board the bus simply by showing their BruinCard identification *without* swiping it through the card reader, and the authors have personally experienced this with surprising frequency. The BruinGO swipe data therefore underreport UCLA's Blue Bus ridership, and also cause the Blue Bus to undercharge UCLA for BruinGO rides.

6. The SCAQMD requires employers to survey employees during the four-hour peak-arrival period of 6 a.m. to 10 a.m. from Monday to Friday. UCLA had 27,644 employees who reported to work between 6 a.m. and 10 a.m. in 2001, and 77 percent of them, or 21,419 employees, commuted to campus on an average day (Table 1, rows 3, 4 and 5). UCLA surveyed randomly selected samples of 3,051 employees in 2000 and 2,078 employees in 2001. The survey response rate was 93 percent in both years.

7. The share of UCLA employees who commute by public transit went from 7.6 percent in 2000 to 13.1 percent in 2001, a 5.5 percentage-point increase. Table 1 reports that 21,419 commuters arrive on campus between 6 a.m. and 10 a.m. on an average day. We estimated the number of daily transit trips by multiplying the number of commuters who arrive on campus

between 6 a.m. and 10 a.m. on an average day by the transit mode shares for 2000 and 2001. We found that the number of daily transit trips increased from 1,625 before BruinGO (2000) to 2,805 with BruinGO (2001), an increase of 1,180 daily transit trips. This is a 73 percent increase in transit ridership in one year. Campus parking fees increased by 11 percent in July 2000, and this may have contributed to the increase in transit ridership to campus in 2001. But the prices for the three classes of campus parking permits increased by between 22 and 66 percent in 1991, while transit ridership fell by 1 percent the following year. And the prices for the three classes of permits increased by 10 percent in 1995, while transit ridership fell by 7 percent in the next year. Therefore, the 11-percent increase in parking fees in 2000 is unlikely to have explained the 73-percent increase in transit ridership in 2001.

8. Similar mode shifts have occurred when other universities instituted a transit pass program for its staff and faculty. For example, the University of California, Santa Barbara offered a pilot transit-pass program for its faculty and staff during Summer 2001, and transit ridership increased 66 percent (Wagner 2001). The University of Colorado-Boulder instituted a transit-pass program for its faculty and staff in 1998, and by 2001 the faculty/staff transit ridership had increased by 87 percent, and their parking demand on campus had declined by 12 percent. Information on UC-Boulder's transit-pass program is available at <http://ucbparking.colorado.edu/FacultyStaff/Default.asp>.

9. Statistical tests of significance of the changes in the individual mode shares show that the change in drive-alone mode share is significant at the 94% confidence level, the change in carpool/vanpool mode share is significant at the 97% confidence level, the change in transit mode share is significant at the 99.9% confidence level, and the changes in walk and bicycle mode shares are not statistically significant.

10. This quote and those throughout the remainder of the paper were e-mailed by UCLA students, faculty, and staff to UCLA Transportation Services in response to an e-mail questionnaire about BruinGO. A summary of the e-mail messages is available on-line at [http://www.spsr.ucla.edu/res\\_ctrs/its/bruingo.pdf](http://www.spsr.ucla.edu/res_ctrs/its/bruingo.pdf).

11. Total transit ridership to campus is greater than Blue Bus ridership because other transit lines also serve UCLA. Because a majority of transit riders use the Blue Bus and there were no significant service or fare changes for the other transit lines, we assume that BruinGO accounts for the increase in total transit ridership to UCLA after the program began.

12. Because BruinGO likely increased additional bus trips after 10 a.m., our estimate is a conservative one.

13. The employers use the results of the annual SCAQMD surveys to calculate their employees' Average Vehicle Ridership (AVR) for travel to work. The AVR is the number of *persons* who commute to work divided by the number of *vehicles* they drive (persons ÷ vehicles). To estimate the total number of vehicle trips, each solo driver is counted as one vehicle trip, each person in a two-person carpool as one-half of a vehicle trip, each person in a three-person carpool

as one-third of a vehicle trip, and so on. No vehicle trips are attributed to transit riders, cyclists, or pedestrians. A higher AVR thus indicates more people per car for the journey to work. UCLA's AVR increased from 1.51 persons per vehicle in 2000 to 1.60 persons per vehicle in 2001 (see Row 1 in Table 1). That is, 151 commuters arrived on campus for every 100 vehicles in 2000, and 160 commuters arrived on campus for every 100 vehicles in 2001. The vehicle trip rate (VTR) is the inverse of the average vehicle ridership (AVR) calculated in the SCAQMD surveys.

14. The number of transit trips increased by 1,180 trips per day while the number of vehicle trips decreased by 809 trips per day. Most new faculty/staff bus riders attracted by BruinGO were former solo drivers, but some commuters switched from carpools and motorcycles to public transit, so the number of vehicle trips decreased by less than the number of bus trips increased. Walking increased, while the number of vanpoolers cyclists did not change (see Figure 3).

15.  $1 \div 1.35 = 0.74$ . UCLA sells 1.35 permits per parking space to take into account two factors: (1) on any given day, some permit holders do not drive to campus, and (2) some permit holders who do drive to campus are not present at the time of peak parking accumulation. Only this second factor (termed the *peak-parking factor*) should be used to convert the estimated reduction in vehicle trips per day to the reduction in parking demand. Because we have used UCLA's spaces-per-permit ratio of 1-to-1.35 (which takes into account both the non-attendance and the peak-parking factors) to represent the peak-parking factor alone, we have underestimated the reduction in parking demand associated with the reduction in vehicle trips to campus.

16. This contrasts with a nearly 51 percent increase in student bus trips. The increase in student bus trips is significantly larger than the decrease in solo driver trips, because many new bus riders were drawn from other modes of travel.

17. See footnote 15 for explanation.

18. UCLA spends \$223 per month to provide a parking space, and students pay \$48 per month for a parking permit. When parking is under-priced—as it is at UCLA—it is futile to try to provide a parking space for everyone who wants one. Between 1995 and 1998, UCLA spent \$44 million to build nearly 2,000 parking spaces. Student enrollment at UCLA increased 1.5 percent between 1995 and 1998, but the student wait list for parking increased 10 percent. To quote an English observer of the relationship between cars and parking, “the more parking spaces you provide, the more cars will come to fill them. It is like feeding pigeons.”

19. See Alegre and Carlson (1998, Table B-2).

20. See Sundstrom and Associates (1999). The student survey (which was conducted before BruinGO began) found that “About one-quarter of students on the waiting list report a residential zip code outside the area considered reasonable for use of alternative [to solo driving] modes of transportation” (Page ii). Therefore, three-fourths of students on the waiting list lived in the area considered reasonable for use of alternative modes. Among students on the wait list that did not

drive to campus, nearly half walked to campus, and slightly more than one-quarter rode the bus (Page ii). A surprising 11 percent of students on the wait list already had a permit or had refused the permit they had been offered. These findings cast serious doubt on the wait list as an indicator of the “need” for more parking spaces on campus.

21. Table 3 in Brown, Hess, and Shoup (2001) shows the ridership increases at universities that calculated the ridership before their programs began.

22. When fare changes are large, as with BruinGO, the preferred measure of elasticity of demand is the logarithmic arc elasticity. But the logarithmic arc elasticity is undefined when the fare is reduced to zero. Therefore, the fare elasticities for BruinGO are calculated as the linear arc elasticity, or “midpoint” elasticity, which approximates the average elasticity between two points along a demand curve. To calculate the midpoint elasticity, the percent change in fare is defined as the absolute change in fare divided by the average of the two fares between which elasticity is measured. Similarly, the percent change in ridership is defined as the absolute change in ridership divided by the average of the two riderships between which elasticity is measured. See Samuelson and Nordhaus (1989, 425) for an explanation of the midpoint formula.

23. The cross-elasticity is the percent change in private vehicle trips divided by the percent change in transit fare, again calculated as the arc elasticity.

24. UCLA Transportation Services provided the data on the shares of total permit revenue paid by faculty, staff, and students, and on the shares of total daily sales revenue paid by faculty, staff, students, university departments, and visitors. Many campus visitors attend athletic events, concerts, lectures, theatrical performances, and other events on campus. Because they pay for parking by the hour or day, visitors account for a disproportionate share of total parking revenue.

25. This high cost is not unique to UCLA. The Parking and Transit Services department at the University of Colorado–Boulder reports that the estimated debt service for a new parking structure on campus is \$227 per month for each parking space added by the structure.

26. UCLA Transportation Services (2002).

27.  $25,000 \times 9.6\% \times 2/5 = 960$ .

28. We calculated this number using the daily reduction in vehicle round trips and the number of weekdays during which BruinGO operated. BruinGO operated during 33 weeks of the academic year, or 165 weekdays. Based on a daily reduction of 1,865 vehicle round trips to campus, we calculated a reduction of 615,000 vehicle trips to campus over the duration of the pilot program (1,865 daily round trips x 2 trips per day x 165 weekdays).

29. The EIR for the IM Field parking structure reports that commuters drive an average 8.8 miles per one-way trip to campus. To be conservative, we use the number reported in the student survey in this paper.

30. After an extensive literature survey, Small (1992) concluded that a peak-period charge of 15¢ per VMT (in 1990 dollars) would be appropriate on congested freeways in Los Angeles. DeCorla-Souza and Kane (1991) estimated that the cost of adding new highway capacity to serve peak users in Los Angeles is 20¢ per peak-hour VMT. Cameron (1991) estimated that the cost ranges from 10¢ to 37¢ per VMT. Cameron (1991) also estimated that a peak-period congestion toll of 15¢ per VMT would be needed to raise average speeds to 35-40 miles per hour on Los Angeles freeways. Because traffic congestion is even worse without a toll, the congestion-related external costs of vehicle use are presumably higher than 15¢ per VMT.

31. The California Air Resources Board (2001b) has estimated the CO, NO<sub>x</sub>, PM<sub>10</sub>, and ROG emissions reductions produced by each motor vehicle trip for use in air quality forecasting models. We multiplied these values by our estimate of the reductions in vehicle trips (267,100) and VMT (2,350,000) to determine the emissions reductions reported in the text.

<u>Emissions</u>	<u>Average Auto Emissions</u>
CO	10.9 grams per VMT
NO <sub>x</sub>	1.14 grams per VMT
PM <sub>10</sub>	0.04 grams per VMT
ROG	1.05 grams per VMT

Source: California Air Resources Board (2001b).

To calculate the reduction in CO<sub>2</sub> emissions, we multiply the reduction in fuel consumption (1.8 million VMT ÷ 24.5 miles per gallon average fleet fuel economy = 75,000 gallons of gasoline) by the US Department of Energy's (1994) estimate that each gallon of gasoline consumed by a motor vehicle produces 30.8 pounds of full-fuel-cycle CO<sub>2</sub> emissions (including emissions from extraction, refining, and transport of the fuel as well as combustion).

32. Regulated firms that create new sources of pollution can purchase offset emissions from existing sources to mitigate the emissions from their new sources. The prices that firms are willing to pay in these transactions should reveal the firms' marginal cost of abatement for each pollutant. The California Air Resources Board (2001a) reported that the average transaction prices for the 336 offset purchases in 2000 were \$3.88 per pound of CO, \$9.68 per pound of NO<sub>x</sub>, \$8.53 per pound of PM<sub>10</sub>, and \$3.28 per pound of ROG. We valued CO<sub>2</sub> emissions reductions at \$25 per ton. This is a mid-range value for the marginal cost of greenhouse gas emission control measures, as reported by Bernow and Dougherty (1998).

33. There are also transfer costs and benefits associated with each strategy. Most of the cost of BruinGO is a transfer payment to students, staff, and faculty. UCLA also earns revenue from the new parking spaces, but this revenue is far less than the cost of the parking space, and this revenue is a cost for the students, staff, and faculty who park in the structure.

34. The transportation and air quality impacts of the parking structure are based on data reported in the structure's environmental impact report. In addition to these impacts of *using* the IM Field parking structure, *constructing* it will require excavating the 10-acre site to a depth of

31 feet. Removing 222,000 cubic yards of earth will require 26,000 truck trips (with a peak of 63 truck trips per hour) along Gayley Avenue, Weyburn Avenue, Veteran Avenue, and Wilshire Boulevard, from the construction site to the San Diego Freeway.

35. The total boarding time began when the first boarding passenger stepped onto the bus and ended when the bus doors closed.

36. The *without* BruinGO equation shows that each additional boarding passenger added 4.4 seconds to the total boarding time; the *with* BruinGO equation shows that each additional boarding passenger added only 2.6 seconds to the total boarding time. The average time per *additional* boarding fell by 41 percent with BruinGO. A statistical test of the standard errors of the coefficients in the two regression equations shows that there is less than a 0.1 probability that this large change in the slopes of the regression lines would occur by chance. The R-squared values for both *without* and *with* data show that variation in the number of passengers explains more than 80 percent of the variation in total boarding time.

37. This is a conservative estimate of how BruinGO reduces boarding time because some of the passengers in the *with* sample were not UCLA riders.

38. We also collected *without* and *with* bus boarding time at the same location for Los Angeles MTA buses. Unlike the Blue Bus, there is no change in fare payment options ‘without’ and ‘with’ BruinGO, so we do not expect to find a change in average boarding time per passenger. We plotted total boarding time as a function of the number of boarding passengers for the MTA. Using the same method of analysis as we used for the Blue Bus, we found no statistically significant change in the standards errors of the two coefficients of the regression equations for the MTA.

39. UCLA’s fare subsidy was \$640,000 for nine months (see Table 3), and faculty/staff accounted for 27 percent of all BruinGO rides, so the fare subsidy for faculty/staff was \$19,200 per month ( $\$640,000 \times 0.27 \div 9$ ).

40. See Crain and Associates (1998, 47) for the consultant’s prediction, and row 5 of Table 1 in this paper for the actual results.

41. Crain and Associates predicted that UCLA would buy 5,752 conventional transit passes for 2,090 transit riders, or 2.75 transit passes for every transit rider. Of these 2,090 transit riders, 1,775 already commuted to UCLA by transit, and the offer of transit passes would attract only 315 new transit commuters. That is, UCLA would buy 1,775 transit passes for the existing riders, and 3,977 transit passes for all other faculty and staff who do not buy a parking permit (5,752 total passes minus the 1,775 passes for existing riders = 3,977). These 3,997 transit passes would increase transit ridership to UCLA by 315 riders per day. UCLA would therefore buy 12.6 transit passes for each new transit rider ( $3,977 \div 315$ )—a very poor bargain indeed.

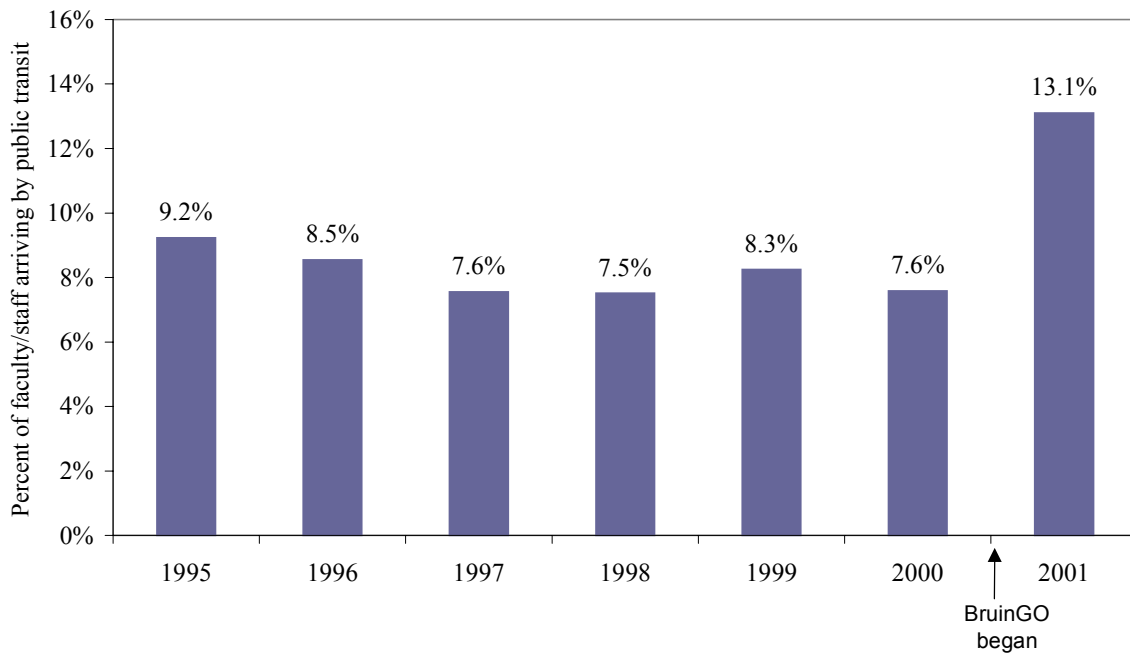
42. See Crain and Associates (1998, 47) for the consultant’s assumption, and row 5 of Table

1 in this paper for the actual results.

43. See endnote 22.

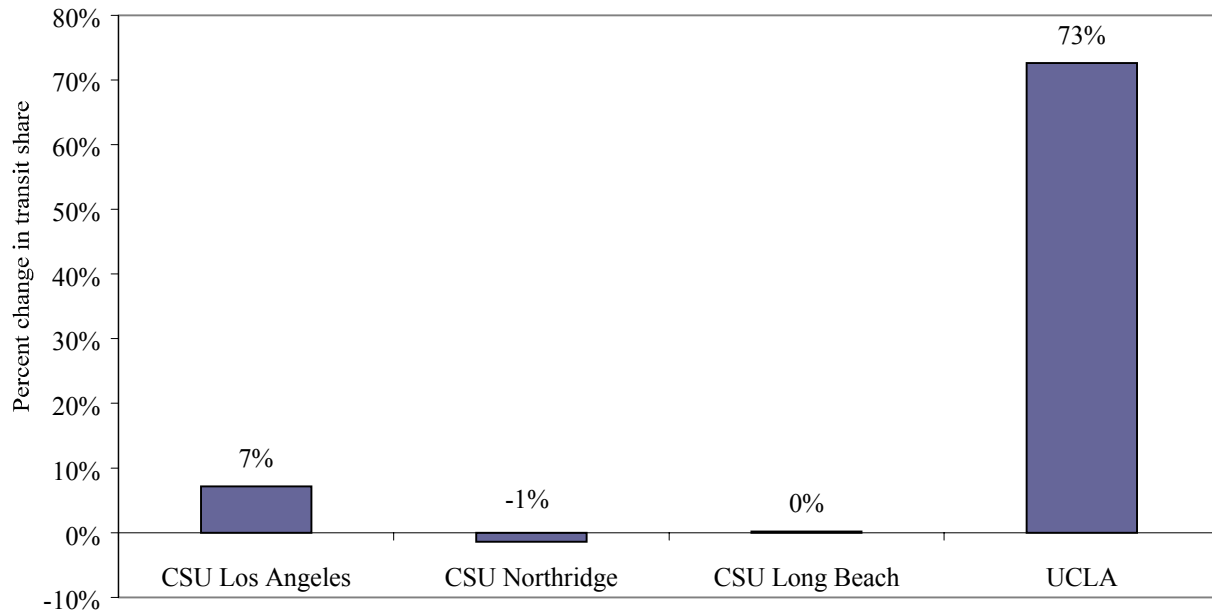
## **Tables and Figures**

FIGURE 1. SHARE OF FACULTY/STAFF COMMUTING TO UCLA BY BUS (1995 - 2001)



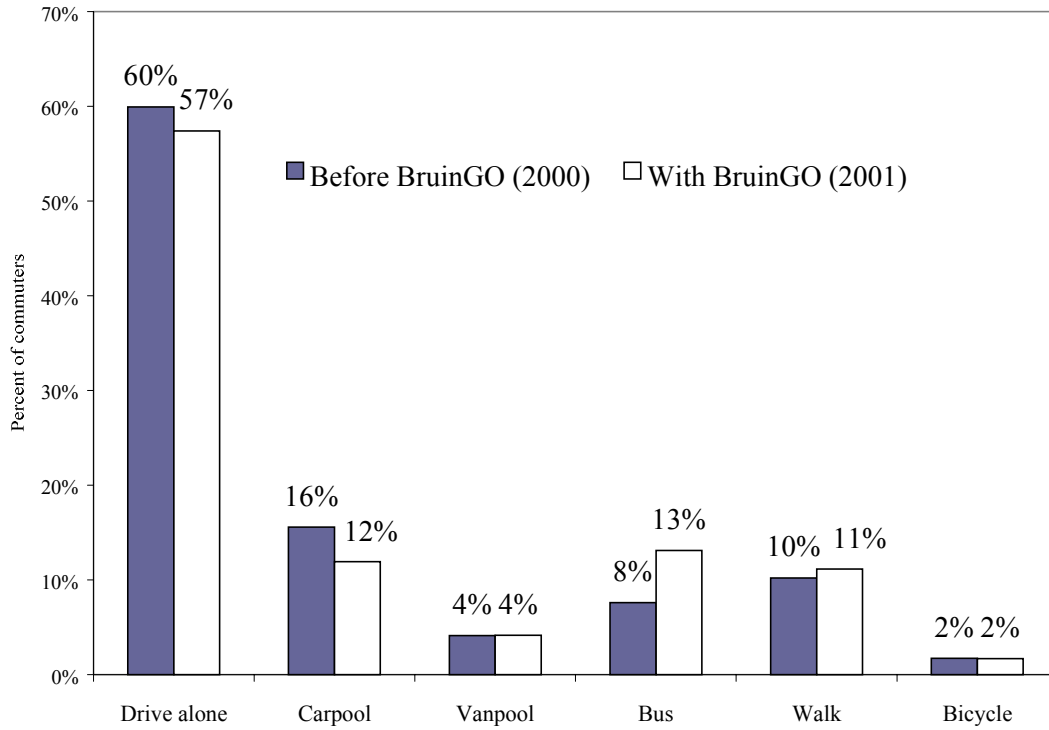
Note: Faculty/staff commute mode shares were calculated from surveys conducted by UCLA Transportation Services and submitted to the South Coast Air Quality Management District. Sample sizes were 3,051 employees in 2000 and 2,078 employees in 2001.

FIGURE 2. CHANGE IN FACULTY/STAFF TRANSIT SHARE AT FOUR UNIVERSITIES IN SOUTHERN CALIFORNIA (2000 to 2001)



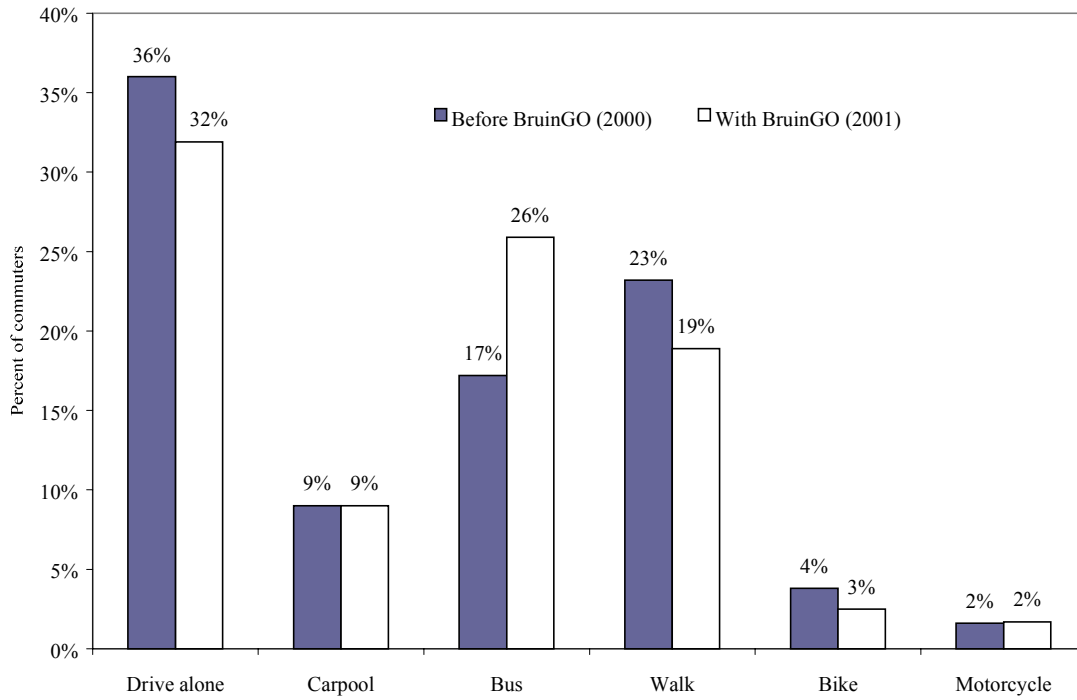
Note: Changes in transit mode shares were calculated from surveys conducted by the universities and submitted to the South Coast Air Quality Management District.

FIGURE 3. FACULTY/STAFF TRAVEL TO UCLA  
(Before and with BruinGO)



Note: Faculty and staff commute mode shares were calculated from surveys conducted by UCLA Transportation Services and submitted to the South Coast Air Quality Management District. Sample sizes were 3,051 employees in 2000 and 2,078 employees in 2001.

FIGURE 4. STUDENT TRAVEL TO UCLA  
(Before and with BruinGO)



Note: Student commute mode shares were calculated from surveys conducted by UCLA Transportation Services.

FIGURE 5. BENEFITS AND COSTS OF BRUINGO FOR UCLA DRIVERS AND BUS RIDERS (\$/Year)

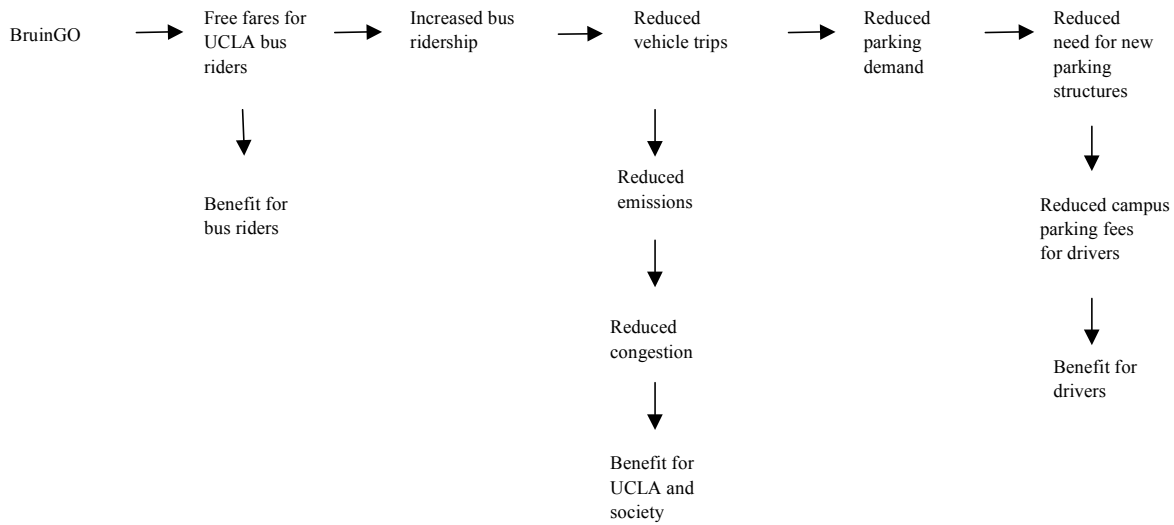
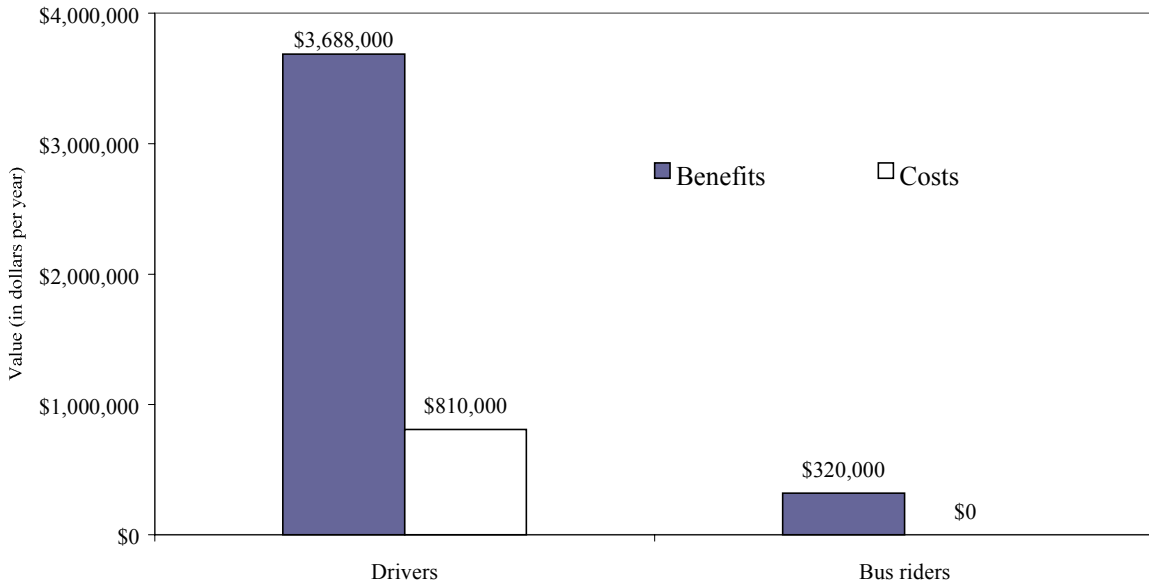


FIGURE 7. DISTRIBUTION OF BRUINGO BENEFITS AND COSTS  
(\$/ year)

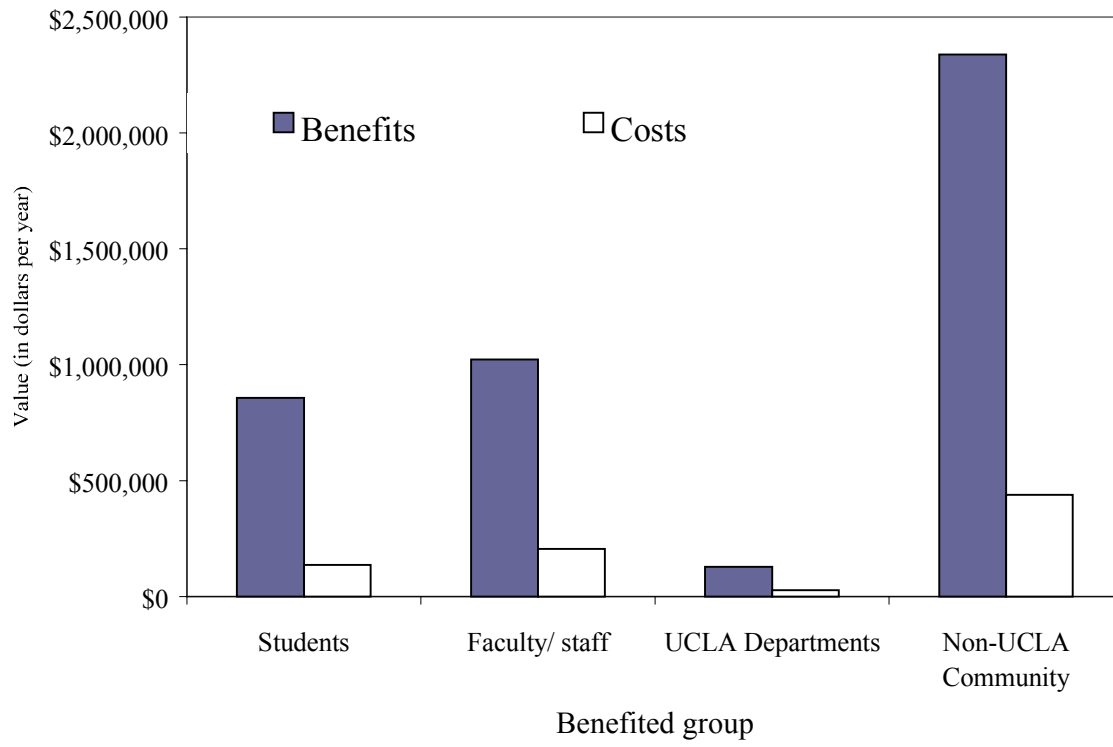


FIGURE 8. BOARDING TIME AS A FUNCTION OF THE NUMBER OF BOARDING PASSENGERS  
Before and With BruinGO

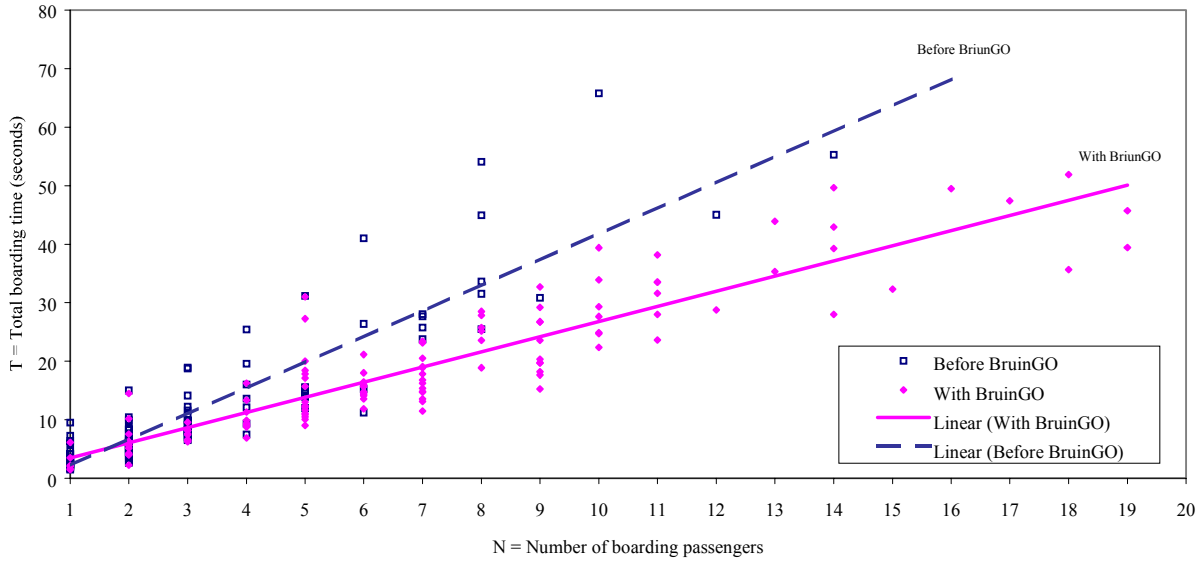
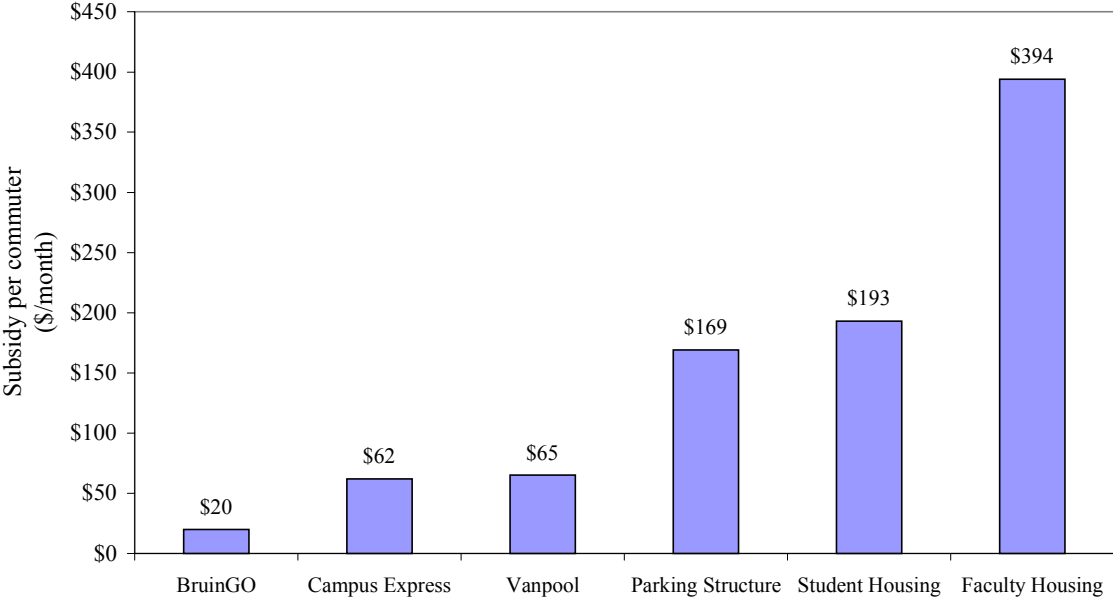


TABLE 6  
BOARDING TIME PER BLUE BUS PASSENGER  
Before and with BruinGO (seconds)

	Average	Range	Standard Deviation	Observations
Before BruinGO	3.7	1.3 - 9.5	2.7	123
With BruinGO	2.7	1.2 - 7.3	0.9	123
Change (absolute)	-1			
Change (percent)	-26%			

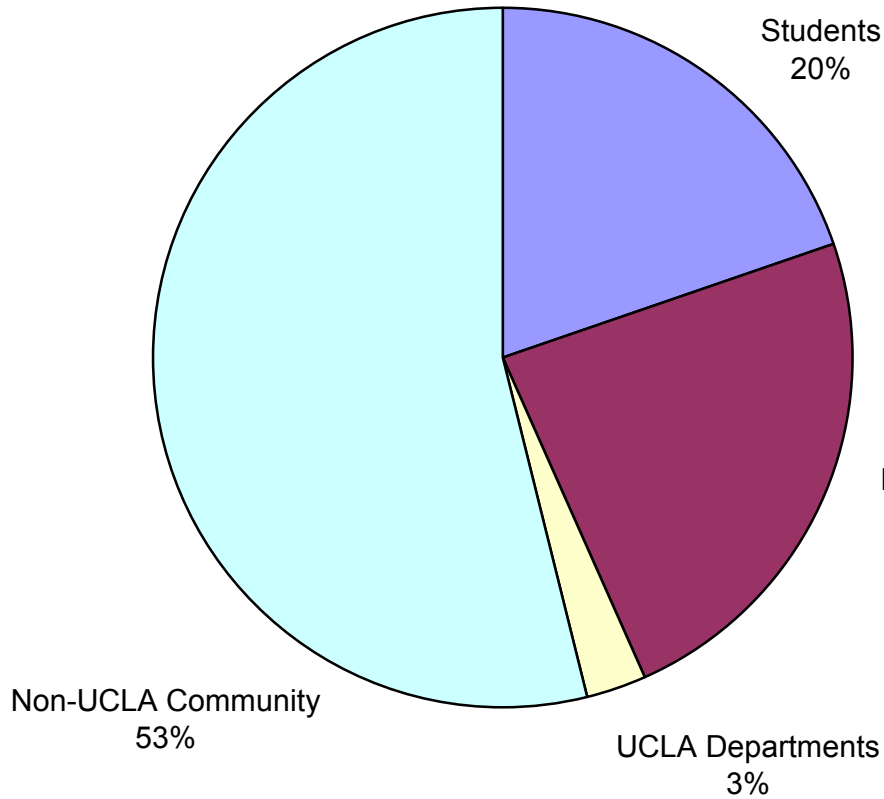
FIGURE 9. BRUINGO COMPARED WITH OTHER  
CAMPUS TRANSPORTATION PROGRAMS  
(subsidy per commuter per month)



**FIGURE 6. BENEFITS AND COSTS OF BRUINGO**

**WHO RECEIVES THE BENEFITS OF BRUINGO?**

Total Benefits = \$4,348,000 per year  
(reduced fares, reduced emissions,  
reduced congestion, reduced parking demand)



**WHO PAYS THE COST OF BRUINGO?**

Total Cost = \$ 810,000 per year  
(UCLA payments to the Blue Bus, UCLA  
administrative cost)

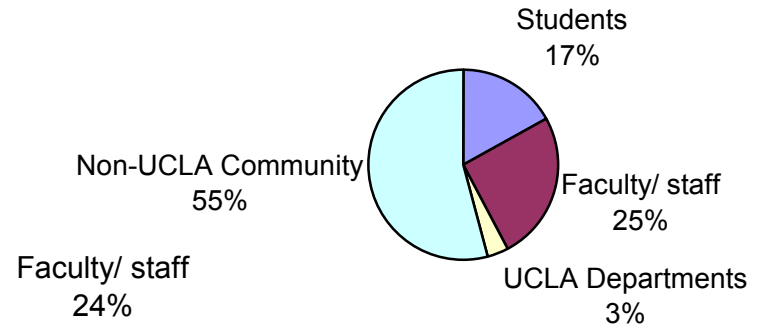


TABLE 1

RESULTS OF UCLA FACULTY/STAFF TRANSPORTATION SURVEYS IN 2000 AND 2001  
(Before and with BruinGO)

	Before BruinGO	With BruinGO	Change			Comment
	2000	2001	Number	Percent	Elasticity	
1 Number of faculty/staff in 2001		31,088				Data from UCLA Campus Profile, 2001
2 Faculty/staff who report to work between 6 am and 10 am		27,644				Data from faculty/staff transportation surveys
3 Percent who travel to campus each day		77%				Data from faculty/staff transportation surveys
4 Faculty/staff commuters to campus between 6 am and 10 am		21,419				(row 2 x row 3)
5 Share of faculty/staff who commute by bus	7.6%	13.1%				Data from faculty/staff transportation surveys
6 Faculty/staff bus trips to campus between 6 am and 10 am	1,625	2,805	1,180	73%	-0.36	(row 4 x row 5)
7 Faculty/staff vehicle trip rate (vehicle trips/ person trips)	0.661	0.624	-0.04	-6%		Data from faculty/staff transportation surveys
8 Faculty/staff vehicle trips to campus per day	14,168	13,359	-809	-6%		(row 4 x row 7)

Source: UCLA Employee Commute Reduction Program Plans submitted to the South Coast Air Quality Management District in 2000 and 2001.

The numbers refer to faculty/staff who report to work between 6 a.m. and 10 a.m on a typical weekday.

The fare elasticity is calculated using the midpoint, or arc elasticity, formula.

TABLE 2

RESULTS OF UCLA STUDENT TRANSPORTATION SURVEYS IN 2000 AND 2001  
(Before and with BruinGO)

	Before BruinGO	With BruinGO	Change			Comment
	2000	2001	Number	Percent	Elasticity	
1 Number of students		36,890				Data from UCLA Campus Profile, 2001
2 Students living off-campus		30,127				Data from 2000 and 2001 student transportation surveys
3 Percent of students who travel to campus each day		85%				Data from 2000 and 2001 student transportation surveys
4 Off-campus commuters to campus		25,741				(row 2 x row 3)
5 Share of students who ride the bus to campus	17%	26%				Data from 2000 and 2001 student transportation surveys
6 Bus trips per day to campus	4,427	6,667	2,239	51%	-0.25	(row 4 x row 5)
7 Share of students who drive alone to campus	36%	32%				Data from 2000 and 2001 student transportation surveys
8 Solo driver trips per day to campus	9,267	8,211	-1,055	-11%		(row 4 x row 7)

Source: Student Transportation Surveys conducted by UCLA Transportation Services in Spring 2000 and Spring 2001.

The numbers refer to all students who commute to campus on a typical weekday.

The fare elasticity is calculated using the midpoint, or arc elasticity, formula.

TABLE 3  
THE MEASURED COSTS AND BENEFITS OF BRUINGO  
(\$ per year)

The Distribution of Costs						
Costs	Who pays the cost?				Total	Share
	Students	Faculty/staff	UCLA Depts.	Non-UCLA		
BruinGO rides	\$108,000	\$163,000	\$22,000	\$347,000	\$640,000	79%
BruinGO administration	\$29,000	\$43,000	\$6,000	\$92,000	\$170,000	21%
<b>Total cost</b>	<b>\$137,000</b>	<b>\$206,000</b>	<b>\$28,000</b>	<b>\$439,000</b>	<b>\$810,000</b>	
<b>Percent of total cost</b>	<b>17%</b>	<b>25%</b>	<b>4%</b>	<b>54%</b>	<b>100%</b>	
The Distribution of Benefits						
Benefits	Who receives the benefit?				Total	Share
	Students	Faculty/staff	UCLA Depts.	Non-UCLA		
Reduced fare payments	\$235,000	\$85,000			\$320,000	7%
Reduced traffic congestion				\$137,000	\$137,000	3%
Reduced vehicle emissions				\$203,000	\$203,000	5%
Reduced parking demand	\$623,000	\$938,000	\$129,000	\$1,998,000	\$3,688,000	85%
<b>Total benefits</b>	<b>\$858,000</b>	<b>\$1,023,000</b>	<b>\$129,000</b>	<b>\$2,338,000</b>	<b>\$4,348,000</b>	
<b>Percent of total benefits</b>	<b>20%</b>	<b>24%</b>	<b>3%</b>	<b>54%</b>	<b>100%</b>	
Comparing the Benefits and Costs						
Benefit-Cost Measure	Students	Faculty/staff	UCLA Depts.	Non-UCLA	Total	
<b>Net benefits (benefits -- costs)</b>	<b>\$721,000</b>	<b>\$817,000</b>	<b>\$101,000</b>	<b>\$1,899,000</b>	<b>\$3,538,000</b>	
<b>Benefit/cost ratio</b>	<b>6.3</b>	<b>5.0</b>	<b>4.6</b>	<b>5.3</b>	<b>5.4</b>	

TABLE 4

COST OF UCLA'S IM FIELD PARKING STRUCTURE

1. Total cost of structure	\$47,282,000
2. Number of parking spaces in structure	1,500
3. Cost per parking space	\$31,500 per space
4. Interest rate (% per year)	6.125% per year
5. Term	27 years
6. Annual debt service per debt-financed space	\$2,414 per year
7. Annual operating cost per space	\$259 per year
8. Annual total cost per debt-financed space	\$2,673 per year
9. Monthly total cost per debt-financed space	\$223 per month

Source: Memo from the UC Office of the President to the UC Regents, November 7, 2001.

TABLE 5  
BRUINGO COMPARED WITH THE IM FIELD PARKING STRUCTURE

Comparison Criteria	BruinGO	IM Field Parking Structure
<i>Transportation Impacts</i>		
Vehicle trips to campus	Reduces 615,000 vehicle trips per year	Adds 1.4 million vehicle trips per year
Vehicle-miles traveled	Reduces 1.8 million VMT per year	Adds 12 million VMT per year
Fuel consumption	Reduces by 75,000 gallons per year	Increases by 425,000 gallons per year
<i>Air Quality Impacts</i>		
CO emissions	Reduces 22 tons of CO emissions per year	Adds 79 tons of CO emissions per year
NO <sub>x</sub> emissions	Reduces 2 tons of NO <sub>x</sub> emissions per year	Adds 8 tons of NO <sub>x</sub> emissions per year
ROG emissions	Reduces 2 tons of ROG emissions per year	Adds 12 tons of ROG emissions per year
PM <sub>10</sub> emissions	Reduces 1 ton of PM <sub>10</sub> emissions per year	Adds 6 tons of PM <sub>10</sub> emissions per year
CO <sub>2</sub> emissions	Reduces 1,200 tons of CO <sub>2</sub> emissions per year	Adds 6,500 tons of CO <sub>2</sub> emissions per year
<i>Campus Impacts</i>		
Noise impact	None	Increases noise
Temporary disruptions during construction	None	Substantial disruptions for 2 years
Benefits for students without cars	Substantial benefits	None
Added income for UCLA students, staff, and faculty	\$320,000 per year	None
UCLA's public image	Good public image	?
Capital cost	None	\$47.3 million

Source of parking structure data: Draft Environmental Report for the Intramural Field Parking Structure, January 2001.  
BruinGO data calculated based on information discussed earlier in this paper.

TABLE 7  
 THE PREDICTED AND REALIZED RESULTS OF A TRANSIT-PASS PROGRAM  
 FOR UCLA FACULTY AND STAFF  
 (\$ per month)

	Consultants' prediction (1)	BruinGO's result (2)	Result as % of prediction (3)=(2)/(1)
1. UCLA's transit fare subsidy for faculty and staff	\$170,000	\$19,200	11%
2. Transit ridership increase (riders per day)	315	1,180	375%
3. Reduction in number of parking spaces demanded	150	599	399%

Source: Consultant's predictions are from Crain & Associates (1998).