

Team Stakeholders



Trash & Recyclable Separation

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I. Introduction to Project Context and Stakeholders

With the amount of students and resources involved in the daily functions of college campuses, sustainability at large universities has become a more pressing concern, especially when examining the environmental impacts these campuses can have on the environment. Specifically, at UC San Diego, sustainability and the conservation of resources is a huge priority, particularly with the university's commitment to becoming a "zero waste" campus by 2020. However, despite the progressiveness of these plans and the detailed work being done by sustainability teams on campus, much of their success is also a product of its users' cooperation and sustainable behaviors, which is an area that we planned to study in our design research.

With these needs in mind, our team, Team Stakeholders, decided to have our project focus on sustainability on campus by looking at the trash and recycling system used here at UCSD. In terms of trash and recycling, we focused on how trash was thrown away and created at dining halls, and how well recycling bins were being used by our primary stakeholders, which were the UCSD students who used the dining halls. The reason why we turned our focus to this aspect of the trash system was because it came to our attention during our initial field research and interviews around campus that we noticed a severe issue in the separation of the recyclables and trash in dining halls. Mixed items were being thrown into both waste and recycle bins, compost bins in the past as well. This issue has both cut down profits gained from recycling facilities and discontinued compost bins use in dining halls.



Figure 1. Trash and recycle bin comparison, illustrating the number of shared item types across bins.

This issue affects a variety of stakeholder groups besides students. For the dining hall staff member, who we consider our secondary stakeholders, the poor separation is affecting their work process, profits and sustainability goals. All dining hall trash recyclables are sent to a third party recycling facility who we have designated as our tertiary stakeholders as they dictate the rules of what may be recycled, but aren't overly concerned about how well students do it. We found that many of the problems surrounding recycling and trash sorting are tied to a number of key factors. By developing a design solution that addresses each of these areas and more, we hoped to be able to improve the current trash and recycling systems in the dining halls in order to align with the university's goals and reduce the environmental impact of students using the dining hall facilities.

II. Design Problem

The design problem we identified concerns the issue of how excess waste is produced as a result of poor trash separation by students in the dining halls on campus. In our initial interviews, which focused on ways that recycling practices existed on campus, we found that many of the underlying issues related to how students engage with appropriate trash and recycling habits involve five key factors. On an individual level their pre-existing knowledge and motivations for separating their waste; external factors included structure of bins, localized rules of recycling, and signage. As more issues within how students utilize trash and recycling in the dining halls became more prevalent throughout our interviews, we began to focus in on how students sort their waste in the trash and recycling bins after finishing a meal at the dining halls. Through field observations and further interview investigation, it became apparent that the behavior of tossing one's trash and recyclables -- although bearing cumulative environmental consequences -- is an activity that many of our stakeholders take for granted and perform without much thought. With these observations in mind, we converged upon the issue of how trash and recycling is sorted by students in the dining halls and how we can best mitigate environmentally harmful behaviors and their consequences by using the key factors we identified as design features for our solution.

III. Overview of Design Process

In order to appropriately design a solution in order to address the issue of trash and recycling sorting in the dining halls, we first conducted human-centered research to better understand our stakeholders and their needs. This information was gathered primarily through various forms of field research and interviews with primary and secondary stakeholders who have various experience with trash/recycling knowledge. This allowed us to immerse ourselves as researchers into the world of our stakeholders. From here, the data gathered was consolidated and evaluated through group interpretation sessions, affinity diagramming, and the construction of design models, which helped inform our ideation of solutions later in the design process.

Field Research

In order to develop a greater understanding of the world of our stakeholders and the context in which our design problem exists, we conducted field research across various locations across campus, including the dining halls. This research largely took the form of observations and evaluations of existing trash/recycling systems and how users interact with them. In order to do so, we went to each dining hall and took notes of salient observations we made in terms of notable qualities in each system. Some aspects that were specifically examined in order to provide information about how the systems work in different areas on campus include the physical attributes of trash/recycling receptacles, the presentation of signage, the distribution of bins, the contents of the bins, and notable behaviors that users exhibited when throwing away their trash or recyclables. This allowed us to be able to make comparisons between the different

trash and recycling systems in each area to see which systems and their attributes seem to enable more accurate separation of waste (recyclables and trash).

In our observations, many of the dining halls utilized similar trash and recycling areas with some notable differences. At Pines and 64 Degrees for instance, the disposal areas consist of a wide, waist-level counter with holes on top that correspond to different trash or recycling bins. On top of each hole, labels read “Landfill/Food Scrap” and “Recycle”, describing in broad categories what should go in each hole. The distribution of these bins were pretty variable in each area, with Pines having a single primary trash and recycling area with five different holes and 64 Degrees using several bins at different exit/entrance points in the dining hall. In addition, we also looked into other populated areas on campus outside of the dining halls with trash/recycling bins in order to compare the strengths and weaknesses of each. For example, in Price Center, the trash bins consist of a flap on the side of the bin that users can push to deposit their trash into, and in Muir College, a number of trash/recycling bins use different shaped holes along the side of bins.

Furthermore, signage demonstrated the most variety across different areas on campus, with differences in the types of information, language, brevity, location, pictorial elements, and more. As a result of this diversity, we found that many of the signs, including instructional components and displays at each of the waste disposal areas, contained varying and inconsistent information. While some of this may be a result of specific recycling and waste management components at different areas on campus, this notion seems to play a significant role in the confusion that users expressed in interviews about their trash/recycling sorting behaviors. Specifically, when comparing some of the information present in the dining halls with those of

Price Center, we found that varying information depicting what items (i.e. utensils and straws) are recyclable and which should be deposited into trash bins. In addition, the manner in which many of the signs are presented are highly variable as well, with areas like Pines using large hanging posters on the wall behind the bins, some outdoor trash cans posting their signage along the sides of the bins, and some on the trash area counters. In the dining halls specifically, signage seems to take several forms at the same time: formal poster signage, display cases, labels, sign holders, etc.

Upon examining the contents of the bins, we also noted that across nearly every area we looked at there was a fairly great amount of materials sorted in the wrong bins, with most plastic containers (cups and bowls) and paper products (napkins and trays) being primary subjects of concern.

Interviews

Our team was able to interview a variety of stakeholders at different levels in order to better understand our problem space and how to improve the way that they interact with trash and recycling systems in the dining halls. Many of our interviews with our primary stakeholders included students with varying knowledge and expertise of sustainable practices, commuter students, and student leaders who all use and interact with the dining hall trash and recycling systems. In addition, we also gathered information through interviews with our secondary stakeholders, namely those representing dining hall management and individuals associated with improving the greater sustainability practices of the university. This range allowed us to gain key insight into the various mindsets of the main users of the recycling systems on campus --

students. Although not all students are the same, investigating the various ways that they interact with the campus played a crucial role in providing insights into the world of our stakeholders.

During the interview phase of our design process, we sought out a variety of different individuals from various roles on campus who engage differently with the trash and recycling systems in the dining halls to participate in our interviews. This included individuals with more conventional experiences with trash and recycling in the dining halls (including residents on-campus who frequent the dining facilities), commuter students, Resident Assistants, dining management and workers, and sustainability representatives from the campus's Sustainability Resource Center. We placed a fairly large emphasis on securing diverse individuals in order to create a system that benefits a wide variety of stakeholders and takes into account edge cases.

During the interview process itself, our first phases of interviews were more casual in nature and were centered around user's experiences with trash/recycling systems, their knowledge of them and what sources they acquired it from, and the issues they face when trying to sort their waste effectively. However, as we began to see trends in some of their responses, we started to focus on more formalized questions that were standardized across the various interviews we performed. For students that typically attend the dining halls, questions ranged from how well they think they separate their trash and the importance of recycling in their lives, to how they typically engage in recycling at home and on campus. For workers and managers that work in the dining halls, our interviews typically focused on how the existing systems work and any common issues they witness with respect to trash and recycling sorting. From this process, we were able to reveal a number of key findings.

One of the primary issues concerning all of our participants included a lack of knowledge when it comes to trash and recycling. While most of the students were aware that recycling is important, and would like to help as much as possible, when there is a simple lack of specific information on what can and cannot be recycled, particularly when such a variety of paper and plastic products are available on campus, most students just have to use their best judgement and hope that they are correct. In the case of many of the stakeholders we interviewed, they claimed that while they do feel personally obligated to recycle and understand the consequences of not sorting their trash correctly, their lack of expertise in the area keeps them from doing so effectively, as they often rely on direct aids like signage and immediately available information. One particular stakeholder, who does feel rather passionately about sustainable practices, still mentioned that they know that sometimes their behaviors are not always correct as well, but for the sake of convenience, will choose to throw things away in whatever bins are immediately available based on whatever they think is correct. This can be especially inefficient, as most times, people carry misconceptions about the recycling systems. There are various sets of rules across the world, country, state, and even county, so expecting every student to be well informed on the specific rules of the campus can be inconvenient.

Not only is a lack of information a factor in preventing students from recycling properly, but the actions of other students can be just as impactful. When one student sees another put something that they feel is non recyclable in the recycle bin, or contrastingly something recyclable in the trash bin, they have a few possible trains of thought: they correct that student, risking being wrong themselves; they follow that student's lead and begin recycle improperly themselves; or they simply keep about their business and hope that somewhere down the line,

the waste will be sorted properly. This leads to great amounts of confusion and misinformation on campus, so being able to correct this confusion from the beginning could have a great spiral up effect in seeing a greater amount of proper recycling. For the purposes of our research, we utilize the term “mob mentality” when discussing this phenomenon.

Lastly, another factor that contributes to students’ inability to correctly sort trash is a lack of motivation, especially from students that don’t always want to put in the extra effort to make recycling work. If a recycle bin is too far out of the way, and the trash is in proximity, that student will use what is most available and throw the item in the trash. Students seeing this behavior follow suit, and the effect is a chain reaction of sorts. Though it is difficult for students who truly care about recycling, when the greater population lacks this motivation, theirs can diminish too.

Design Models

The design models that we made use of during the design process included an affinity diagram, a sequence model eating at a dining hall, and user personas, in that order. Each model fed information into the next, highlighting certain key interactions our stakeholders made with the world around them. This included things such as points in time that have design opportunities, stakeholder goals, and components of the trash system.

Affinity Diagram

In order to consolidate our information collected from various interviews, we used an affinity diagram. This data was not limited to the processes occurring in only dining halls, but

rather the whole campus and some parts included general recycling principles. The consolidation of information allowed us to key into concerns in the dining halls, this included some of our five design features. From each of our interviews, we took some key points and placed them on Post It notes. We also wrote down some of our observations in various dining halls. At that point, we sorted each note by the theme of the observation or key point, categorizing as we read them. We broke some larger themes into smaller themes as they contained too many notes. When we finished sorting for the first time, we had a few prominent themes that encompassed most of the notes we came up with. We found that the biggest themes were the availability of recycling bins, convenience, and misconceptions of recycling. There were other themes than those that stood out, such as motivation and signage, but we were initially more focused on the aforementioned themes and how we could try to address a few of them. We then took our affinity diagram notes and used them to support the superiority of a solution that geared towards a specific design feature such as knowledge or motivation. It was from there we were able to narrow down to dining halls, thus narrowing our problem focus, and we were also able to begin ideating and identifying potential solutions.

Sequence Model

After narrowing down the scope of our project to simply dining halls we decided it was useful to use a sequence model to visualize what exactly occurs in a dining hall that leads to waste being produced and ultimately being separated poorly. Below is one of the versions of our sequence model which breaks down the possible lines of actions a student may take when eating at a dining hall. During and after visualizing the events that transpire in a dining hall we identified two major points in time where we can make an impact. They were namely when people obtain their dining ware, recyclable or otherwise, and

when they go to throw away their items. Additionally, we wanted to add little notes that explain the idea mentality that people have when doing certain actions. For example, people who separate their trash well are following signs and are motivated to be environmentally friendly.

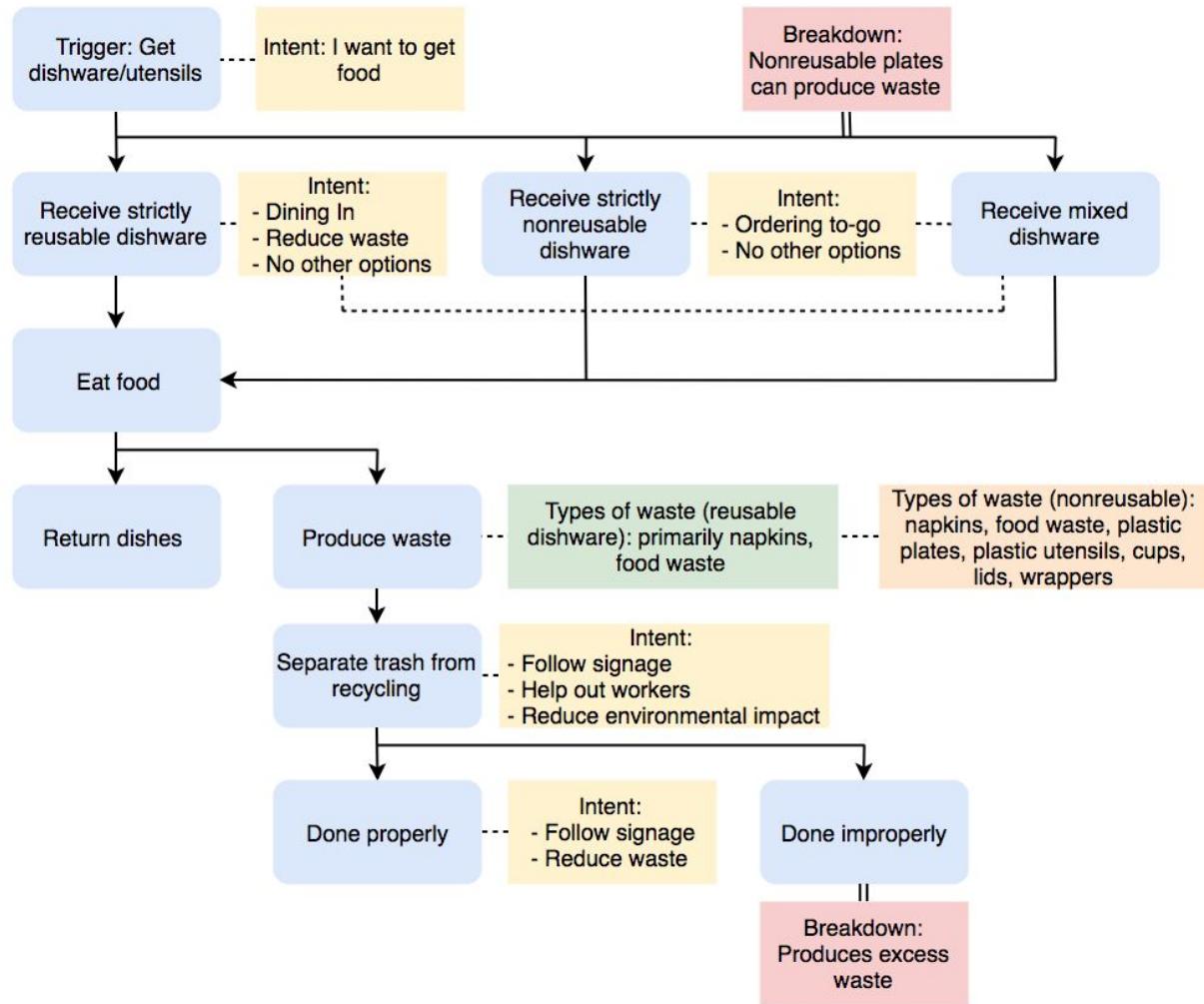


Figure 2. High fidelity mockup of sequence model.

User Personas

Whiler user personas were a mandatory deliverable they were useful for adding depth to the intents we identified in the sequence model. Creating them was an opportunity to reevaluate

and redefine what kind of people our stakeholders were and what they actually cared about. We were trying to understand the idiosyncrasies of our primary stakeholders, the students. By doing so we can start to grasp which part of the student body population we want to target our solution towards. On the other hand writing down what HDH management cared about was important to define their goals in a space outside of an affinity diagram. This also served to remind us that whatever the HDH management values they serve as an anchor for what we should do.

Interpretation Sessions

After performing the modelling and consolidation of data, we took the generated information and used it to inform us what are areas a solution might be available. In the sequence model, we were able to determine points in time for redesign. They were when students received their dining ware, recyclable or otherwise, and when they threw away their trash. We then took that information and started our ideation sessions. Our initial designs were split between these two points in time and with varying levels of friction being imposed on the primary stakeholders. We wanted to consider how much we wanted to teach people or if it even mattered because recycling rules are localized. The amount of friction that we wanted to introduce into our primary stakeholders' lives was something that we weighed seriously with each design solution we came up with.

IV. Key Insights, Roadblocks, & Lessons Learned

The main roadblock we had to surmount was the one that caused us to pivot to redesigning the disposal system: Our original idea to replace recyclable dishware with reusables that could be washed (like ceramics) turned out to be a design already in the process of being

implemented. Indeed, OzziBox is already in use at UC Merced and is making its way over to UCSD. We learned this three days after our Week 7 mini-presentation, when Raquel interviewed an upper management HDH employee, after weeks of emails. Thus, it is inappropriate to say that we could have prevented our floundering by simply being proactive and volleying our idea to management earlier, taking initiative to discover any potential obstacles. No, Raquel had been requesting an interview for a while and only just then received one. Therefore it was fortuitous that we found out about OzziBox as early as we did; our fate was good and cannot have been prevented by foresight. And as Taylor Jackson Scott said after our final presentation, the situation was unfortunate but showed that we were on the right track to something, if it's already being implemented by the university. To fill the void where previously we had a design, we pivoted. The original reusable-dishware design was based on the idea, from Ryan and also from interviewee Rachel Smith (director of energy & waste at student sustainability collective), to reduce the amount of recyclables and improperly trashed recyclables, by eliminating recyclables altogether. Reusables could just be washed. Instead of that, our replacement idea was one we originally brainstormed at the beginning: to simply facilitate student sorting of debris, thus ensuring recyclables end up being recycled as much as possible (instead of ending up in landfills or the bottom of the ocean). Therefore we started making some prototypes for trash lids that were better designed for users to properly dispose of debris. This design process is explained in more detail in the upcoming sections.

As far as lessons learned, we definitely grew our communicative abilities, and we also learned how to handle rejection and failure. At the beginning of the quarter, we came into the project as a group that got together because of proximity during the group search and a modicum

of an idea for us to work on. We learned that communication was paramount if we wanted to make the project work. Though we sometimes felt discouraged by the project at times, we kept a positive attitude throughout the project, teaching us that positivity is the key to enduring the times when it's hard to keep going. During the validation interviews, Raquel was initially hesitant to go and ask people for feedback, and when she did, her advances were rejected. Through the persistence of her team members and taking some time to breath, she eventually tried again and got an interview. She learned that day that rejection does not mean much except to keep trying.

V. Iterative Ideating-Prototyping-Testing Process

At the beginning of the ideation process, we first brainstormed some ideas that we thought would address the problem statement that people were not recycling as much as they possibly could. Since, by this point, we had discovered that there were plans to roll out the Ozzi Box, we had to pivot our focus away from a system to check out dishes and instead, shift it towards creating a different solution that would focus on getting the diners to use the recycling bins, as we had learned that the recycling gets sorted at the landfill facility such that trash is sorted out from the recycling. Thus, as we began to sketch out our possible prototypes, we focused on designing a system at the trash and recycling receptacles rather than before it, as was outlined in our design models.

Our sketches were essential for visually demonstrating to one another our mental image of how the prototype could or should look like. Oftentimes a team member would begin trying to explain an idea, then stop and take out a piece of paper and inscribe the layout before continuing and pointing to the different parts of the design to explain. This was crucial in making sure the entire team was on board with a design layout.

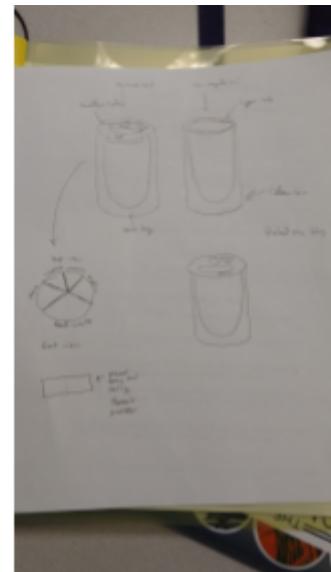


Image: An example of using quick sketches in order to portray ideas to teammates.

We didn't get much out of making our storyboards. They would certainly have been helpful if a team member was out-of-the-loop, or if we were pitching our idea to the university, or a company, because such viewers would be unfamiliar with our concepts and goals. But within our team, the storyboards were designed after-the-fact,

demonstrating ideas that everybody in the team was already familiar with. So, we hardly consulted the storyboards.

The first component of our original prototyping was designing a better lid/hole for recycling/trash bins in the dining halls. Early on, we had originally ideated that the hole in which people dump their debris could be manipulated. Ryan was partly inspired in this by his recalling the Price Center Theater recycling bin holes of various shapes for different recyclable categories. Furthermore, our interviewee Rachel Smith, director of energy & waste at the student sustainability collective, mused upon the idea to get people to slow down before disposing of something, make them step in some sort of box or to pull open a handle, in order to make them think about what they are throwing away and whether it is right. Essentially, her ideal was to create friction. This is what we attempted to accomplish with one of our early prototypes (and was the concept that we picked and use in our final design). Another early prototype involved making transparent the entire trash/recycling bin and thus utilize “mob mentality” that we saw in our very early interviews with student stakeholders- people could see what others were recycling and do the same. This was impractical however, because the bins in dining halls are enclosed in a cabinet and transparency of bins would be useless; and we found in our interviews that mob mentality can work negatively, as interviewee A___ said if a paper plate was



Image: A set of early paper prototypes for the design that would go over the receptacle opening.

in the recycling bin she would follow the example and throw her plate in there (this is the wrong choice and she was happy to be informed). Another prototype was the funnel-lid: this was meant to make the hole smaller so that only trash would fit in there and not recyclables like plastic plates. This was also scratched as infeasible, for sticky food would get stuck on the funnel instead of sliding down into the smaller hole.

The prototype we decided to build, from our early miniature collection, was the one that divided the trash hole into four compartments, each with signage, thus slowing people down and informing them what items can go into the trash (and anything not listed on the signage should be put into the recycling bin). The aim with this was to ensure that things that are recyclable would be prevented from being trashed, partly due to not fitting the smaller compartments and partly due to the friction made to make people read the signage about what can be recycled or not.

The synergistic second component of our prototypes was the signage. In a desperate fumble to inform people better than the pre-existing signage does, we taped on some paper signs for people to read above the trash hole. The problems with that first tested prototype are detailed in the next section.

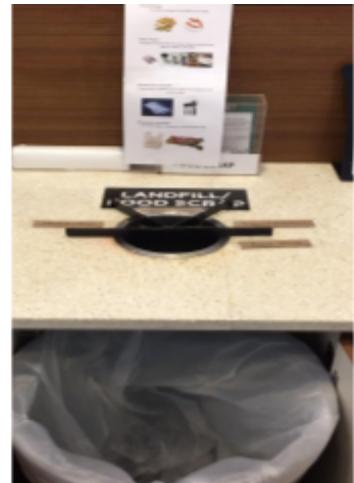
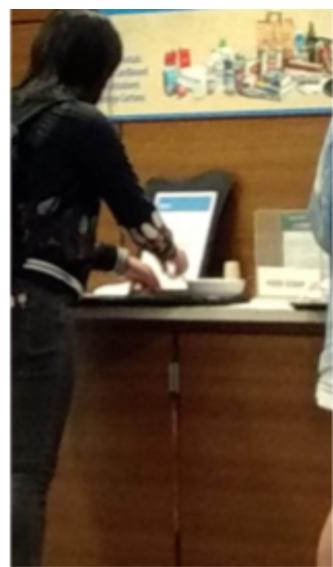


Image: The first prototype sitting on top of the hole leading into the trash bin below. We had 4 different sections in that prototype.



Picture: Someone taking the time to sort through their trash to use our second prototype. 19

We conducted four validation interviews during the 1 hour and 10 minutes of our second prototype testing, catching people after they disposed of their waste, having separated it (or not) with our design.

Will caught up with two people who disposed of their waste wrongly. L___ dropped some things into the recycling bin, then **scraped all of his food into the recycling bin**, and then put his plate in. So, Will walked quickly and got to talking with him. The reason he scraped all of his food into the recycling bin was because he saw the divider in the trash holes, and thought they were meant to be blocking off the trash hole. Otherwise, he would have put his food into the trash. This is an oversight on our design. He didn't read the signage (which would have implied that the trash holes were useable and not blocked off) because he never reads signage - because it is common knowledge. "Most people know that [information], they don't need to read." At the beginning of the interview Will ascertained by asking, that he is an international student from China, a freshman living in the residence halls. Thus, at the end of the interview, Will asked him if there is as much recycling in China as there is in America, and he said no. "They just trash it all in one big trash bin." There aren't any recycling bins, really. Will himself was there last summer and was slightly distraught to trash bottles (everyone does) instead of recycling. This is important to note as we consider the second validation interview.

X___ brought a plastic cup and plastic bowl and some other things to the disposal area. She put everything into the far trash hole, including the plastics. Thus, Will ran after her and invited her to talk about her experience with the design. It turns out she, like L___ before, did not read the signage (despite noticing the divider). This was likely out of habit. So, she put her plastics and the plastic cup into the trash hole and seemed a little bit abashed about that. When

asked what could be done to make it easier for her, she said, “make the sign more noticeable, I guess.” She probably said that just to say something, however, and it is likely that no matter how noticeable the sign is without hindering or blocking one’s throwing away of trash, she would not have looked, simply because she is used to just throwing her things away. Indeed! She also came from China. When asked if growing up in China with little recycling had an impact on her, she was smiling and said, “probably.” Thus, she trashed everything and put her plastic drink cup into the trash.

These two interviews have high importance, as detailed in the later section Future Works.

Zeke interviewed K_____, who stated that dividing the hole did not help facilitate waste disposal, because all trash is going to the same place: in that hole. This may be skewed, however, as she only had food scraps to throw away (which she did put in the left compartment). She stated that the divider would be better if it were better made - as in built-in with the ring around the hole, metal. This interview brings up the consideration that the divider is wholly superfluous, that perhaps the most important design aspect is just the signage on the same level around the trash hole. The purpose of the divider is to design for friction, make people slow down, but we must consider whether it is a piece of silly folly or not.

Raquel interviewed A_____, who said that she thought the design was confusing, but the divider did get her to stop and think. However, even if there was no divider, she claimed that she would not have changed what she chose to throw away. This interview supports Ezekiel’s observation that the divider might be unnecessary to the minimally required product.

VI. Final Design Solution

After gathering data from our first prototype, it was clear that there was too much friction added on top of the trash can hole. Since the hole where trash was thrown into was divided into four sections, the stakeholders had to place their trash accordingly into the correct divider. This, however, led to some users not using the prototype at all and opting for the other trash can. By nature of being split into four compartments, the compartments were small and this likely turned some people away from using the prototype, especially if they had to scrape food off their plate into the hole as they would prefer a larger hole for that task. There was also the unfamiliarity aspect- it is human nature to prefer what is familiar and comfortable, so the stakeholders would opt out of using our prototype and instead dump in the regular, uncovered holes. In order to combat these issues, we took our field data and observations and eventually re-designed our prototype and system, as covered later.

From our field data and notes, the stakeholders who did use the prototype were able to separate non-recyclable trash from trash that was recyclable. In the pic below, there was no recyclables in the trash can which was a success from the use of the our first prototype. Yet there was not much trash in there simply because not many people used the prototype, instead opting for the trash can to the right.



Image: our first prototype, over one trash receptacle, with appropriate trash in receptacle. It worked, but people tended to avoid it, thus the low volume of trash.

Our final prototype was designed so that there was still a divider, but only in the middle and to also enlarge our icons and make the signage more clear of which trash goes into the



Image: The second prototyped divider over the trash receptacle, with appropriate signage.

divided section. Having only one divider in the middle would still create friction, but the larger spaces allow the user to access the holes for designated trash easier. Additionally, we also decided to rotate the divider so that it splits the hole vertically, in order to make both halves physically equally close to the user and thus more accessible. This change in shape required

us to adjust our labels; one half for food waste and one half for utensils/straws, wrappers/bags, and dirty paper products. Different colors were used to indicate which labels correspond to which side of the hole and make the model more visually intuitive. In addition, in order to enable users to look at signage and information, we proposed the idea of bringing the information covered in the initial signage downwards so that it surrounds the trash holes rather than hangs

behind. This allows the information to be built-in to the process of discarding trash rather than act a supplemental step that most users are not interested in pursuing. Furthermore, the recycling hole remained open as usual and was labeled for all other items from the dining hall to be recycled, including some of the more common items, and an extra label that specifically said no dirty paper products, which was the most common sorting mistake during our first test. Our solution involved constructing a mat-like prototype that fused the descriptions and images from the original signage into the labels that surround each trash hole, while also enforcing the simplified dividers that segment the trash hole in half.

The main reason for the divider was to keep some friction from the first prototype and to keep big recyclable items such as the plastic plates, plastic salad containers, and plastic cups from going into the landfill / food scrap hole (also referred to as the trash bin hole). The change in signage was a big move, as we saw through field observations in first user testing that people as they walk over to dispose their waste, tend to only look at the trash/recycling holes and not up at the other signs that we or HDH placed for separating debris. Their eye levels were oriented down at the hole level, because disposal was their goal. Their eyes weren't up, at the level of the signage, because that would be wholly superfluous to accomplishing their goal. Thus, we sought to meet the users where they were; Kenny in our meeting drew a sketch for the signage to surround the hole, placed flat on the table... and we made it happen. This signage was somewhat successful as discussed in the next section.

Originally, plastics would be tossed into the landfill / food scraps hole along with other trash. With the divider on the landfill holes reducing available size to dispose, we reduced the ability to throw away recyclables was the recycling hole since the the size of the hole could only fit the plastics. Yet, based on observation during the testing and the garbage data at the end, a



Image: Our second prototype in place. For the recycle bins, we only placed signage that make the recycle bin more inclusive so as to encourage recycling.



Image: A look into the recycle bin after the prototype was applied. There is still trash in there, but because it's a negligible amount, it will get sorted at the facility, thus this doesn't matter as much.

few people still threw salad containers into the trash, which is one of the largest pieces of plastic in the dining halls- but there was still a reduced amount of salad containers in the trash compared to the first user testing (though that may be due to randomness and regression to the mean). Ideally we would solve the salad container problem, which is the worst (albeit small) culprit of recyclables in the trash, perhaps by educating people or modifying our signage to explicitly mention salad containers.

Lastly, in order to address the first user testing unfamiliarity problem and people choosing the familiar over the unfamiliar, putting their trash in the uncovered hole as opposed to

the prototype hole, we simply left no alternative option for stakeholders except to use our prototype hole. We put our prototypes on all three trash holes.

VII. Evaluation of Success

Overall, our reiteration of our first prototype to our second version was seen more successful. As opposed to our first testing, the second prototype was created for all holes of the landfill and recycling bins so that the stakeholders would use the prototypes. Each stakeholder who used the prototype was engaged by the signage and sorted their food scraps on one side of the divider and

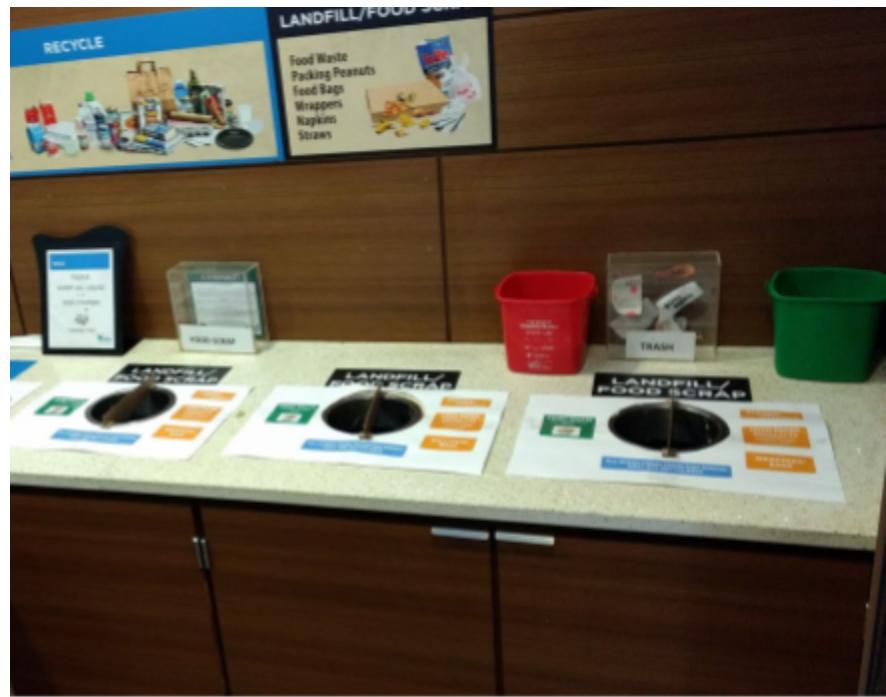


Image: Our second prototype in place over the trash receptacles. Over each hole is a divider, and around each hole, a sign with what to put into the receptacle.



Image: A trash bin almost perfectly sorted without recyclables.

physical trash on the other side. It was observed that the users at Pines dining hall stopped in front of the prototype to read the signage and successfully separate their trash. If the user still had plastic left as trash, they would then move on to the recycling bin and dispose of their plastic trash into the correct bin. In one instance, a girl was observed to a plastic cup and was

in the motion of throwing it into the landfill bin. However, she stopped due to our prototype, read the signage and proceeded to throw it into the recycling bin. In the picture below, one trash can was successful in having only food waste and physical trash.

As for the other two trash cans, plastic was accumulated inside but at a very small amount. There no more than four pieces of plastic in each of the other two landfill holes.



Images: A look into the trash bin after applying the live prototype in Pines. There are a few plastic containers, but not many.

The stakeholders were able to use the prototypes in an efficient way and the friction that was added to the prototype was effective in the sense that the users were able to separate their trash in an easier effort while not taking too much time. Although this success was met as a goal, there were still some complications that came with the final prototype design. One complication that was still present was the use of too many words in our signage. The prototype was designed to give a clear designation of majority of the trash, but without the perfect wording for the icons, it caused some users to take more time to read the signage and have other users wait behind.

Pictures of items, instead of words, would be ideal, as suggested by Professor Scott after our final presentation.

Even though there were some flaws in our final prototype, the goal to raise awareness and have users be more aware of trash separation and recycling was still a success because we were able to reach users who would have thrown recyclables into the landfill hole.

VII. Future Work

While we did experience greater success in our prototype testing sessions, we do see potential for future iterations in order to further address our design problem. In the case of the actual design of our model, having more sessions for user testing and feedback could ultimately be beneficial. While most of our testing occurred on the weekends and in the afternoons, when the use of the dining halls was considerably less than during a lunch rush, there could potentially be more insights from users interacting with the model when the dining hall experiences high traffic. Furthermore, although our model did suffice in creating more accurate sorting behaviors, we still experienced some individual deviations, with some individuals putting incorrect items in each bin. In order to address these users, adjustments in signage and content may be useful in being more clear and concise. Specifically, we see a particular opportunity to see how our stakeholders respond to changes in the addition or removal of particular words or pictorial elements. This may also enhance how people get information out of the model to promote the spread of lasting knowledge.

Another line of iteration may lie with accommodating for the OZZI Box implementation in the future. Given that OZZI boxes replace all dining ware, then our solution will be obsolete to a certain degree. Since waste items in dining halls become simplified, student shouldn't need the same sorting instructions as the ones we currently have. In theory they should only have compost and recycling items at that point, at least exclusively within the dining hall system. Thus our solution becomes obsolete unless we adapt its usage to compost bins or perhaps throughout the whole campus.

In our validation interviews, we also discovered a cultural aspect that influenced how people interacted with the prototypes. For instance, one individual who came from China, asserted that trash and recycling sorting is not emphasized at all and most items go into the same bin. A second student corroborated this point and agreed when Will proposed that her trashing all her recyclables was perhaps due to her upbringing in China. Neither of the two bothered to read the signage placed around the holes, out of habit. These findings demonstrate that, even despite the amount of signage and physical constraints placed on the trash and recycling bins, the issue may have more ideological foundations. As a result, it may be interesting to investigate how to get all students, including international students, to reach the same base level of recycling/trash fluency in order to promote more sustainable behaviors, perhaps through hands-on seminars/workshops/presentations at orientation sessions. If we are to facilitate getting all students on board with the campus sustainability movement, it is essential to reach outlier cases and those who don't read signage in the first place. In this situation, the outlier cases are actually a significant student population, as if we look at the UCSD undergraduate profile for 2017-2018, we see that 19.5% of undergraduates are international students, and 37.6% are Asian. Thus, offering a quick seminar to the international students from China may prevent a significant amount of improper waste disposal.

IX. Conclusion & Reflection

We came into this project with some knowledge of the human centered design process, but throughout the quarter, we really learned the importance of interacting with the stakeholders, the people who this design is primarily meant to affect. From our interviews and observations of stakeholders, we learned that our design worked to really slow people down when throwing their trash away, but some would still not use the receptacle properly, and often it would be . From this, we could tell that even though the project time is up, there were still a bit of issues to fix with the prototype. We learned that empathy was a large part of learning how to put ourselves into other people's shoes, and that even if we are our own stakeholders, it definitely still requires getting an outside perspective to clear our assumptions. We also learned that collecting hard evidence is the most important aspect of human centered design, as it allows us to base our design decisions on something concrete, and it prevents us from implementing something completely unnecessary. We learned that iteration is really important and paramount for improving the design, as the first design is never guaranteed to be perfect, and will often have flaws, as we found out with our first prototype. The way we created ideas from the affinity diagrams made it such that we addressed multiple concerns and/or comments fixated around a unified idea, which made our design all the more robust in terms of how it solved problems. We also learned that while less friction means that users are more amenable to the idea, it doesn't necessarily mean that less friction is better. We actually increased the amount of friction in some of our earlier design ideas in order to slow down people and make them think about what they're throwing away, which was a major factor in ensuring our design worked as effectively as it did. Towards the end of the process, we learned that a lot of our unchallenged assumptions would

come back to bite us in the end, as we found that culture played a big role in why people were so poor at recycling well.

X. References

UCSD Undergraduate Profile 2017-2018. Retrieved from:

http://ir.ucsd.edu/_files/stats-data/profile/profile-2017-2018.pdf