IDSA

WISHCYCLE

REFRAMING THE VALUE OF PLASTICS THROUGH EDUCATIONAL GAME DESIGN

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PAPER ABSTRACT: Research demonstrates how socially modeled consumer behaviors can be adapted with incentives; to encourage active learning of often tedious recycling rules, we present an interactive game called "WishCycle" for mobile devices that teaches players how to distinguish common plastics by augmenting the recycling experience with game elements. While the player's attention is focused on a game, data about consumer preferences is compiled on the backend. The experiment gamifies an Implicit Association Test (IAT) mechanism to evaluate when test subjects reflexively categorize comparable stimuli into binary categories, then analyzes for biases. Our game perpetuates desirable behaviors by pairing real items that must be sorted for rewards and immediate feedback for each selection. The combination of recognizable products and positive reinforcement reframes the chore of recycling into a fun experience that educates consumers about sustainable consumption practices while also documenting how players interact with specific items.

Keywords: Gamified Education, Cultural Change, Sustainable Practices, Product-Service System Design

1. INTRODUCTION

Since the midcentury rise of plastics' popularity and exponential growth of production, plastic pollution has been concomitant. Pollution is a measurable result of insufficient recycling amidst increasing production rates (Dent, 2020). Researchers indicate that plastics have infiltrated even the most remote corners of the planet where it will take decades, if not centuries to degrade (Wilke, 2020). In populous regions that generate a significant amount of waste, specifically in Houston, TX, rampant plastic consumption is supported by the misperception that any and all plastics can be recycled if placed in the recycling bin, when in reality, recycling rules depend on local infrastructure (Prabhu et al, 2020). Contributing factors include the prevalence of plastic packaging, misleading Resin Identification Codes, and a single-stream recycling infrastructure that encourages aspirational recycling (Nemat et al, 2019). Consequentially, consumer societies rely on plastics but know very little about distinctions between grades (Humes, 2019). Because the problem is deeply systemic, improvement will require identifying and unpacking consumer motivations to pollute.

Our hypothesis that a gamified test can passively educate consumers about types of plastics and recycling procedures was tested in a three-phase Product-Service System model, guided by a long-term vision for sustainable plastic management seen in Figure 1. Due to the immensity of the problem, the Investigation phase narrowed the breadth of research into an actionable Experiment phase. The ongoing experiment as the product itself is continuously refined in the third Scaling-up phase.

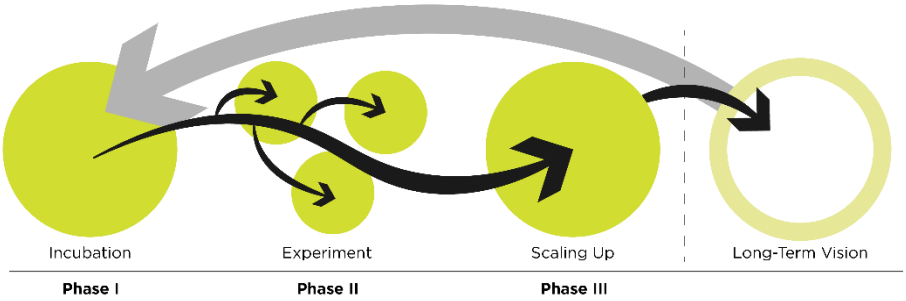


Figure 1. The Product-Service System model.

2. INVESTIGATION

Due to the immensity of plastic pollution, solutions require systemic change (Rittel & Webber, 1973). In order to reverse engineer practical steps toward a sustainable future, and to perform precise research within a limited timeframe, this scope of research converged on how plastic is consumed and the infrastructure by which it travels. An inductive logic approach was used to gather informative qualitative data from industry reports, visiting facilities, interviewing experts, and observing consumers in the Investigation phase. Broad findings informed about infrastructure, unique problems, and opportunities for improvement. Those findings directed divergent research into methods for educating consumers, which were further narrowed into actionable goals.

2.1 ANALYSING THE STATE OF THE INDUSTRY

An investigation revealed that most contamination occurs when people attempt to recycle non-recyclable materials (colloquially referred to as “wish-cycling”) (Prabhu et al, 2020). Without immediate feedback, even people who agree recycling is important may habitually misplace non-recyclables. Growing contamination from aspirational recycling practices threatens the economic viability of recycling as a whole (Dance, 2018). The phenomenon is symptomatic of misinformation about the lifecycle of plastic packaging, which leads to consumer biases. Environmental cues that plastic can be infinitely returned to a useful form assuage consumers’ doubts about recyclability (Humes, 2019).

Evidence suggests that most people find recycling tedious and often confuse what makes plastic recyclable (Workman, 2015). Behavioral economics research indicated a “distortion bias” that prevents deformed items from being considered recyclable. These findings suggest perceptions can be manipulated, but people must be informed and involved in shaping that perception. Consumer behaviors are dictated by emotional responses, capable of being manipulated and socially embedded (Ariely, 2008; Carruthers, 2006; Sangiorgi 2010). Two things become apparent: a measurement of implicit bias is necessary to shed light on the underlying assumptions people have about what is recyclable (Brownstein et al, 2020), and learning is easier when it is fun (Jones, 2015).

2.2 HOW DESIGNERS HAVE INITIATED CHANGE

To invigorate an otherwise boring activity, gamification strategies were investigated for insights. Gamification is described as, “…the use of game design elements in non-game contexts.” (Deterding et al, 2011). Popular examples of a successful rollout demonstrate how reward-driven competition can bolster user engagement, as Samsung’s *Badgeville* saw 66% more users submitted 447% more product reviews by introducing incentives (Swallow, 2012). Gamification is also a means for crowdsourcing

solutions from users, as the University of Washington demonstrated when gamers solved a protein configuration in just three weeks that had baffled scientists for over a decade (Gray, 2011). It was discovered that gamification can enhance the salience of educational experiences by making them more memorable (Sterelny, 2003). What might be perceived as a stressful task is instead reframed as an exciting journey (Rober, 2018). Unfortunately, precedent educational games often lack convincing incentives, which in turn challenge a player's attention span (Sailer et al, 2016).

Studies cited in this research indicate that younger generations who will be most affected by environmental degradation are highly receptive to messaging about sustainability, so qualitative and quantitative insights will outline paths to address generational issues with recycling (Wals, 2017). Additionally, their input in consumption practices will affect how their parents purchase and dispose of recyclable materials in the home (Kraak & Pelletier, 2016). Therefore, industries will benefit from relating to this key demographic's values and cultivating future purchasing power.

Cultural anthropologists argue that intergenerational cognitive capital is amplified by multi-source oblique transmissions of cultural variants. In other words, ideas and values can be shared across a culture in a non-hierarchical flow; information can originate from horizontal inputs and learned experiences (Siemens, 2017). In the context of cultural change, the norm activation model proposed by Schwartz suggests that systems can foster cultural norms by incentivizing a widespread behavior with a tangible outcome efficacy (Onwezen, 2013). These cultural norms influence personal norms and thus behavior, which produces incremental improvements in the social sphere (Sterelny, 2003; Van der Werff, 2016). In her research on digital experience design, Leung (2010) reasons that every digital experience demands some form of tacit learning on the part of its users because learning is a fundamentally emotional construct (Boud & Miller, 1996). It is reasoned that emotional perceptions about the value of plastics can influence recycling practices over time, so it is important to understand the biases that cause recycling mistakes in order to effectuate desired behavior.

2.3 USING DESIGN TO GENERATE AND COLLECT DATA

The Product-Service System (PSS) approach, as described by Vezzoli (et al, 2014) and explored by Ceschin (et al, 2013), perpetuates the niche industry that the design is intended to serve, analogous to a self-fulfilling prophecy. In this methodology, researchers use socio-technical experiments to introduce test subjects to that very innovative product or system (Van den Bosch, 2008). The PSS as a data collection tool serves the purpose of gathering data to refine the final design, simultaneously popularizing the innovation amongst an intended audience.

An Implicit Association Test (IAT) is a computer-based exercise that measures the strength between concepts in memory by rapidly assigning items onscreen into one of two categories. The test assumes Piaget's theory of intelligence (1976) that suggests people impose cognitive structures on objects as a means of understanding them (Yolles, 2020). When subjects must rapidly associate a series of stimuli with the correct category in the test, patterns emerge from measurements of time it takes a subject to respond. As each proceeds through the test, reactions to onscreen stimuli reveal subconscious preferences (Brownstein et al, 2020); which is why the test has been popularized as a tool for consumer research (Hao & Wang, 2013). Outside of the test portion, a survey collects self-reported data that can

be compared to the results of the test. The IAT provides a metric for attitudes that are otherwise difficult to quantify (Fazio, 1990).

Qualitative questions that were pursued asked how individuals feel about recycling, why they feel that way, and whether they believe their consumption habits make any substantial difference. More broadly, the research inquired what drives change in the plastic and recycling industries.

3. RESEARCH METHODS & DESIGN PROCESS

3.1 RESEARCH METHODOLOGY

Research was executed in three divergent and convergent phases, guided by a long-term vision for circular plastics. An inductive qualitative Investigation including literature reviews, interviews, and observations corroborated a need for more nuanced data; a mixed-methods approach was necessary to thoroughly analyze the data collected. Findings led to the development of an engaging data collection tool to be evaluated in the second Experiment phase and expanded in the third Scaling Up phase.

The PSS is overlaid on an IAT in what Creswell (2014) describes as an *embedded experiential design procedure*, by adapting aspects of the test to the design of the game. In this paper, we describe the development and execution of the ironically titled "*WishCycle*" game as a means for collecting data and modifying consumers' context for plastics. The purpose for this study was to address systemic causes of plastic pollution by testing whether individuals could learn to associate post-consumer plastic with real-world value.

3.2 WISHCYCLE DEVELOPMENT & DESIGN APPROACH

Considering findings about what audience will be most susceptible to lessons about recycling, we disguised the IAT as a virtual cartoon game called "*WishCycle*," where plastic items on screen must be sorted into 'trash' or 'recycling' categories for points while an emotive mascot reacts to the validity of each selection in real time. The final concept is aimed at creating a more informed customer base that will raise demand for sustainable packaging.

Initial data was collected from the broad literature review, interviews with experts, and observations. A number of informal observations and interviews were conducted with parents who take their young children grocery shopping. In general, parents want to (1) encourage healthy consumption practices, (2) engage their children with educational entertainment, and (3) distract their children from the myriad temptations of attention-grabbing toys and sugary foods. In many cases, parents will sacrifice the first two points to avoid potential tantrums, resorting to distractions such as cartoons or video games. Observations also found a significant number of people using their phones while shopping.

Research that led to the development of *WishCycle* was already underway when the COVID-19 pandemic began, and social distancing became a major consideration. Attaining data through interviews and surveys was impacted as a result, so the form of the experiment adapted accordingly. A sharp uptick in virtual shopping as a result of lockdowns inspired a virtual rollout of the final design as the experiment tool itself. Because most shoppers and their children have access to smartphones, the medium for such a game was obvious.

PROTOTYPE FOR A DATA COLLECTION TOOL

Data collected from interviews and observations guided the development of *WishCycle*. Our design

concept was to distract users with an immersive challenge, then gauge whether players glean accurate recycling knowledge or false confidence from the interaction, while durations of decisions in the game are recorded. Incentives for interaction were applied to maximize player engagement. An initial data gathering tool was directly modeled in the IAT format by displaying visual stimuli to be sorted into one of two categories, which are written out at the top corners of the screen. The only feedback in this setting is when a virtual object is sorted incorrectly, and the test subject must select the correct category to proceed in the timed test. However, to incorporate findings about gamification and instituting cultural change, it was decided to make the final concept resemble other app-based games that only serve entertainment purposes (see Figure 2). Engaging elements from these games such as points and competition were replicated in the cartoon world of *WishCycle*. Much like popular kid's cartoon games that use ironic humor and challenging levels to appeal to adult viewers (e.g. *Where's My Water?*), the game is intended for a wide range of players.

Our proposed PSS design is manifested as a virtual challenge to be played on a smartphone, built using the Unity game engine. An easily-downloadable app assures parents their children will be distracted with an engaging, educational game that promotes healthy behavior.

Figure 2. Items lined up to be sorted in the virtual game setting for WishCycle.

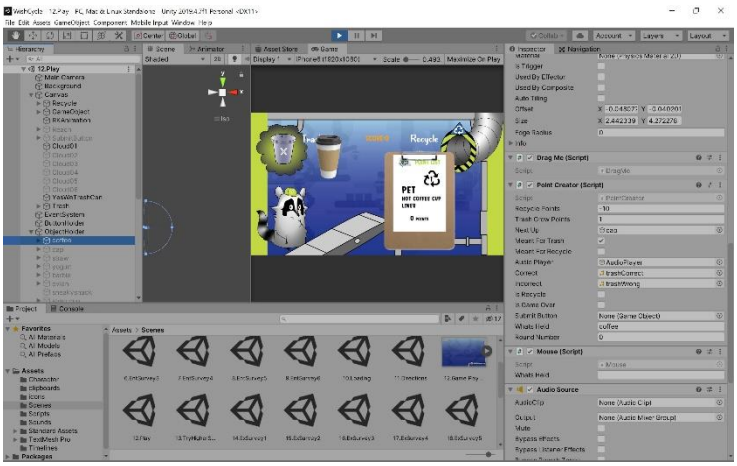
DESIGNING THE GAME

The name of the game ties into the game's "magical" theme and ironic humor. The user plays as Rice Krispy the Recycle Racoon, who must correctly sort enough post-consumer waste to find the magic wand, which ends the 1st level. Data generated from the experiment will inform improvements and future levels, contributing to a game universe that grows with more data input from more players.

BUILDING THE GAME

The capabilities of the game as an entertainment vehicle and data collection tool were made possible with Unity software. Complexities of each item were scripted using the C# coding language. Figure 3 demonstrates how points were modified to each item and displayed on the representative clipboard for that item. Pseudocode is provided that demonstrates the backend sorting algorithm for how the game will respond to an item designated for trash.

```
private void OnCollisionEnter2D(Collision2D col)
```



```
{
    if (col.gameObject.tag == "Trash")
    {
        KeepScore.TrashGrow += TrashGrowPoints;
        if (isRecycle == false)
        {
        audioData.PlayOneShot(Correct,1);
        }
        else if (isRecycle == true)
        {
        Handheld.Vibrate();
        audioData.PlayOneShot(Incorrect,1);
        }
        if (isGameOver == true)
        {
        SubmitButton.SetActive(true);
        return;
        }
        NextUp.SetActive(true);
        Destroy(gameObject);
}
```

Figure 3. Point specifications by item in Unity game engine.

THE CHALLENGE

The game asks users to enter their zipcode before playing so that recycling rules can be adapted and confusion avoided. For example, some items made from a high-value material cannot be recycled in localized infrastructure and are therefore non-recyclable. Feedbacks delivered in several forms (e.g. sounds, vibrations, lost points, character reactions, and events onscreen) are intended to convey the nuances of recycling plastics based on local rules, shown in Figure 4. In addition to rudimentary feedback that indicates right or wrong, a message displays material information about an incorrectly sorted item. The range of possibilities include right and wrong choices, as well as missed opportunities when a recyclable item doesn't get properly recycled or a player recycles without cleaning.

Figure 4. Multiple feedbacks indicating a player's incorrect selection.

THE EXPERIENCE

A player's actions will dictate how Rice Krispy reacts and the cumulative total in the point bank and the trash cloud. More wrong moves in a sequence will cause the trash cloud to grow, the point bank to shrink, and Rice Krispy to become increasingly frantic. If the trash cloud grows too large and touches Rice Krispy, the character catches rabies and the player is presented with an opportunity to try again. However, when enough points are earned and Rice Krispy discovers the magic wand, the game is won, and the respective dataset is sent to the researcher for analysis. During the game, a clipboard with details about each item is available in the bottom corner that a player can drag up to review. To earn

more points, a player can “clean” certain items by feeding the contents to Rice Krispy and break down complex items. Such tasks that mirror real-world procedures add to response duration, which indicates how a player is interacting with the virtual items onscreen.

Like the IAT the game is structured upon, an entry and exit survey provide context for the researcher and prime the subject for the task at hand. Explicitly stated self-rankings of recycling skills are compared to that player’s performance. At the end of the experiment, a quiz asks each subject several questions related to items shown in the game. The UX flow for the experiment is illustrated in Figure 5.

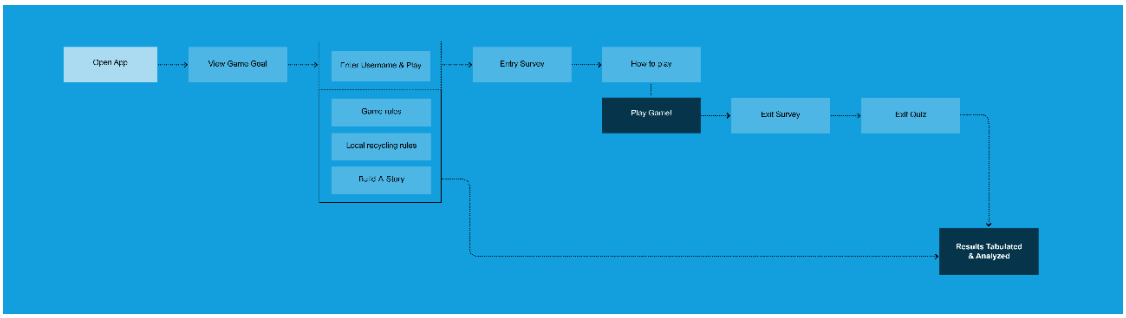


Figure 5. UX flow for WishCycle experiment.

USER JOURNEY

Refer to Appendix A for visualization.

4. RESULTS

The game-as-experiment was made available to play remotely, so subjects could contribute data while maintaining social distancing guidelines. Datasets from each experiment were analyzed for consistencies and compared to the total data pool.

Results indicated that details about procedures of the game were still gleaned by players whose test times confirmed self-reported focus on speed over accuracy, though players who took longer to process each item generally performed better. More than half the participants responded correctly to every section of the final quiz portion. When results from the explicit self-reporting sections were compared with test scores using a PSPP statistics tool, evidence suggested a statistically significant inverse relationship between a test subject’s trust in local infrastructure and performance in the experiment; subjects who indicated a higher level of distrust were more likely to reach a higher score.

5. DISCUSSION

Questions about consumer attitudes in the investigation phase were quantified in the experiment. Generally, apathy for recycling stems from ignorance about the value of materials, which enables proliferation from plastic producers; knowledgeable consumers make informed purchasing decisions.

PLAYER RESPONSES

Subjects who played *WishCycle* were surveyed as a part of the experiment. A majority of the official IRB-sanctioned test-takers confirmed their preexisting biases about recyclable items and expressed interest in avoiding wishcycling in the future. Not included in the official results due to IRB restrictions, six children between 5 to 12 years old who also played the game performed similarly to older test

subjects; however, all children surveyed expressed interest in finding out more about the game universe and Rice Krispy.

IMPLICATIONS & SPECULATIONS

People who play *WishCycle* are encouraged to associate contexts for the plastic items they see onscreen into analogous items in everyday life. The game uses points to distinguish value between items, which is otherwise invisible in real-world settings. Players are introduced to these items in terms of how much they are worth to recycle. It would stand to reason that high-score items impress positively on players, which in turn reinforces positive perceptions about the brand on the label. Reciprocally, brands would feel pressure to improve favorable perception of items that are worth less in the game. In the short-term, people who play *WishCycle* would be less likely to recycle in error and reduce contamination in recycling streams.

When more people have access to the *WishCycle* experience, their confidence to recycle correctly will be increased. As future levels in the game become increasingly complex, players will learn more about what plastics are recyclable; setting expectations for a younger generation will raise demand for sustainable packaging options over time. Moreover, it invites players to become more conscious about the lifecycle of plastic purchases and question why plastics are so prevalent in the first place.

The most significant takeaway from this research is that gamification principles can make learning about tedious topics enjoyable. Future research can expand on the guidelines established in this study to educate while measuring emotional responses, then using the data collected to improve education.

6. CONCLUSION

WishCycle was developed as an engaging way to learn how to recycle. The hypothesis that players will learn passively was verified by an improvement in procedural knowledge after playing the game. Research questions about what drives consumer behavior toward plastics were explored through diverse investigations. People display an overall desire to recycle but struggle to discern what is recyclable; learning rules is generally unexciting. However, research revealed desired behavior can be incentivized with rewards, or points, in a gamified system.

Plastic pollution is a very real issue that requires pragmatic action. This study suggests that humans are skilled at adapting abstract concepts into real situations; direct parallels from *WishCycle* that inform about real-world practices ease that process. In this paper, we presented an interactive game that reframes managing plastics into an exciting journey. The incorporation of an expressive mascot and competitive elements encourage players to retrain mental models for interactions with plastic waste.

In the future, the game could be applied in a grocery store setting to deliver customer data-driven services that respond to a stimulated demand for sustainable packaging. More in-depth testing will include wider studies in the target demographic with advancing game levels to compare wider player data, and eventually offer rewards beyond the digital restrictions of a game universe. Larger implications about gamification may inspire future designers to improve on the model explored in this research.

7. REFERENCES

Ariely, D. (2008). Predictably irrational: The hidden forces that shape our decisions. London: Harper Collins.

Boud, D., & Miller, N. (1996). *Working with Experience: Animating Learning*. Routledge.

Brownstein, M., Madva, A., & Gawronski, B. (2020). Understanding Implicit Bias: Putting the Criticism into Perspective. *Pacific Philosophical Quarterly*, *101*(2), 276–307. Retrieved April 16, 2021 from https://doi.org/10.1111/papq.12302

Carruthers, P. (2006). The Architecture of the Mind. Oxford: Oxford University Press.

Ceschin, F. (2013). *Sustainable Product-Service Systems: Between Strategic Design and Transition Studies (SpringerBriefs in Applied Sciences and Technology)* (2014th ed.). Springer.

Creswell, John W. (2014). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. Thousand Oaks, California: SAGE Publications.

Danigelis, A. (2020, May 07). TerraCycle Launches Loop Circular Delivery Service with Major Brands. Retrieved April 18, 2021 from https://www.environmentalleader.com/2019/01/terracycle-circular-delivery-loop/

Dance, S. (2018, June 20). *People are throwing too much garbage in the blue bin – and it's upending the economics of recycling*. Baltimore Sun.

Dent, M. (2020, March 25). *The Plastic Problem is Getting Worse. Could Bioplastics be the Answer?* IDTechEx. Retrieved on April 16, 2021 from https://www.idtechex.com/en/research-article/the-plastic-problem-is-getting-worse-could-bioplastics-be-the-answer/20194

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From Game Design Elements to Gamefulness: Defining "Gamification". Paper presented at the 15th International Academic MindTrek Conference, Tampere. Retrieved on April 16, 2021 http://dx.doi.org/10.1145/2181037.2181040.

Fazio, R. H. (1990). Multiple Processes By Which Attitudes Guide Behavior: The Mode Model as an Integrative Framework. In 1048654349 801246489 M. P. Zanna (Author), Advances in experimental social psychology (pp. 75-109). San Diego, CA: Academic Press. - Fazio 1990

Gray, L. (2011, September 19). *Gamers succeed where scientists fail*. UW News. Retrieved on April 18, 2021 from https://www.washington.edu/news/2011/09/19/gamers-succeed-where-scientists-fail/#:%7E:text=After%20scientists%20repeatedly%20failed%20to,called%20in%20the%20Foldit%20players.&text=Firas%20Khatib%20was%20one%20of,skills%20of%20Foldit%20game%20players.

Hao, H., Wang, Y. Implicit Association Test and Consumer Psychology[J]. Advances in Psychological Science, 2013, 21(10): 1865-1873.

Humes, E. (2019, June 26). *The US Recycling System Is Garbage*. Sierra Club. Retrieved on April 13, 2021 from https://www.sierraclub.org/sierra/2019-4-july-august/feature/us-recycling-system-garbage

Jones, E. B. (2015, September 16). *The Fun Theory*, Penn State.

Kraak, V., Pelletier, D. L. (2016, September 18). *The Influence of Commercialism on the Food Purchasing Behavior of Children and Teenage Youth*, Division of Nutritional Sciences, Cornell University.

Leung, L. (2010). *Digital Experience Design: Ideas, Industries, Interaction* (2nd ed.). Intellect Ltd.

Nemat, B., Razzaghi, M., Bolton, K., Rousta, K. (2019). "The Role of Food Packaging Design in Consumer Recycling Behavior—A Literature Review." Sustainability 11, no. 16: 4350.

Onwezen, M., Antonides, G., & Bartels, J. (2013). The Norm Activation Model: An exploration of the functions of anticipated pride and guilt in pro-environmental behaviour. *Journal of Economic Psychology, 39*, 141-153.

Pashak, T. J., Conley, M. A., Whitney, D. J., Oswald, S. R., Heckroth, S. G., & Schumacher, E. M. (2018). Empathy Diminishes Prejudice: Active Perspective-Taking, Regardless of Target and Mortality Salience, Decreases Implicit Racial Bias. *Psychology*, *09*(06), 1340–1356. Retrieved on April 13, 2021 from https://doi.org/10.4236/psych.2018.96082

Prabhu, A. Davis-Peccoud, J., Branden, J., & Mattios, G. (2020, April 6). *Solving the Consumer Plastics Puzzle*. Bain. Retrieved on April 18, 2021 from https://www.bain.com/insights/solving-the-consumer-plastics-puzzle/

Rittel, H.W.J., Webber, M.M. (1973). Dilemmas in a general theory of planning. Policy Sci 4, 155–169.

Rober, M. (2018, April). The Super Mario Effect: Tricking your brain into learning more. Retrieved April 18, 2020 from https://www.ted.com/talks/mark_rober_the_super_mario_effect_tricking_your_brain_into_learning_more?language=en

Sailer, M., Hense, J., Mayr, S., & Mandl, H. (2016, December 23). How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. Retrieved April 8, 2021 from https://www.sciencedirect.com/science/article/pii/S074756321630855X

Sangiorgi, D. (2010). *Transformative Services and Transformation Design*. ImaginationLancaster, Lancaster University.

Smith, T. (2012, September 26). *Implementing gamification and social media for business: Q&A with Casewise*. Tech Monitor. Retrieved April 13, 2021 from https://techmonitor.ai/techonology/data/implementing-gamification-and-social-media-for-business-qa-with-casewise

Sarasvathy, S.D., Dew, N. (2005). New market creation through transformation. J Evol Econ 15, 533–565.

Sassen, S. (2004). Local Actors in Global Politics. Current Sociology - CURR SOCIOL. 52. 649-670. 10.1177/0011392104043495.

Siemens, G. (2017, January 1). *Connectivism – Foundations of Learning and Instructional Design Technology*. Pressbooks. Retrieved on April 18, 2021 from https://lidtfoundations.pressbooks.com/chapter/connectivism-a-learning-theory-for-the-digital-age/

Sterelny, K. 2003. The Evolution and Evolvability of Culture. Victoria, Australia: Australian National University.

Swallow, E. (2012, January 20). *How Badgeville Is Gamifying the Internet*. Entrepreneur. Retrieved on April 16, 2021 from https://www.entrepreneur.com/article/222657

Van den Bosch, S.J.M, & Rotmans, J. (2008). Deepening, Broadening and Scaling up: a Framework for Steering Transition Experiments.. Knowledge Centre for Sustainable System Innovations and Transitions (KCT).

Van der Werff, Ellen & Steg, Linda. (2016). The psychology of participation and interest in smart energy systems: Comparing the value-belief-norm theory and the value-identity-personal norm model. Energy Research & Social Science. 22. 107-114. 10.1016/j.erss.2016.08.022.

Vezzoli, C., Kohtala, C., Srinivasan, A., Xin, L., Fusakul, M., Sateesh, D., & Diehl, J. C. (2014). Product-Service System Design for Sustainability. Sheffield, UK: Greenleaf Publishing.

Wals, A. E. J. (2017). Sustainability by Default: Co-creating Care and Relationality Through Early Childhood Education. *International Journal of Early Childhood*, *49*(2), 155–164. Retrieved on April 16, 2021 from https://doi.org/10.1007/s13158-017-0193-5

Wilke, C. (2020). “Plastics are showing up in the world’s most remote places, including Mount Everest,” ScienceNews, Retrieved on April 3, 2021 from https://www.sciencenews.org/article/plastics-remote-places-microplastics-earth-mount-everest

Workman, M. (2015). “Sorting out collection systems,” Recycling Today. Retrieved on April 16, 2021 from https://www.recyclingtoday.com/article/rt0615-municipal-recycling-debate/

Yolles, M. (2018). Sustainability Development: Part 1 - from the cybernetic of cybernetics to the cybernetics of development, International Journal of Markets & Business Systems, Vol. 3, Iss. 3.

APPENDIX A

Player Journey Map: Grocery Store Setting

Child

- Knows how to elicit certain allowances from parent: good behavior usually results in rewards.
- Plays other developmental games that are designed to build logic skills through fun challenges.
- Generally unexcited by the idea of going to the grocery store, but knows there are certain aisles that have candy and other things their parents don't want them to have.

Spread awareness to new players.

	Awareness	Download	Play	Learn	Earn	Challenge
Thoughts:	"something grabbing my attention in the grocery store must be fun."	"this looks like other games I like. the process is familiar."	"I'm good at this! I want to help Rice Krispy win."	"I didn't realize how much plastic I use everyday."	"I won!" "I'm helping with groceries!"	"I can do better than my friends, I should invite them."
Actions:	asks parent to download app.	takes the device with new game downloaded.	plays while shopping. has an excuse to play games.	improves playing skills. advance levels.	wins points. builds a point bank.	invites friends to play.
Emotions:	excitement, escapism, curiosity	excitement, inquiry	entertained, challenged	frustration, excitement, suspense, investment	pride, fulfillment, honor	competition
Touchpoints	Advertisement invites players to download app.	QR code eases the process of beginning a game.	The game is played on the shopper's existing device.	Players pick up directions for how to properly recycle.	Points translate to in-store discounts and savings.	The app can be shared for competition.
Thoughts:	"I want to distract my child w/ something educational"	"This looks like other games I let my child play."	"My child is sufficently distracted."	"My child is enjoying this game."	"My child can help save money on groceries by playing this game!"	"This is pretty awesome, I should share this with my friends who have kids."
Actions:	helps download the game.	creates profile, enters zip code.	shops uninterrupted.	continues shopping.	encourages child to win. becomes involved.	shares, invites, joins.
Emotions:	interest, concern for child's development	relief, inquiry	relief, inquiry	relief, inquiry	curiosity, pleasure, pride	appreciation, competition

Parent

- Prepares to run errands with child by making sure they have entertainment, tries to avoid triggers that might set off a tantrum (like seeing candy in the store).
- Keeps an eye on what media child consumes by regulating what games are allowed on their smartphone or tablet.
- Interested in saving money by avoiding superfluous buys at the grocery store and using coupons.

Parents learn how to recycle better and buy responsibly.

Opportunities	• Partner with a grocery store. • Make a catchy advertisement. • Emphasize both parties' points of interest in the promo.	• Provide a quick summary of the game in download. • Build child's investment in the game universe. • Explain goals to parent.	• Reinforce rewards in the experience with stimuli. • Use captivating screen sequences and visual cues.	• Make it easy to win AND lose points. • Provide pop quizzes and opportunities to earn more points.	• Emphasize winnings and show visuals about how points can transfer. • Connect the dots with plastic in the game and plastics in real life.	• Introduce idea of challenging friends. • Ease the process of sharing the game.