

Society's lack of understanding of the immediate link between their food consumption, energy intake, and the associated physical activity necessary to meet the energy expenditure. A better understanding between the link will have substantial positive health impacts. Our game intends to create a gameplay link between calories consumed and the effect this has on the body. In this way, we want to enforce a mental connection that can be transferred to the real world. The game explores the many factors that influence how a person chooses their diet, how calories are communicated to the consumer through labelling, as well as the effect this calorie intake has on the body and mind. The process that communicates calories to the consumer do not align with the knowledge of the general public, and are thus ineffective. *Intake - Outtake* aims to bridge this gap. A combination of gameplay mechanics and in-game labelling are used to communicate the effects of unhealthy and healthy eating habits.

Time scarcity and ease of access affects our food choices/contributing factors to our food choices. There are a variety of factors contributing to our food choices, these can include time scarcity, financial capabilities, and upbringing. In the daily life of a working person they wake up, go to work, and come back to sleep, and within that time they need to fit in meals such as breakfast and dinner. However, sometimes there may not be enough time to fit all that in, especially for a really busy person. Some people may feel cooking is well worth their time, others may feel it is not necessary or worth their time. (Jabs, J., & Devine, C. M., 2006). In this situation the character is a very busy person with all their daily activities such as cleaning up the house, going for a walk and other tasks that take up their time and energy. When a person has spent a lot of their time doing activities and using up all their energy and with little time left in the day. The character you play has an energy level which is affected by the time scarcity and choices in food you make, this may end up determining your choices in dinner as well, if there is not enough energy or time left to create a healthy meal and instead buy take out. A person's financial capabilities directly affects their ability to buy desirable foods - as typically healthy, fresh produce is more expensive in supermarkets - or so people think. In America, for example, a meal at McDonalds can be as low as \$2 which is appealing to the consumer's eye, especially with a tight budget. Funnily enough, if proper research is undergone, it can be found that buying healthy meals at the supermarket is cheaper. This proves that although one's budget can affect their food choices, so can the influences of society and societal norms. Fast food industries can be seen as the downfall of America's health. On another note with upbringings and how a standard American family can be seen buying take out quite often, the children may never learn or be bothered to learn how to cook

foods or what to do when it comes to dinner, lunch or any meals. This causes a lack of knowledge of food, the person would go for the safest and only option they would know due to their previous years with their parents, buying take out.

When it comes to deciding what to eat, a key factor in guiding our decisions is the food nutritional labelling. Research by the Centers of Disease Control and Prevention have found the following. Amongst the consumers that classify themselves as weight concession, 81 percent happen to read the nutritional panel. From which they evaluated their decisions (The Hartman Group, 2016). The nutritional labeling displays information such as the fat, protein, sugar and calories in the product. A key driver in the nutritional labeling section is the calories. Calorie labeling has been implemented to guide consumer behaviour, however the effects of behaviour change has been minimal (Viera et al., 2017). The behaviour change here is referred to as the awareness and understanding when making food related choices. When a consumer has to make a decision about their food choices they should be able to understand the effects of what they are about to consume. A research by the Calorie Control Council found that out of 1024 people surveyed, only 12% understood the calories they consumed on a day to day basis (Calorie Control Council, 2015). This clearly proves the fact the having such sections in the nutritional section of food isn't as effective as it is assumed to be. An alternative to calories labeling is physical activity calorie equivalent (PACE) labels. Which instead displays the calories in a symbolised manner by stating the minutes of exercise needed to burn off the calories (Yang et al., 2021). Using this method of displaying PACE labeling has proved to be successful in lowering the amount of calories a consumer ordered, by 65 Kcal (Seyedhamzeh et al., 2018). Using this research, a game element in our game was developed. With the idea of experimentation, our game gives the player a choice between various food options. The game deliberately implements different methods of nutritional labeling, which is split into different scenes. The first method is to display no nutritional labeling, just price. The object for the player here is to make the decision based on their prior knowledge. The next method is to provide the player with a nutritional panel with PACE labeling. This will hopefully allow for behavioural change in the player. Seeing the impact of the food you are able to consume will affect the decision. The final method is to display a regular nutritional label, with the calories in Kcals. Through the iteration of these methods, the aim is to educate the player around the importance of understanding the effect of your food choices.

The effects of caloric intake is often not understood by both younger people and adults. For this reason we wanted to display these effects to the player, as well as the relationship it has with exercise. The Texas Obesity Research Centre collected information from middle school students (aged 12-15), and concluded that the students “do not understand that calories are a measure of the energy content of food” nor the “physical activity...required to expend the calorie content.” This reflects that the students were not being educated about calorie intake by either their school or parents. Adults too have this lack of understanding. While BMC Public Health found that most adults understand caloric needs, “90% underestimated the calorie content” of unhealthy foods. In this way, many adults’ energy intake is greater than their energy expenditure. Our game intends to display this relationship between caloric intake and its effects by transferring them to gameplay elements so they are easier to understand. The food items are designed to be clearly distinguishable as either healthy or unhealthy. For example, the lunch options of either a burger or a salad clearly portray the salad as the lower calorie option. The choices then affect the feedback during gameplay, reflecting the real world relationship between calorie intake and the body’s function. Specifically, caloric intake also has an effect on the brain and nervous system. Neuromolecular Med. found that “prolonged excessive caloric intake impairs neural function.” The report also states that “neurons in the hippocampus have among the highest energy requirements,” and thus the cells in the hippocampus are greatly “influenced by energy expenditure and intake.” Conversely, “increased [energy] expenditure enhances neuronal function.” To reflect this in our gameplay, we had negative effects for consuming high calorie foods, such as poor feedback and slower movements when completing tasks, and the opposite effect for the low calorie options. Additionally, “excessive energy intake leads to deficits in neuroplasticity,” while the opposite occurs for an energy expenditure. Neuroplasticity refers to the brain’s ability to adapt to new experiences, again mimicked in poor/good gameplay feedback. In terms of exercise, the American Physiological Society states that, an “increase in physical activity due to exercise has little effect on energy intake,” i.e: energy expenditure does not affect how the body takes in calories. For this reason, exercise can be an independent means of having a desirable energy balance, and thus is kept separate from our food mechanics.

In summary, there is a clear lack of understanding between the lack of our food intake, energy content and the physical activity needed to burn it off. Research has proved that our current ways of dealing with the food calories and the way it is labeled is ineffective. The result of this is that our lifestyle and health is being greatly impacted. There is a need to come up with

new solutions and ways to better educate and raise awareness about this link. Our game aims to achieve this with the game elements that have been designed with the research in mind. Through our gameplay players will start to build a desire from within to get over this challenge. Eventually, leading to behaviour change with the decisions they make with deciding what to do, and greater understanding of the link.

References

- Bleich, S. N., & Pollack, K. M. (2010). The publics' understanding of daily caloric recommendations and their perceptions of calorie posting in chain restaurants. *BMC Public Health*, 10(1). <https://doi.org/10.1186/1471-2458-10-121>
- Calorie Control Council. (2015, October 23). *Americans Mostly Clueless When It Comes to Calories*. <https://caloriecontrol.org/survey-says/>
- Coppin, J., Mcneal, C., Spaulding, C., Warren, C., Srinivasan, V., Shimak, C., Paulhill, K., & Doucet, L. (2010). Middle School Students' Understanding of Calories, Energy Expenditure and the Nutrition Facts Panel. *Middle School Students' Understanding of Calories, Energy Expenditure and the Nutrition Facts Panel*. Published. <https://digitalcommons.wku.edu/cgi/viewcontent.cgi?referer=https://scholar.google.com/&httpsredir=1&article=1190&context=ijesab>
- Jabs, J., & Devine, C. M. (2006). Time scarcity and food choices: An overview. *Appetite*, 47(2), 196–204. <https://doi.org/10.1016/j.appet.2006.02.014>
- Seyedhamzeh, S., Bagheri, M., Keshtkar, A. A., Qorbani, M., & Viera, A. J. (2018). Physical activity equivalent labeling vs. calorie labeling: a systematic review and meta-analysis. *International Journal of Behavioral Nutrition and Physical Activity*, 15(1). <https://doi.org/10.1186/s12966-018-0720-2>
- Stranahan, A. M., & Mattson, M. P. (2008). Impact of Energy Intake and Expenditure on Neuronal Plasticity. *NeuroMolecular Medicine*, 10(4), 209–218. <https://doi.org/10.1007/s12017-008-8043-0>
- Stubbs, R. J., Hughes, D. A., Johnstone, A. M., Whybrow, S., Horgan, G. W., King, N., & Blundell, J. (2004). Rate and extent of compensatory changes in energy intake and expenditure in response to altered exercise and diet composition in humans. *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology*, 286(2), R350–R358. <https://doi.org/10.1152/ajpregu.00196.2003>
- The Hartman Group. (2016, July 20). *Nutrition 101: Consumers Actually Do Read Product Labels*. Forbes.

McLatchie T.J., Singh R. & Gibson D.

<https://www.forbes.com/sites/thehartmangroup/2016/07/20/nutrition-101-consumers-actually-do-read-product-labels/?sh=33a7c1f745e6>

Viera, A. J., Tuttle, L., Olsson, E., Gras-Najjar, J., Gizlice, Z., Hales, D., Linnan, L., Lin, F. C., Noar, S. M., & Ammerman, A. (2017). Effects of physical activity calorie expenditure (PACE) labeling: study design and baseline sample characteristics. *BMC Public Health*, 17(1). <https://doi.org/10.1186/s12889-017-4710-0>

Yang, X., Huang, Y., Han, M., Wen, X., Zheng, Q., Chen, Q., & Chen, Q. (2021). The Differential Effects of Physical Activity Calorie Equivalent Labeling on Consumer Preferences for Healthy and Unhealthy Food Products: Evidence from a Choice Experiment. *International Journal of Environmental Research and Public Health*, 18(4), 1860. <https://doi.org/10.3390/ijerph18041860>