Final Technical Report

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1.1 *Abstract*

"Pong" is a game played with two ping pong balls and 10 disposable plastic cups filled halfway with water, placed in a triangle formation on two sides of an 8 foot table so that there are 20 cups total. There are two teams on each end of the table and teams can be either one or two players. Each take two shot attempts with their ping pong balls to get their ball into the cups in formation at the other end of the table where their opponents stand, alternating each turn. Whichever team makes it to 10 successful shots into all the opponent's cups wins the game. Players are often seen dunking the ball in a cup in front of them and shaking off excess water before attempting their shot. Articles support the idea that this method makes one a better Pong pong player[1]. This experiment investigated whether or not this described play style increases a player's shot accuracy in Pong. Contrary to popular belief among Pong players, there was no significant evidence to support that the dunk method is superior to the dry ball method. The experiment questions the commonly accepted notion surrounding the dunk method and its origins as a recognized play style in Pong.

1.2 *Introduction*

Whether were ever a fan of parties, have preferred smaller gatherings, or even stayed in on Friday nights, surely you have heard of the game "Pong," also referred to as "Beer Pong." Since text messaging is so popular, you may even have played or seen GamePigeon's pocket version of the game, "Cup Pong," which is compatible with Apple's iOS iMessage. In the case you have never heard of the game and its variations, Pong involves two opposing players, or teams of two, that take turns in tossing ping pong balls into their designated ten half filled cups of water (or beer, for Beer Pong) that start out in a triangular formation, in order to be the team that makes it into every cup first. The cup formations sit on both ends of a long 8 foot table, and each team must shoot their ping pong balls into the cups that are directly in front of where the opponent stands. Standard rules of the game include having two shots per turn and allowing any shot which makes it into one cup count as a successful shot, and whichever cup it is made in is removed at the end of that turn.

There are three main methods of shooting the ping pong ball into the cup: the default throw with a dry ping pong ball, a bounce shot also with a dry ball, and a throw with a wet ball—a playing method that involves dunking the ping pong ball into water and shaking excess off before tossing. The main focus of this study is to compare the two tossing methods, one with a dry ball and the other with a wet. Many Pong players dunk their ball before each shot, confident that it improves their chances of landing the shot. This pre-conceived notion has no known origin My experiment will assess whether this "dunk method" has positive effects on performance in a game such as Pong through a comparison of the shooting accuracy between each play style. The intended outcome of this project is to spark a discussion on a belief passed around among young adults that has no previous scientific reasoning. Despite the strategy's unknown origins and lack of scientific studies to support it, the dunk method is commonly used across generations of Pong players as an advantageous playing method.

In this report, I will describe the experiment's detailed process and structure and the means of the statistical analysis with its results. At the end there will be a discussion of my thoughts on the experiment's results, with a conclusion which determines what the study has to say about the dunk method to being the better Pong play style.

1.3 *Data and Methods*

To determine if a player's ping shot accuracy is better when dipping the ball in water before their shot into a cup, I will complete trials that simulate a game of Pong, with either a completely dry ball or a method of dunking the ball and shaking excess water off before each shot a participant takes. This experiment will investigate if the shot accuracy when using a ball that has been dunked in water is greater than the shot accuracy when using a dry ball in Pong.

I carried out the experiment indoors, such as traditional Pong. My residence in Morro Bay, CA was the location of data collection. The experiment used a table with dimensions 96" L x 30" W x 29" H, eleven disposable 18-ounce Chinet brand red plastic cups, water, a microfiber towel, and 2 Franklin brand 40mm standard ping balls. The set up of the table and cups is as depicted in Figure 1. The ten cups in the formation have are labeled from integers 1 to 10. All sampled attempts were from behind the singular cup at one end of the table, facing the triangle cup.

Each trial is a single attempt to make the ping ball into the cup. Two trials were performed consecutively, similar to traditional Pong. After each set of two trials, I removed each ball that landed in a and dried them off with a towel; if the ball was missed, I made sure that it was dry before the next attempt. When balls were removed from the cups' insides, I left the formation undisturbed. Trials where the ball was made into a cup not using a bounce-shot was counted as successful. For the wet method, the ball was fully submerged in water and shaken lightly five times to remove excess water, which is similar to the standard technique for the "dunking method" in . I recorded whether or not the shot attempt was a success, and

if it was, I also recorded the number of the cup that the ball landed into. Each shot attempt was made with an overhead toss and no bounce onto the table—a bounce-shot.

The total sample size of this experiment is the researcher's 100 attempts to make it into the cup. I am the researcher, Hannah Pawig, a sophomore Statistics Undergraduate student at the California Polytechnic State University in San Luis Obispo, CA. No other abilities or certifications were needed to carry out the trials, besides my own ability to participate in the activity without needing any accommodations or aid. I have some experience with Pong, but do not consider myself a proficient player of the game. We must note that conclusions from this study may not be generalized to a larger population of college students, because the researcher was the only recruited member of the study.

I used Microsoft Excel[2] to record data in between each 2 trials (Excel Version 16.71). Prior to carrying out the experiment and collecting data, I randomized the order of the "wet" and "dry" treatments for the 100 total shot attempts; there were 50 allocated attempts per treatment. This then acted as the order in which I carried out each trial. Since the order of the treatments was pre-randomized, I recorded the data for *success* and *which_cup* after every set of two trials. The success variable was input as a binary variable: 1 was input for successful attempts and 0 for unsuccessful attempts. The *which_cup* variable was coded numerically from integers 0 to 10, each integer greater than 0 corresponding to a cup in the triangle formation. The integer 0 was recorded for *which_cup* when the shot was unsuccessful.

With the statistical software R and the tidyverse package, I used a one-sided 2 proportion z-test to conduct the analysis (R version 4.3.0[3], tidyverse v. 2.0.0; Wickham et al., 2023[4]).

1.4 *Results and Discussion*

1.4.1 Results

Of the 100 total shot attempts, the ball successfully went into the cup 38% of the time, disregarding shot method (Figure 2). However, when considering shot method, the proportion of times in which the shot was successful when using the dunk (wet ball) method was far from significant, using a 5% significance level (z-stat = 0, p = 0.5, n = 100). The 95% confidence interval for the mean difference proportions of success of each play method was (-0.16, 1.00). This interval includes that the value the mean difference in proportions is 0, which leads us to fail to reject the null hypothesis.

Out of 50 attempts, the dunk method resulted in 19 successful times where the ball landed in one of the ten cups. The same results occurred with the dry ball method, and is visually depicted in Figure 3. As stated before from the results of the two proportion z-test, there is a severe lack of statistical significance between each play method.

Table 1:
Frequencies and Percentages of Successful Shots by Cup Pong Method

Method	Total Attempts	Count of Success	Percentage Made (%)
Dry	50	19	38%
Wet	50	19	38%

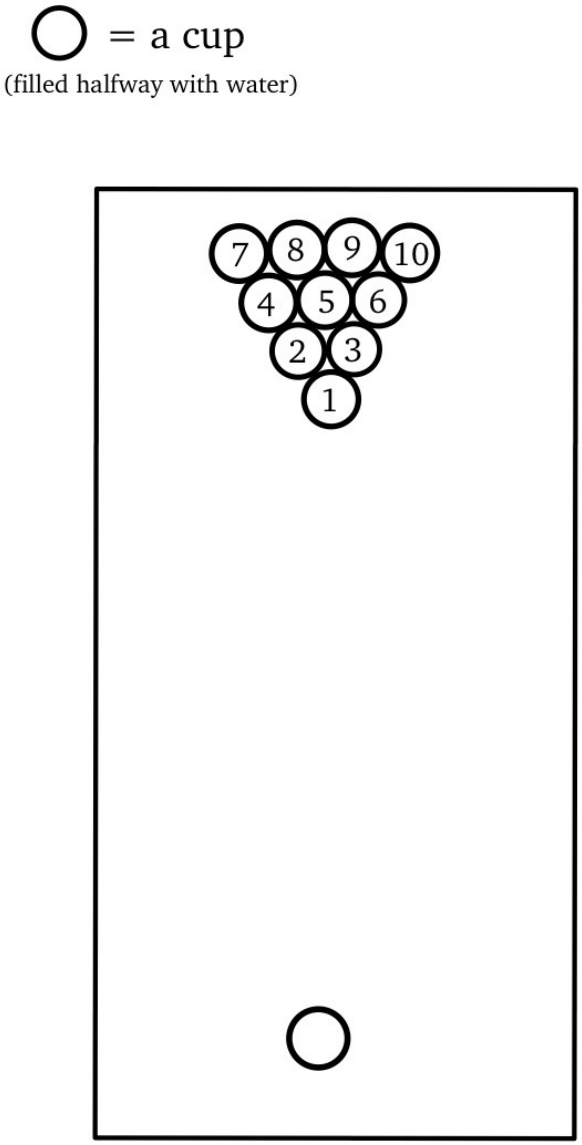


Figure 1: Cup Formation

Figure 2: Overall Successes of the 100 Shot Attempts

Successes with the Dunk Method and Dry Ball Method

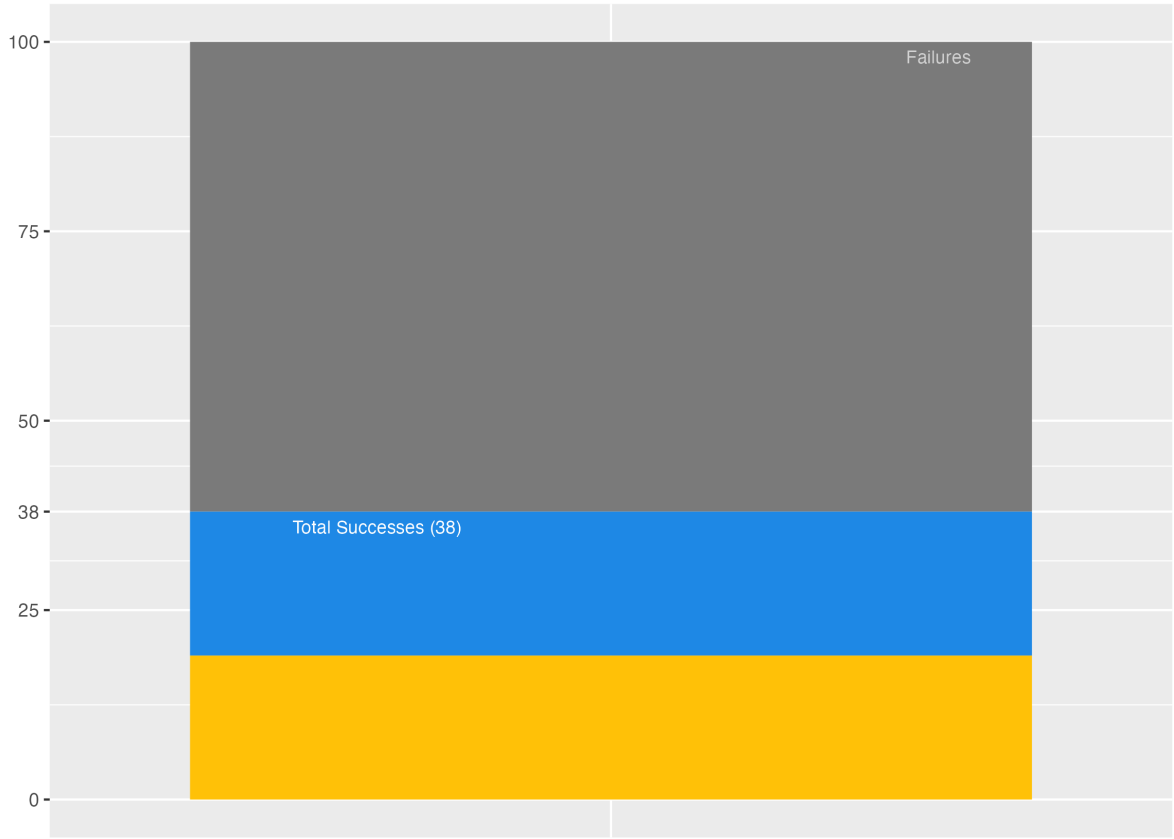
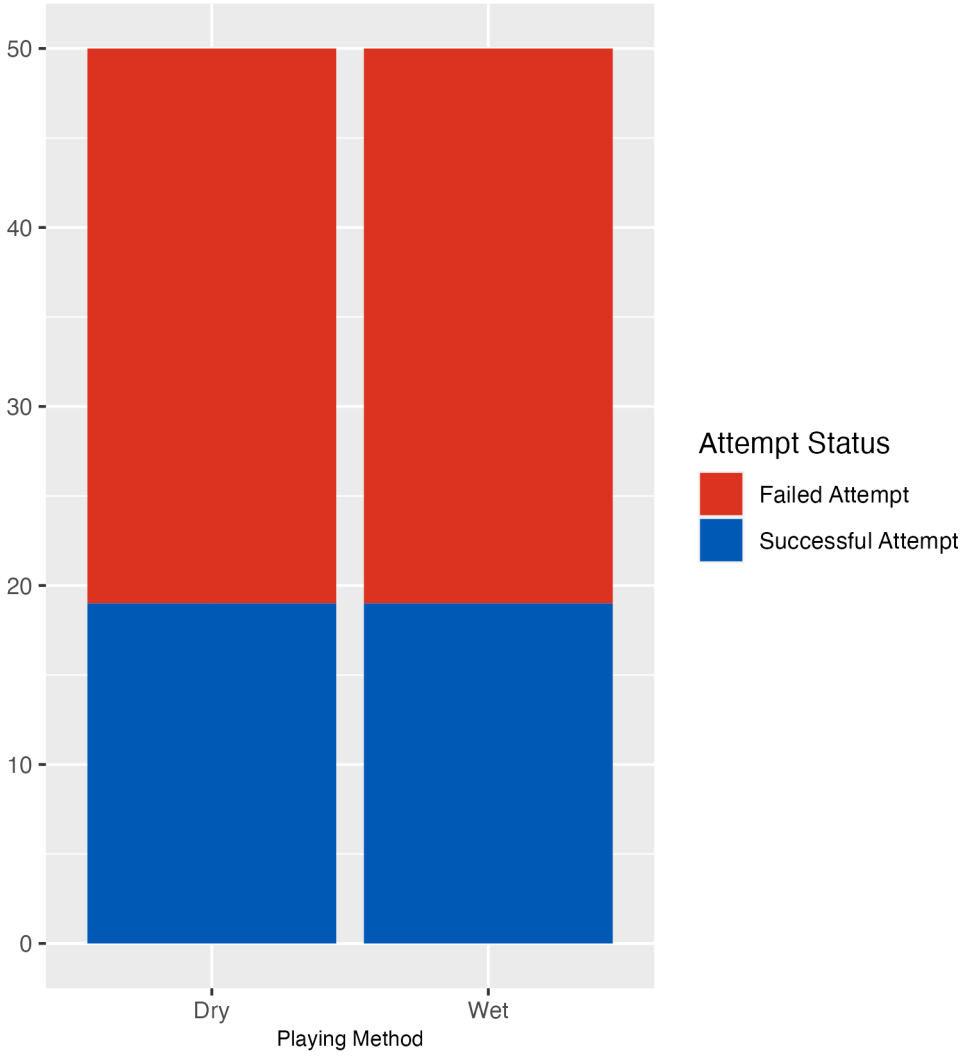


Figure 3: Breakdown of Shot Attempts

Between Dry and Wet Playing Methods



1.4.2 Discussion

The results observed from the experiment suggest that the dunk playing method has no improving effect on my performance while attempting to throw ping balls into a cup in Pong. The results show no significance of the dunk method; these results are other than what I expected, as though I believed that my performance in the experiment would at the least differ between play styles. This is because I have been exposed to the pre-existing notion that dunking the ball in water improves performance.

Therefore, when I participate in Pong using the dunk ball method, my shot accuracy is not enhanced more-so than when I use the default dry ball method. This was a randomized experiment, and so we may consider these results to lead us to a cause-and-effect, or lack thereof, relationship between play method and my shot accuracy. Additionally, the experiment was a *simulated* game of Pong that has similar structure but most importantly not identical. Thus, my accuracy may be affected in a real game of Pong, which involves removing cups as the game continues with each successful shot.

It is crucial we also evaluate these results keeping in mind that I, the researcher, was the only participant in the Pong simulation. We are unable to consider these results in the scope of any other college students, but we may hope so in the future. This experiment alone at the least starts the conversation in the importance of the decision of play method in a game such as this, or other games which involve landing ping balls into cups of water. Moreover, my role in this experiment as both the data collector and participant limits the potential of this particular study insofar as we cannot see a wider range of variation in subjects with varying degrees of Pong experience or ability that could depict a better, more informative result regarding the effect of the wet ball "dunk" method. I have hopes that a future experiment and analysis could collect data on a large number of various students to see if college students play better using the "dunk" method, and even make the experiment structured more closely to the traditional one of Pong. Future experiments may even test whether liquids other than water have some effect in shot accuracy in this game, by running the experimental Pong trials with the cups filled with other liquids such as soda or beer. In this way, there is hopes of significant findings that consider more than one factor and can more confidently be applicable to true Pong games.

1.5 *Conclusion*

As seen through the report, this Pong experiment cannot lead us to believe that the Pong dunk method improves my accuracy when tossing the ball into the cups. Considering this study, which has minimized outside disruption through the controlled environment and experimental design, I have yet to see results that will affirm the belief that a wet ball causes me a better Pong player in terms of shot accuracy. For my own ability, I can surely based on my results say there is no effect on my shot accuracy due to the randomized aspect of this experiment. Since I was the only participant of this experiment, we cannot make any conclusions about

the dunk method's effect on shot accuracy for other college-aged players, which is the larger demographic of Pong players.

As discussed previously, I would hope to see a Pong experiment that replicates closer the real game of Pong and uses a larger sample of participants to have applicable results that decide whether the dunk method has any positive effect on game performance or not. Due to my experiment's contrasting results to the popular belief surrounding this dunk method, I have come to challenge the widespread notion that it is better to play Pong with a ping pong ball that has been wet, at least for my own abilities. My own personal ability and prior experience with Pong cannot be used as the average player's ability in this game. This furthermore supports the fact that there is no general conclusion for all Pong players, or even college-aged Pong players.

This leads me to question why Pong players believe that wetting the ball makes for a more accurate shot, whether it be finding its origin or discover if it was some rumor that turned into something of a placebo effect in the world of Pong. Unbeknownst to me there are no previously documented origins of the dunk method and its rumored advantageous quality. What is known are the possible origins of Pong, which is claimed to have started as a college party game in the 1950s-60s at Dartmouth College[5]. I wonder where the dunk method came from and how it was so easily spread among Pong players, so much so that it became something of unquestioned popular belief.

1.6 References

1. Chen, E. (2016, December 6). *10 Tips & Tricks to Playing Beer Pong Like a Boss*. Society19. Retrieved May 31, 2023, from https://www.society19.com/tips-tricks-to-playing-beer-pong-like-a-boss/.
2. Microsoft Corporation. (2018). *Microsoft Excel*.
3. R Core Team (2023). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.
4. Wickham H, Averick M, Bryan J, Chang W, McGowan LD, François R, Grolemund G, Hayes A, Henry L, Hester J, Kuhn M, Pedersen TL, Miller E, Bache SM, Müller K, Ooms J, Robinson D, Seidel DP, Spinu V, Takahashi K, Vaughan D, Wilke C, Woo K, Yutani H (2019). "Welcome to the tidyverse." *Journal of Open Source Software*, **4**(43), 1686. doi:10.21105/joss.01686.
5. Bhabha, L. (2013, December 27). *The History of Beer Pong*. Insider. Retrieved May 31, 2023, from https://www.businessinsider.com/the-history-of-beer-pong-2013-12#:~:text=In%20its%20original%20form%2C%20the,began%20aiming%20for%20the%20cups.

1.7 *Appendix*

1.7.1 Research Protocol

Purpose. To determine if a player's ping pong shot accuracy is affected when dipping the ball in water before their shot into a cup, the Cal Poly students will be recruited to complete a trial that simulates a game of Cup Pong, with either a completely dry ball or a method of dunking the ball and shaking excess water off before each shot a participant takes.

Pong is a version of a popular game with a similar name, "Beer Pong." Cup Pong is often played by college and university students, and it is widely accepted that wetting the ball before a shot in this game increases the chances of getting that ball into a cup. However, there are limited to no scientific investigations as to support why this notion is believed by those who play the game. Despite the strategy's unknown origins, it is commonly used across generations of players. This experiment will see if using this wet-ball method is a fluke, or if it is advantageous for college-aged players of Cup Pong, through determining if higher shot accuracies are attributed to either method of play.

Methods. The experiment will need a table that is 96-inches in length and 30-inches in height, 11 count disposable 18-ounce Chinet red plastic cups, water, a microfiber towel, at least 2Franklin 40mm standard ping pong balls, and ameans of recording data such as the softwareMicrosoft Excel (Excel Version 16.71).

For the set-up, first prop up the table on level ground. On one short edge at the end of the table's length, arrange 10 of the cups in a 4-3-2-1 triangle formation, so that the cups' rims are touching the neighboring cups. The formation triangle's point should be pointing inward facing the table's center. The bottom edge of cup formation and should be 3 inches from the short edge of the table, and the triangle formation should be centered widthwise. On the opposite short edge 96 inches away, place the last cup also centered widthwise and 3 inches from the short edge of the table. Fill all 11 cups with 8 ounces of water.

For each trial, have the participant stand at the edge of the table opposite to where the triangle cup formation is situated. The triangle of cups should be pointed at the person and aligned with them by the tip of the formation; the person has the singular cup right in front of them while still facing the cup formation.

I will have 100 shot attempts to make as many shots as possible, shooting two shots at a time. If a shot is made into a cup, that cup will not be replaced like traditional cup pong, so that each shot attempt has the same number of cups it may go into. Instead, after a set of two attempts, remove the balls that made it into the cups without disrupting the triangle formation. Then with the towel, dry the balls before giving the two balls to the participant and repeat this until the participant has completed 10 shot attempts. Only a shot attempt that was made into a cup without bouncing the ball on the table will be counted as successful. These are the rules of the simulated version of Cup Pong that will be used for the participant trials.

Random assignment is done beforehand in the Excel sheet for each of the participants, the number of rows corresponding to the planned number of observations (n = 100 shot attempts). If the shot was assigned the dunk method, the participant must do so before attempting the shot. Record the number of successful shots for the participant in the corresponding row with their assigned play method in the Excel sheet (MS Excel).

The researcher is Hannah Pawig, a sophomore Statistics undergraduate at California Polytechnic State University, San Luis Obispo. No other abilities or certifications are necessary to conduct this experiment besides the ability to carry out the presented instructions in this section. Experiment location will be in the dining area of the researcher's current residence in Morro Bay, CA. Do not set up experiment outside, since weather conditions may affect the ping pong ball's trajectory during a shot.

1.7.2 Additional Documentation

Nichols, D. (n.d.). *Coloring for Colorblindness*. Davidmathlogic.com. Retrieved May 31, 2023, from https://davidmathlogic.com/colorblind/#%23005AB5-%23DC3220

Two-Proportions Z-Test in R. Statistical Tools for High-Throughput Data Analysis. Retrieved May 31, 2023, from http://www.sthda.com/english/wiki/two-proportions-z-test-in-r#case-of-large-sample-sizes

1.7.3 Original Data

Can be found on GitHub under the user hpawig and the repository named tech-report.

Link to the location of the raw Excel data sheet: https://github.com/hpawig/tech-report/blob/main/data/data_raw