

# Analyzing the Relationship Between Game Factors and Psychological Pressure During a Penalty Kick

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## ABSTRACT

A Penalty Kick is the most advantageous dead ball situation in soccer. It is a direct spot kick twelve yards away from the goal with only the goalkeeper to beat. Instead of an issue with soccer technique or skill that causes professional players to miss penalty kicks, it is hypothesized that the psychological pressure infiltrating the penalty kick taker creates self-doubt, freezing up, and uncharacteristic errors, preventing them from striking the ball into the goal using their highest potential. Forty-six total penalty kick cases that occurred either during the 2018 Men's FIFA World Cup or 2020 Men's European Championships were analyzed along with a questionnaire sent out to players on the 2021/2022 Pine Creek High School Men's Varsity Soccer Team to determine the specific game factors that influence the most psychological pressure. The conclusion of this study is that the time of when the penalty kick occurs during the match has the greatest impact on the psychological pressure a player experiences and has the most influence on the outcome of the penalty kick. The pressure a player experiences increases as the game goes on, with the most pressure and lowest level of penalty kick performance happening at the end of a game.

## Introduction

Football, or soccer as it is called in the United States, is the most popular sport on the planet. Eleven players on each team try to score the ball into the other team's goal without using their arms or hands. Since soccer is a mostly fluid, random, and unpredictable game, dead ball situations are crucial moments. If these opportunities are successfully capitalized upon, game results can be significantly influenced in the scoring team's favor. Furthermore, there are not many goals that are scored during a soccer game, only around 2.5 total per match in the English Premier League (1). In decisive games such as a tournament final where the two teams are evenly matched, goals typically decrease in frequency. Therefore, the penalty kick, the most advantageous dead ball situation in soccer, is given so much significance by soccer players.

A penalty kick is awarded to the opposition for any foul committed inside a team's own eighteen-yard box. It is a direct spot kick that is taken twelve yards away from the goal, with one attacker attempting to score past one goalkeeper (2). It is an agonizing moment filled with pressure and expectation, especially for the penalty taking player. As a result, even though a penalty can appear to be an automatic chance to score a free goal, a study titled "Massive Research of Penalties" by Instat, where 100,000 penalty shots since 2009 were analyzed from professional soccer matches all over the globe, shows that penalty kicks were successfully converted 75.49% of the time (3). Even if the regulation size soccer goal is 24 feet wide and 8 feet high (192 square feet in total area), and only one goalkeeper stands in between the attacker and the goal, the probability of scoring is not near 100% certainty. Since 2016, with the introduction of Video Assistant Referee (VAR) in professional soccer, referees have been calling more penalties during the game as they are able to use replay video systems to help assist in their decisions and see the play from multiple angles and speeds (4). This advanced monitoring system leads referees to be able to scrutinize over any minute contact that is made by a defender on an attacking

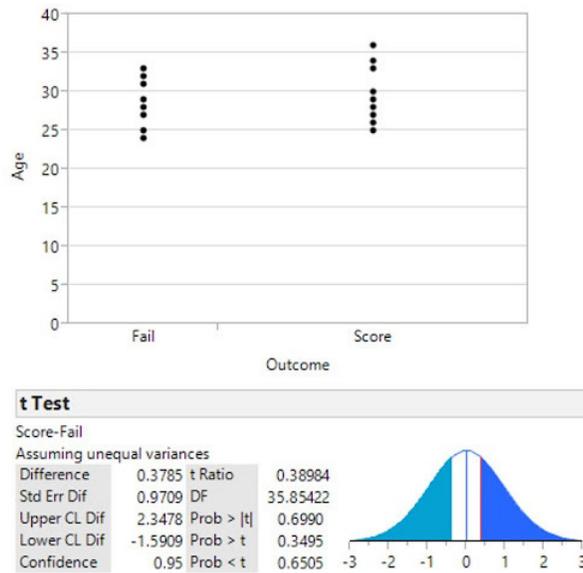
player in their own eighteen-yard box, and as recent trends show, most of the time the attacker is able to draw the foul on the defender and earn a penalty kick.

There are many research studies regarding free kicks or penalty kicks. Alcock's study on direct free kicks revealed the best areas on the field to attempt a direct free kick with highest success (5). Bessenouci's study on biomechanical variables impacting free kick accuracy shows the phases of motion on a well-executed kick (6). However, these studies focus more on improving the success of these situations. In this study, penalty kick failure was researched from a psychological point of view. The aim was to find the competitive factors in games that have the most psychological impact on soccer players during a penalty kick. It is expected that the success or failure of a penalty kick is impacted more by the internal pressure the penalty kick taker experiences rather than their soccer skill level. Because it is such a simple shot from close range on a big target (the goal) the skill and technique of the shot is not of maximum difficulty. Instead, the psychological arousal and stress a player feels during the taking of a penalty kick that majorly impacts their performance. Furthermore, when players are experiencing the same competitive factors, thus the same amount of pressure, individual factors of the penalty kick taker were also taken into consideration. It is considered that the lower a player's arousal, the more advantageous the player's mindset is during a penalty kick, such as in archery, putting in golf, and free throws in basketball.

It is predicted that younger players with not a lot of experience would undergo the most pressure. Looking at competitive factors of the penalty kick, the time in the game and game situation (winning, losing, tied) were analyzed to see if they had an effect on the success rate of the penalty kick from a psychological pressure perspective. In this case, losing game situations and time near the end of the game would cause the most pressure.

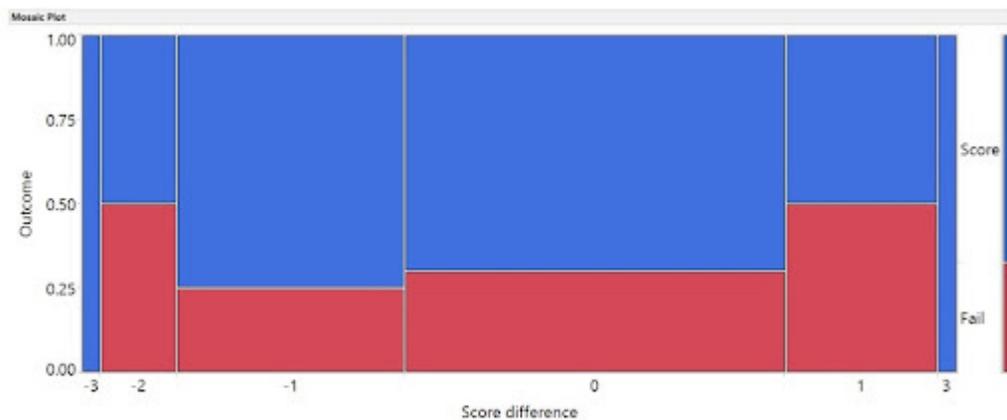
The outcomes and circumstances of all twenty-nine penalty kicks awarded during the 2018 Men's FIFA World Cup and all seventeen penalty kicks awarded during the 2020 Men's European Championships were thoroughly analyzed. These recent major international tournaments provided the sample size for quantitative data to be collected on penalty kicks at the highest level of professional men's soccer. In order to further analyze the pressure felt by a player based on their position, total years of soccer experience, and the time and situation of a soccer game, a questionnaire survey was sent out and completed by twenty players of the 2021/2022 Pine Creek High School Men's Varsity Soccer Team. The survey ran from August - September 2021 and was conducted online through Google Forms. All varsity team players were asked to complete the study except goalkeepers, as only the attacking penalty kick taker's perspective was taken into consideration for this research.

## Results



**Figure 1.** Penalty kick outcome based on player’s age

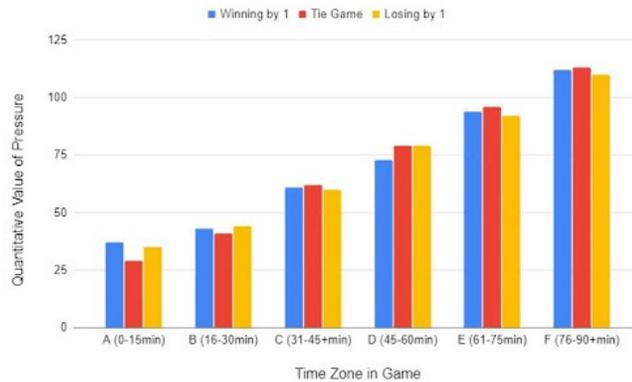
Figure 1 shows a T-Test that reveals there was no difference between the scored and failed penalty kick groups when analyzing the age of the players in each outcome. Data from the 2018 Men’s FIFA World Cup and 2020 Men’s European Championships were combined, with the combined data being separated into two groups based on scored and failed penalties. It was analyzed whether the age of the penalty kick taker influenced the amount of pressure they felt in the penalty kick situation. It was predicted that players who are older, thus most likely having more professional soccer experience, would be better at converting penalty kicks. Since most top level professional soccer players begin playing the game of soccer from a young age, the age of the penalty kick taker is a good indicator of their soccer experience.



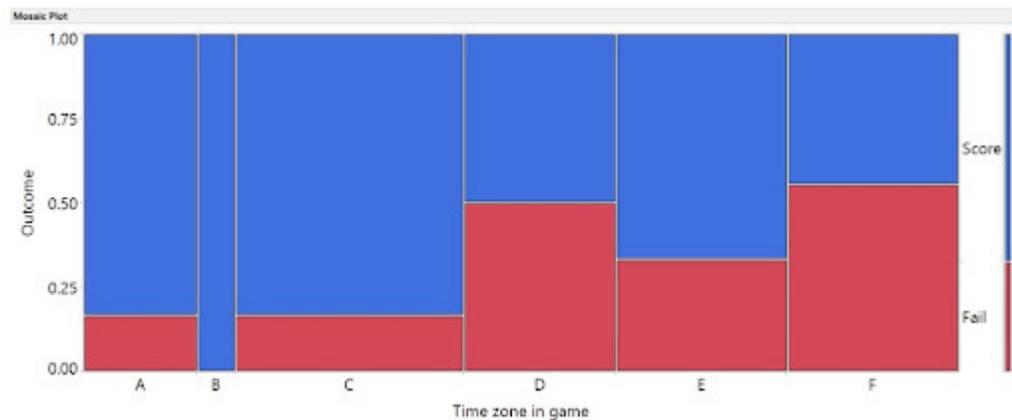
**Figure 2.** Penalty kick outcome based on score difference in game

Figure 2 shows the penalty kick success rate based on the difference in score of the game just before the penalty kick is taking place. The negative values indicate a losing situation, 0 indicates a tied game, and positive numbers indicate a winning situation, with the number showing how many goals the penalty kick taker’s team is winning or losing by. The -3 and +3 situations can be ignored from analysis as there were only

1 of each scenario that occurred, both of which were scored. Also, the -2 situation had 4 cases which is a smaller number of cases when compared to the -1, 0, and +1 score differences. Therefore, analysis of the -2 results needs to be completed with caution. Because of these restraints, the -1, 0, and +1 score differences provide the best data for analysis. These results correspond to the results of Figure 4, as the best penalty kick success rate was found in the -1 score difference (when losing by 1) and the worst penalty kick success rate was found in



the +1 score difference (when winning by 1).



**Figure 3.** Penalty kick outcome based on time in game: The time zones are named A-F, with A = 0 - 15 min, B = 16 - 30 min, C = 30 - 45+ min, D = 45 - 60, E = 61 - 75 min, F = 76 - 90+ min

The penalty kick success rate based on the time in the game (0-90min) when the penalty kick is taking place is plotted in Figure 3. The time zones are named A-F, with A = 0 - 15 min, B = 16 - 30 min, C = 30 - 45+ min, D = 45 - 60, E = 61 - 75 min, F = 76 - 90+ min. The time zones A-C represent the first half of the game divided into 3 equal sections, with C including the first half extra time, and the time zones D-F represent the second half of the game divided into 3 equal sections, with F including the second half extra time. Since B only had 2 cases, the data is too small for consideration, so it is ignored in this analysis. The other 5 time zones all had a relatively even number of penalty kick scenarios, so comparison between these time zones is reasonable. The Penalty Kick success rate in the second half is considerably worse than the Penalty Kick success rate in the first half. The worst penalty kick success rate is found during the first 15 minutes and last 15 minutes of the Second Half, time zones D and F respectively. It seems apparent that the time in the game correlates to penalty kick success, and therefore also significantly impacts the psychological mindset of players.

**Figure 4.** Quantitative value of pressure based on time zone in game

By using their prior soccer experience and knowledge, twenty players on the 2021/2022 Pine Creek High School Men's Varsity Soccer Team were asked to rank time zones (A-F) during a game from most pressure to least pressure, based on specific game scenarios +1(winning by 1), 0(tied), and -1(losing by 1). Figure 4 shows the figure of the time zones (A-F), same as the time zones mentioned earlier, related to a numeric value of pressure based on these survey results. Therefore, each player ranked each of the three game scenarios from 1 - 6 based on the pressure they would personally experience. For each game scenario, 6 points were given to the time zone with the most pressure, 5 points given to the time zone with the second most pressure, with the trend continuing until the time zone with the least pressure was given 1 point. This was done in order to assign a numerical value of pressure for each time zone. After this was complete, the total sum of the values for each time zone within each game scenario was calculated to get 6 numerical values indicating the pressure level at each time zone for the specific game scenario. This means that the higher the number, the more pressure Pine Creek High School players experienced in that time zone during that game situation. Then for each game scenario (+1, 0, -1), a bar graph was constructed with the x axis having the time zones in chronological order of the game (A to F), and the y axis having the numerical value of pressure. For all three figures, there is clearly a positive correlation between these two variables of pressure players experience and time. Interestingly, time zones E and F indicate more pressure for winning game situations compared to losing situations, albeit an extremely fine margin.

## Discussion

The more experience a player has could lead them to undergo less pressure and stress when taking a penalty kick, since they would have already encountered multiple high-pressure situations during their career, which would lead to more successful penalty kick outcomes. However, data reveals that age has no correlation with the penalty kick success rate because all professional players playing in high level tournaments have enough soccer experience to have undergone these pressure-filled situations during their career. It is concluded that when the same pressure is experienced based on the competitive game factors, a player's age (soccer experience) has no significant correlation to the penalty kick outcome.

It can be theorized that a winning situation correlates to less pressure than a losing situation. Therefore, The Inverted U Law Graph for the Arousal Theory of Motivation supports that, in general, a winning situation would create similar or better performance (7). This means the penalty kick success rate should be similar or higher. The survey results in Figure 3 support this claim as all three game situations (winning, losing, tied) have similar levels of stress experienced by players. However, the penalty kick percentage was the worst when winning by one. This is different to what was expected.

The time of the game exerts the most influence on the amount of pressure a player experience. The data shows that the penalty kick success rate is worse in the second half compared to the first half, possibly due to pressure increasing as the game progresses, which matches the results of the survey. The personal experience of the twenty players on the Pine Creek High School Men's Varsity Team revealed in Figure 4 that the most pressure they experienced during a game was during time zone F (76-90+min). Since the outcome of the game is nearing, it is theorized that players could perform worse than their typical standard which leads them to miss penalty kicks. This reasoning aligns the data presented by the 46 penalty kick cases gathered from the 2018 FIFA World Cup and 2020 European Championships as there was a considerable drop-in penalty kick success rate in the second half and the worst penalty kick success rate was found in time zone F (76-90+min). The last 15 minutes of a soccer game, where the most decisive moments of a game occur and pressure is assumed to be

highest, correlates to the greatest number of penalty kick misses. Physical fatigue could also explain these results. Generally, physical fatigue would increase as the game progresses and therefore negatively impact the penalty kick success rate. Further research is needed on the impact of fatigue on mental processing as the impact of pressure a player experiences can be related to their physical freshness. Furthermore, the time in the game could also be of impact to goalkeeper performance. Perhaps, goalkeepers are getting better with pressure as the game progresses, so these forementioned results about a decrease in penalty kick success rate is less about the penalty kicker's pressure and more about the goalkeeper's performance. The goalkeeper could be the factor that distinguishes penalty kick success rate for the attacking player in different time zones of the game. These are variables where further research is needed to have a better understanding of how game situations impact pressure.

## Methods

Official Match Reports on the websites for the 2018 Men's FIFA World Cup (8) and 2020 Men's European Championships (9) were used to determine the penalty taker, opponent, game time and score when the penalty took place as well as the outcome of the penalty kick. Information about the penalty taker, including position and age were also found on the official websites for these tournaments. In order to analyze the collected data, JMP (SAS, Version 13) was utilized to create t-tests between penalty kick outcome and players' age.

A total of twenty players on the 2021/2022 Pine Creek High School Men's Varsity Soccer Team participated in this study. These players were males between the ages of fourteen and eighteen. The questionnaire was sent via Google Forms and submitted by players online. The first question on the questionnaire was asking the players "What position do you play?" with the options being Forward, Midfield, or Defense. Then, the second question to gauge soccer experience was: "How many years have you played soccer?" The main aspect of the questionnaire was to have the players rank each game scenario by the pressure they experience in each of the 6 specific time zones

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