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Utilizing Valence Theory to Influence Player Navigation in First-Person Shooter Multiplayer Maps

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Abstract
This research explored tactical & visual valences, different valence weights and the transformation of valences under different circumstances in first-person shooter multiplayer maps, then incorporated them into a level artifact, utilizing the valences to influence player navigation.

Keywords
Level Design, Valence Theory, First-Person Shooter, Multiplayer Map, *Counter-Strike 2*, Bomb Defusal, Player Navigation.

1 INTRODUCTION

This research aims to examine the application of Valence Theory in multiplayer maps of First-Person Shooters (FPS), specifically focusing on Counter-Strike 2. The objective is to influence player navigation with strategic placement of tactical and visual valences in FPS multiplayer maps, guiding players along the intended paths.

2 DEFINITION & RESEARCH

2.1 *Counter-Strike 2* & Bomb Defusal Mode

Counter-Strike 2 is an online-only multiplayer tactical first-person shooter game that offers various game modes.

2.1.1 Tactical shooter definition

Tactical shooters refer to games that not only require player's shooting skill but also require player to use strategies and tactics in gameplay to win.

2.1.2 Bomb Defusal Mode

Bomb Defusal is a gameplay mode in *Counter-Strike 2*. In this mode, players assume roles as either Terrorists, whose goal is to plant and defend a bomb until detonation(40s), or defeat all Counter-Terrorists; or as Counter-Terrorists, aiming to prevent bomb plantings, defuse any planted bombs, or eliminate all Terrorists.

2.1.3 Offense & Defence

In the Bomb Defusal mode, before the bomb is planted, the Counter-Terrorists (CT) need to protect the bombsites, while the Terrorists (T) aim to breach the bombsites and plant a bomb. Given the differing objectives of each team, their perception of valence will also vary. Additionally, after the bomb has been planted, the objective of both teams will shift as now Ts must defend the planted bomb while CTs need to retake the bombsite and defuse the bomb. Therefore, when discussing the valence in the map, the researcher will use 'Offensive side' and 'Defensive side' to represent the roles of CT and T before the bomb is planted, as well as T and CT after the bomb has been planted.

2.2 Valence & Valence Theory

2.2.1 Valence

In psychology, valence refers to 'the intrinsic attractiveness or aversion of an event, object, or situation, varying from negative to positive. [1] [2].' In game development, valence can be categorized as positive, negative, or neutral. Valence usually exists in visual forms. For instance, in stealth games, shadow is a positive valence while light is negative to players; the reason is, shadows can provide a sense of safety as players can hide within them, whereas light may expose players, making them feel endangered.

2.2.2 Valence Theory

In games, players always tend to get close to positive valences and keep away from negative valences. This behavioural pattern is the core principle of valence theory. In level design, this theory empowers designers to strategically deploy various types of valences to effectively guide players to their intended paths.

2.2.3 Different Valence Weight

In open-world games, different objects have varying levels of attraction for players. This principle applies to valences as well. The stronger the feelings an object evokes, the greater its valence weight. For example, both a legendary weapon and a common weapon represent positive valences, but obviously the legendary weapon carries a higher weight since they always carry extra abilities and symbolize more power. Based on this, the researcher has classified the valences into seven categories according to their positive or negative value and weight: +3, +2, +1, 0 (Null), -1, -2, -3. The higher the number, the stronger the power.

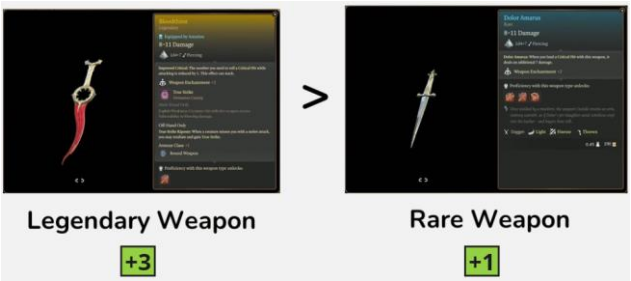

Figure 1: Legendary weapon & Rare Weapon [3]

2.2.4 Transformation of Valence

In certain situations, positive valences can transform into negative valences, and vice versa. As previously mentioned, in the context of stealth games, shadows are seen as positive while light is seen as negative; however, if there emerges a type of enemy that only exists in shadows, then shadows will become a negative valence for players.

2.2.5 Different Perception

Additionally, the same objects might be different valences to different players. For example, in confrontation games like *Dead by Daylight*, an open area is positive for killers as it offers a better view, enhancing their ability to track. Conversely, for survivors, the same open area is negative, as it increases their visibility and likelihood of being discovered. Therefore, when discussing valence, it's important to consider its applicability to the current situation and target players.

2.3 Tactical Valences

This research will primarily focus on tactical and visual valences in *Counter-Strike 2*. Any element that affects the balance of combat will be classified under tactical valences.

2.3.1 Bombsites

Bomb Defusal maps always feature two bombsites: Bombsite A and Bombsite B. Terrorists must plant the bomb at a bombsite, while Counter-Terrorists are tasked with protecting these sites from being compromised. Therefore, as symbols of victory, bombsites always represent the strongest positive valence for both Counter-Terrorists and Terrorists.

2.3.2 Advantaged Positions

Advantaged Position refers to locations that offer players strategic advantages, such as places with high visibility, with cover, or key rotation points.

2.3.2.1 High Visibility

Places with high visibility always offer players tactical advantages as they offer better views, making it easier for players to find their enemies. Additionally, places like high ground can keep players to be minimally exposed to their enemies while still offering clear views, serving as a positive valence, and carrying greater weight. In general, the valence weight of advantaged positions may vary, depending on how many advantages they can bring to players and how safe they are.

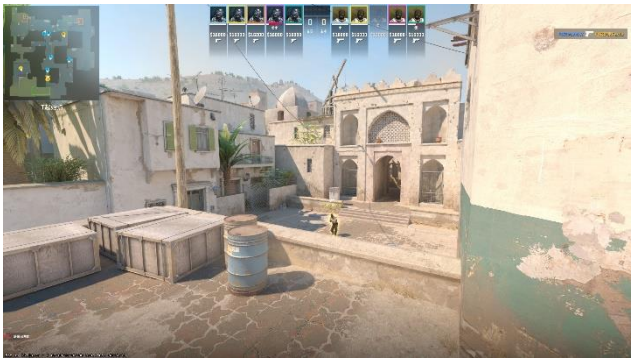

Figure 2: Place with High Visibility [4]

2.3.2.2 Cover

Cover is objects or structures providing players protection from enemy fire, where players can hide or take a defensive position. Cover allows players to remain in relative safety and less likely to get hurt. The weight of positive valence varies depending on how much protection it can provide to the player. For instance, some cover is considered 'soft' cover which only provides visual protection, they usually carry lower weight than solid cover. Thus, based on cover's height, whether it is solid or soft, and whether it is breakable or not, their valence weight is also different. The more a cover can protect players, the more it contributes to their sense of safety, and thus, the higher its weight.

2.3.2.3 Key Rotation Points

Key Rotation Points refer to areas that allow players to quickly move between key locations like bombsites. Mastering such locations can bring a significant strategic advantage to players because they can quickly support teammates or switch attack points based on the situation, serving as a positive valence.

2.3.3 Disadvantaged Position

Disadvantaged Position refers to locations that put players at a strategic disadvantage, such as in open areas or high-traffic areas.

2.3.3.1 Open Areas

Open areas always make players more susceptible to attacks and offer limited options for concealment. This exposure contributes to a feeling of vulnerability and thus serves as a negative valence.

2.3.3.2 High-Traffic Area

High-traffic areas always evoke a sense of danger to players as the possibility of enemies passing by here is higher than other areas, thus serving as a negative valence.

2.3.4 Defensive Position

Defensive positions refer to spots that give players an advantage when they are defending key areas, such as bomb sites. These positions always act as a positive valence for the defensive side and a negative valence for the offense side. For example, in Dust2, the two spots within the pink squares are excellent defensive points because they keep the defensive side to be protected

while maintaining clear visibility of both entrances, potentially preventing the offensive side from entering bomb sites. Once the defensive side occupied these positions, they will get great tactical advantages, making it hard for the offensive side to attack.

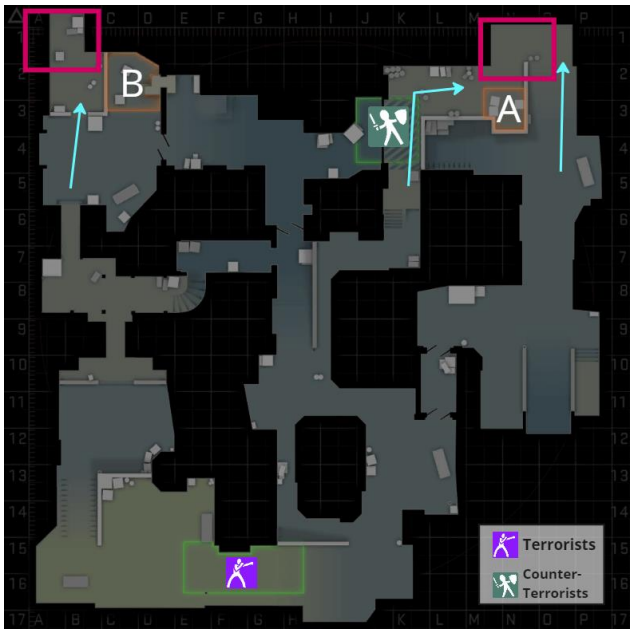

Figure 3: Dust 2 Radar Map [5]

Figure 4: Defensive Positions

2.3.4.1 Chokepoint

Chokepoints are narrow areas of the map that the offensive side must pass through to reach their objective. Due to the narrowness of chokepoints, they can often be covered by a single person with their gun, making it easier to guard. Therefore, chokepoints represent a tactical advantage for the defensive side, especially in bomb sites, and serve as a positive valence. However, for the offensive side, chokepoints serve as a neutral valence since they must pass through them to arrive at their destinations though it's dangerous.

2.3.5 Offensive Position

Offensive positions refer to locations that offer tactical advantages to the offensive side, such as grenade throwing points and flanking routes. These positions can provide offensive side attacking advantages and make it easier for them to enter the bombsites, serving as positive valences.

2.4 Visual Valences

2.4.1 Signs & Arrows

In *Counter-Strike 2*, visual valence refers to signs & arrows marked with an 'A' or 'B' on the walls. These signs are strongly associated with Bombsites, helping players navigate and identify the bombsites, serving as positive valences.

2.4.2 Cover

In *Counter-Strike 2*, cover is also a visual valence, as cover usually exist in visual form and players will try to get close to it when they saw it in a distance. But, since they will also affect the balance of combat, in this research, cover will be included in advantaged positions (tactical valence).

3 BEST PRACTICES

3.1 A Balanced Bomb Defusal Map

Having a balanced bomb defusal map is a fundamental prerequisite for this research. An imbalanced map can easily lead to strong frustration among players, and such negative emotions will impact the weight of different valences, thus impacting the research outcomes.
To create a balanced map, the researcher needs to pay attention to several key aspects:

- Placement of cover
- Timing
- Management of long sightlines

3.1.1 Placement of cover

Cover is a crucial factor that influences players' combat strategies and has a significant impact on game balance. When placing and designing cover, the researcher should avoid making cover too powerful. The height of the cover should be full or half-height to ensure it can cover standing or crouching players. Additionally, if a level includes cover like head peaking spots that can give players a significant advantage, there should be opportunities for the opposing players to counteract to ensure game balance. With this best practice, the researcher can spread cover with positive valence across the map to attract players to approach.

Figure 5: Site B of the Artifact Level

3.1.2 Timing

Timing plays a crucial role in determining whether a *Counter-Strike 2* map is balanced, influencing how these tactical advantages and valences impact gameplay, and also serves as valence. When a player needs to reach a

specific destination, shorter paths allow them to arrive more quickly to support teammates or to prevent enemies from planting or defusing bombs, giving them tactical advantages. Therefore, the shorter the path, the more advantageous it is, correspondingly the higher their strength will be.

Therefore, managing the time is essential for making a balanced map. Timing management should focus on two aspects: the time it takes for different teams to reach bomb sites from their spawn points, and the time it takes to move from one bomb site to another. The researcher needs to ensure that the travel times for both teams from their spawn points to the bombsites along different routes are equal; otherwise, all players will choose the closest path, without being influenced by other valences. Meanwhile, the time for Counter-Terrorists to reach bomb sites from their spawn point should be less than for Terrorists, allowing Counter-Terrorists sufficient advantage time to prepare for the upcoming fight. Regarding the distance between the two bomb sites, profoundly prolific creator of community maps 'Exodus' stated in his article 'The dos and don'ts of Counter-Strike level design' that It's better to set the rotation time in the range of 10- 15 seconds, or it will be impossible for CTs to win as they only have 40s to defuse the bomb after the bomb is planted. [6].

In this artifact level, the time it takes for players to travel from the spawn point to the two bomb sites is equal (7s and 13s), while the distance from the Ts to both sites is 5 seconds longer than that for the CTs. The time required to rotate between the two sites is 10 seconds, ensuring the map's balance.

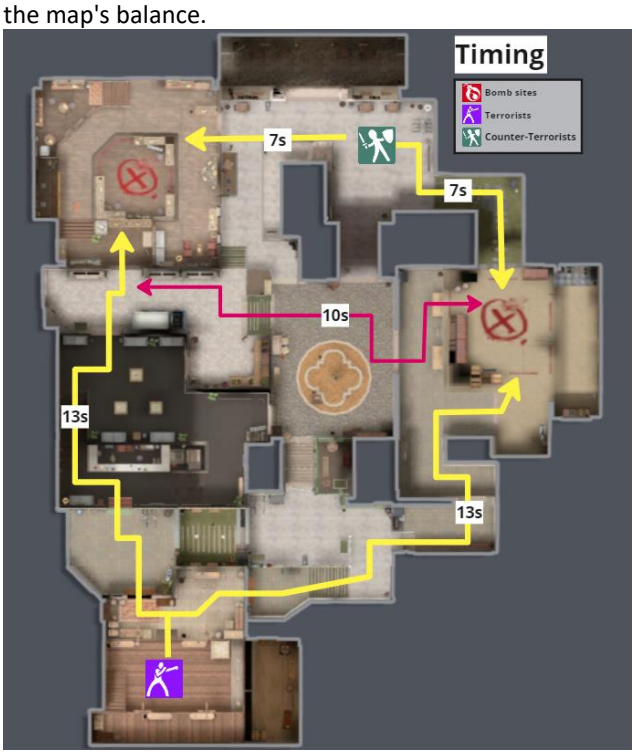

Figure 6: Timing of the Artifact

3.1.3 Management of long sightlines

Long sightlines refer to particularly long and unobstructed lines of sight within the map, enabling players to spot and engage with enemies from a distance. An excessive number of long sightlines can significantly deteriorate the gaming experience, leading to player frustration and influencing the research results. Therefore, the researcher must strategically manage the long sightlines within the map. This involves preventing unintended long sightlines and carefully designing appropriate ones to serve as challenges or negative valences. For example, the researcher can leave long sightlines on certain paths in the map as a form of negative valence and serve as a challenge for players.

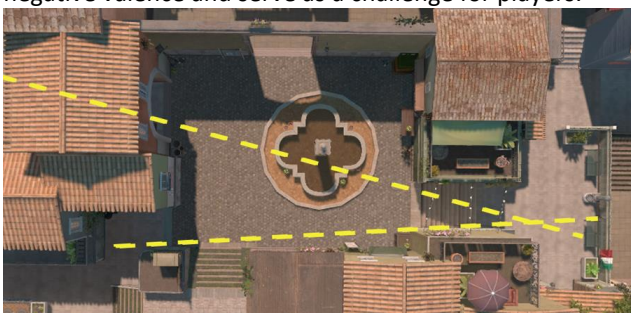

Figure 7: The Long Sightline in the Middle Area

3.2 Classify valances based on their value and strength.

Based on the previously mentioned tactical and visual valences, the researcher has given the valences different value and weight based on the emotion they bring to players and how strong the emotion is, then classified them according to their value and weight.

- Bombsites are the objectives for both teams, with the entire game revolving around this ultimate goal, serving as the strongest positive valence and rated as +3.
- Advantaged positions can offer players tactical advantages, but their attraction is less than that of bombsites, thus they are rated as +2. Depending on the degree of advantage and safety provided by such positions, the weight of an advantaged position can vary between +1 and +2.
- Shorter paths allow players to rotate and support their teammates or defend against enemies more quickly, giving them tactical advantages, thus serving as a positive valence. The shorter the path is, the greater their value are (the values fluctuate between 0 to +2 based on the amount of advantage it can provide to players.)
- Key rotation points also allow players to rotate quickly, existing as +1 before a bomb is planted; after the bomb has been planted, they become +2, as the CTs need to quickly retake the bomb sites within 40s or they will lose.
- Directional Information like Signs & Arrows can indicate the direction to bombsites, but they do not offer strategic advantages, so they are merely rated as +1.

- Chokepoints can provide the defensive side with a defensive advantage, thus being positive for the defensive side, but they also indicate potential directions from which enemies might come, posing potential dangers, and are therefore rated as +1. For the offensive side, chokepoints symbolize a challenge and are necessary passages, hence they are considered neutral.
- Players are more likely to encounter enemies in high-traffic areas than in other areas, but this does not place them at a strategic disadvantage, so it is rated as -1. Open areas expose players to enemy sightlines, putting them at a strategic disadvantage, and are rated as -3.
- Defensive positions can offer strategic advantages to the defensive side, rated as +2. For the offensive side, however, they represent danger, and are thus rated as -2.

With this best practice, the researcher can position these positive valences on the designated routes and negative valences in divergent areas.

Type	Weight	Elements (Offense)	Elements (Defensive)
Positive	+3	• Bomb sites	• Bomb sites
	+2	• Shorter Paths • Advantaged Position • Offensive Position	• Shorter Paths • Advantaged Position • Defensive Position
	+1	• Sign & Arrow	• Chokepoints • Sign & Arrow
Neutral	0	• Chokepoints	• N/A
Negative	-1	• High-traffic area	• High-traffic area
	-2	• Defensive Position	• Offensive Position
	-3	• Open Areas	• Open Areas

Table 1: Valence Table

3.3 Utilizing Tactical Valences and Visual Valences to Influence Player Navigation

3.3.1 Placing Tactical Valences

As mentioned before, when designing the artifact, positive tactical valences should be placed along the desired paths to attract players, while negative tactical valences should be positioned in the opposite direction to steer players towards the intended routes.
Therefore, when designing the artifact level, the researcher set three main paths on the map, and most of the positive tactical valences like cover and advantaged positions are concentratedly arranged on the left and right paths, leaving the middle path with two open areas and long sightlines as negative valences, aiming to attract players to choose the left or right paths.

Figure 8: Valence Map of Offense side (Tactical only)

Figure 9: Valence Map of Defensive side (Tactical only)

3.3.2 Placing Visual Valances

After arranging the tactical valences, it's noticeable that the valences are pretty separated. Therefore, to make them more concentrated and connected as a path, there is a need to add other types of valences.
Visual Valences can guide players towards certain areas, such as bombsites, and serves as a positive valence. Therefore, based on the existing valence map, the researcher can place more positive valences on the intended routes to make the valences on this path more concentrated, thereby increasing the attractiveness of this path.
After placing the visual valences, the researcher can use the valence map to check if the positive valences on the

anticipated path are connected and concentrated, and if the weight of the intended paths are greater than other paths, then proceed to testing.

Figure 10: Final Valence Map

Figure 11: Valence Weight of Three Main Paths

4 RESULTS & ANALYSIS

The researcher divided the artifact level into several areas and analysed the data based on these areas.

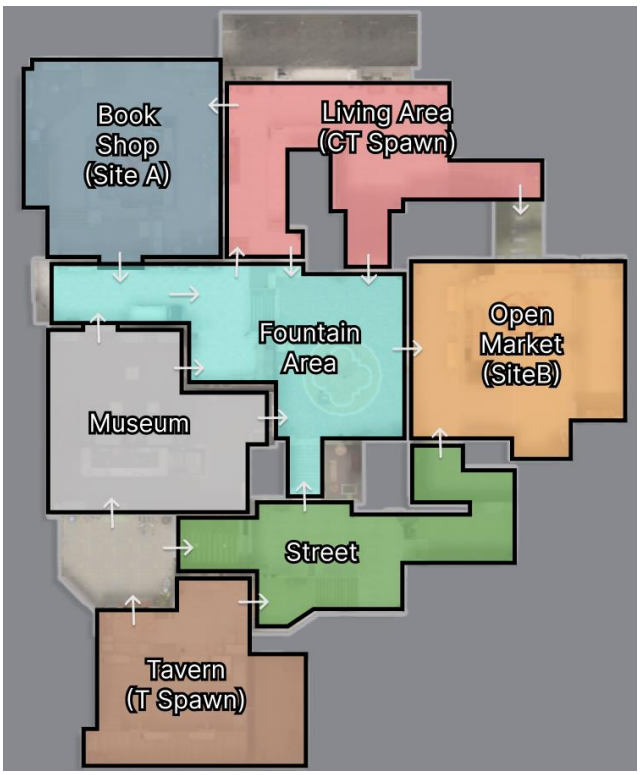

Figure 12: Area Division

4.1 Valence & Valence Weight

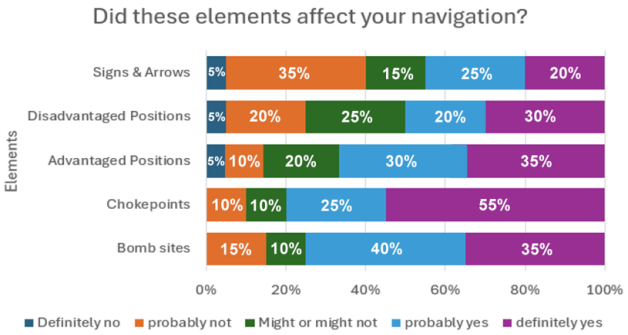

Figure 13: Valence Perception

According to Figure 13, it is evident that most testers perceived that all the elements outlined had an impact on their navigation, with chokepoints having the most significant effect, while signs and arrows were deemed to have the least impact.

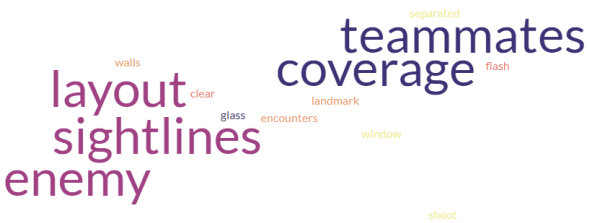

Figure 14: Other elements affected their navigation

When inquired whether there were any additional elements influencing their navigation, some participants indicated that teammates and enemies played a role. For instance, sometimes they just followed their teammates

or strategically moved towards or away from their enemies based on the situation.

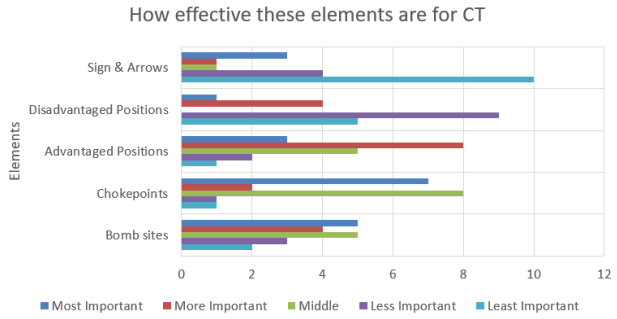

Figure 15: Valence Strength for Counter-Terrorists

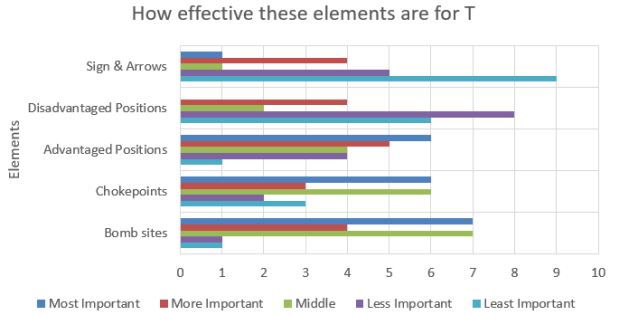

Figure 16: Valence Strength for Terrorists

Based on Figures 15 and 16, it is observable that chokepoints have greater influence on the navigation of Counter-Terrorists, even more than bombsites. However, this effect is less pronounced for Terrorists.

4.2 Danger Level of the Areas

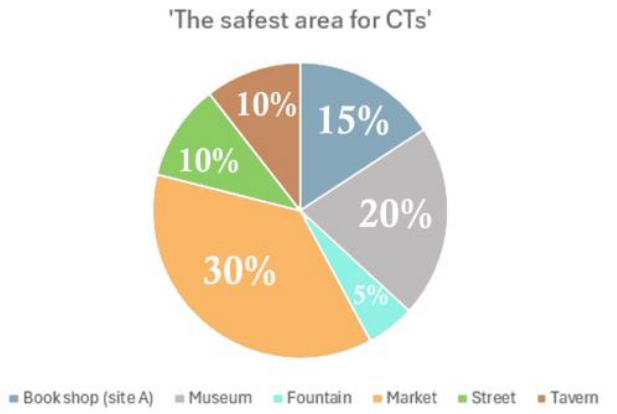

Figure 17: The safest area for Counter-Terrorists

Figure 18: The most dangerous area for Counter-Terrorists

Figure 19: The safest area for Terrorists

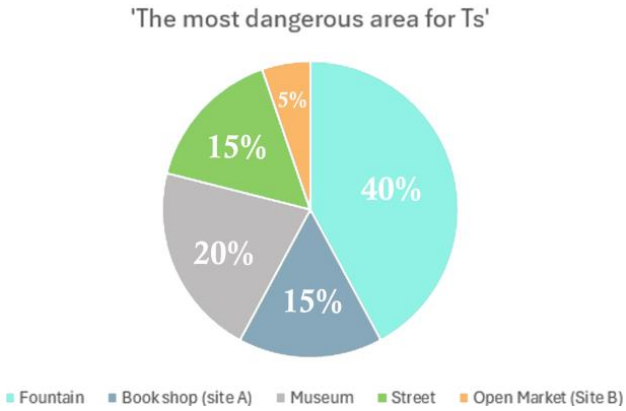

Figure 20: The most dangerous area for Terrorists

From Figures 17 to 20, it shows that both Counter-Terrorists and Terrorists consider the fountain area to be the most dangerous; Site B and the street are perceived as the safest areas by Counter-Terrorists and Terrorists.

4.3 Path Choices

4.3.1 Preferred bomb site (defensive side)

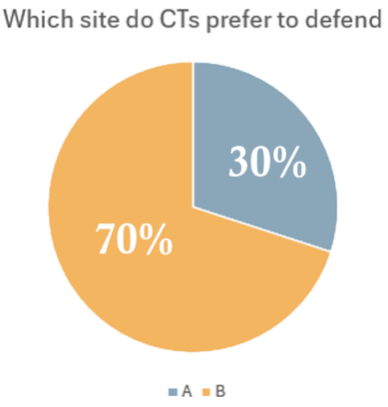

Figure 21: Preferred bomb site (defensive side)

Figure 22: The Reasons why they prefer to defend site B

As seen in Figure 21, 70% testers prefer to defend site B. Figure 22 indicates that the reasons for this preference include Site B having more advantaged positions, such as more cover and better sightlines. Additionally, Site B's proximity to high-traffic areas makes it more likely to be attacked.

4.3.2 The First Area CTs usually Visited

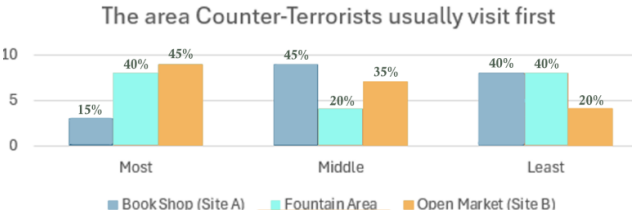

Figure 23: The Area CTs usually Visit First

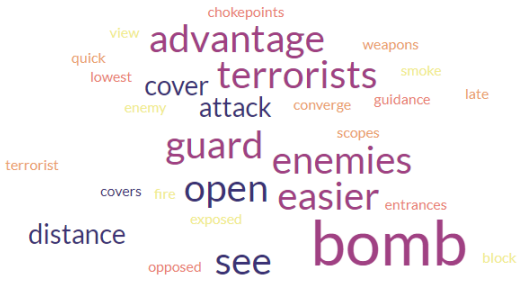

Figure 24: The Reasons why they Chose this Path

According to Figure 23, most Counter-Terrorists typically visit the open market (Site B) first, followed by the book shop (Site A), and lastly, the fountain area. Figure 24 outlines the reasons for their choice of route:

1. The fountain area is overly exposed and dangerous, also it's more likely to meet enemies in the fountain area.
2. Site B offers more advantaged positions.
3. The bomb sites are their primary objectives as they need to defend the bomb sites.

4.3.3 The Paths Terrorists Preferred to Take to the Bomb Sites

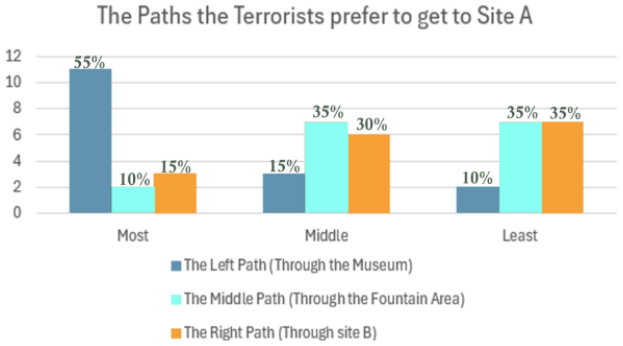

Figure 25: The Paths Terrorists prefer to take to Site A

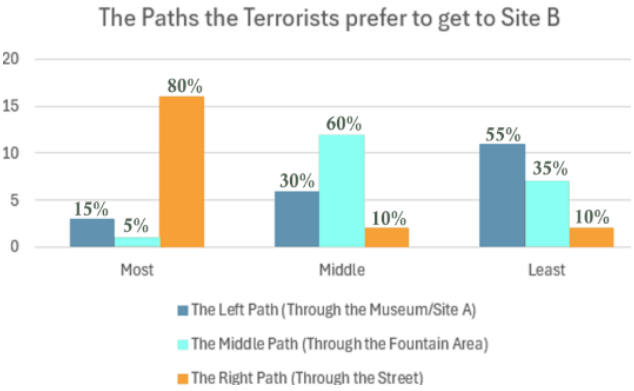

Figure 26: The Paths Terrorists prefer to take to Site B

Figure 27: The Reason they Prefer to Choose this Path

Based on Figure 25 and 26, when Terrorists navigate towards the bombsites, they typically avoid choosing the middle path as their primary route; they mostly choose the side paths. Figure 27 shows that that's because Terrorists think the middle area is more dangerous and the side paths are better. They also avoid taking a longer route, like going to Site A through Site B, because it's too far.

4.3.4 The Paths Counter-Terrorists usually take when a bombsite fell

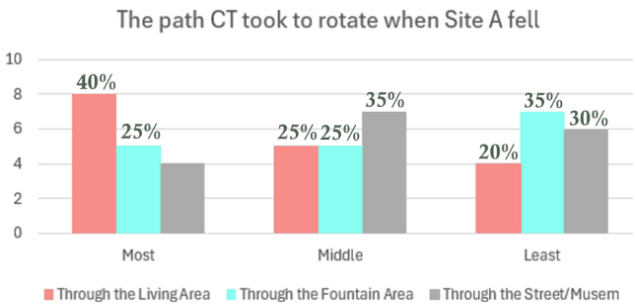

Figure 28: The path CT usually take to rotate when Site A Fell

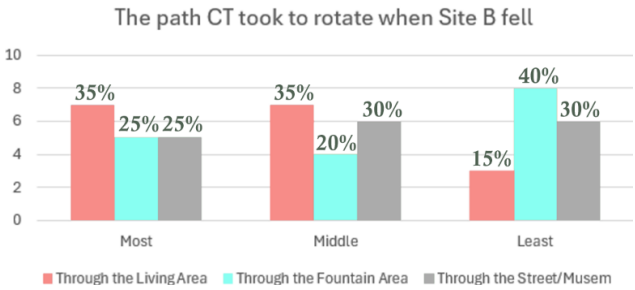

Figure 29: The path CT usually take to rotate when Site B Fell

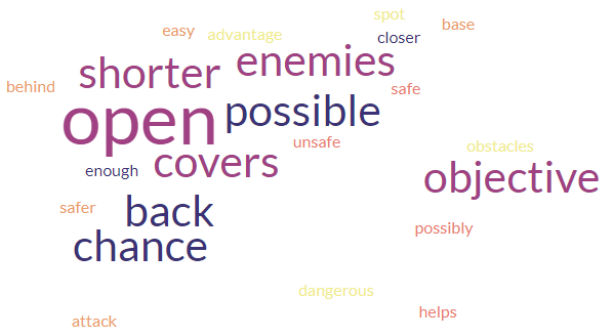

Figure 30: The Reasons they chose this Path

From Figures 28 and 29, we can see that when a bomb site falls, Counter-Terrorists usually rotate from the living area instead of the fountain area, even though the fountain area is closer. Figure 30 shows their reason: the fountain area is too dangerous, and the living area has more cover.

4.3.5 The Impact from Enemy Movements

The data above shows that most testers followed the intended paths, thought the fountain area is more dangerous and would avoid being in the fountain area. However, after the researcher recorded the killing and death points from the match (Figure 31 and 32), the map shows that the most killing and death points are around the fountain area.

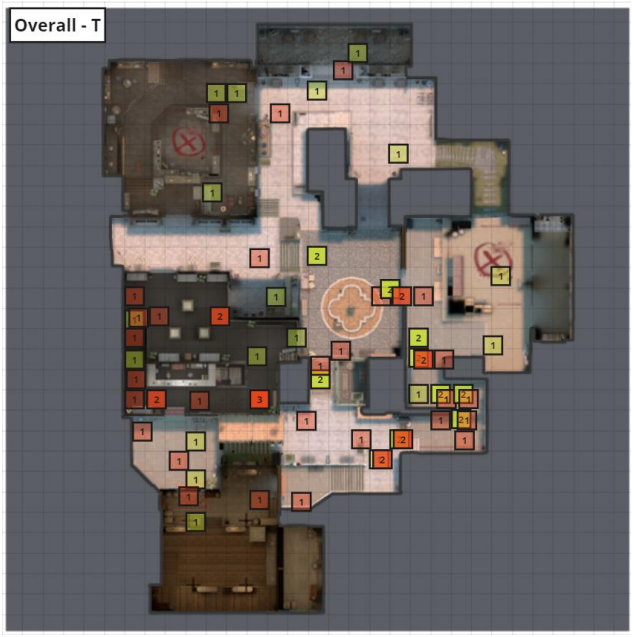

Figure 31: Killing and Death Points of Terrorists

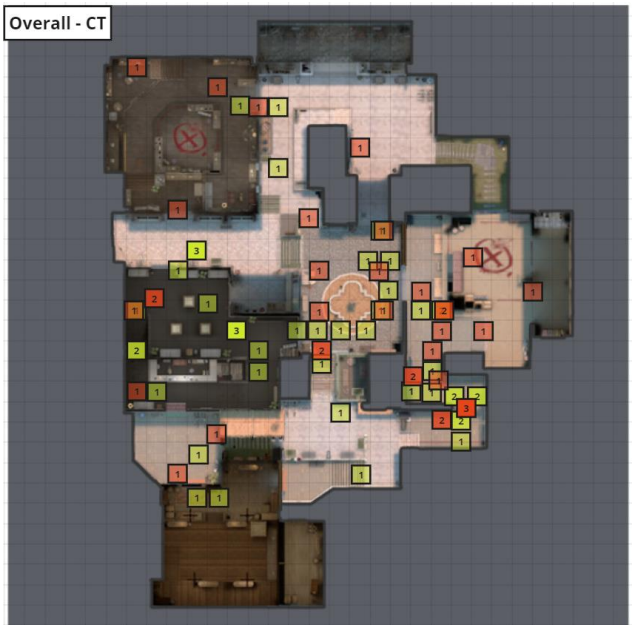

Figure 32: Killing and Death Points of Counter-Terrorists

According to our hypothesis, players should be around the areas with the most positive valence rather than the most dangerous areas (the fountain area). Moreover, all data indicate that players perceive the fountain area as dangerous and tend to avoid it, but this observation clearly contradicts our initial hypothesis.

After reviewing the gameplay videos, the researcher discovered that enemy movements are the cause of this behaviour. When players observe enemy movements, they will be drawn to these locations because eliminating enemies is also one of their objectives. For example, although players may initially gather in positive areas like Site B, the enemy movements near the fountain area will attract them, then leading them to engagements. This phenomenon explains why, despite the data indicating that players view the fountain area as highly dangerous

and prefer to avoid it, both the killing and death points are still concentrated around this area.

5 CONCLUSIONS

Overall, this research successfully proved the elements in the following table can serve as different valences and influenced player navigation with them.

Type	Weight	Elements (Offense)	Elements (Defensive)
Positive	+3	• Bomb sites	• Bomb sites
	+2	• Shorter Paths • Advantaged Position • Offensive Position	• Shorter Paths • Advantaged Position • Defensive Position
	+1	• Sign & Arrow	• Chokepoints • Sign & Arrow
Neutral	0	• Chokepoints	• N/A
Negative	-1	• High-traffic area	• High-traffic area
	-2	• Defensive Position	• Offensive Position
	-3	• Open Areas	• Open Areas

Table 2: The Original Valence Table

However, according to the survey data, the weights assigned to some valences actually need to be adjusted either higher or lower. For example, the influence of chokepoints on the defensive side is actually greater than that of bombsites. Therefore, the weight for chokepoints should be increased to +3 instead of +1. Meanwhile, the weight for shorter paths should be lower than that for advantaged positions because, instead of choosing a shorter but more dangerous path, most testers preferred a slightly longer but safer route to their destination. Based on these observations, the final valence table should be adjusted:

Type	Weight	Elements (Offense)	Elements (Defensive)
Positive	+3	• Bomb sites	• Chokepoints • Bomb sites
	+2	• Advantaged Position • Offensive Position	• Advantaged Position • Defensive Position
	+1	• Shorter Paths • Sign & Arrow	• Shorter Paths • Sign & Arrow
Neutral	0	• Chokepoints	• N/A
Negative	-1	• High-traffic area	• High-traffic area
	-2	• Defensive Position	• Offensive Position
	-3	• Open Areas	• Open Areas

Table 3: The Final Valence Table

In conclusion, based on this result, designers can strategically place different kinds of positive or negative valences in the table to guide players to their intended paths; but designers should also consider the impact of enemy movements to player navigation.

6 REFERENCES

[1] N. H. Frijda, The Emotions, Cambridge University Press, 1986.

[2] S. M. A. a. M. J. F. Filipe Galvão, "Predicting Exact Valence and Arousal Values from EEG," *Sensors (Basel),* 2021.

[3] "Rare and Legendary Weapons," 19 January 2024. [Online]. Available: https://www.ign.com/wikis/baldurs-gate-3/Rare_and_Legendary_Weapons.

[4] [Online]. Available: https://sfx.thelazy.net/media/medthumb/%D0%91%D0%B5%D0%B7%D1%8B%D0%BC%D1%8F%D0%BD%D0%BD%D1%8B%D0%B97_7U7vwKQ.png.

[5] "Simple Radar," [Online]. Available: https://readtldr.gg/simpleradar.

[6] Exodus, "The dos and don'ts of Counter-Strike level design," 14 8 2017. [Online]. Available: https://steamcommunity.com/sharedfiles/filedetails/?id=1110438811.

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