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Using Spatial Composition to Influence Player Tension

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Abstract
This thesis focuses on how space and level geometry in a video game influence a person's tension. The researcher explored a few potential best practices, which a level designer might utilize when employing spatial composition in video games. By modifying a space's density, size, and openness, a designer can effectively increase or decrease the player's spatial tension. To explore the effectiveness of the best practices and the related spatial methodology, the researcher recruited playtesters to play the thesis artifact, a customized game level in *Dying Light* called, "A Way Out." The researcher then analyzed the heart rates and experiences of participants to test the hypothesis and methodology. The conclusions drawn from this research will contribute to defining a methodology for evaluating tension based on spatial composition.

Keywords
Level Design, Video Games, Horror, Spatial Language, Refuge, Prospect, Pacing, Tension, Density, Size, Openness, *Dying Light*

1 INTRODUCTION

Walking in tight hallways can make us feel uneasy, and this feeling is defined as 'claustrophobia' in psychology [1]. This psychological reaction suggests that the way spaces are structured can influence a person's emotions. The same psychological concepts apply to video games. Designers can create virtual spaces using spatial composition to emotionally affect players.

The goal of the thesis is to explore various practices for effectively utilizing 3D spatial composition within a level to influence player tension. The researcher explored spatial characteristics, such as density, size, and openness, and their distinct impacts on tension. Based on these explorations, the researcher defined a spatial methodology to use when evaluating a space's tension. To test the effectiveness of the methodology, the researcher crafted an artifact, called "A Way Out." The artifact took the form of a single-player, horror-based level in *Dying Light*, featuring various types of spatial compositions designed to manipulate player tension. The researcher also collected data from playtesters and analyzed the results.

2 RESEARCH

2.1 Tension

2.1.1 Definition of Tension

Tension is an emotional experience that occurs in a wide variety of contexts, such as film, music, literature, and everyday life [2]. In video games, tension describes the atmosphere and mood of the level or a player's perceived danger [3].

In a psychology article titled, "Toward a general psychological model of tension and suspense," the author pointed out that, "in some contexts, experiences of tension are associated with negative emotions such as fear, concern, or distress, which are generally avoided; in other contexts, tension is experienced as positive, and can, in fact, be a major motivator to engage in certain activities." [4] This can also apply to video games, utilizing tension to engage players, or create emotional experiences like fear, distress, or uncertainty.

In video games, tension might be affected by multiple factors, including time, space, lighting, enemies, color, texture, and sound. For example, in the *Super Mario Bros.* series, certain levels have a time limit. The lack of control over their situation creates a sense of panic. To add to this feeling, in those levels, the screen scrolls independent of the player's movement. This pushes the player forcibly along – making them address dangers whether they are ready to or not.

2.1.2 Build and Release

Tension follows a build-and-release cycle. Initially, players are exposed to the potential for a threat, which gradually increases their tension. When the threat finally appears—whether through a jump scare, a chase sequence, or a monster introduction—tension reaches a sudden peak. After the player successfully deals with the threat, either by defeating it or escaping, the tension is released.

A tension curve is often used to depict the rise and fall of a player's tension throughout a game sequence. As shown in Figure 1, ideally, a tension curve is characterized by a series of rises and falls with an overall ascending trend. The fluctuation represents the build-and-release cycle, while the upward trend ensures a continuous build-up of anticipation and engagement.

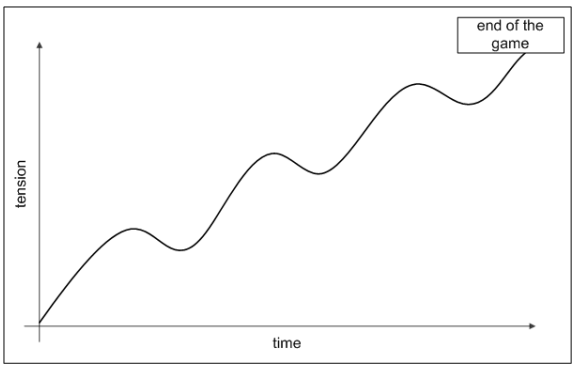


Figure 1: An ideal tension curve [5]

In horror games, designers should avoid constantly scaring players, as it may lead to exhaustion. Conversely, if the player does not experience a rise in tension for too long, they may become bored. Therefore, the increase and decrease in tension must be balanced. Players require moments of calm to recharge and prepare for the next intense experience. Whenever tension drops, it should be followed by a resurgence.

For example, in the game *Outlast*, when the player hears the evil monster creeping closer, they are able to hide in a nearby locker. The player may then peek through the ventilated holes of the locker's door to see if the monster is entering the room. As the threat seemingly gets closer and closer, the sense of danger intensifies, gradually escalating the tension to a peak. After a while, the monster leaves the room, and the player's tension is released.

Figure 2: An example in *Outlast* (2013) [6]

2.2 Spatial Composition

2.2.1 Spatial Composition Definition

Spatial Composition is derived from the architecture term "spatiality," which relates to how certain characteristics may be used to define the quality of a space. It includes qualities such as size, depth, width and height, openness, visibility, expressivity, etc. [7]

2.2.2 Prospect & Refuge

Prospect and Refuge are concepts derived from architecture. In the book, *Origins of Architectural Pleasure,* Hildebrand defines Prospect space as, "a place where we can hunt and forage, a place that offers open views over long distances and is brightly lit" [8]. In contrast, Refuge space is described as the opposite of Prospect space — a place that is "small and dark," which provides safety for retreat and protection from dangers.

These architectural concepts can be applied to level design in video games. In games, Prospect spaces are expansive, open spaces characterized by the player's vulnerability to attacks (Figure 3). Refuge spaces are shielded, concealed areas that offer the player safety from threats and minimize visibility (Figure 4).

Figure 3: Prospect space example in *The Last of Us Part 2* [9]

Figure 4: Refuge space example in *The Last of Us Part 2* [9]

As a result, the researcher assumes that Prospect spaces increase more tension, since open exposed spaces can make one vulnerable to attacks from multiple directions. However, the researcher assumes that Refuge spaces decrease tension because they are often shielded and make one feel safer.

3 RESEARCH METHODOLOGY

3.1 Methodology Overview

In the early research phase, the researcher conducted preliminary tests to explore the validity of her Prospect and Refuge assumptions. Utilizing basic geometry and lighting within the Unreal 5 game engine, the researcher designed a block-out level, comprised of various types of spaces, and enlisted testers to play through it. The researcher recorded the testers' playthroughs, capturing their verbal comments about each space. After analyzing the feedback, the researcher established a methodology to evaluate how a space affects a player's tension.

3.2 Inventing a New Spatial Methodology

The researcher developed a new spatial methodology based on Hildebrand's concepts of Prospect and Refuge spaces. This methodology helped the researcher to better analyze certain spatial characteristics, such as density,

size, and openness. It is assumed that these spatial characteristics have a critical impact on player tension.

3.2.1 Density (Empty or Dense)

Density describes the compactness of a space, including the quantity of objects [10].

In the researcher's methodology, Dense space relates to a space that is occupied by a large number of objects. People tend to feel cramped or trapped in such a space. In contrast, a space that has no objects or that only has a small number of objects will be labeled as Empty.

Figure 5: Example of a dense space in real-life [11]

In video games, density also pertains to the available room for the player to navigate and the percentage of the line of sight that is obstructed. For example, Figure 6 shows a rather densely packed space in *The Last of Us Part II*. The cabinets block the player's view of the left front area. The furniture also limits the player's movement. On the other hand, Figure 7 shows a relatively empty space in *Resident Evil 7*. The emptiness provides the player with good visibility. As a result, the player is able to ensure their safety and move much more freely.

Figure 6: Example of a dense space in *The Last of Us Part 2* [9]

Figure 7: Example of an empty space in *Resident Evil 7* [12]

3.2.2 Size (Wide or Narrow)

Size describes the dimensions of a space, including the height of the ceiling and the width in the horizontal dimension.

A space can be wide or narrow. Wide means the space is large in all aspects of the horizontal dimension, as seen in Figure 8. The space in *The Last of Us Part II* is a wide space.

A narrow space is large in only one direction but is compact in the other two. Figure 9 shows a narrow space in *Resident Evil 7*.

In this study, the researcher also found that small space (not narrow space), is space that is compact in all directions.

Figure 8: Example of a wide space in *The Last of Us Part II* [9]

Figure 9: Example of a narrow space in *Resident Evil 7* [12]

3.2.3 Openness (Open or Enclosed)

Openness relates to how many openings (or entrances/exits) exist in a space and the size of those openings. The openness of a space is determined by the number of accessible approaches that lead to it.

In an interior scenario, the openness is determined by the number of sides that feature windows or doors which connect to adjacent spaces. The size of these windows or doors also impacts the openness of the space. However, not all windows/doors in a game will contribute to the openness of the space. Only those open windows and doors that allow enemies to enter and players to exit can be counted as openings.

In an exterior scenario, the openness is determined by the number and size of openings, such as pathways, gates, or entrances, that connect to the surrounding area.

Similarly, only entrances/exits that allow enemies to come in or players to go out are counted as openings.

Figure 10: Example of an open space in *The Last of Us Part 2* [9]

3.3 Space and tension

3.3.1 How do spatial characteristics affect tension?

After establishing the three spatial characteristics, the researcher began to contemplate the ways space affects tension. In a video titled "The Secret to Resident Evil's Success" by Adam Millard [13], Millard points out that the essence of tension lies in the "Loss of Control," echoing the famous saying of H.P. Lovecraft, "...the oldest and strongest kind of fear is fear of the unknown. " [14]

The player can "Lose Control" in two ways:

1. "Unknown Information."
2. "Movement Constraint."

Unknown Information

"Unknown Information" occurs when the player observes a space. For example, if a large wardrobe near the entrance of a door blocks most of the player's view into the room, they may experience a feeling of suspense - unsure of what awaits them inside. Many famous horror games employ various methods to limit the player's perception, such as the fog in *Silent Hill* and the darkness in the *Slender* franchise.

Figure 11: Fog in *Silent Hill 2* [15]

Figure 12: Darkness in the *Slender* franchise [16]

Movement Constraint

"Movement Constraint" is associated with the usage of a space, especially when the player encounters a threat and must either fight or escape. Horror games frequently employ space scarcity to evoke vulnerability by restricting player movement options. For instance, in *Outlast*, desks are strategically placed in narrow hallways, serving as obstacles to heighten the tension of players as they evade enemies.

3.3.2 The Researcher's Spatial Methodology

A space can be classified by density, size, and openness. To form her spatial methodology, the researcher analyzed the impact each spatial characteristic had on a player's tension.

Density

Dense Space (Raises Tension)

- Unknown Information - A dense space introduces more unknown and uncertain information, where an enemy may be concealed etc.
    - Raises the player's tension.
- Movement Constraint - A dense space can trap the player, offering less room to escape.
    - Raises the player's tension.

Empty Space (Lowers Tension)

- Unknown Information - An empty area tends to release tension as it offers good visibility, allowing the player to see enemies clearly.
    - Lowers the player's tension.
- Movement Constraints - An empty area, providing more room for the player to maneuver.
    - Lowers the player's tension.

Size

Wide Space (Raises Tension)

- Unknown information - A wide space contains more space and therefore requires more exploration. The player cannot fully comprehend the space and its contents quickly.
    - Raises the player's tension.
- Movement Constraint - A wide space allows the player to have more freedom and space to move.
    - Lowers the player's tension.

Narrow Space (Raises Tension)

- Unknown information - A narrow space contains less unknown and uncertain information as the player can grasp the entire situation immediately.
    - Lowers the player's tension.
- Movement Constraint - A narrow space can make the player feel confined and trapped, leading to an increase in tension due to limited evasion space.
    - Raises the player's tension.

As wide spaces and narrow spaces have features that both increase and decrease tension, they may not heighten tension as effectively as density. The outcome will depend on the actual size of the space. The researcher anticipated that the wider or narrower the space, the more tension it would generate.

Medium-sized Space (Lowers Tension)

- Unknown information - A medium-sized space allows the player to have a view of the whole space, which helps them gain more control.
    - Lowers the player's tension.
- Movement Constraint - A medium-sized space gives the player enough room to move.
    - Lowers the player's tension.

Openness

Open Space (Raises Tension)

- Unknown Information - An open space offers more ways for a threat to enter.
    - Raises the player's tension.
- Movement Constraint - An open space provides the player with more ways to escape.
    - Lowers the player's tension.

Enclosed Space (Lowers Tension)

- Unknown Information - An enclosed area has limited ways for a threat to approach.
    - Lowers the player's tension.
- Movement Constraint - An enclosed area limits the player's evasion options.
    - Raises the player's tension.

The researcher's expectation for Openness in spaces aligns with the concepts of Prospect and Refuge space. Prospect spaces are open spaces and tend to increase tension, while enclosed, Refuge spaces tend to decrease tension.

3.3.3 What is a Spatial Tension Curve?

After exploring the potential impact of each spatial characteristic on tension, the researcher needed a more intuitive way to present the results. The researcher developed a tension curve based on the artifact to evaluate and predict how spaces will affect tension. The researcher called this curve the "Spatial Tension Curve."

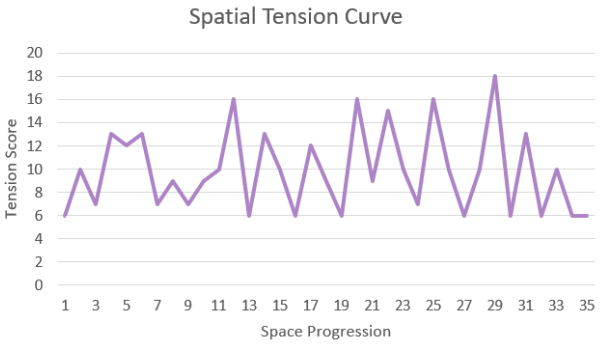


Figure 13: Spatial Tension Curve

The X-axis represents each space the player will traverse through in the game. If the player walks through a space twice, it will be recorded as two distinct points on the X-axis in chronological order.

The Y-axis represents a tension score for each space. The higher the score, the greater the tension a space will create for the player.

This evaluation focuses entirely on space. There are other factors which may impact the results. The researcher addresses those elements later in the postmortem.

3.3.4 How to Calculate the Spatial Tension Curve

The creation of a Spatial Tension Curve involves multiple steps:

1. Classify a space's density, size, and openness.
2. Define the impact of each characteristic.
   The researcher needed to define how wide is wide, how dense is dense, and this may vary from game to game (due to a difference in player and game metrics).

As depicted in Figure 15, the researcher defined the following for the artifact made for the game *Dying Light*:

(Metrics: Character height = 1.5 m, width = 1 m, including both player characters, NPCs, and enemies).

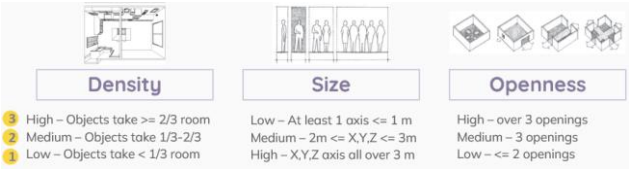


Figure 14: Example definition of each space characteristics [17]

- Density
    - Dense: Objects within a space occupy or fill 2/3 of the space.
    - Medium: Objects within this space occupy or fill 1/3 – 2/3 of the room.
    - Empty: Objects within this space occupy or fill less than 1/3 of the room.
- Size
    - Wide: The X, Y, Z axes of the space are all over 3 meters long.

        - (3 player character wide, 2 player character high in *Dying Light*)
    - Medium: The X, Y, Z axes of the space are all about 2-3 meters.
        - (2-3 player character wide in *Dying Light*)
    - Narrow / Small: The X, Y, Z axes of the space are all less than or equal to 1 meter, or at least one of the axes is less than or equal to 1 meter.
        - (1 player character wide in *Dying Light*)
- Openness
    - Open: The space has more than three openings.
    - Medium: The space has three openings.
    - Enclosed: The space has less than or equal to two openings.

3. Add weight to different characteristics.

    - Dense and Open spaces receive 3 tension points for a space.
    - Spaces labeled as Narrow, Wide, Medium Dense and Medium Open space receive 2 tension points.
    - Spaces labeled as Empty, Enclosed, or Medium Sized receive 1 tension point.

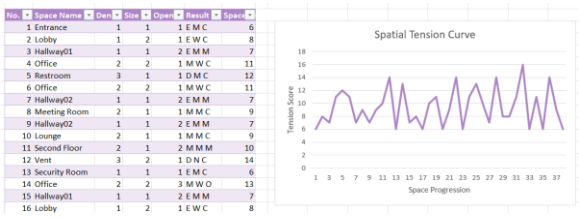
4. Calculate a tension score for each space.
   The following formula is used to calculate each space's tension score.

   Density Value * 3 + Size Value * 1 + Openness Value * 2 = Spatial Tension Score

   The researcher assigned different weight values to different characteristics based on how greatly they affect tension. Density affects the player for the longest amount of time and is more influential than other factors.
   Openness surpasses Size as it has more influence in whether the player believes there will be an enemy or not.

5. Generate a Spatial Tension Curve.
   After calculating the score for each room, we can generate a curve graph using Excel.

Note: All the spatial characteristics will be referred to by their abbreviations. For example, an Empty Wide Enclosed room will be marked as EWC. (To distinguish "Empty" and "Enclosed", both starting with the letter "E", "Enclosed" will be abbreviated as "C", "C" for "Close")



No.	Space Name	Den	Size	Open	Result	Space
1	Entrance	1	1	1	E M C	6
2	Lobby	1	2	1	E W C	8
3	Hallway01	1	1	2	E M M	7
4	Office	2	2	1	M W C	11
5	Restroom	3	1	1	D M C	12
6	Office	2	2	1	M W C	11
7	Hallway02	1	1	2	E M M	7
8	Meeting Room	2	1	1	M M C	9
9	Hallway02	1	1	2	E M M	7
10	Lounge	2	1	1	M M C	9
11	Second Floor	2	1	2	M M M	10
12	Vent	3	2	1	D N C	14
13	Security Room	1	1	1	E M C	6
14	Office	2	2	3	M W O	13
15	Hallway01	1	1	2	E M M	7
16	Lobby	1	2	1	E W C	8

Figure 15: Example calculation of Spatial Tension Curve

3.3.5 How to Generate a Finalized Tension Curve

Besides space, there are some additional factors that need to be considered when evaluating the tension of a level. Two major influences on tension are lighting and threat.

6. Calculate the Lighting Impact
   For lighting, Brightness and Tension are directly proportional to one another. The brighter the space, the lower the player tension, while the darker the space, the higher the player tension. The space is then evaluated by its brightness on a scale from 1 to 3. The brightest room receives 1 point for tension while the darkest room receives 3 points for tension.

7. Calculate the Threat Impact
   Threats in video games are enemies and hazards within a given play space (essentially anything that might hurt the player). A space's threat level is related to the amount and difficulty of each threat type. The greater the number of enemies and hazards, the more difficult the encounter. The more difficult the encounter, the higher the player's tension.
   Like how lighting is evaluated, the goal is to evaluate the threat on a scale from 1 to 3. The researcher first assigned values to the enemies and hazards based on their difficulty. For example, the Biter is the easiest enemy in *Dying Light*. As a result, the Biter enemy receives 1 point for difficulty. In contrast, the Volatile is the hardest enemy and it receives 8 points for difficulty. Next, the researcher multiplied each threat's difficulty points by the number of threats. Finally, the researcher added all these numbers together to get the final threat points.

   Diffulty of Threats * Number of Threats = Threat Points

8. Calculate the Final Tension Points
   For this study, the researcher assumed that space, lighting, and threat apply the same amount of influence to tension. She used the following formula to get the final tension points of a space.

Light Points * 3 + Threat Points * 3 + Space Points = Final Tension Points

9. Generate the Final Tension Curve
   A final tension curve is created based on the tension calculations. Figure 17 shows the original Spatial Tension Curve compared to the Final Tension Curve.

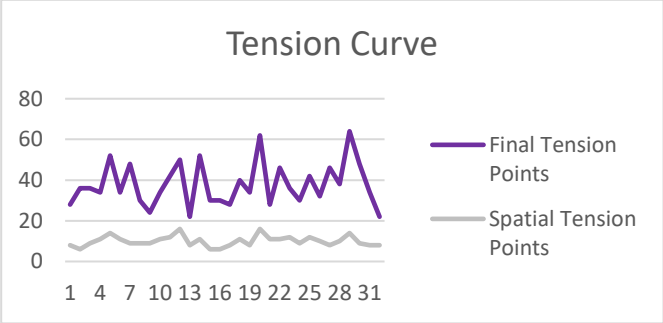


Figure 16: Final Tension Curve Generated

4 LEVEL DESIGN PROCESS

4.1 Process Overview

The researcher created a single-player level, "A Way Out," in the game *Dying Light*, in which the player is trapped in a laboratory building and tries to escape through the underground sewer. The level is structured in three parts:

- Part 1: Building Left Side (First Floor & Second Floor).
- Part 2: Building Right Side (Basement & First Floor).
- Part 3: Sewer.

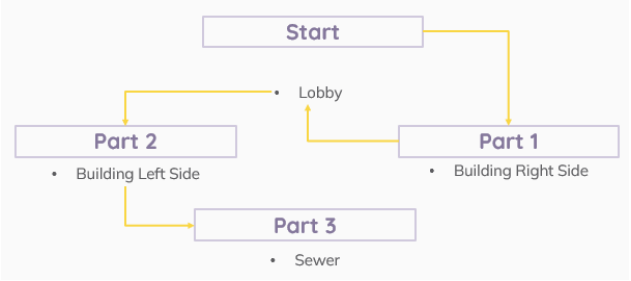


Figure 17: Artifact Structure

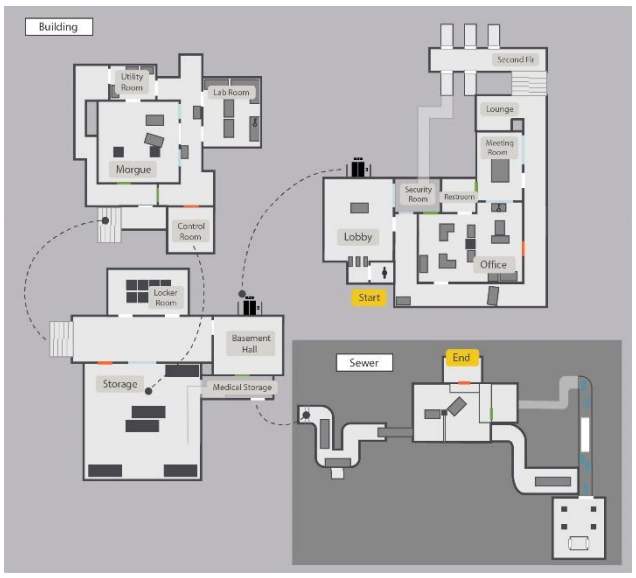


Figure 18: Artifact Overview Map

4.2 General Space Structure and Tension

To achieve the expected tension curve, the three sections of the level had to exhibit distinct spatial characteristics.

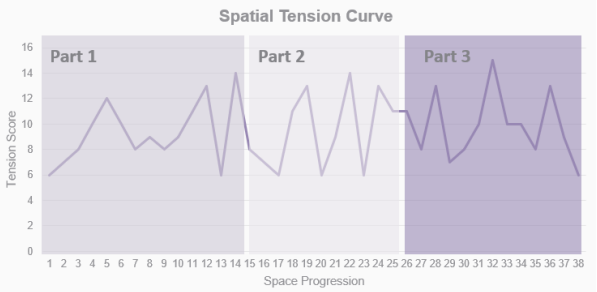
Part 1 (Building Right Side) predominantly contains Empty, Medium-Sized, and Enclosed spaces, yielding an average spatial tension score of 6. The score is relatively low based on the spatial tension curve calculation.

In contrast, Part 2 (Building Left Side) is characterized by Medium-Dense, Narrow, and Open spaces, resulting in an average spatial tension score of 14.

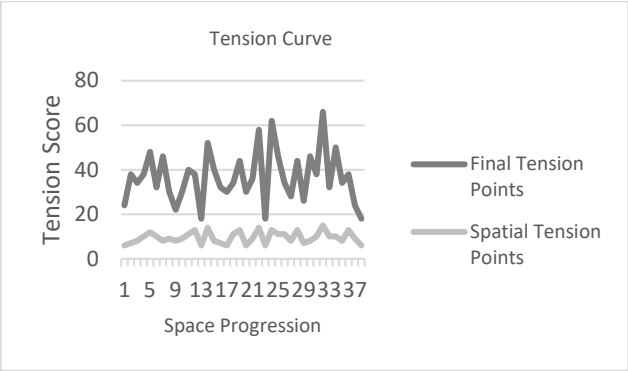
Part 3 (Sewer) is generally a Medium-Dense, Medium-Sized, and Enclosed space with an average spatial tension score of 9.

Based on these calculations, the researcher believed the player's tension level would modulate (raise and lower) throughout their playthrough.

The Spatial Tension Curve the researcher generated for the level is:



The Overall Tension Curve for the level is:



4.3 Specific Level Spaces and Tension

In the following section, the researcher will discuss, case-by-case, how each room's spatial composition affects player tension.

4.3.1 Part 1: Building Right Side (First Floor & Second Floor)

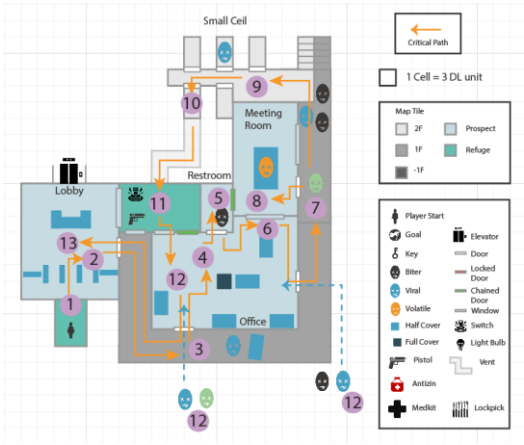


Figure 19: Artifact layout: Building Right Side [18]

Room 2: The Lobby [EWC]

- Spatial Tension: 7 Points
- (E = 1, W = 2, C = 1, Score = 1 * 3 + 2 * 1 + 1 * 2)
- Light Tension: 3 Points
- Threat Tension: 1 Point

Figure 20: Screenshot of the Artifact - The Lobby [19] [20]

The researcher wanted to build the player's tension gradually. As a result, the researcher designed the Lobby space as a relatively low spatial tension space.

Density: Empty

The empty space provides the player with ample room to maneuver away from potential enemies.

Size: Wide

The space is large on the X axis and Y axis, which makes it a wide space. The wide size does bring a feeling of vulnerability, but it also gives the player more time to explore and discover the narrative background.

Openness: Enclosed

The space only has two exits. One exit is the elevator, and the other exit is the door located on the right of the room. Both exits are initially closed off to the player but do eventually open. As a result, this room is somewhat enclosed and provides safety.

Room 4: The Office [DWC]

- Spatial Tension: 13 Points
- (D = 3, W = 2, C = 1, Score = 3 * 3 + 2 * 1 + 1 * 2)
- Light Tension: 2 Points
- Threat Tension: 0 point

Figure 21: Screenshot of the Artifact: The Office [19] [20]

The Office plays a critical role in the player's experience. The exit is locked, and the player needs to find the key within the office to progress in the level.

Density: Dense

The researcher wanted the tension to rise to a small peak in the office space. To achieve this desired result, the researcher made this room rather dense. Tightly arranged desks and pillars block the players' sightlines.

Size: Wide

The wide size builds more tension as the player cannot fully grasp the layout of the entire space.

Openness: Enclosed

All the doors and windows of the Office are either locked or closed, which makes the Office a strongly enclosed environment. The room does eventually open, which slightly decreases the tension.

Room 4: The Security Room [EMC]

- Spatial Tension: 6 Points
- (D = 1, W = 1, C = 1, Score = 1 * 3 + 1 * 1 + 1 * 2)
- Light Tension: 1 Point
- Threat Tension: 0 Point

Figure 22: Screenshot of the Artifact: The Security Room [19] [20]

At the end of Part 1, the player enters the security room to activate the elevator. This area is where the player completes their first sub-goal. The completion of the goal allows the player to release their tension.

Density: Empty

The space is designed to be empty, within which the player can see the whole space at first glance. The player also has plenty of room to move and react. The brightness of the space is used to highlight the sub-goal objective.

Size: Medium-Sized

The size of the room is neither large nor small. It is a comfortable size for the player.

Openness: Enclosed

The only exit/entrance door is closed, and all the windows are sealed. The Enclosed feature gives the player safety in the Security Room.

4.3.2 Part 2: Building Left Side (Basement & First Floor)

For Part 2, the researcher wanted the tension to be higher than earlier in the experience. Consequently, the researcher tried to add more openness to the building's left side (basement and first floor).

Figure 23: Artifact layout: Building Left Side - 1st floor [18]

Room 16: The Locker Room [MMO]

- Spatial Tension: 13 Points
- (M = 2, M = 1, O = 3, Score = 2 * 3 + 1 * 1 + 3 * 2)
- Light Tension: 1 Point
- Threat Tension: 2 Points

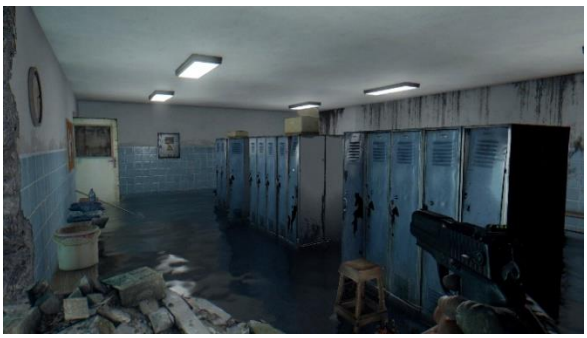


Figure 24: Screenshot of the Artifact - The Locker Room [19] [20]

Density: Medium-Dense

Lockers in the center of the room block the player's view, leaving the player uncertain about the presence of enemies inside and providing a moderate level of tension.

Size: Medium-Size

Like the Security Room, the Locker Room space is also a comfortable, average size.

Openness: Open

The researcher built a giant hole on the entrance wall in the Storage Room. This large hole allows enemies to easily cross over into the hallway.

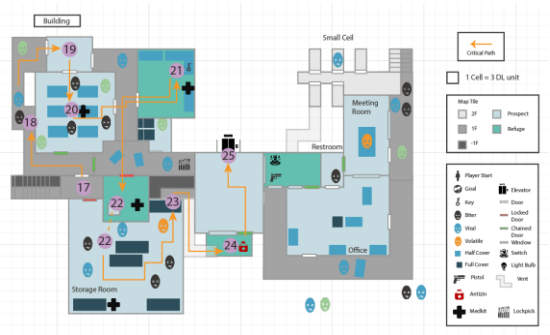


Figure 25: Artifact layout: Building Left Side – 2nd Floor [18]

4.3.3 Section 3: Sewer

After the overall rather tense experience in the second section, the researcher wished to release the tension a little bit at the beginning of the third section, the Sewer.

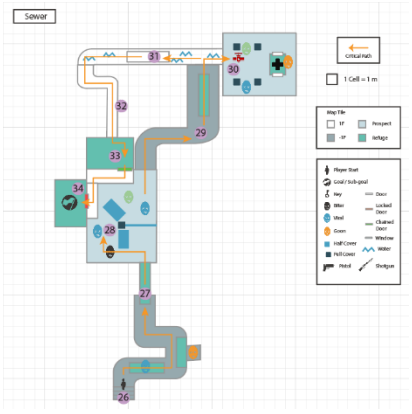


Figure 26 Artifact layout: The Sewer [18]

Room 26: The Sewer Hallway [EMM]

- Spatial Tension: 8 Points
- (E = 1, M = 1, M = 2, Score = 1 * 3 + 1 * 1 + 2 * 2)
- Light Tension: 2 Points
- Threat Tension: 3 Points

Figure 27 Screenshot of the Artifact: The Sewer Hallway [19] [20]

Density: Empty

The sewer hallway is empty with good visibility, which brings the tension down.

Size: Medium-Size

The size of the sewer hallway is medium-sized.

Openness: Medium-Open

The sewer hallway has several fake openings, which are presented as dark doorways. Since the player will treat the dark doorways as real openings, they will increase the player's tension.

4.4 Process Conclusion

By considering the space's potential impact on tension and aligning the space with the desired gameplay experience, the researcher can effectively influence the player's overall level of tension.

5 RESULTS AND DATA ANALYSIS

5.1 Surveyed Playtests and Heartrate Monitoring

The researcher recruited 20 consenting participants to playthrough the level "A Way Out." Each participant was equipped with a Fitbit wristwatch, which monitored their heartrate second-by-second. Before playing the level, participants completed a pre-test survey assessing their tolerance to violent horror content and general gaming experience. After completing the level, they filled out a survey detailing their perceived tension for specific scenes. Additionally, the playtesters were asked to compare two scenarios and identify which scenario elicited a higher tension level.

5.2 Participant Average Tension Curve vs. Predicted Tension Curve

Each participant rated 8 sections' tension on a scale from 1 to 10. The researcher calculated each section's average tension value and compared the values to the researcher's predicted tension value.

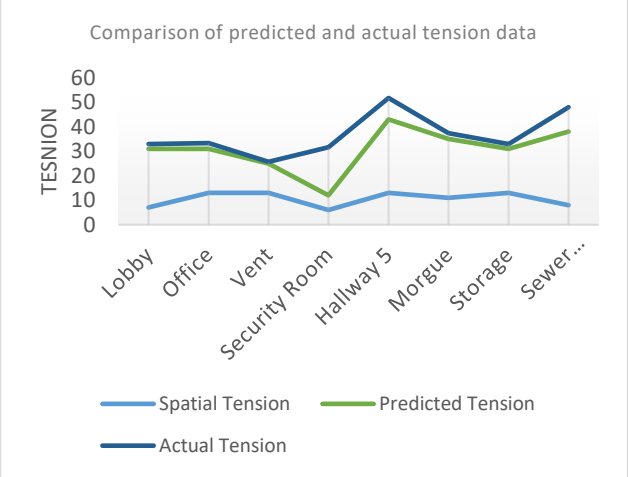


Figure 28: Comparison of Average Tension vs. Predicted Tension

As illustrated in Figure 28, the actual average tension closely follows the predicted tension trends. Generally, the playtesters' tension value starts at around 32, dips to 25 in the Vent, and then peaks at 52 in the Hallway 5. The tension value drops again in the Morgue (38) and Storage Room (33), then rises in the Sewer Hallway (48). This curve implies that the researcher's methodology was effective. However, notably, the actual tension of the Security Room (32) was much higher than predicted.

However, the spatial tension is quite different when compared with the actual tension and the predicted tension. The researcher believes this result is because the Lighting and Threats played a critical role in affecting tension.

Figure 29: Screenshot of the Artifact - Security Room

The researcher believes that this discrepancy is possibly due to the presence of the dead security guards. The guards were intentionally placed in the space to create a more realistic scene. However, previously in the lobby, players encountered security guard bodies which reanimated to suddenly attack the player. This behaviour raised the player's tension. As a result, when players were locked in the Security Room with the guard bodies, they felt they were facing potential threats.

5.3 Participant Average Heartrate vs. Predicted Tension Curve

The researcher collected the participants' heartrate data, while they playtested the artifact. However, only 17 out of the 20 results were viable. The Fitbit wristwatch did not effectively detect three participants' heartrates during their playthrough. The researcher gathered the heartrate data for 8 significant level areas and calculated the average playtester heartrate value for each area.

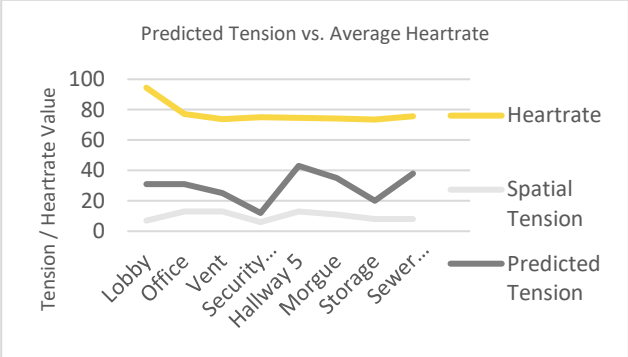


Figure 30: Comparison of Average Heartrate vs. Predicted Tension

The heart rate data did not align with the researcher's predicted tension curve at all. As shown in Figure 30, the predicted tension curve fluctuates, while the heartrate line remains somewhat linear, only notably decreasing once toward the start of the experience. The researcher believes that this discrepancy is possibly due to the wristwatch failing to effectively monitor the participants' heartrates. However, the results could also indicate that the heartrate does not effectively reflect a person's tension level. Participants were likely excited at the beginning of the playthrough but became somewhat acclimatized to the tension as they progressed.

5.4 Two Scenario Tension Comparisons

The participants were asked to compare two given scenarios and decide which scenario felt more tense. They were also asked to provide reasons for their decision and rank the factors that influenced their responses.

For example, as shown in Figure 31 and Figure 32, 15 out of 20 participants felt more tense in the Locker Room as opposed to the Utility Room. Ten participants attributed this rating to the central lockers, which made the space feel dense and obstructed their view of the space. Three participants noted that the Locker Room felt more open because of the broken wall, and because threats were more likely to enter the space. As the Locker Room is evaluated as a Medium-Dense, Medium-Sized and Open space, these responses imply that both density and openness are factors that enhance tension.

Figure 31: Screenshot of the Artifact - Utility Room

Figure 32: Screenshot of the Artifact - Locker Room

Another example involves comparing Hallway A and Hallway B. Nineteen participants agreed that Hallway B felt more dangerous. Eight participants mentioned Hallway B was tighter, and nine participants mentioned it was darker and had more blood. The results prove that the narrowness of the space significantly impacts the player's tension, but the player is also affected by the lighting and aesthetic decorations.

Figure 33: Screenshot of the Artifact: Hallway A

Figure 34: Screenshot of the Artifact: Hallway B

The playtesters' responses indicate that the participants' feeling of tension aligned with the researcher's

predictions. Most testers recognized the impact of the spatial components on their emotions.

6 CONCLUSIONS

In conclusion, spatial composition does have an influence on a players' tension. Dense, narrow, wide, and open spaces tend to increase tension, while empty, medium-sized, and enclosed spaces tend to decrease tension. However, while spatial composition is important, lighting plays a primary role in affecting tension. Threats in a space and a space's aesthetic decoration also play a large role in affecting tension. Understanding these factors can guide game designers in modulating a players' tension throughout a level and creating an immersive and emotionally engaging experiences.

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