

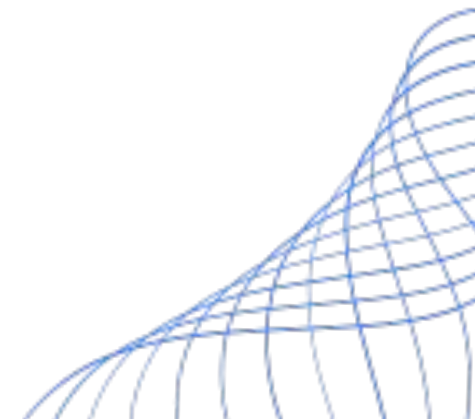


# Cartography M.Sc.

## **A Story of Space & Sound :**

### Affective Affordance of Ambient Sound in Cartographic Storytelling

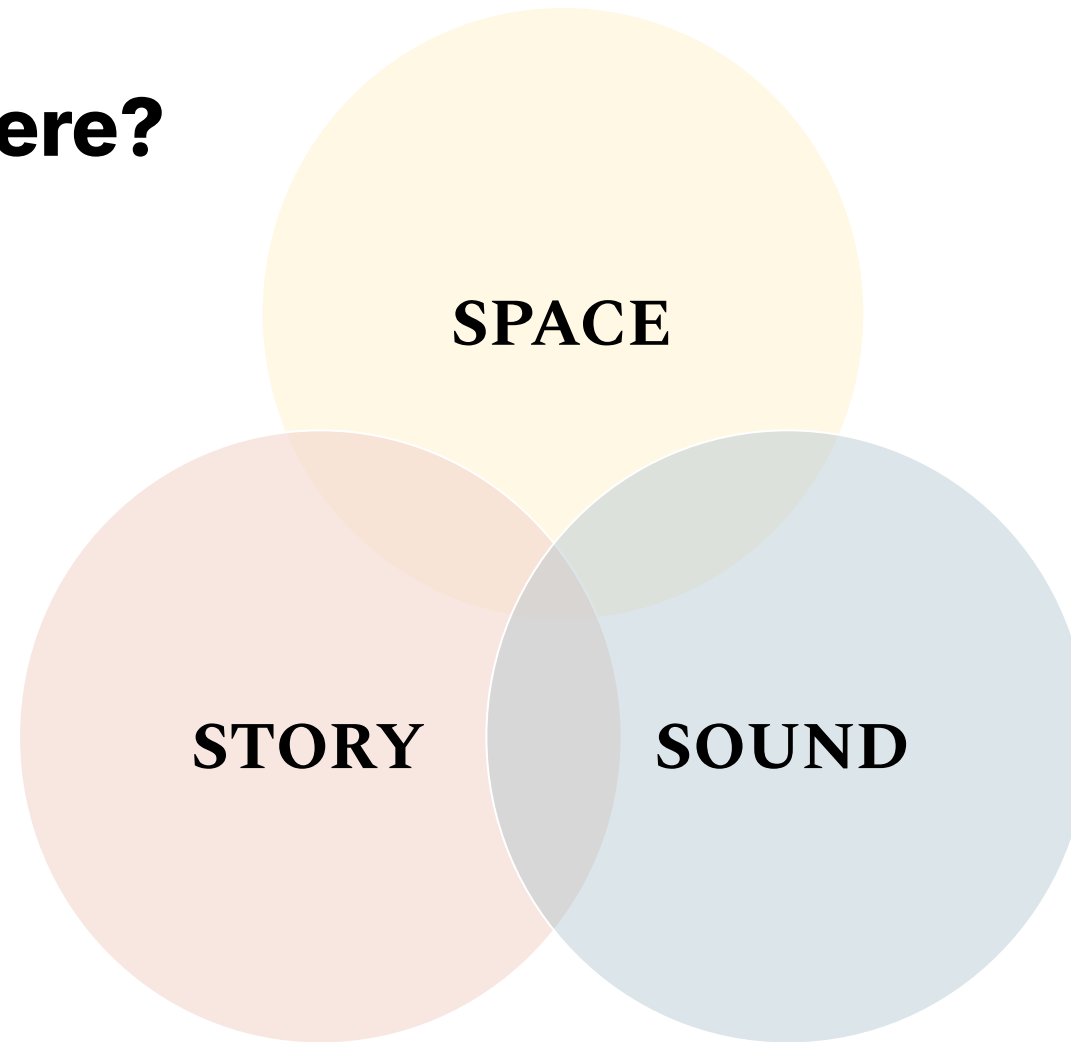
Nicole Yeung | Technical University of Vienna



# ROAD MAP

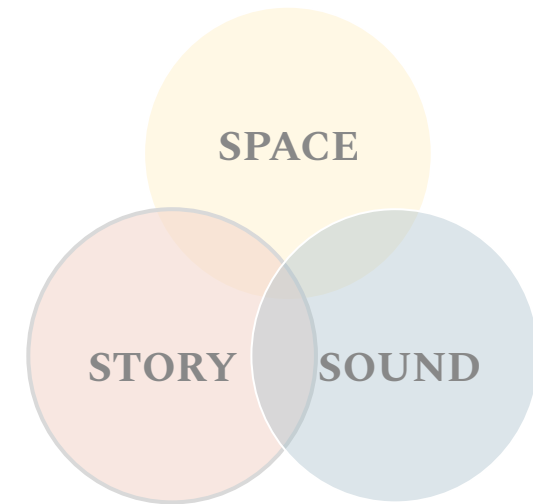
- Research Motivation
- Research Goal and Question
- Objective (RO) 1
- Objective (RO) 2
- Objective (RO) 3 - User Study
- Results & Discussions
- Limitations and Future Opportunities

# Why are we here?



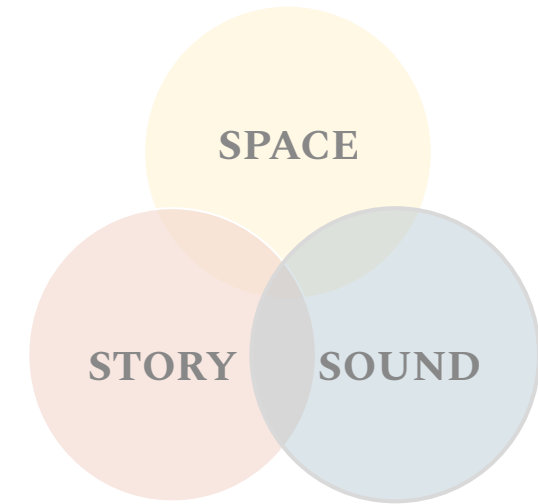
# Why - Cartographic Storytelling?

- **Every map is a story**
- Fundamental **essence** of map
- **\*Cartographic Storytelling** = any expression or mode of embedding and sharing stories through maps
- a **medium** to tell stories about space that **connect** us

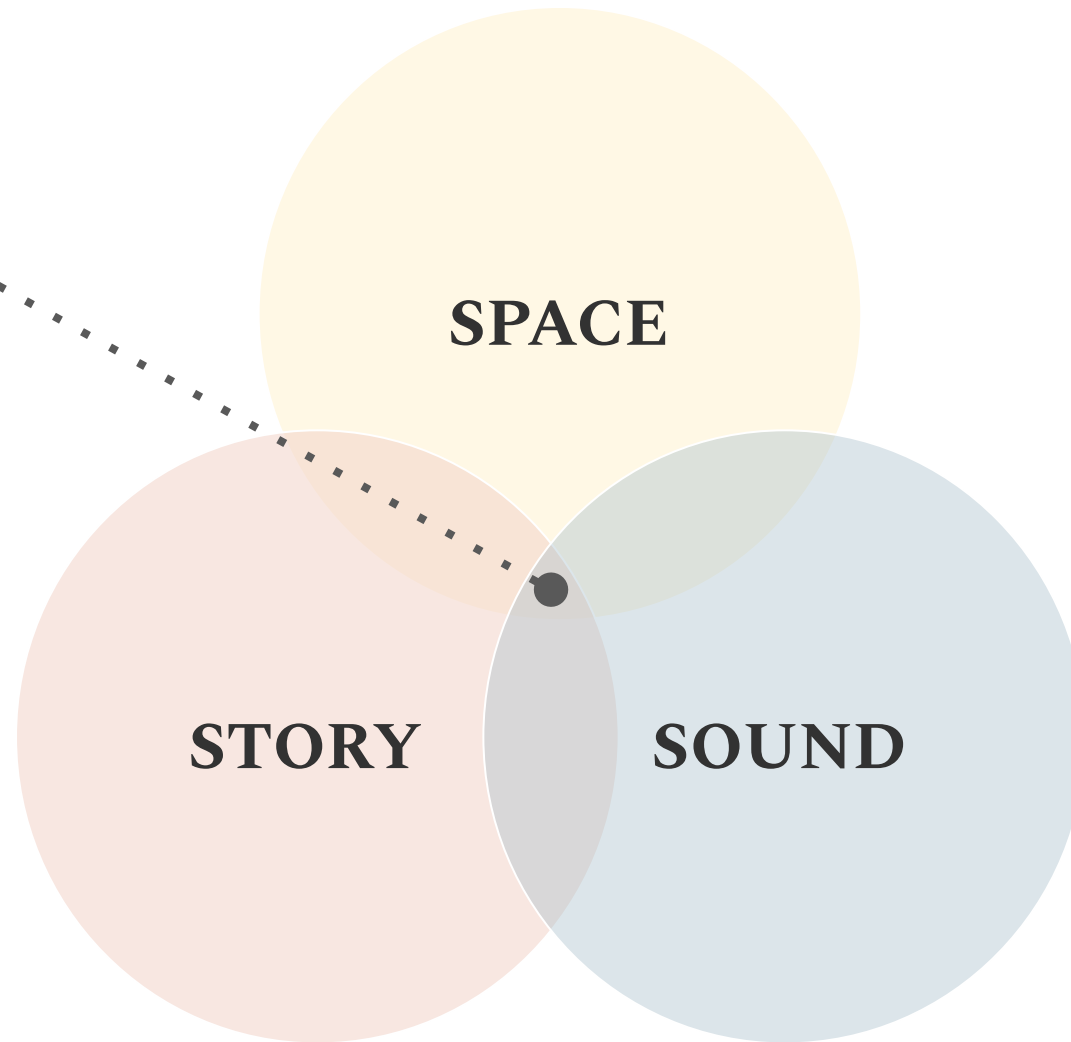


# Why - Sound?

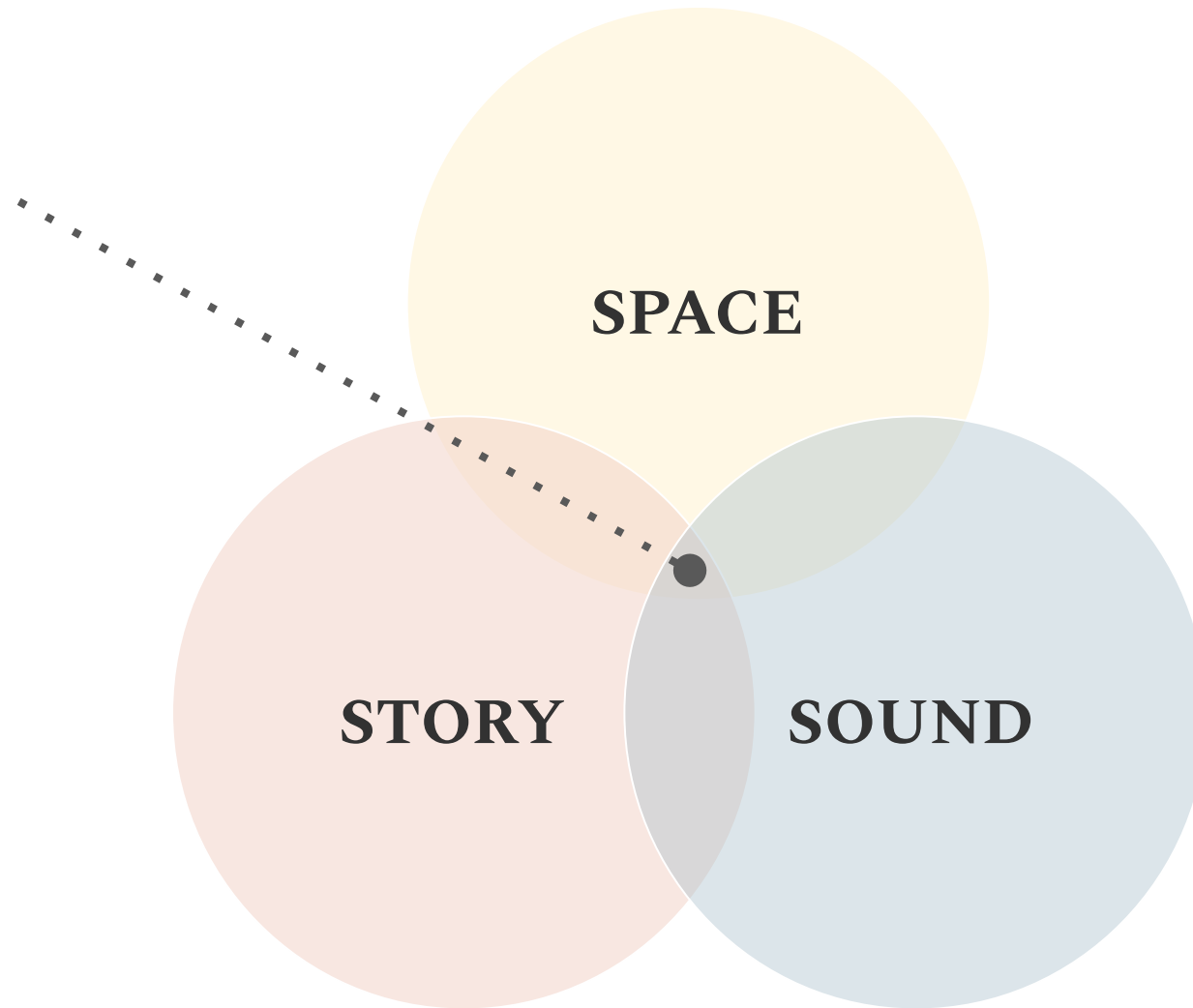
- **Sound is ...**
  - Important for **perceiving** the world
  - Like space: gives context to how we relate
  - **Everywhere**
  - **Under-utilized** in maps - Bearman, 2013



**We are here :**



# Emotions



# Research Goal

What is the **Affective Affordance** of  
**Ambient Sound in Cartographic Storytelling?**



# Research Goal

What is the <sup>\*</sup>Affective Affordance of Ambient Sound in Cartographic Storytelling?

- \* Affect - psychological term for emotions
- \* Affordance | Capabilities and potential uses that an entity or a process offers.

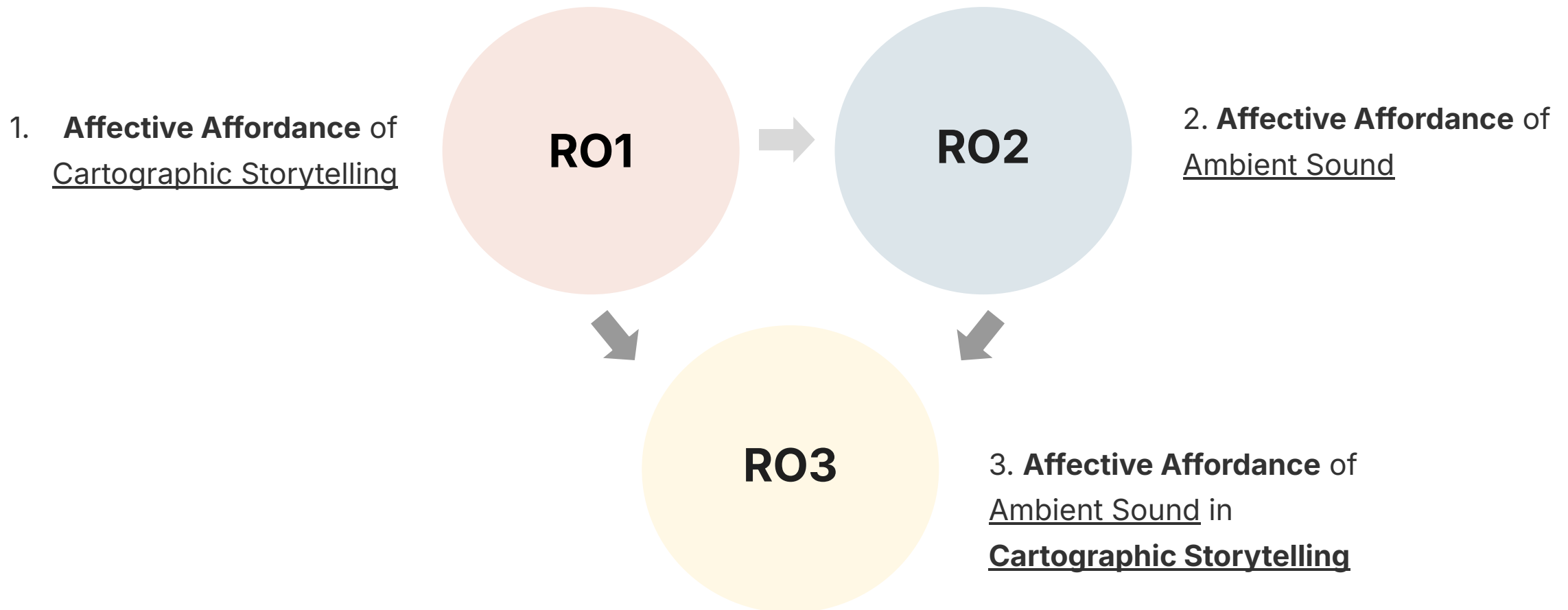
# in other words . . .

What **capabilities** can \* **Ambient Sound** offer to support  
\* **Emotional Engagement in Cartographic Storytelling?**

- \* Ambient sound - inherently **spatial**; all background sounds in an environment - Chion, 1994
- \* Emotional engagement ↔ affective affordance

# Overarching **Research Question**

What is the **Affective Affordance of Ambient Sound in Cartographic Storytelling?**



# Research Objectives

## Objective °1 | RO1

To examine the **Affective Affordance** of Narrative Devices in **Cartographic Storytelling**

## Objective °2 | RO2

To examine the **Affective Affordance** of **Ambient Sound**

## Objective °3 | RO3

To determine the **Affective Affordance** of Ambient Sound as Rhetoric Devices in **Cartographic Storytelling**

# Research Approach

Objective °1 | RO1

Literature Review



Objective °2 | RO2

Literature Review



Objective °3 | RO3

Prototype & User Study

# Research Objectives

Objective °1 | RO1



To examine the **Affective Affordance** of **Narrative Devices** in Cartographic Storytelling

Objective °2 | RO2

Objective °3 | RO3

# Research Objectives

Objective °1 | RO1

- ▼ To examine the **Affective Affordance of Cartographic Narrative Devices** in Cartographic Storytelling

Objective °2 | RO2

## RQ 1.1

What is the **affective affordance** of **Cartographic Storytelling**?

Objective °3 | RO3

## RQ 1.2

What **cartographic narrative techniques** serve to **support** the **affective affordance** of cartographic storytelling?

## RQ 1.1 - What is the affective affordance of Cartographic Storytelling?

- **Maps** - "suggest, convey, and **evoke emotions**" - Caquard & Griffin, 2018
- Emotions are **critical** to storytelling
- "Emotions and empathy help **situate** the audience's **perspective** in the story, while **enhancing** their ability to **immerse** themselves in the environment and the **experiences** presented in a story" - Bach et al., 2018
- **Value** of storytelling maps - ties to "how they make the audience **feel**" - Roth, 2021



## RQ 1.2 - What cartographic narrative techniques serve to support the affective affordance of cartographic storytelling?

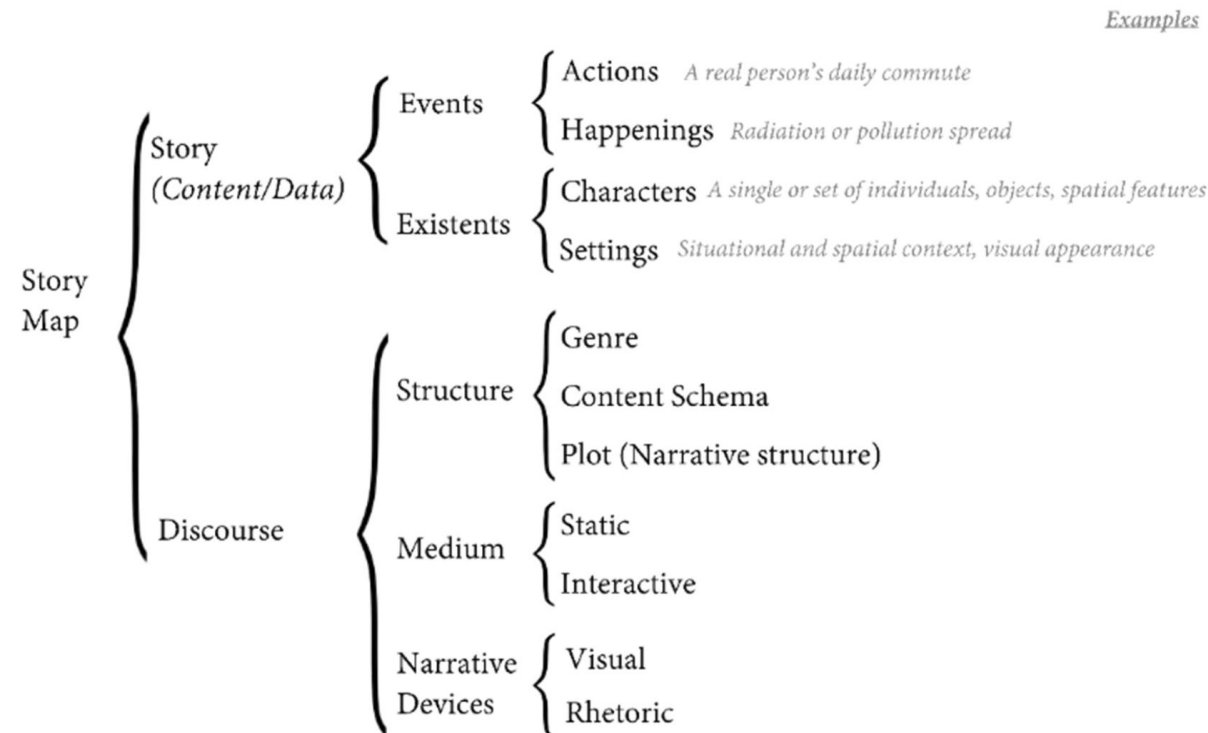


Figure 3-16. Hierarchical diagram comprising the components of a Story Map. Based on Chatman (1978).

# Rhetoric Device in Cartographic Storytelling

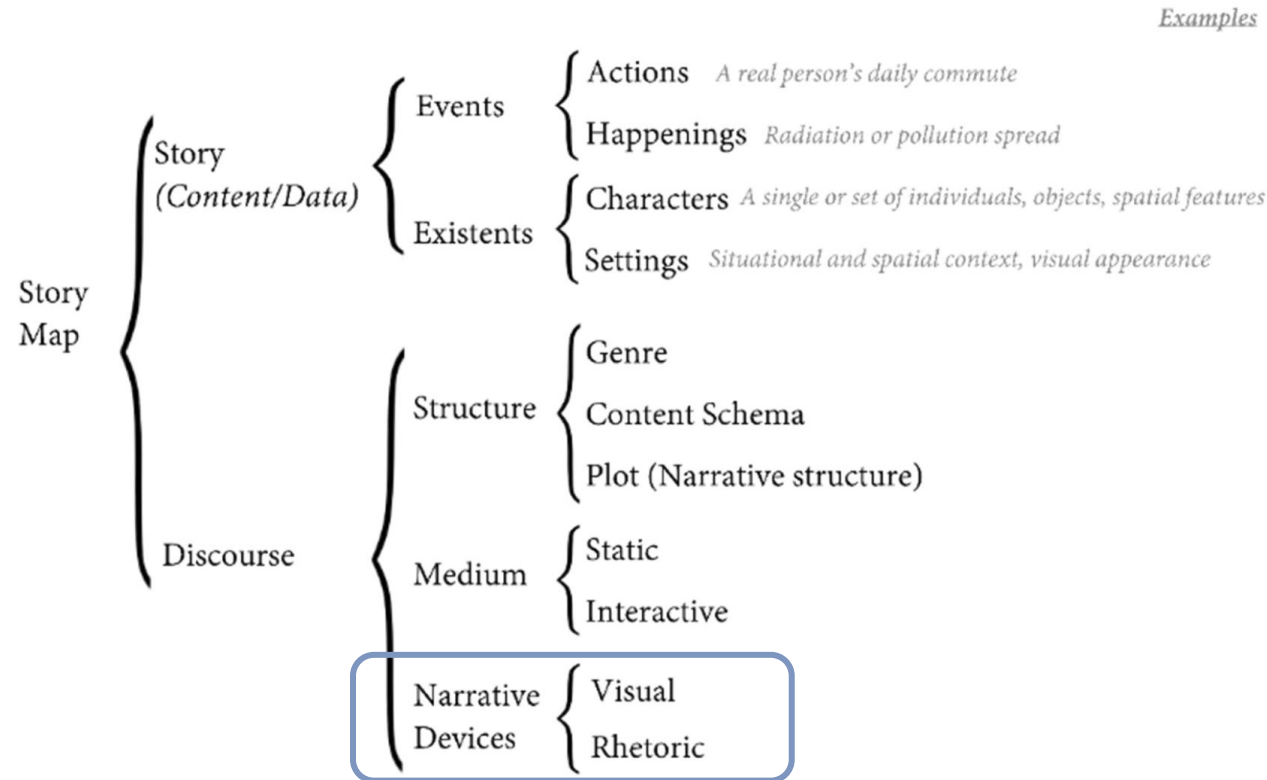


Figure 3-16. Hierarchical diagram comprising the components of a Story Map. Based on Chatman (1978).

# Rhetoric Device in Cartographic Storytelling

- Narrative **strategy, methods, and decisions** that implement and **support** the action of **communication** in a narrative
- Can generate **affective** response to **“build interest, engagement, and emotions”** - Cortés, 2018
- **Blueprint** for developing the auditory equivalents in a cartographic narrative

# Research Objectives

Objective °1 | RO1

- ▼ To examine the **Affective Affordance of Cartographic Narrative Devices** in Cartographic Storytelling

**RQ 1.1** ✓

What is the **affective affordance** of **Cartographic Storytelling**?

**RQ 1.2** ✓

What **cartographic narrative techniques** serve to **support** the **affective affordance** of cartographic storytelling?

# Research Objectives

Objective °1 | RO1



To examine the **Affective Affordance** of **Cartographic Narrative Devices** in Cartographic Storytelling

Objective °2 | RO2

Objective °3 | RO3

# Research Objectives

Objective °1 | RO1

Objective °2 | RO2

- ▶ To examine the **Affective Affordance of Ambient Sound**

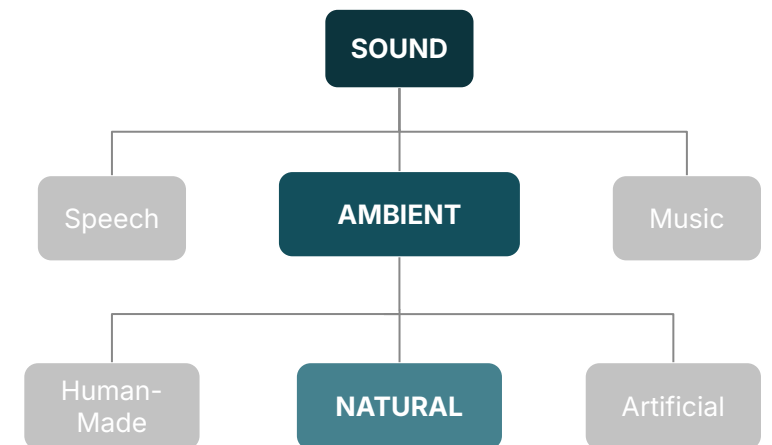
Objective °3 | RO3

## Ambient Sound

- (Cinematography) all background sounds that are in an environment;
- (Storytelling) “helps describe the location and **enhance** the **emotive atmosphere** described in the narrative”
- affects “the way we perceive the narrative and (the) level of our **immersion**” - Turner, 2005

## RQ 2 - What is the affective affordance of Ambient Sound?

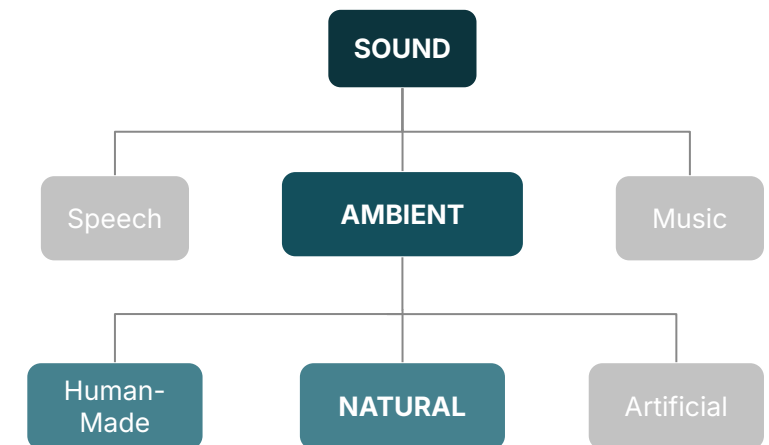
- **Natural Sound**
  - sounds generated by nature phenomenon / not generated by human activity.
- ⇒ **Positive** emotive experiences
- e.g. bird songs, wind, river: **pleasant, calm, relaxing**





## RQ 2 - What is the affective affordance of Ambient Sound?

- **Human-made Sound**
  - sounds generated from human activities.
- ⇒ **Negative** emotive experiences
- e.g. road noises: **stress, annoyance**



# Research Objective II - Findings

Objective °1 | RO1

Objective °2 | RO2

Objective °3 | RO3

- ▼ **RQ2: What is the **Affective Affordance** of **Ambient Sound**?**
  - **Natural** ambience → **Positive** Affects
    - e.g. relaxation, joy
  - **Non-natural** ambience / noises → **Negative** Affects
    - e.g. anxiety, frustration

# Research Objective II - Findings

Objective °1 | RO1

Objective °2 | RO2

Objective °3 | RO3

- ▶ To examine the **Affective Affordance of Ambient Sound**

# Research Objectives

Objective °1 | RO1

To examine the **Affective Affordance of Cartographic Narrative Devices** in Cartographic Storytelling

Objective °2 | RO2

To examine the **Affective Affordance of Ambient Sound**

Objective °3 | RO3

To determine the **Affective Affordance of Ambient Sound as Rhetoric Devices in Cartographic Storytelling**

# Sound as Rhetoric Device for Emotional Engagement

- Based on Cartographic Rhetoric Devices (RO1) & sound design approaches
- = blueprints for integrating Ambient Sound as cartographic narrative techniques - Cortés, 2018; Bach et al., 2018
- Proposing: **Cartophonic Rhetoric Devices**
  - **mechanisms** that can be **implemented via sound** to **achieve similar functions** as cartographic rhetoric devices in **cartographic storytelling**

# Carto phonic Rhetoric Device

Functional Group	Cartophonic Rhetoric Device	Description
Similarity	<b>Comparison</b>	<ul style="list-style-type: none"> <li>Two or more contrasting auditory materials can be embedded to highlight their differences.</li> </ul>
	<b>Simile</b>	<ul style="list-style-type: none"> <li>Two or more sound materials can be embedded to demonstrate their similarity.</li> </ul>
	<b>Double Entendre</b>	<ul style="list-style-type: none"> <li>Hinges on a linguistic or visual similarity that unite two ideas or entities, based on the inherent association between sounds</li> </ul>
Individuality	<b>Familiarize / Familiar Setting</b>	<ul style="list-style-type: none"> <li>Creates a familiar setting for audiences; helps the reader to familiarize and relate to the story in order to foster empathy</li> </ul>
	<b>Substories</b>	<ul style="list-style-type: none"> <li>Allocates subsections of the story to provide more "specific, and perhaps more accessible views"</li> </ul>

## Carto phonic Rhetoric Device (cont.)

Functional Group	Cartophonic Rhetoric Device	Description
Anchoring	<b>(Geographic) Context</b>	<ul style="list-style-type: none"> <li>Auditory cues and materials that establish and maintain a tone "congruent with the setting, characters, and problem context" - Roth, 2016</li> <li>akin to "setting the mood" and "atmosphere"</li> </ul>
	<b>Framing</b>	<ul style="list-style-type: none"> <li>Sound materials can be modified to alter its representation and meaning, which in turn shifts the atmosphere of the soundscape of the cartographic narrative.</li> </ul>
Empathy	<b>Concretize</b>	<ul style="list-style-type: none"> <li>Illustrates abstract concepts with concrete objects; strongly evoke emotions, grounding an empathic response within that emotional context. e.g. Isotype</li> </ul>
	<b>Humans behind the dots</b>	<ul style="list-style-type: none"> <li>Introduces a concrete person or setup as an example for the matter of the story; presenting individual stories to evoke empathy</li> </ul>

## Carto phonic Rhetoric Device (cont.)

Functional Group	Cartophonic Rhetoric Device	Description
Managing Flow	<b>Gradual Reveal</b>	<ul style="list-style-type: none"><li>• Auditory cues and sound elements can be gradually introduced to the cartographic narrative to engage the audience's sense of curiosity and anticipation</li></ul>
	<b>Slowing Down</b>	<ul style="list-style-type: none"><li>• Slows down the narration and focuses on a single aspect of the data, while leaving the user alone with the data.</li></ul>
	<b>Speeding Up</b>	<ul style="list-style-type: none"><li>• Speeds up and through multiple aspects, which creates an overwhelming sensation and/or heightens the sense of urgency</li></ul>



# Cartographic Narrative Prototype

- Objectives
  - To **demonstrate** and **validate** the proposed application of ambient sound in cartographic storytelling
  - To **evaluate** whether this **supports** the function of emotional engagement with the audience.
- Two Versions
  - **with** ambient sound
  - **without** ambient sound

# Cartographic Narrative Prototype

- "the **Green Heart of Europe**"
- **Conservation**-themed story map; 3-act spatial narrative arc
- To promote and showcase **biodiversity** of the conservation area (WWF)
- Original goal: a subpage and map for each area
- Reduced scope: only one area of the Green Heart as an example



**\*Please use a computer and ear-phones for this experience.**

# Prototype - Cartophonic Devices Examples

## 1. *Home Page, slide 1*

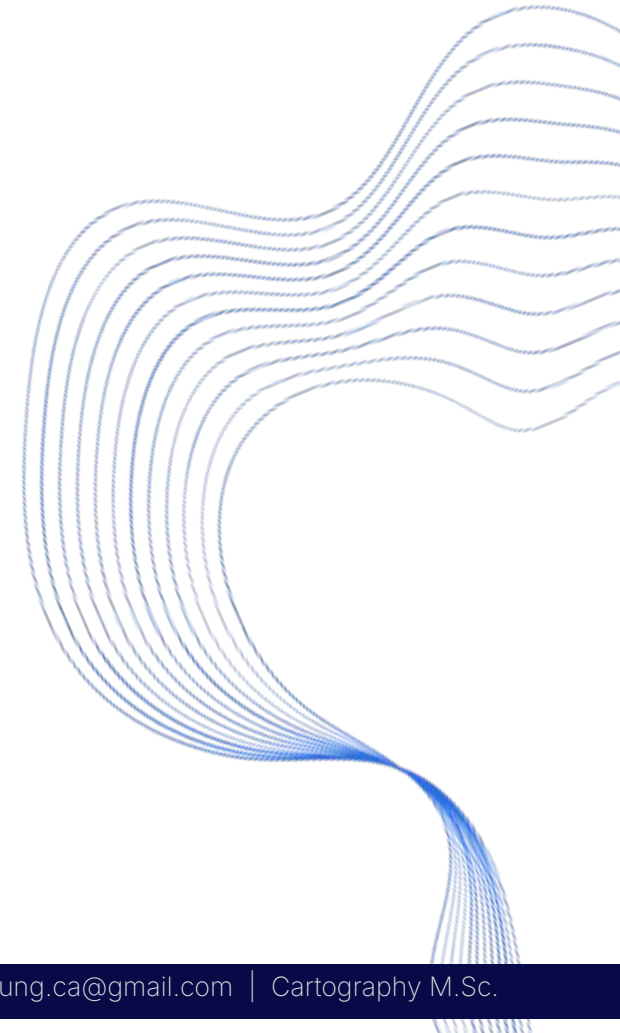
- **Sound Elements:** river flowing and beating heart sounds
- **Cartophonic Rhetoric Devices**
  - i. **Double Entendre** - beating heart **hints at the idea** of the Green Heart of Europe
  - ii. **Simile** - beating heart is a simile to the **living, pulsing dynamic** of a running river
  - iii. **Slow down** - original sound of beating heart was slowed down to induce a **calming** effect
  - iv. **Context** - river flow to situate the context in **nature**
  - v. **Framing** - river to bring calmness and **tranquility**

# Prototype - Cartophonic Devices Examples

2. *Second Page (River), slides 7- 10: dredging, drilling, and construction sounds*
  - i. **Gradual Reveal**
    - sounds from anthropogenic activities **gradually added**, remained there
    - **unceasing** sounds of dredging, drilling, and construction **accumulated**
    - to create **tension**
  - ii. **Speed Up**
    - **shortened** and **compressed sequence** and duration between sounds
    - i.e. sounds were introduced to the narrative faster and faster.
    - to create **overwhelming urgency**

# User Study

- **Ambient Sound = independent variable**
- Randomized controlled experiment
- Data collection - user survey
  - Hybrid approach (Quantitative + Qualitative)



# Survey Structure

Section	Content	Format
1   Introduction	Survey Disclaimer	/
	*Pre-Survey Sound Test	/
2   Pre-Experience	Pre-Experience Affect Score (PANAS)	20 Likert scale questions
3   Link to Map	Hyperlink to story-map	/
4   Post-Experience	Post-Experience Affect Score (PANAS)	20 Likert scale questions
	Questions on Emotional Engagement	7 Open-text questions; 4 Likert scale questions
5   Demographics	Demographic Information	4 Single-choice questions; 3 Likert scale questions; 2 Open-text questions

## Research Hypothesis

Embedding ambient sound as a rhetoric technique in a storytelling-map will lead to stronger emotional reactions in the audience.

**Between Control Group (Map without Sound) & Experimental Group (Map with Sound):**

$H_0$

There is **no significant difference** in the intensity of emotional reaction.

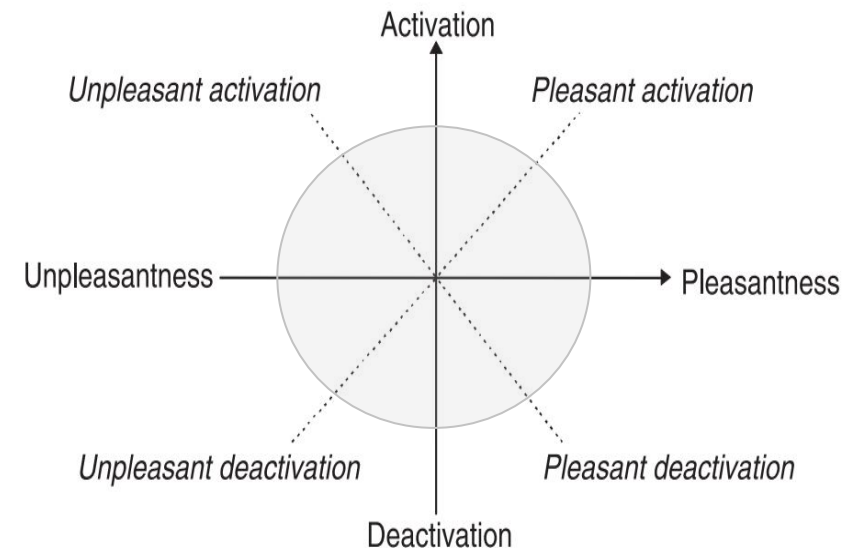
$H_1$

There **is a significant difference** in the intensity of emotional reaction.

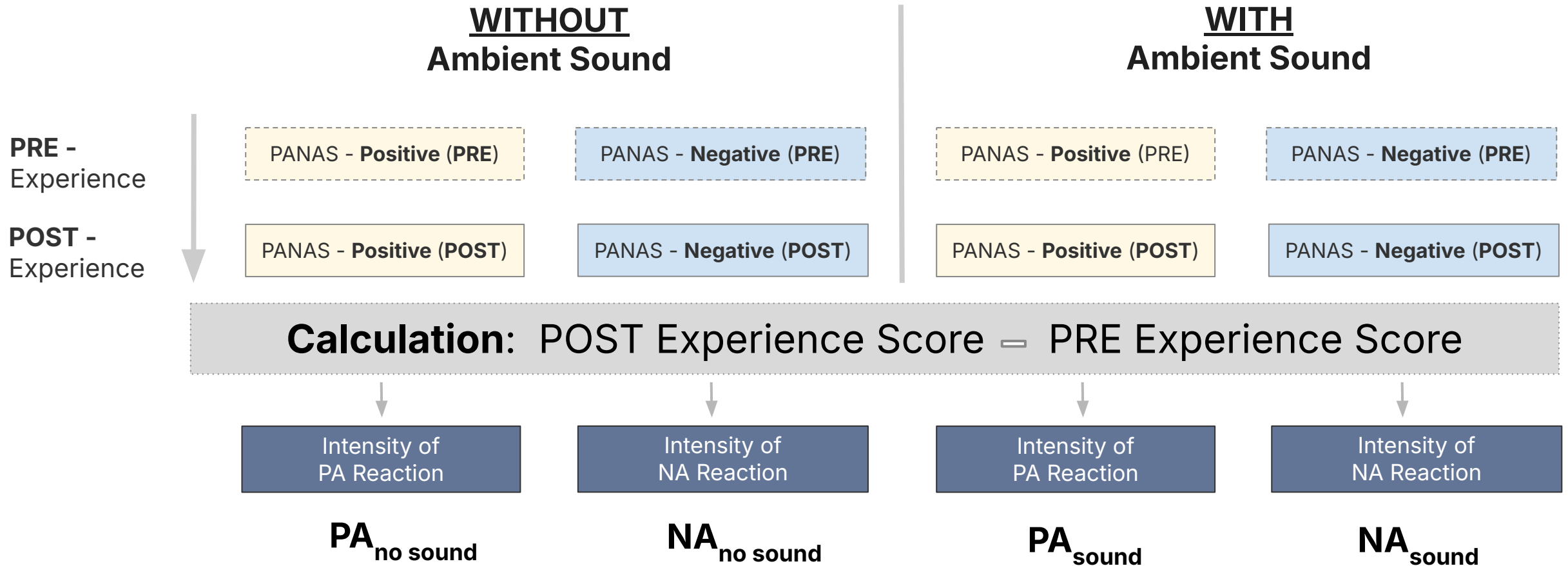


# Affect Metrics

- **PANAS** (Positive Affect & Negative Affect Schedule)
- Derived from the **Affect Circumplex** theory - Russell, 1980
- Group emotions by two dimensions of emotion experience: **valence & activation**
- **Other metrics**
  - Likert-scale & Open-text questions
  - e.g. **Immersion**, narrative engagement



## Test Statistics - PA Score & NA Score

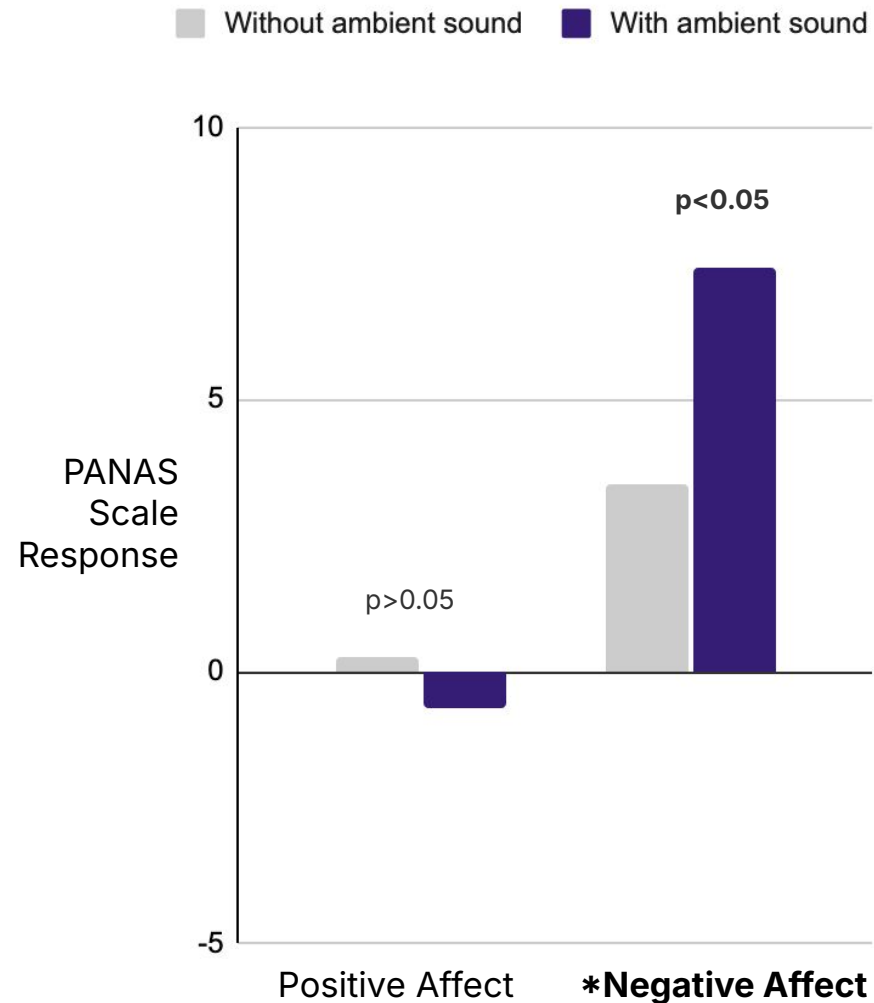


## Statistical Test

- Conducted on each of the PANAS scores between **Control & Experimental**:
  - **PA**<sub>no sound</sub> & **PA**<sub>sound</sub>
  - **NA**<sub>no sound</sub> & **NA**<sub>sound</sub>
- Sample size: 88 respondents (43 control, 45 test)
- *Original plan: 2-sample z-test*
  - assumption: sample size >30, ~~normal distribution~~
- Revised test: **Mann-Whitney U-test**
  - also known as the Wilcoxon rank sum test  
(run as *Wilcoxon-Mann-Whitney* test in R)

# Summary

Measured Affective Elements	Z-Value	p-value (alpha = 0.05)
Positive Affect (PA) scale	-0.90408	0.366
<b>*Negative Affect (NA) scale</b>	2.3471	<b>0.01892</b>
Emotional Connection	1.6273	0.1037
<b>*Narrative Immersion</b>	2.0452	<b>0.04083</b>
Narrative Engagement	0.14218	0.8869



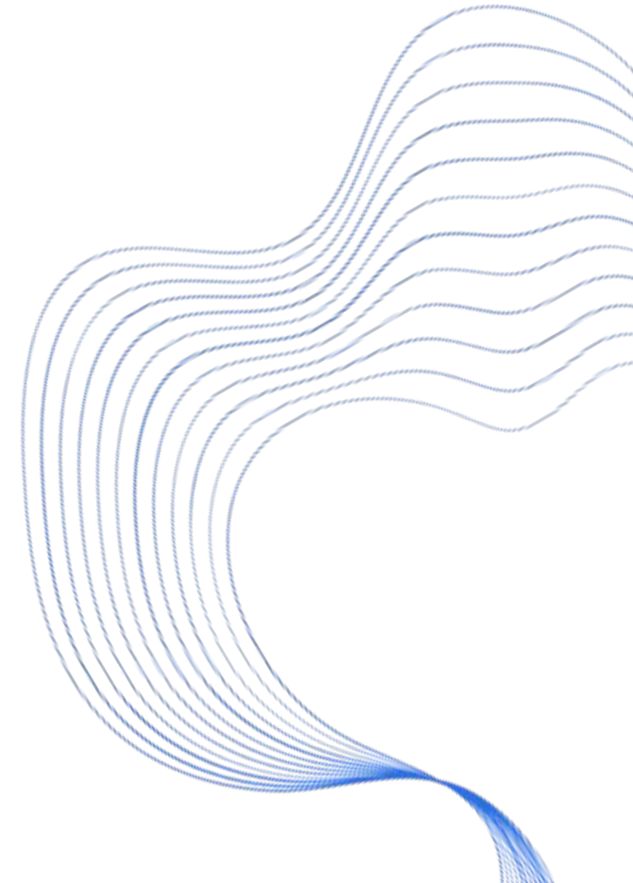
## PANAS

- Sample size: 88 respondents (43 pairs)
- Ambient sound → **significantly stronger** change in **negative** affects
- insignificant difference in positive affects

# Negative Affective State

**Ambient sound → significantly stronger change in negative affects;**  
→ insignificant difference in positive affects

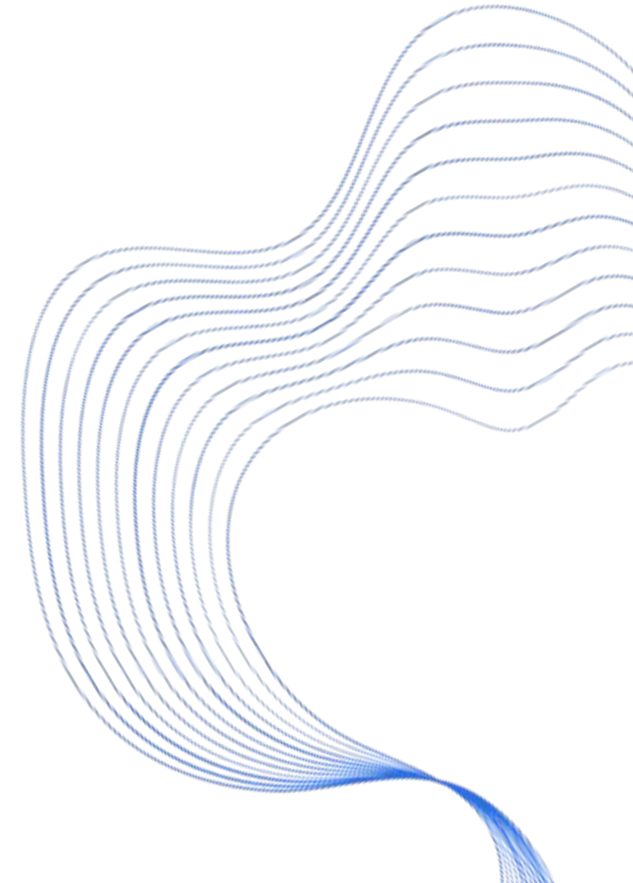
- Emotion states e.g. upset, irritable, nervous
- **aligns with narrative intention & emotion theories**
- **Narrative Intention:**
  - Cliff-hanger after conflict with no resolution
  - cartophonic devices of noises: tension, overwhelming sensations
  - → accumulation of negative emotions



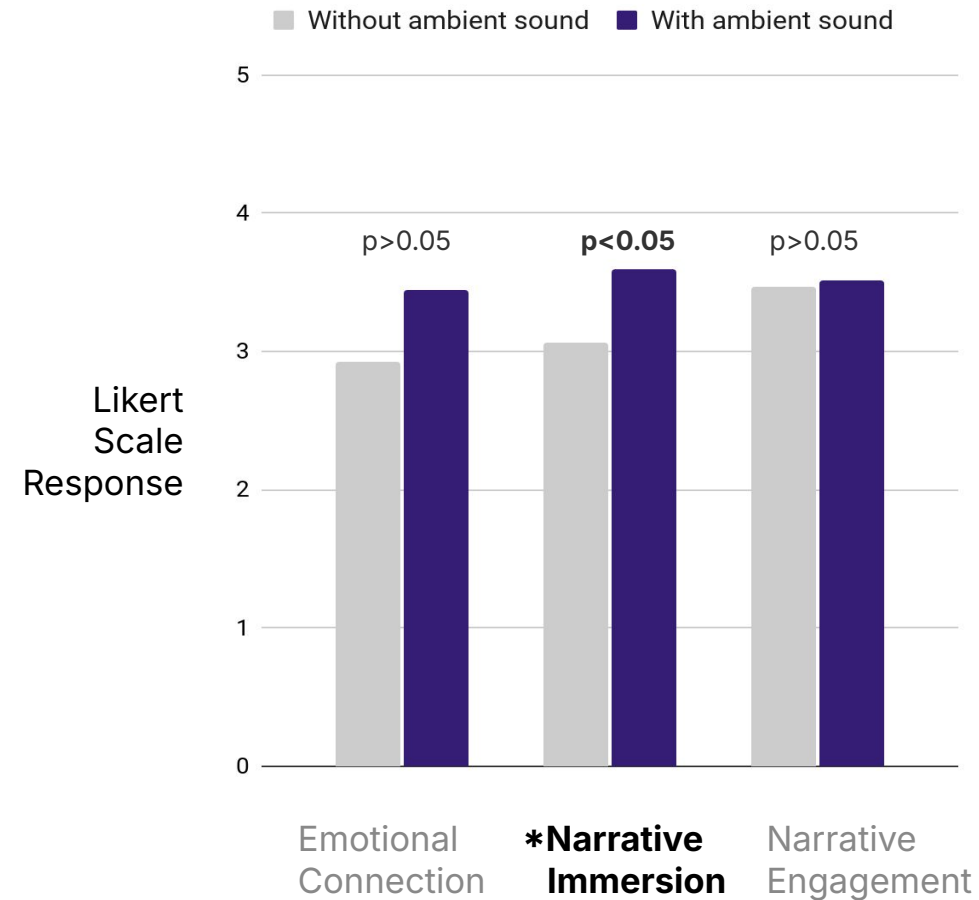
# Negative Affective State

**Ambient sound → significantly stronger change in negative affects;**  
→ insignificant difference in positive affects

- Emotion states e.g. upset, irritable, nervous
- **aligns with narrative intention & emotion theories**
- **Emotion theories**
  - Negative experiences = stronger empathetic responses - Keen, 2006
  - Deeper resonance
  - Amplified negative affects



# Narrative Immersion

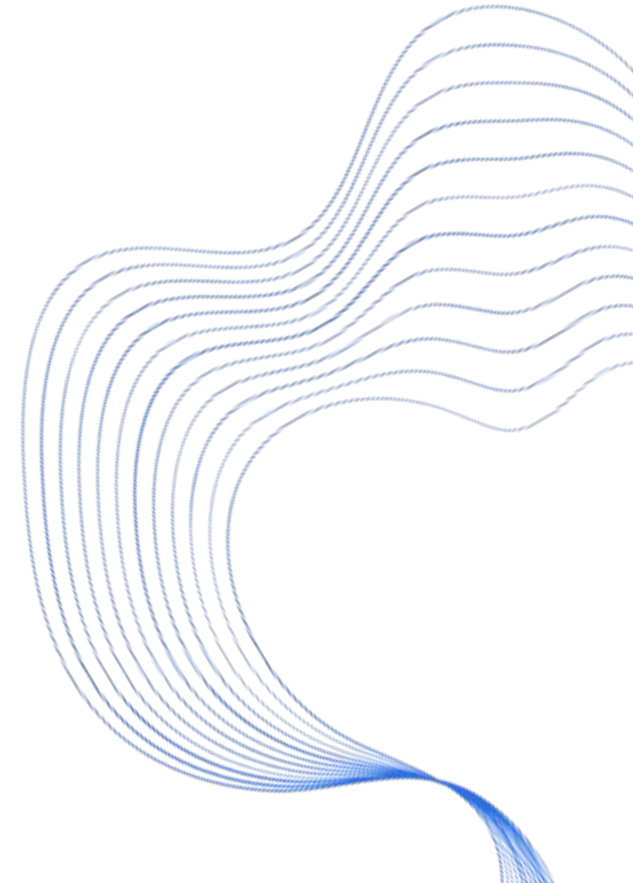


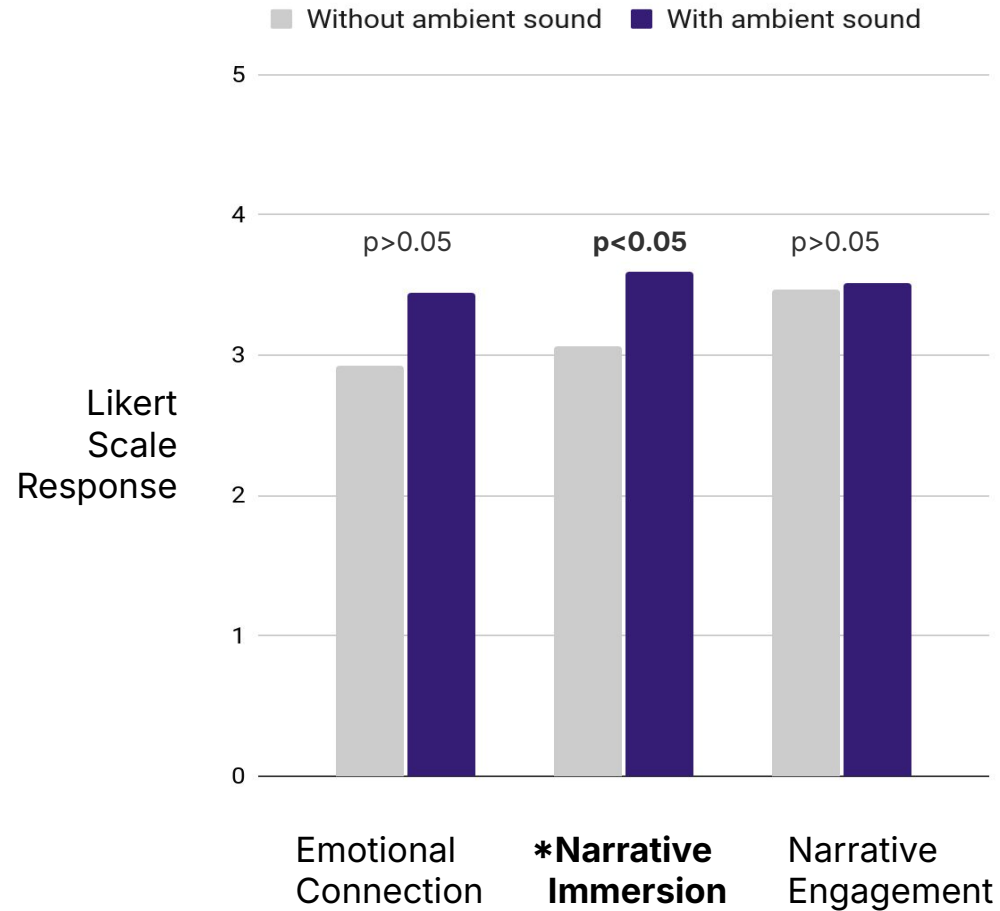


## Narrative Immersion

**Ambient sound → significantly more immersive**

- aligns with Theory of Embodiment
  - **Immersive realism**
  - **Imaginative empathy**
- Realistic soundscape:
  - **sense of reality** in a virtual environment - Alves & Roque, 2011
  - bridges the gap between **"the real" and the "rendered"** - Chion, 1994
  - guides & immerses the audience
- echoes sound designs in cinematography and game development





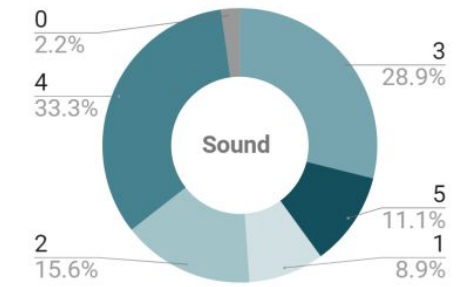
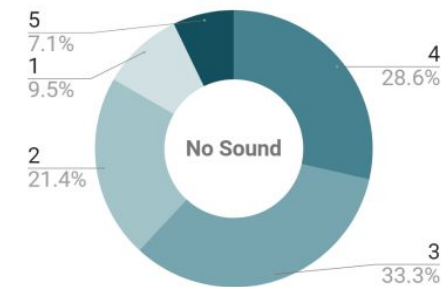
## Affective Affordance

- Overall observation:
  - stronger emotional connection
  - stronger narrative immersion
  - inconclusive difference in engagement level

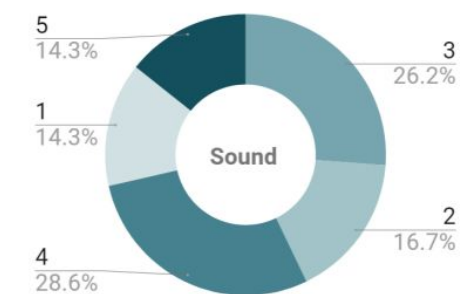
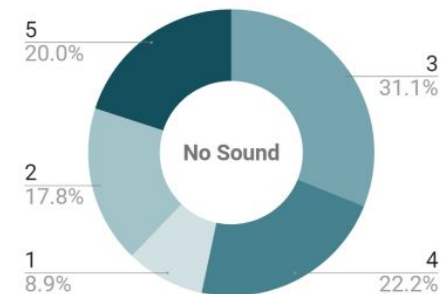
## Limitations

- **PANAS Metric**
  - depends on temporal factors
  - sensitive to mood variation
  - not as effective for short-term measurement
- **Confounding factors**
  - **Predisposition of Audience**
    - pre-existing connection to theme
  - **Visual Design**
    - map design
    - colour

Prior Knowledge



Emotional Predisposition



## Emotion Cartography

- Affective Design in Cartography
- Alternative to PANAS
- Affective Affordance metrics

## Cartographic Storytelling

- Narrative Structure
- Narrative Theme
- Cartography Rhetoric Device
- Sound as Cartophonic Rhetoric Device

## Sound Cartography

- Acoustic variables for data representations
- Sound design attributes
- Map cartophonic devices to acoustic variables
- Ambience → Speech, Music

# Thank You

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