Materiality in Cartography, A First Attempt to Evaluate its Usefulness

MASTER THESIS Image: A flor de Piel, Doris Salcedo.

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Presentation Overview

- Introduction
- Thesis Structure
- Literature Review
- Case Study
- User Study
- Results
- Conclusion
- Future Work

"Materiality matters because it refers to more than mere matter. It refers to the constitutive intertwining of mind with matter."

Motivation

The exploration of materiality has brought significant transformations and has expanded the paradigms of diverse academic fields. Acknowledging the materiality of maps could shape different processes and relations studied within the field of cartography.

Explore materiality in cartography as a design variable and its effect in the different stages of the cartographic process.

Malafouris



Thesis structure



What is materiality?

"materiality: the quality of being **composed of matter**" Oxford English Dictionary

"how art's material **qualities** are **sensed**, **interpreted** and understood" (Murdoch Mills, 2009)

> the **agency** of objects through their material **affordances** to shape human **behavior** through human - object **interaction** (Lievrouw, 2014)



LITERATURE REVIEW



Embodied mind Material **agent** in cognitive processes

Design variable

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How to explore materiality as a variable of cartographic design?

Topic Selection



Nasa, 2019

Degradation of the Amazonia

- Amazon biome + Hydrographic basin + Legal borders
- Around 8 million km² (RAISG)
- Biggest tropical forest 7 million km²
- 10% of worlds known biodiversity (Quintanilla et al, 2022)
- 20% transformed (Quintanilla et al, 2022)
- Tipping point (Vergara et al., 2022)

Conventional map selection

Candidates

- National Geographic
- Nasa
- Mapbiomas
- RAISG

CASE STUDY

Selected conventional media map

Amazonia against the clock

Criteria

- Simplicity
- Replicability





(Quintanilla, Guzmán León, & Josse, 2022) (RAISG, 2020)





Bruno Kelly, 2020 Amazônia Real

• 11 materials

Material	Relation to the Topic	Physical Characteristics	Cartographic Limitations	Possibilities in Design	
Wood	Direct product of deforestation, remaining material of dead trees	Diverse alternatives of texture, potential for tactile exploration. Lines of the wood could serve as a design component	Difficulty of manipulation. Limited scale for data depiction	Possibility of being engraved, marked, shaped. Different woods to represent areas.	
Plants	Alive material with symbolic meaning of life and representation of victims of ecosystem degradation	Organic smell, independent growth, tactile quality of leaves.	Preservation limitation. Low manageability. Time dependency for growing	Represent forested areas with alive plants and degraded with dead ones.	
Leaves	Organic materials originating from trees	Soft texture, variety of color, can produce sound when being touched.	Fragility for manipulation. Easy degradation	Possibility of being marked and easily cut. Use a variety of color or livelihood for forested or degraded areas.	
Meat	Product behind one reason for deforestation, livestock farming	Strong sensory affordances in texture and smell.	Preservation limitation. Strong sensorial impact (smell). Easy degradation, biological risk	Use in degraded areas as a representation of dead and cattle ranching.	
Bones	Remaining matter after the death of cattle, evoke thoughts of death	Various texture, particular smell. Difficulty of manipulation.	Scale limitation for data depiction	Possibility of being marked, engraved. Use on degraded areas. Can be used to generate relief.	
Plastic	Human-made material commonly related to environmental issues	Smooth texture, potential for creative manipulations, various colors.	More abstract relation to the topic	Possibility of use as a surface representing human impact, can also be manipulated to generate relief.	
Coal	Represents the remaining matter of burned trees	Rough texture, potential for dark color contrasts, can cause stains when touching.	Fragility for manipulation	Represent degraded areas, offers relief effects. The color can offer an interesting contrast with other materials.	
Coins	Symbolizes economic interests behind environmental impacts	Metallic texture and smell, color variations. Scale limitation for data depiction.	More abstract relation to the topic	Use as a surface representing the economic interest behind. Can be engraved but would require machinery. Can also be piled up.	
Soybeans	Product behind deforestation for agricultural purposes	Grainy texture, tactile experience.	Preservation limitation Dried beans to represent degrad presented as a product. Use sprouts forested areas.		
Matches	Made from wood, symbolizing fire hazards and deforestation	Striking friction for lighting, potential for sound and experience resultant from ignition.	Fragility for manipulation. Potential risk	Burned ones represent the degraded areas, and unused ones can represent forested areas, symbolic of the fragility of the ecosystem.	
Leather	Represents the use of cattle and its link to deforestation	Soft and supple texture, tactile experience.	Scale limitation for data depiction (depending on design)	Possibility of being engraved, marked, shaped. Different colors could represent different areas.	

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Bruno Kelly, 2020 Amazônia Real

• Economic interest, (Pereira & Gebara, 2023)

• Meat production, (Machovina et al., 2015; Picoli et al., 2020)

Material	Relation to the Topic	Physical Characteristics	Cartographic Limitations	Possibilities in Design
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Bones	Remaining matter after the death of cattle, evoke thoughts of death.	Various texture, particular smell. Difficulty of manipulation.	Scale limitation for data depiction.	Possibility of being marked, engraved. Use on degraded areas. Can be used to generate relief.
Wood	Direct product of deforestation, remaining material of dead trees.	Diverse alternatives of texture, potential for tactile exploration.	Difficulty of manipulation. Limited scale for data depiction.	Possibility of being engraved, marked, shaped. Different woods to represent areas. Lines of the wood could serve as a design component



CASE STUDY

Material Exploration





- Time / resources
- Material as co-designer (Aktaş, 2018)
- Experience of the map maker processual approach









Does the materiality of a map influence the map-user encounter?

USER STUDY

Comparative study



Effect of materiality in user interaction and perception



- 23 participants
- Physical encounters
- Individual
- Free interaction



Data collection

- Observation
- Questionnaire

(Likert scale, open ended)

8 variables
Object categorization, sensory
interaction, engagement, perception

Data Analysis

Quantitative		Qualitative
Bar charts	Impulse of interaction	Coding
Descriptive statistics	Central tendencyVariability indicator	Word cloud
Hypothesis Test	Wilcoxon signed-rank testNon parametricAre distributions different?	Qualitative and

The red COlOF gives me a sens of emergency, whereas the material map does not give me this impression. The material map is also not as precise. The paper map is very distanced to the topic at hand and the material map shows the CONSEQUENCES through bONES, as well as the Capitalistic reason behind it



iswer

"The paper map is very distanced to the topic at hand and the material map shows the consequences through bones, as well as the capitalistic reason behind it."

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Observation

•	Dynami	c vs.	static	obser	ation/
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- 9 participants touched material map, 2 smelled it, 0 participants touched or smelled the paper map
- General interest on material origin, and reason of their use

Different:

Hypothesis Test

• Perception of the object as a map. • Impulse for multisensory interaction

• Trust in the map

Not Different • Additional information perception • Invitation to a critical reflection

• Emotional response (intensity)

RESULTS



Scientific, traditional

easy

precise

familiar

color

" the paper map was easier to understand, more 'normal'." distinct emotional reactions



unique, artistic

"I wanted to touch it"

material

reasons

"The materials used were probably chosen to represent something (degradation with bones as dead material; coins as a critique for the exploitation of the rainforest - monetary value)"



- Materiality as a design variable represented a challenge in map design.
- The materiality of the map had multiple effects through the cartographic process.
- Changes in materiality led to multisensory interaction.
- Conscious selection of materials had an effect on the interest towards the map.
- The change of materiality of the map was perceived as an element of communication.
- The change of materiality had an effect on the emotional response of map users.



Future Work

- Personal Context analysis
- Eye tracking analysis
- Embodied experience of the map maker
- Material effects on an individual map
- Technical material exploration
- Spatial cognition and navigation
- Digital vs. physical maps

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