

# Decoding The Chemesthetic Sensations Of Topical Pain Relief Creams Using Descriptive Sensory Panel

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## INTRODUCTION

Chemesthetic sensations play a crucial role in user experience of Over-The-Counter (OTC) topical pain relief creams.

These sensations happen through the interaction with sensory receptors in the skin and nervous system, modulating pain perception through dynamic and evolving sensations.

Accurately capturing these chemesthetic perceptions in real-time is challenging, due to individual variability, temporal dynamics, cross-modal interactions, and desensitization.

## METHOD

**PRODUCT SET**

This study compares the chemesthetic sensations of 10 commercial topical pain relief cream products that contain various active ingredients at different levels.

**LEXICON & PROTOCOL DEVELOPMENT**

Chemesthetic sensations were deconstructed through leveraging qualitative discussions, personal experiences and physical references.

Five attributes were evaluated at 7 time points (immediate, 2, 5, 10, 15, 20, 25 minutes) using 100-pt scale. All sensations were evaluated without touching the application area on forearm.





**ANALYSIS**

Mixed effects ANOVA model combined with Fisher’s LSD test was used to understand product differences in sensation attributes.

Only attributes showing significant differences at 95% loc with ranges ≥ 5 points (out of 100 points) were included for principal component analysis and clustering analysis.

Correlation analysis was performed across all 10 products, with active ingredients defined at distinct factors, to explore how actives related to the sensations.

### DECONSTRUCTING CHEMESTHETIC SENSATIONS

	OVERALL SENSATIONS	WARMING	COOLING	NUMBING	TINGLING
Personal experience		<ul style="list-style-type: none"> <li>Using hand warmers</li> <li>Sitting in the car while the sun is heating you up through the windows</li> <li>Placing hands near fire pit</li> <li>Soft &amp; saturated feeling; wave-like</li> </ul>	<ul style="list-style-type: none"> <li>Ice cube in hands</li> <li>Standing outside on a snowy day</li> <li>Holding an icepack on arm</li> <li>Ripple effect; starts localized and expands out</li> </ul>	<ul style="list-style-type: none"> <li>Loss of feeling</li> <li>Having a ball-like tightness in your skin, a knot in a muscle</li> </ul>	<ul style="list-style-type: none"> <li>Pins and needles</li> <li>Paint brush on skin</li> <li>Prickling sensation</li> <li>Swiping and rolling a paint push or toothbrush over the skin</li> </ul>
Definition	Measures the overall impact of sensations including cooling, warming, tingling and numbing	Measures the intensity of the warming sensation associated with the feeling on forearm (inside and out)	Measures the intensity of the cooling sensation associated with the feeling on forearm (inside and out)	Measure the perception of inner tightening and lack of feeling sensation in the forearm	Measures the perception of tingle and prickle sensations in forearm
Anchors	Low - High	Not - Very	Not - Very	Not - Very	Not - Very
Reference		Hold hand warmers on forearm and focus on feeling in inner forearm 	Hold ice pack on forearm for 5 seconds 	Hold ice pack on forearm for 15 seconds, rate right after removing the ice pack 	Rubbing paint brush on forearm, tickling feeling of individual bristles 

## KEY RESULTS

01

### 3 DYNAMIC COOLING/WARMING JOURNEYS ARE IDENTIFIED AMONG THE 10 PAIN RELIEF CREAMS

#### INTENSE COOLING DOMINANT

- Noticeable cooling sensation upon application, which steadily increases over time
- Slight warming is also experienced, likely as a secondary effect of the intense cooling

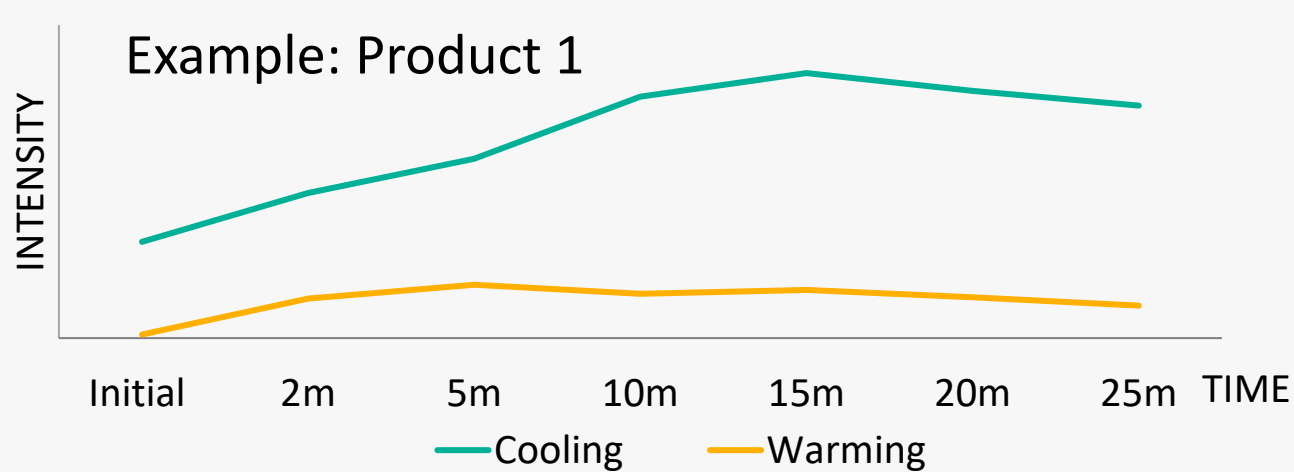


FIG.1A

#### COOLING WARMING NEUTRALIZATION

- Noticeable cooling sensation upon application
- As coolness gradually fades, a gentle warming sensation emerges and builds (maybe due to the **warming phenomenon**)

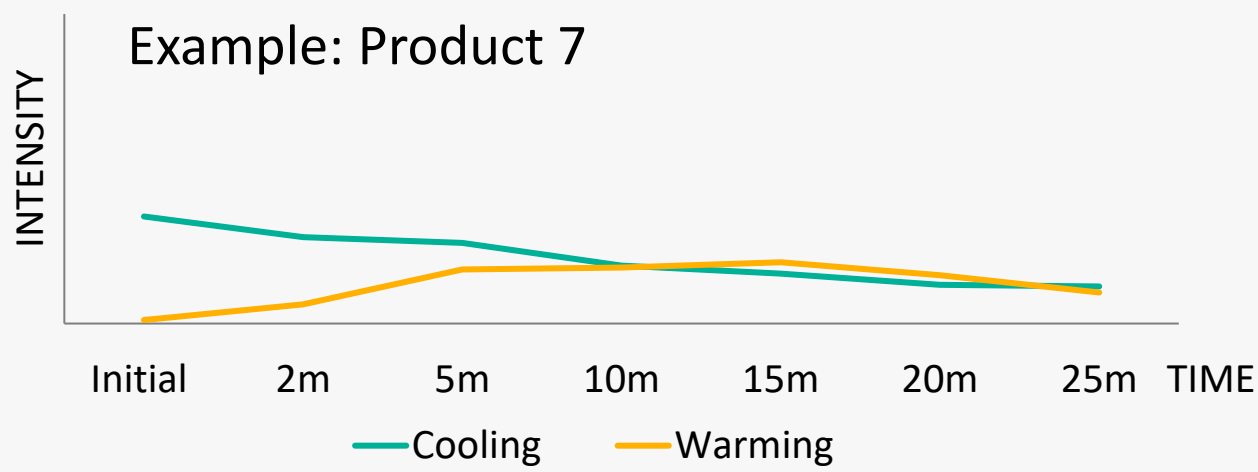


FIG.1B

#### COOLING WARMING INVERSION

- Noticeable cooling sensation upon application
- As cooling sensation gradually fades, a warming sensation develops and becomes dominant

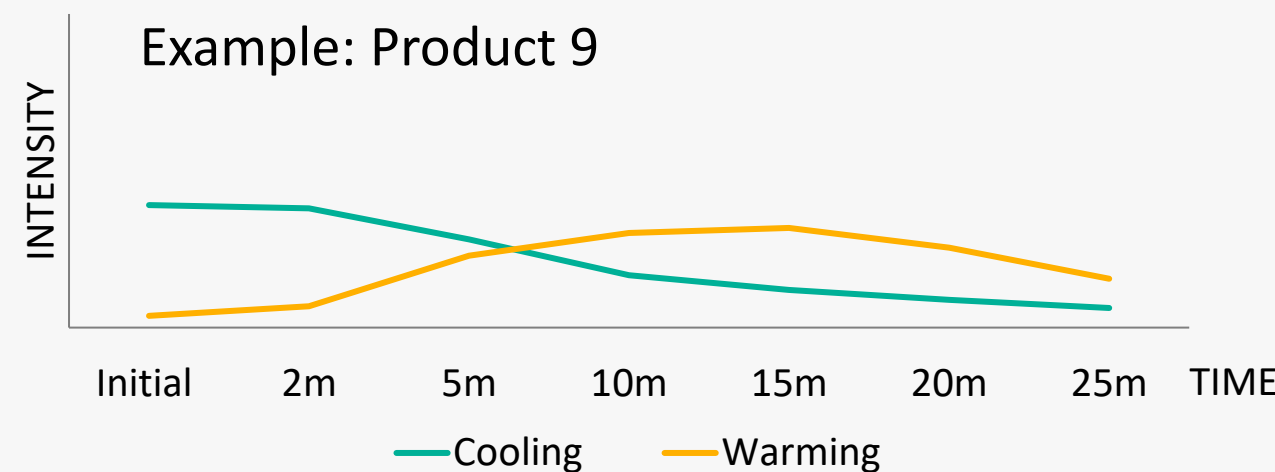
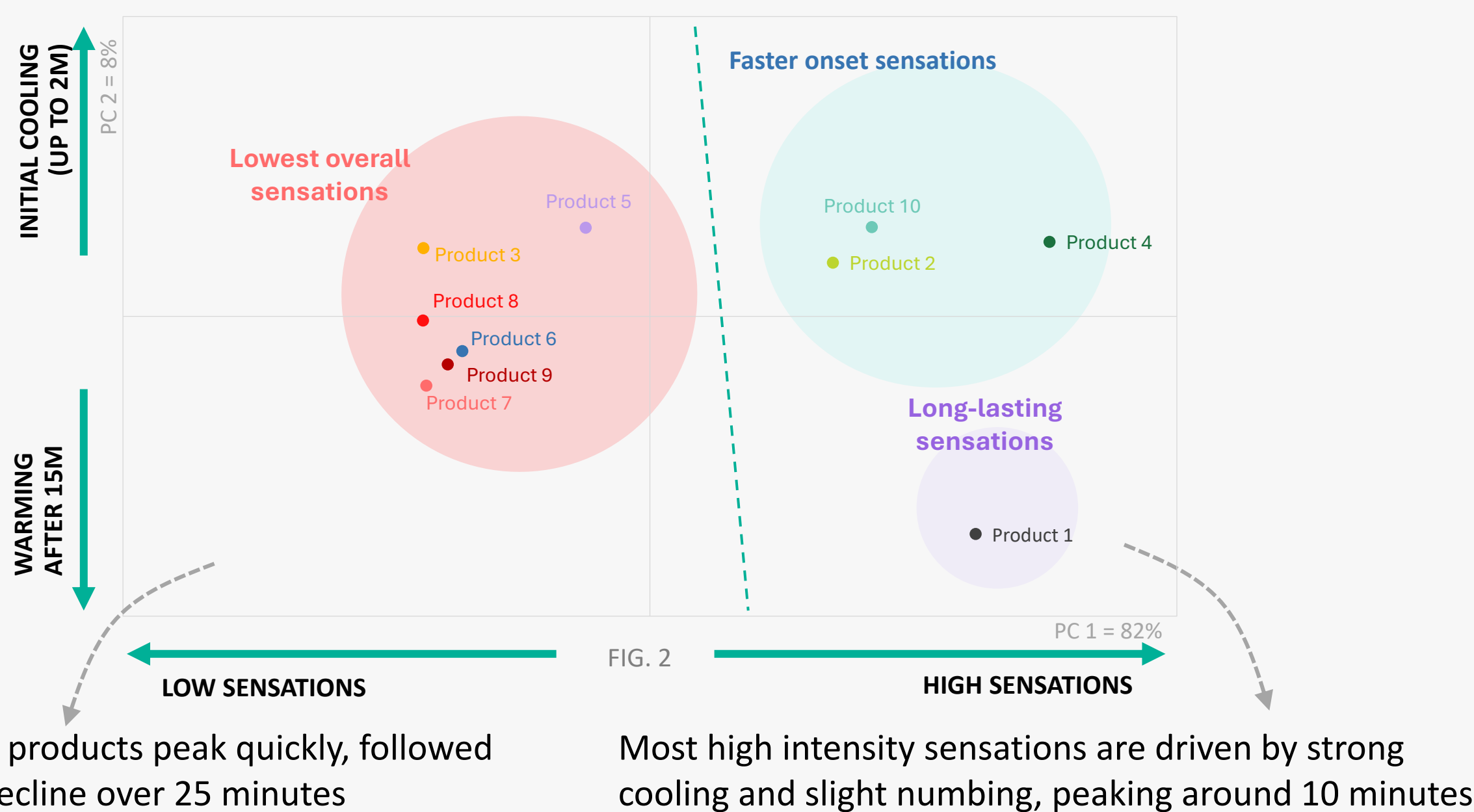


FIG.1C

02

### PAIN RELIEF CREAMS ARE MAINLY DIFFERENTIATED BY INTENSITY OF SENSATIONS



03

### OVERALL SENSATIONS, COOLING AND NUMBING HAVE OPPOSING CORRELATION PATTERNS IDENTIFIED WITH TWO MAIN ACTIVE INGREDIENTS

#### Active ingredient A

⊕ Overall Sensations

⊕ Cooling

⊕ Numbing (15-25mins)

- Active ingredient A trends a strong positive correlation with cooling and numbing, aligning with its intended cooling effect.
- Correlation with numbing at later timepoints suggests numbing is a side-effect of intense, long-lasting cooling.
- Active ingredient A is present in all products that follow an Intense Cooling Dominant journey.

#### Active ingredient B

⊖ Overall Sensations

⊖ Cooling

⊖ Numbing

- In contrast, active ingredient B, shows a negative correlation with cooling & numbing.
- Given its analgesic function, it is expected to produce a numbing effect; interestingly, a negative correlation is observed with perceived numbing. This may be because the compound is not potent enough to induce noticeable numbness in the absence of pain.
- It is commonly found in creams that follow a Cooling Warming Neutralization sensory journey.

KEY: ⊕ Positive correlation ⊖ Negative correlation

## LEARNINGS OF EVALUATING CHEMESTHETIC SENSATIONS

Real-time evaluation of cooling and warming presents challenges:

#### SUBTLE SENSATIONS

Lower intensity sensations are hard to classify (cool vs. warm), even when a reaction is present. To address this, “overall sensation” was introduced as an overarching measure of the intensity of all sensations, regardless of characteristic.

#### INTENSE SENSATIONS

Very intense sensations can fluctuate between being cool or warm. Intense cold may also feel numbing or warm.

#### WARMING PHENOMENON

Following intense cooling, a warming sensation may occur as the skin returns to baseline, similar to feeling warmth after coming indoors from the cold.

## CONCLUSION

- Sensory Descriptive Analysis (DA) testing on OTC topical cream products involves significant complexity.
- All of the products in this study have some sensation of warming and cooling. Main differentiation is in the intensity and timing of the sensations.
- It is important to acknowledge the value of DA in capturing individual variation while still providing reliable sensation comparisons.
- Adapting the traditional DA approach by providing rapid training to category users could be a promising solution worth further exploration.