

Decoding crunchy and crispy

Linking chewing acoustics to texture perception in crackers



Introduction

Auditory cues significantly influence texture perception. This study investigated whether external sound recordings made during eating, could predict consumer perception of crisp and crunchy textures as well as, or better than, a trained sensory panel.

Authors

Marcia Petit¹,
Ryan Dillman¹,
Joyce Lizzi²,
Lise Dreyfuss²

¹Tate & Lyle, USA
²SAM Sensory and Consumer Research

A three-step approach using seven commercial savoury cracker brands

- 1

Consumer ratings of crispness and crunchiness from USA, Germany and UK.
- 2

Spectrum profiling by Tate & Lyle trained panel (11 texture attributes).
- 3

Sound recordings in a soundproof media room using three microphones around the participant's mouth during 10 chews; 12 participants (Figure 1).



Analysis

Sound data were from the three microphones were collated to give one mono soundtrack per participant and cracker, and its sound graph of volume (dB) and pitch (Hz) (Figure 2). PRAAT, sound and speech analysis software, extracted the parameters in Table 1 from each soundtrack for further analysis.

Using statistical regression and random forest machine learning algorithms, sound and sensory panel attributes were related to the consumer ratings of crispness and crunchiness. Correlations were analysed alongside decision trees to mine for crispy and crunchy attribute interpretation.

Descriptive Texture Attributes

Fracturability
Toothpack
Moistness of Mass
Denseness
Dissolvability
Loose Particles
Tooth Stick
Hardness
Amount of particles
Cohesiveness of Mass
Roughness of Mass

Descriptive Sound Attributes

Volume (R)
Duration of First Bite (sec)
Duration of Mid Bite (sec)
Duration of Final Bite (Sec)
Volume Duration @ 5s (T)
Volume Duration @ 10s (T)
Volume Duration @ 15s (T)
Intensity of First Bite (dB)
Intensity of Mid Bite (dB)
Intensity of Final Bite (dB)

Table 1. Sensory and Sound Attributes

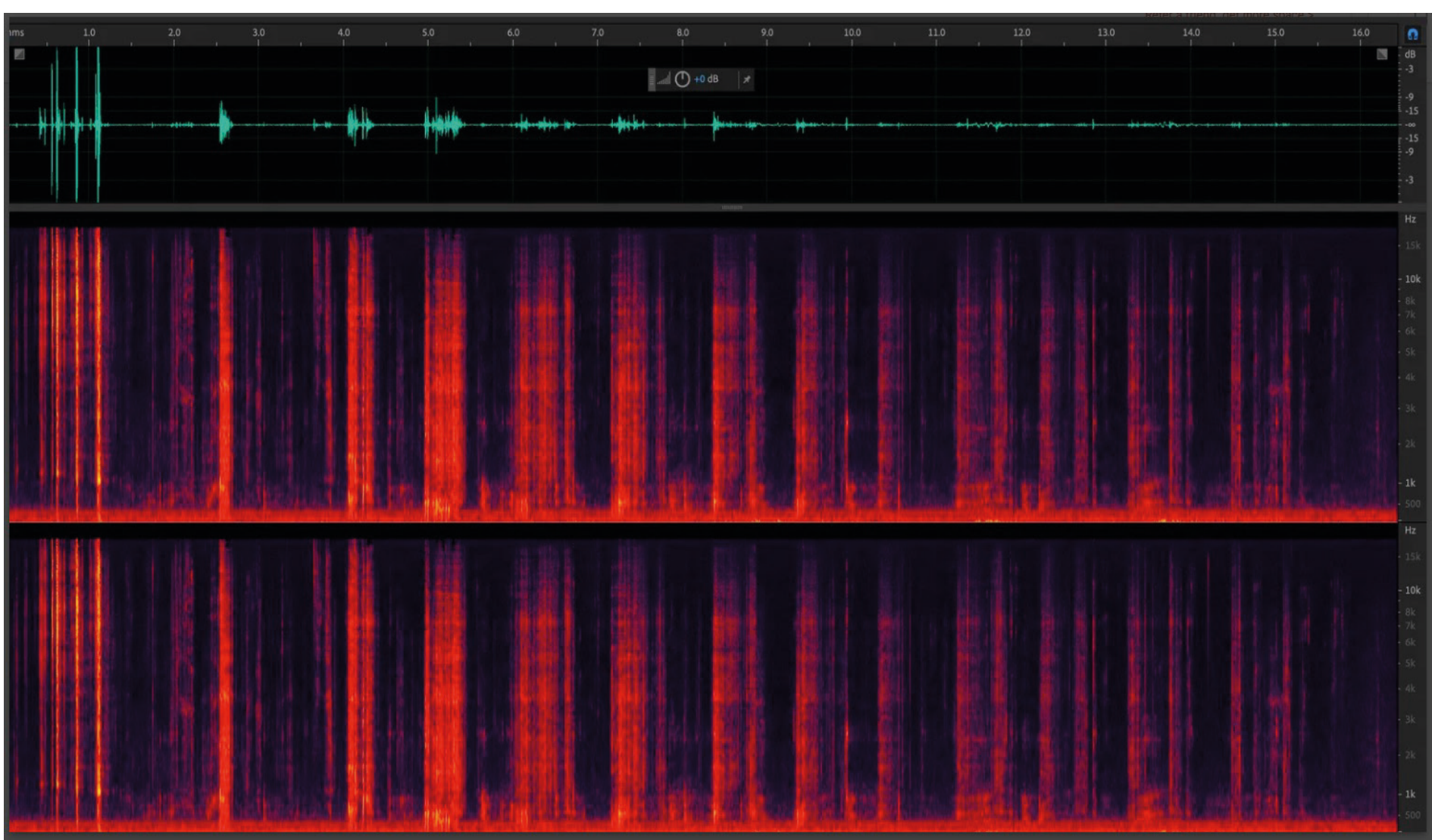


Figure 2. Sound graph depicting volume (dB/ green) and pitch (Hz/ red; purple indicates no sound).

Key learnings

- 1

Crunchy was explained by nine sensory attributes: Volume duration (+), Hardness (+), Fracturability (+), Volume (+), Tooth pack (-), Moistness of Mass (-), Denseness (+), and Dissolvability (-).
- 2

Sound, as measured by audio recordings, was not related to crunchiness.
- 3

Crisp was more complex and explained by a combination of fifteen sound and sensory attributes. Crisp could be predicted from the volume duration and volume intensity of the first, fifth and tenth bites plus five sensory attributes.



Conclusion

Sound and texture attributes are both important measures of crispiness and crunchiness. In measuring crispiness, sound measured by audio recordings alone could be a strong predictor. In terms of crunchiness, trained panel assessment were more predictive than audio recordings. This study also suggests crispy and crunchy are not opposites, and their association on opposite ends of the Spectrum scale should be revisited.