

LABORATORY OF GASTRONOMIC SCIENCES

Smart Sensor Tray for Advanced Analysis of Consumer Eating Behaviour

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Context

Nowadays, a thorough understanding of consumer behaviour is essential for the development of new products, effective marketing strategies and hospitality/catering models. Innovation in the field of sensory analysis and digital technologies offers new perspectives for deeply understanding consumers' eating habits and behaviours. Furthermore, the interest of connected tools lies in their ability to be deployed on a large scale, to be used in various environments other than traditional sensory analysis rooms, and to collect a wide range of pertinent data.

Experiment

This study explores the use of a connected tray with a weight sensor to monitor meal evolution over time. Conducted as a pilot study with 60 participants in a restaurant setting during the 2022 KIKK Festival, it focused on a standardized dish: "Scallops in sauce with vegetables." The smart tray data was processed to track variables such as bite count, applied force, meal duration, and quantity consumed. The study aimed to compare consumer data and characterize different eating behaviours. Out of 60 data sets collected, 39 were deemed usable for analysis.



Outcomes

Individual Characterisation

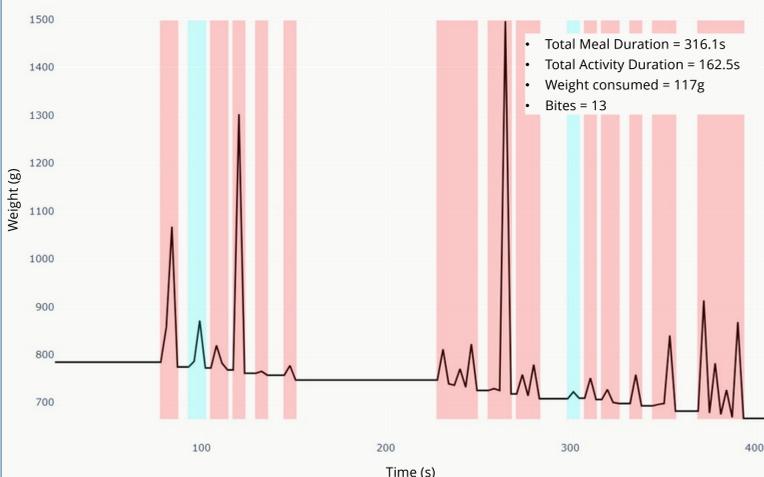


Plate Weight over a Meal for an Individual

■ Activity period followed by a bite ■ Activity period not followed by a bite

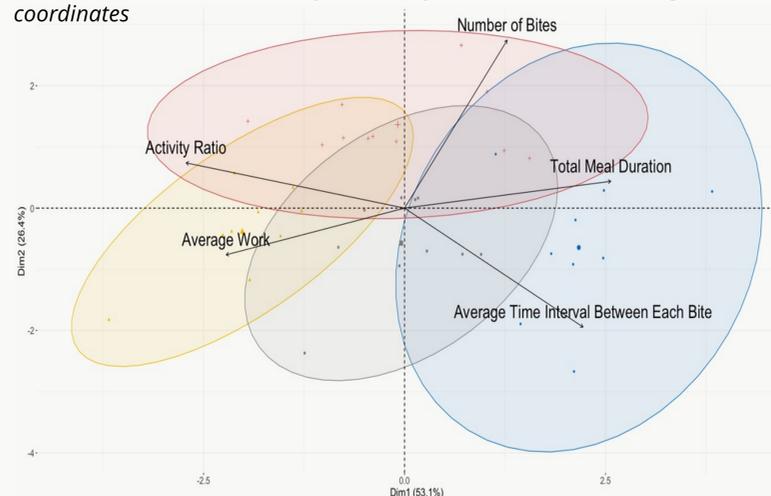
	Bite Weight (g)	Time Interval Between Each Bite (s)	No Activity Duration (s)	Activity Duration (s)	Work (N.s)*
Min	3.0	3.1	3.0	3.1	20.1
Max	22.0	76.9	129.2	24.6	178.6
Mean	8.9	14.6	24.7	9.6	71.9
Median	8.0	6.2	6.2	9.1	64.0
Standard deviation	5.2	20.7	36.9	5.8	43.6

Individual Consumption Metrics

* Work : Area under activity period (N.s)

Meal characterisation

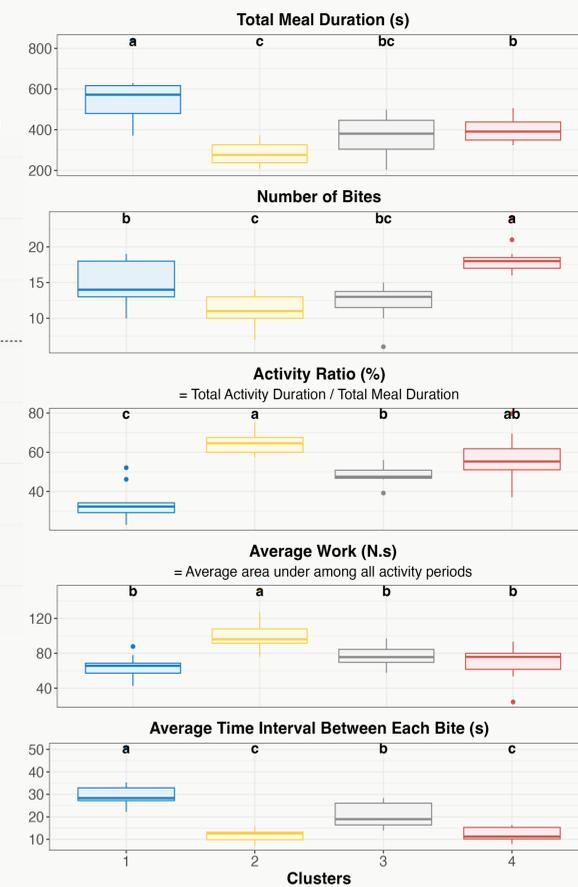
Method : Standardised PCA followed by Hierarchical Clustering on PCA coordinates



PCA Biplot with Colorization According to Groups from Hierarchical Clustering with 95% Confidence Ellipses

Cluster	Characterisation
1	Have longer meal durations
2	Exert more effort or intensity during eating
3	Balance and moderate eating behaviour
4	More active and do more bites

Cluster Interpretation



Boxplots of Meal Metrics on the 4 Groups
Letters indicate the results of the Tukey test following an ANOVA (p-value < 0.05)

Perspectives

- Currently, the tray can estimate the consumed weight and the number of bites with an **accuracy of over 97%** following a laboratory experiment. The accuracy of the algorithm will be tested in real-life conditions.
- The algorithm correction should prevent various biases such as the placement of utensils on the plate.
- The tray can be used in other contexts, particularly in health facilities, as a tool to monitor patient food intake.
- Ongoing work on action and **utensil recognition through artificial intelligence** is currently under development to optimise and automate more the data interpretation.

References

Mattfeld, R. S., Muth, E. R., & Hoover, A. (2017). Measuring the Consumption of Individual Solid and Liquid Bites Using a Table-Embedded Scale During Unrestricted Eating. *IEEE Journal of Biomedical and Health Informatics*, 21(6), 1711-1718. <https://doi.org/10.1109/JBHI.2016.2632621>

Mertes, G., Ding, L., Chen, W., Hallez, H., Jia, J., & Vanrumste, B. (2020). Measuring and Localizing Individual Bites Using a Sensor Augmented Plate During Unrestricted Eating for the Aging Population. *IEEE Journal of Biomedical and Health Informatics*, 24(5), 1509-1518. <https://doi.org/10.1109/JBHI.2019.2932011>

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