

# From alimentary intake to swallow: coding eating behavior applied to mealtime - design and inter-judge agreement.

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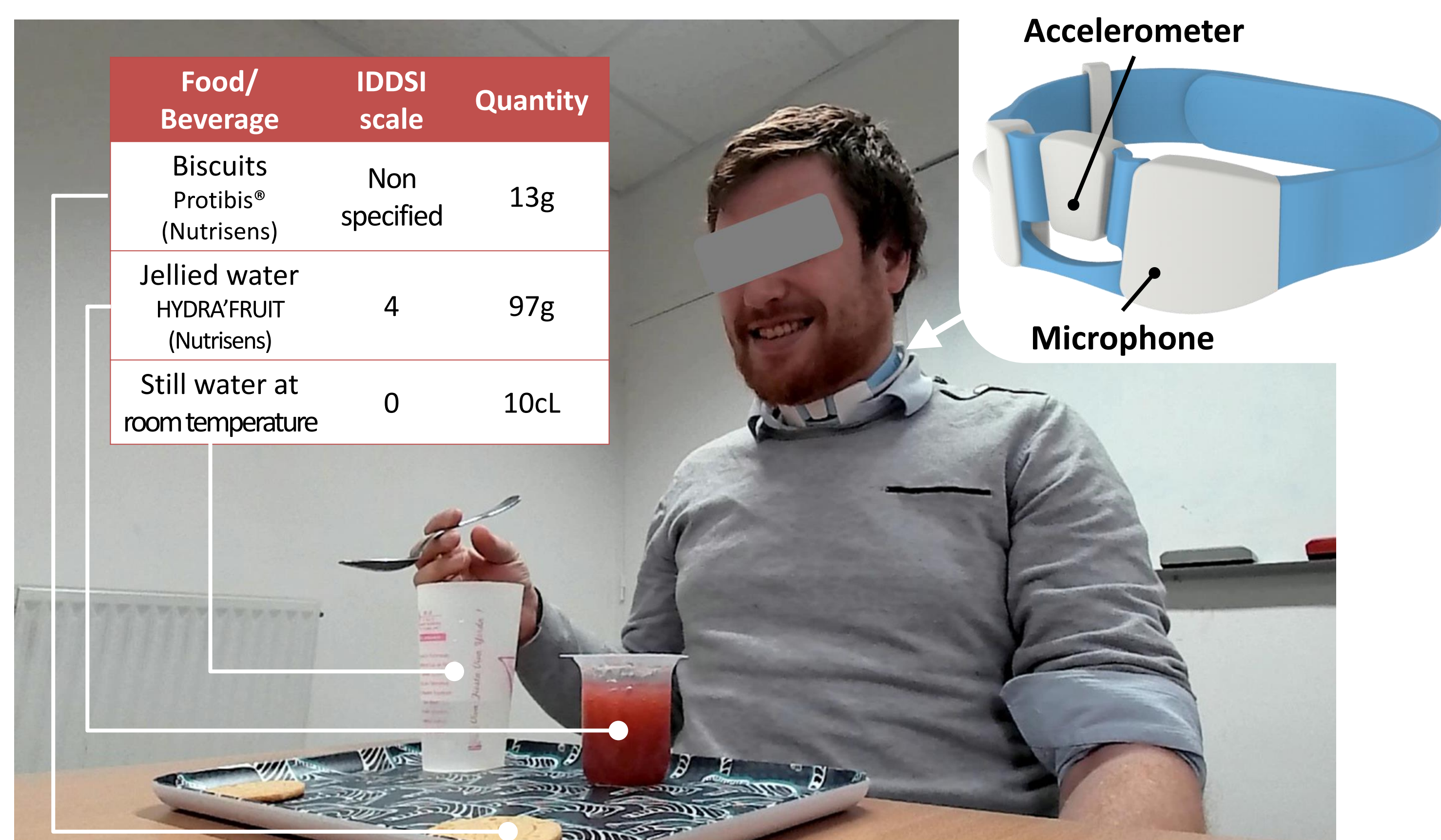


## INTRODUCTION

- Behavioral coding scheme interesting to map the mealtime and describe the behavior of a subject during a meal.
- Aim of the study:** Validate the reproducibility of our behavioral coding scheme based on the detection of alimentary cycles<sup>(1)</sup> (i.e., from the bolus transport to its swallowing) in 2 steps:
  - Refine the definition of the main events composing an alimentary cycle,
  - Validate the inter-judge agreement of this segmentation.

## MATERIAL & METHOD

- Segmentation carried out on recordings of a standardized meal (**Fig.1**) eaten without specific instructions by healthy adult.
  - Video recording used to localize handgrips and in-mouth,
  - Vibro-acoustic recording of the subject's neck using a cervical auscultation device (Swallis DSA™) used to localize swallowing (**Fig.1**).
- 1<sup>st</sup> step:** Phase of test-retest to refine definitions of “handgrips” and “in-mouth” labels by a 1<sup>st</sup> pair of annotators using a sample of meals from the corpus. Initial definitions adapted to achieve a concordance rate > 85%.
- 2<sup>nd</sup> step:** Annotations of entire corpus of meals by a 2<sup>nd</sup> pair of annotators using the refined definitions and the validated swallowing sound definition<sup>(2)</sup>: with a target agreement of 90% ±5% for each of the three labels, with a time tolerance of 1 sec.
- The annotation of these events allows then to structure the alimentary cycles during meal according to preexisting definition<sup>(1)</sup>.



**Figure 1:** Description of standardized meal and installation of the subject with Swallis DSA™ device at the neck level (webcam view)

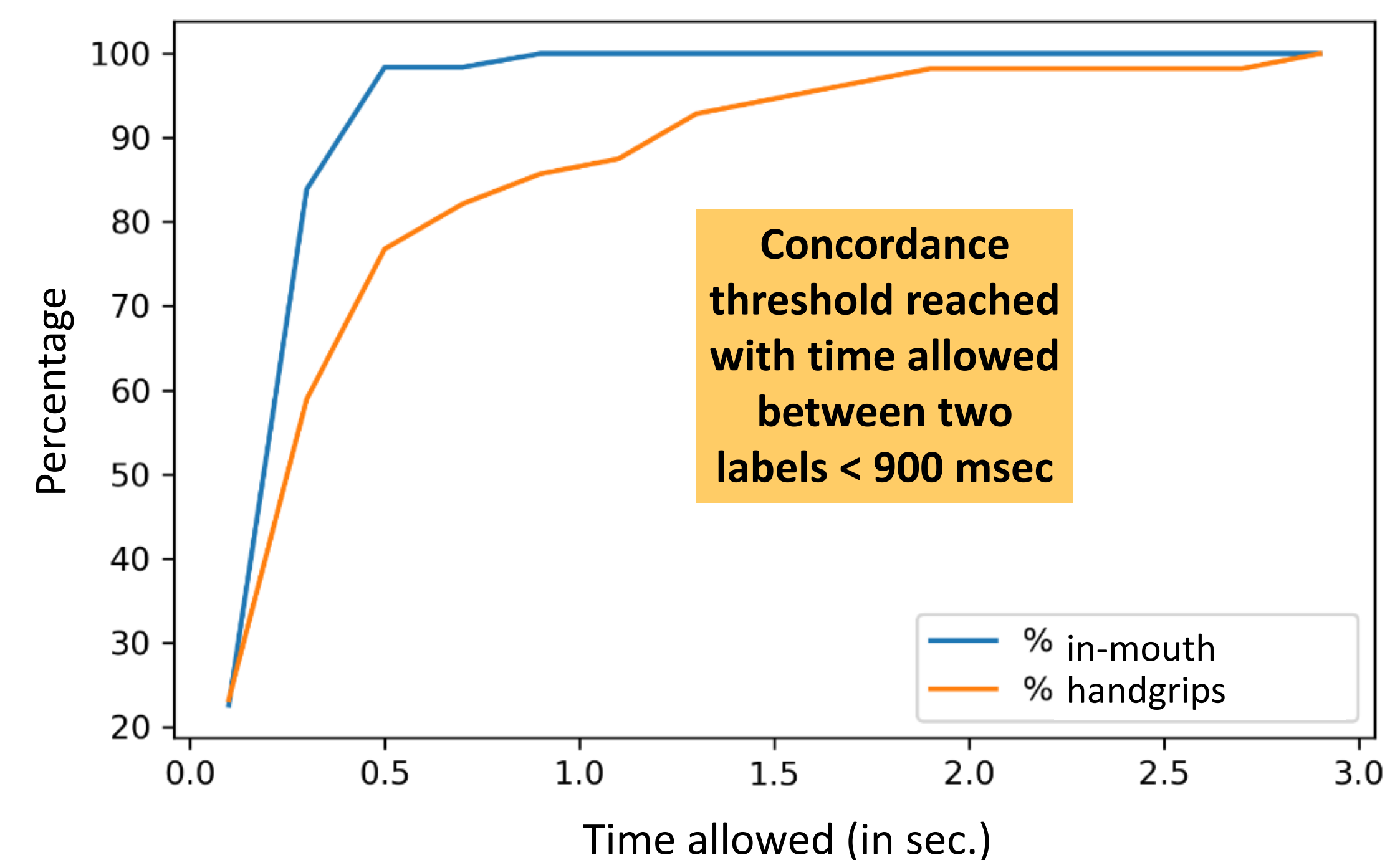
## CONCLUSION

- The refined definitions lead to very good inter-annotator agreement for the segmentation of alimentary cycles.
- Perspectives** for using this behavior coding scheme:
  - Provide an exhaustive description of an individual's eating behaviors.
  - Clinical perspectives in the field of evaluation of nutrition and eating behavior and even swallowing disorders.
- In progress:** Coding applied to a corpus of meals eaten by a sufficiently large and homogeneous population of healthy volunteers to establish a physiological description of “normal” mealtimes.

## RESULTS

- Corpus of meals:** 46 usable recordings. Characteristics: 28♀/18♂, average age: 36.5 ± 12.7 y.o., and average BMI: 23,3 ± 3,9 (min. 17,7; max. 39,8).

**1<sup>st</sup> step** The **test-retest phase** reached the concordance threshold at the end of the 2<sup>nd</sup> round (result presented in **Fig.2**). The refined definitions of “handgrips” and “in-mouth” are in **Tab.1**.



**Figure 2:** Agreement rate after 2<sup>nd</sup> round of test-retest phase

**Table 1:** Refined definition of “handgrips” and “in-mouth”

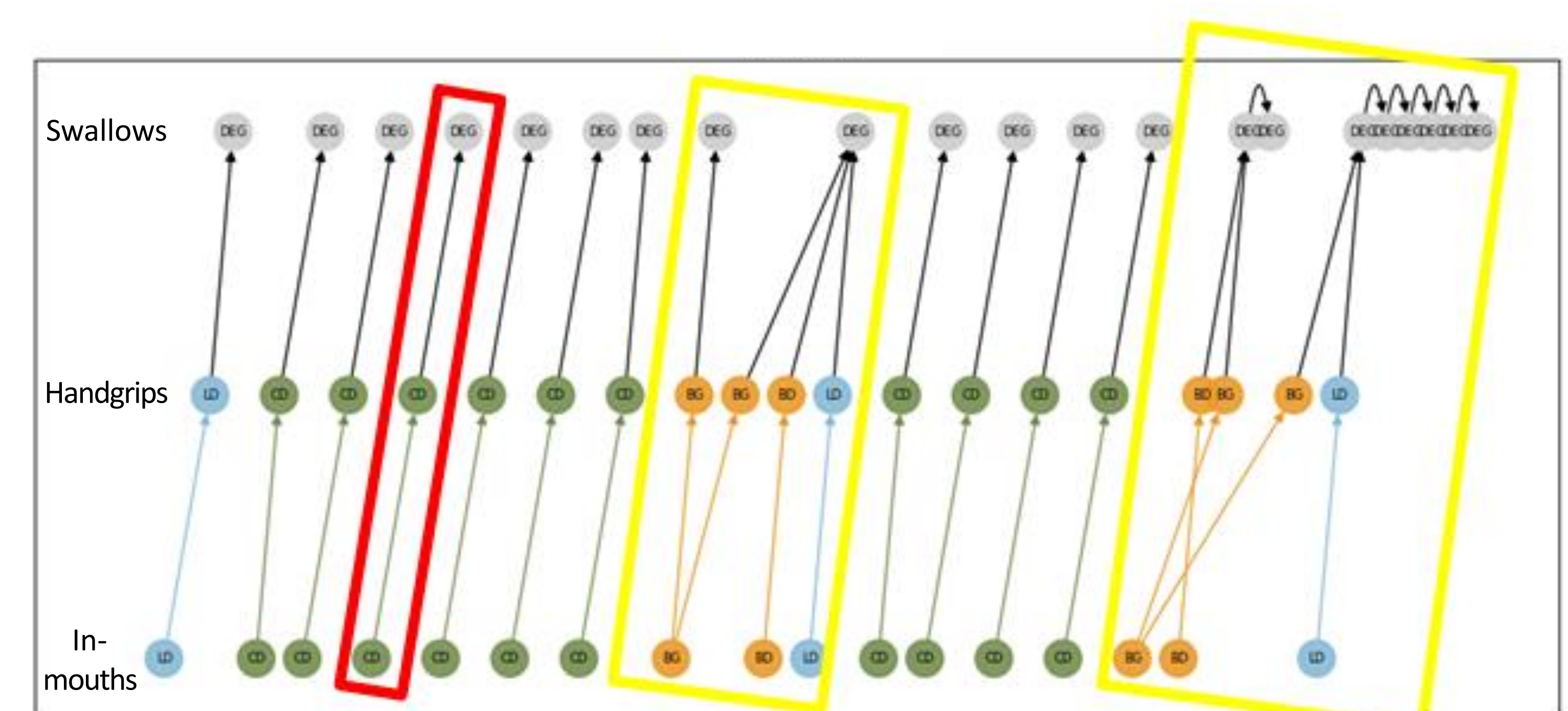
Label	Refined definition
Handgrips	Any contact seen or estimated on the video between the hand (left or right) or a hand-held utensil and a bolus which is held until it is taken into the mouth. In this case, the grip is annotated as soon as the hand or hand-held utensil touches the bolus. When scraping a pot with a spoon: a single grip is annotated, now the spoon meets the bolus.
In-mouth	The moment seen or estimated on the video when the food enters the mouth or when the utensil with the food meets the lips or enters the mouth (a spoonful of compote that enters the mouth, a glass of water placed on the lips, or a piece of bread put in the mouth are examples of situations to be considered as mouthfuls).

**2<sup>nd</sup> step** The **rate of agreement** between the annotators from the refined labels and the swallowing label is reached (cf. results in **Tab.2**).

**Table 2:** Agreement rate of the 3 main labels making up an alimentary cycle

	Handgrips	In-mouth	Swallowing
Matching labels number	740	922	975
Gap between annotators	5	4	9
Discordant label number	49	28	108
Agreement rate	<b>93,2%</b>	<b>96,7%</b>	<b>89,3%</b>

- After alimentary cycle structuring, some labels may be part of different alimentary cycles, creating complex inter-cycles relationship (example of segmented meal in **Fig.3**).



**Figure 3:** Illustration of meal segmentation (bottom: temporality of handgrips; middle: temporality of in-mouth; top: temporality of swallows)

(1) W. Liu, M. Batchelor, et K. Williams, « Ease of use, feasibility and inter-rater reliability of the refined Cue Utilization and Engagement in Dementia (CUED) mealtime video-coding scheme », J. Adv. Nurs., vol. 76, no 12, p. 3609-3622, déc. 2020

(2) MA. Crary, L. Sura, et G. Carnaby, « Validation and Demonstration of an Isolated Acoustic Recording Technique to Estimate Spontaneous Swallow Frequency », Dysphagia (2013) 28:86–94