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Laboratoire  
Motricité - Interactions - Performance  
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# Experiential and mechanical data crossed analysis for a better understanding of sports performance

*Case study on expert interpersonal coordination in rowing*

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# *Introduction*

# The primacy of the subjective dimensions of performance within activity-centered approaches in the field of sport psychology

- The example of the « course of experience » (Theureau, 2006)
  - the level of activity that is « meaningful for the athletes »
  - the chain of units of experience « that athletes can tell us about »: actions, communications, focuses of attention, interpretations, judgments, sensations, or emotions, during activity
- A window on the situated cognitive phenomenology of athletes: A view « from the inside » (e.g., Bourbousson et al., 2010; Hauw, 2009; Mottet & Saury, 2013)

# The emergence of a joint analysis of first- and third-person to understand athletes' activity

## Athletes' activity and performance

« From the inside »

Course of experience  
(Theureau, 2006)

« From the outside »

Behavioral, mechanical and  
biomechanical indicators

Doubles table tennis



Poizat et al., 2012

Swimming



Gal-Petitfaux et al. 2013

Ice-climbing



Seifert et al., 2014

Rowing



Saury et al., 2010;  
Sève et al., 2013

# The complementary of both « inside » and « outside » points of view to analyze collective activity in rowing

(Saury et al., 2010; Sève et al., 2013)

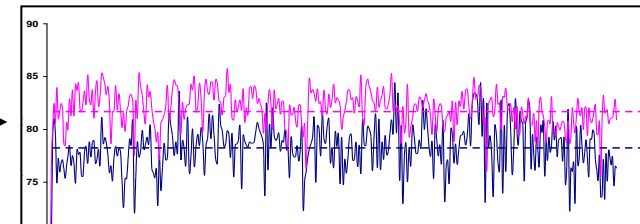
*To be (or not to be) « in synch »...*

**Lucy:** *The start was OK... We were in synch, the boat was gliding along. And I had good sensations. I thought about really flattening my legs, positioning myself the way the coach told me to...*



**Marion:** *Right away the boat started moving. We didn't do it together. I also saw that we weren't in synch because we didn't get our oars into the water at the same time, I felt pushed in fact, I felt like she was ahead of me.*

*Such a subjective perception can be better understood through the testing of mechanical hypotheses (e.g., differences in stroke amplitudes)*



## Objectives of the study

- Explore the potential of a mixed analysis of rowers' course of experience and of mechanical parameters
  - to characterize interpersonal coordination in expert rowers
  - to describe the dynamics of the interpersonal coordination during a whole race



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# *Methods*

# Data collection

- Data collection for analysis of the courses of experience

Two rowers from an elite men's coxless pair crew (Pôle France - Nantes)

3000-meter race against the clock (duration: 10'49")

Video-recording of behaviors and verbal communications

Individual self-confrontation interviews with each rower (duration: 1h)





- Mechanical measures

Apparatus: Powerline system  
(Peach-Innovations)



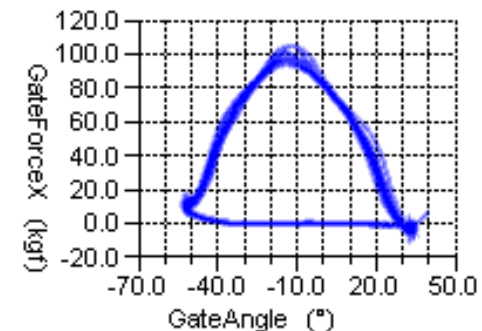
Measures (50 Hz):

Boat speed



Forces applied at the pin of the oarlocks (longitudinal axis of the boat)

Changes in oar angles in the horizontal plane



# Data analysis

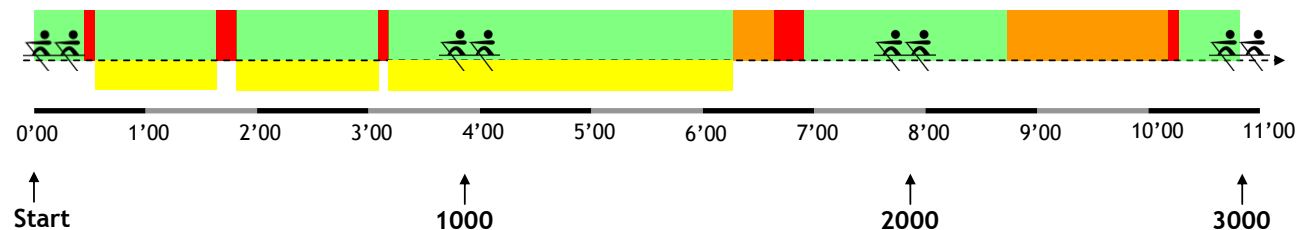
- Analysis of the rowers' collective activity

Synchronizing of the rowers' courses of experience

Identifying of the *interferences* (Castelfranchi, 1998) among the rowers' courses of experience during the race

Identifying of typical modalities of mutual adjustments between rowers

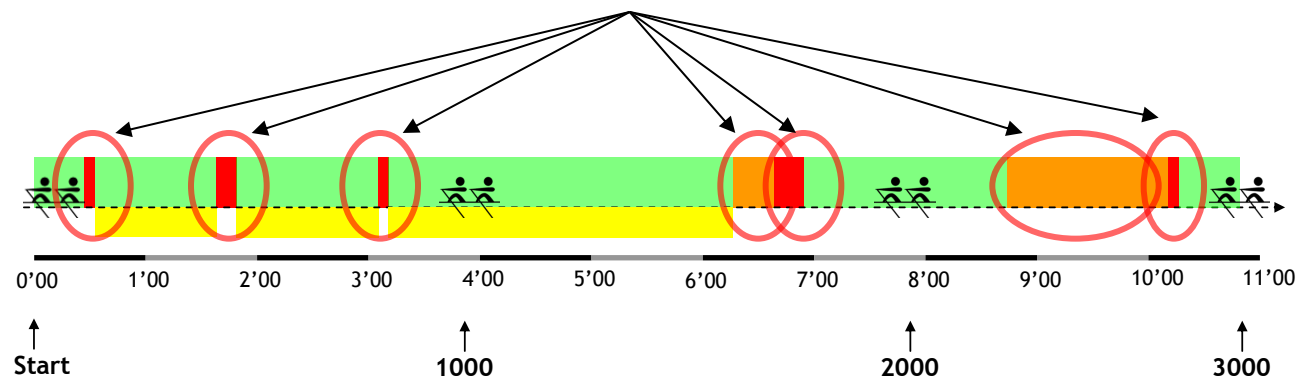
Modelling of changes in typical modalities of mutual adjustments between rowers during the race



- Crossed analysis of courses of experience and mechanical indicators

1. Determining the periods of interest from the point of view of changes in interpersonal coordination patterns

Periods of interest for the crossed analysis



- Crossed analysis of courses of experience and mechanical indicators

1. Determining the periods of interest from the point of view of changes in interpersonal coordination patterns

2. Calculating mechanical indicators about coordination for each period of interest, compared to the 10 "pre-" and "post-" oar cycles

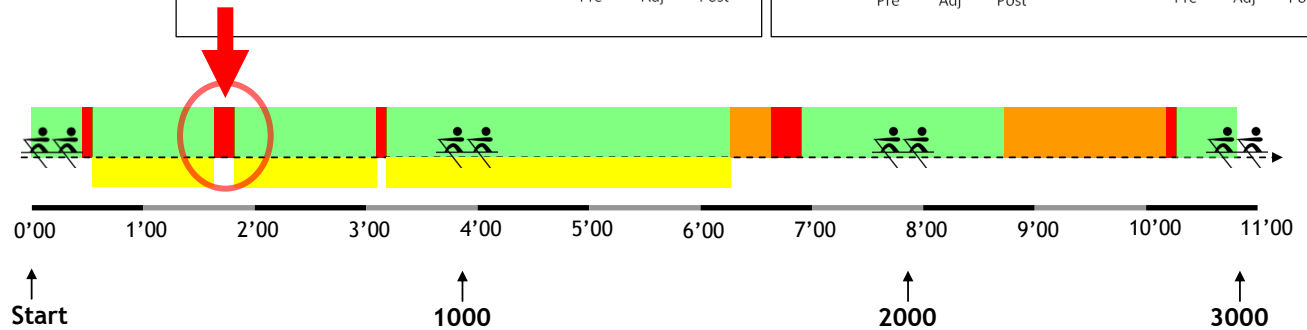
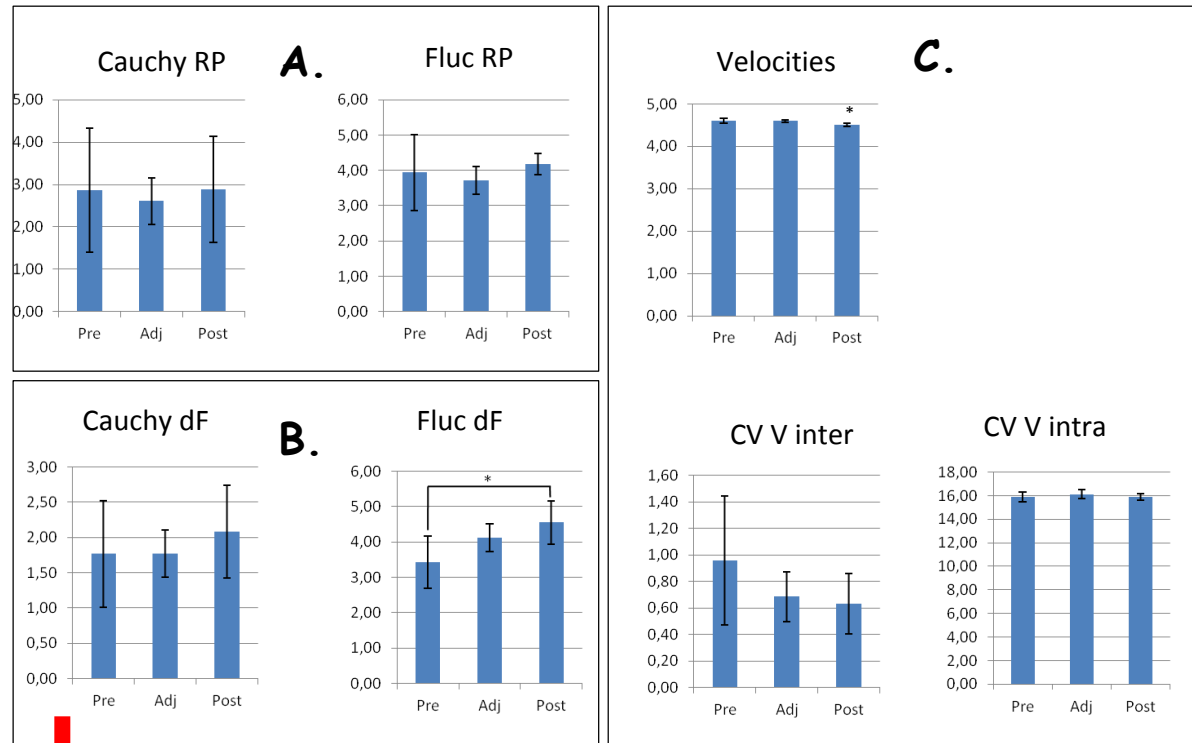
**A. Kinematics analysis:** Cauchy index (Chen et al., 2005) and Critical fluctuations (Kelso et al., 1986) of Relative phase (RP) between polar angles of the oars

**B. Kinetics analysis:** Cauchy index and Critical fluctuations of differences between forces applied at the pin of the oarlocks ( $dF$ )

**C. Speed variations:** Velocities ; Intra-cycle and Inter-cycle coefficients of variation of the boat speed ( $CV V_{intra}$  /  $CV V_{inter}$ )

3. Calculating of statistical differences between periods of interest, and the periods pre- and post-

4. Calculating of the same indicators in the periods of the race except the periods of interest





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# Results

# Three typical modalities of mutual adjustments between rowers

- No interference between rowers' activities

Rowers' joint activities directed towards boat speed

Rowers' joint activities focusing on the effectiveness of their's own rowing technique

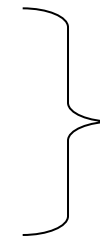
Independent activities directed towards respectively boat speed and rowing technique



*A coordination mediated by the boat ("transparency" of interpersonal coordination)*

- Indirect interferences between rowers' activities

Rowers' activities directed towards the crew as a whole: Induce / adapt to collective actions ("we-intentions")



*A coordination mediated by the crew (indirect interpersonal coordination)*

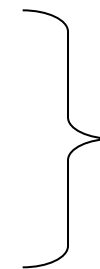


- Direct interferences between rowers' activities

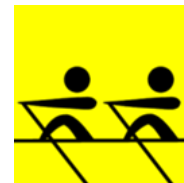
Adjust to one's partner's behavior or communication

Attempt to induce an adjustment of one's partner (effective / ineffective)

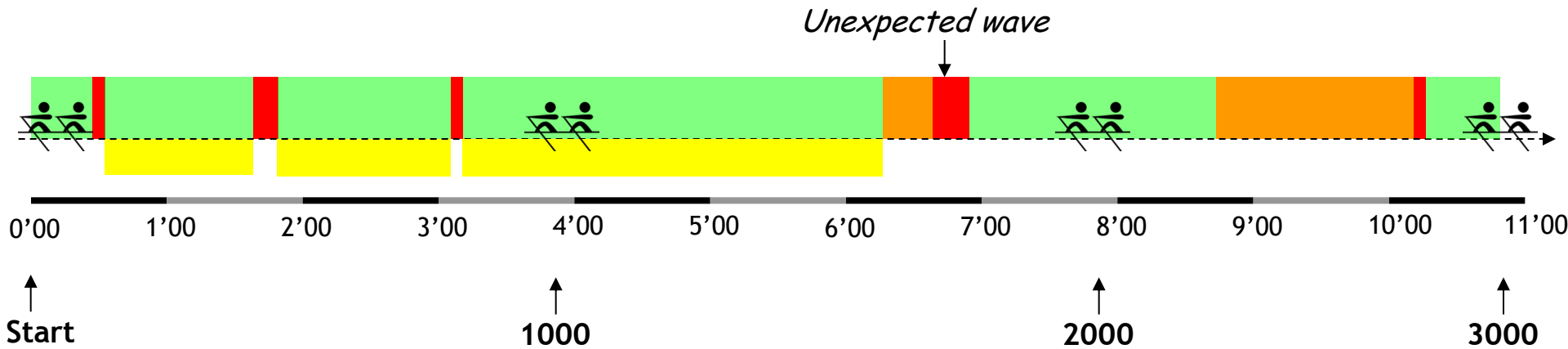
*The specific case of the collective control of the boat direction*





*A direct interpersonal coordination*



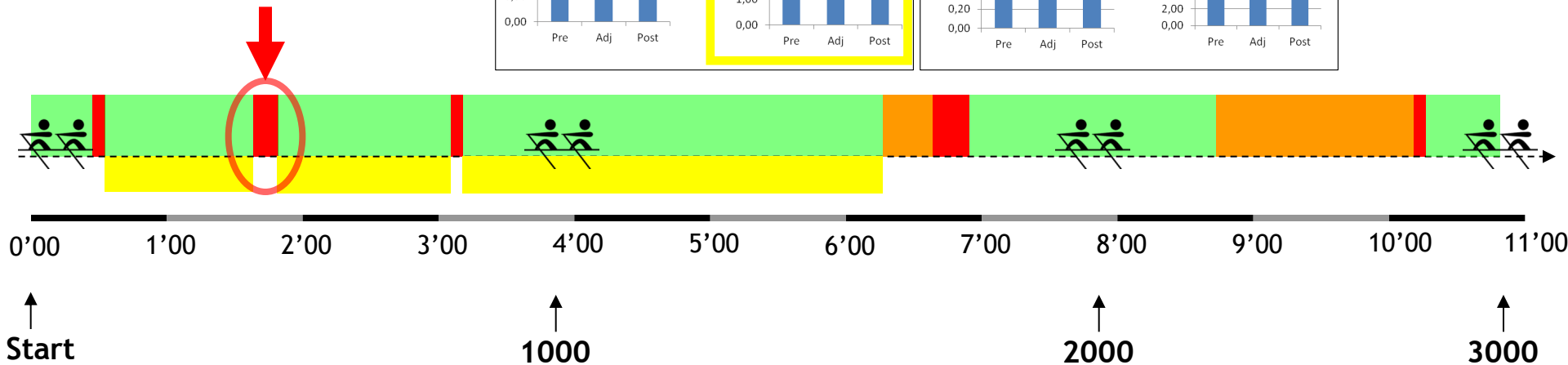
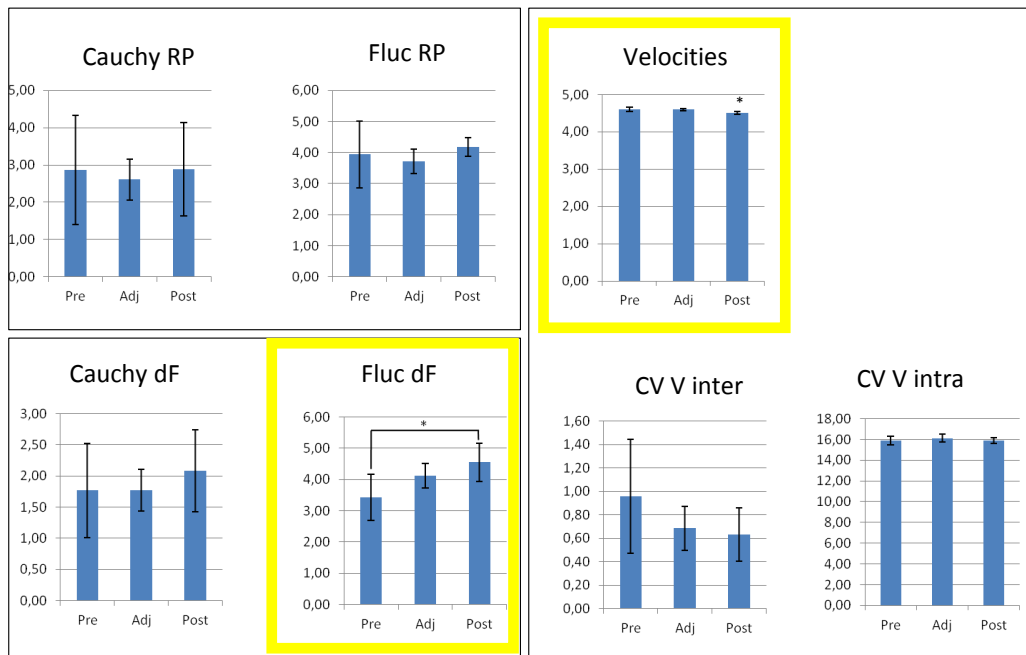
# Changes of mutual adjustments during the race

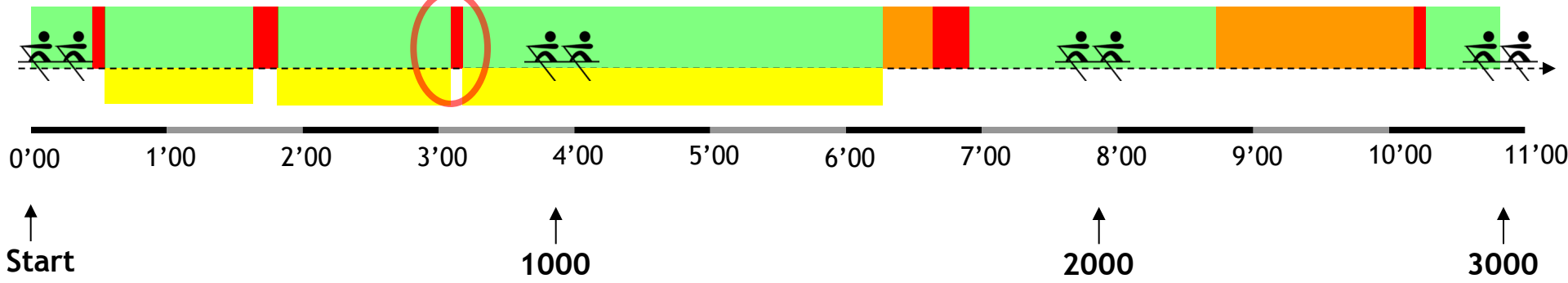
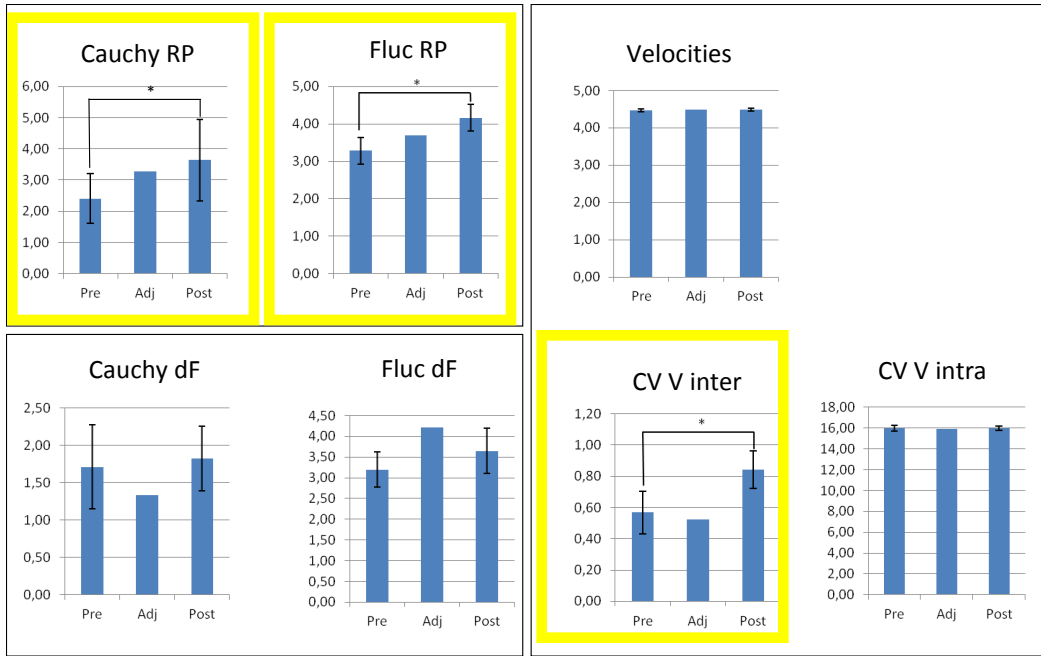


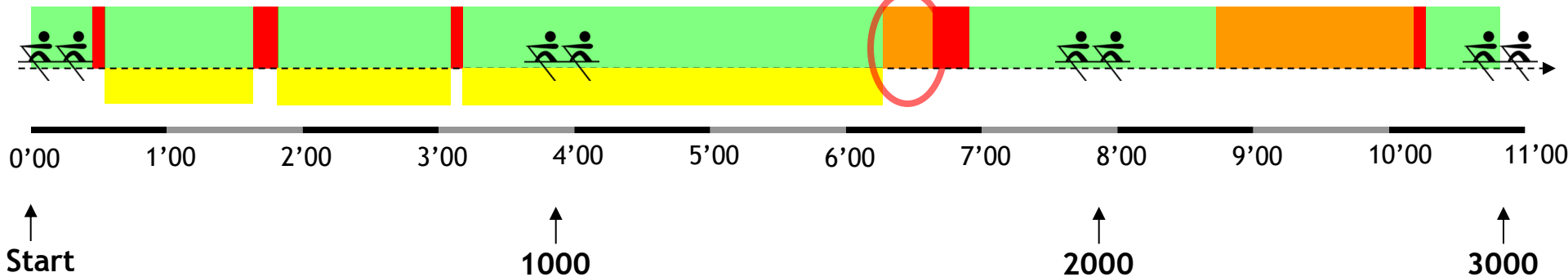
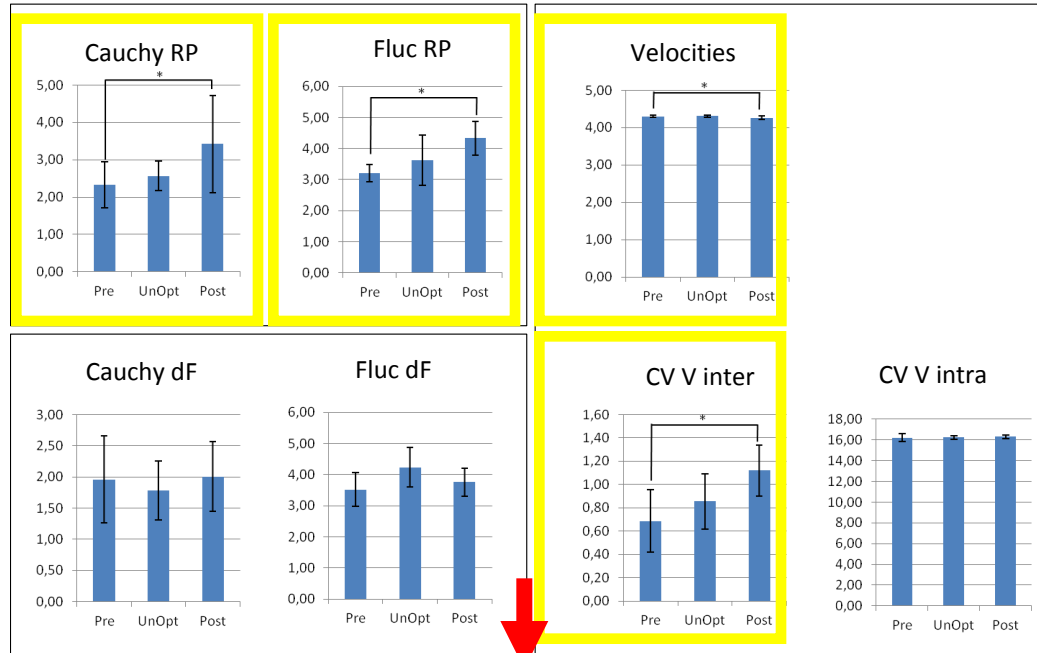
- Fluctuations of modalities of mutual adjustments during the race
- Co-occurrence between divergences of perceptions and concerns of rowers and the interferences  &  (excepted the case of a major external perturbation: an unexpected wave)

# Mechanical indicators associated with changes in modalities of mutual adjustments (except direction control)

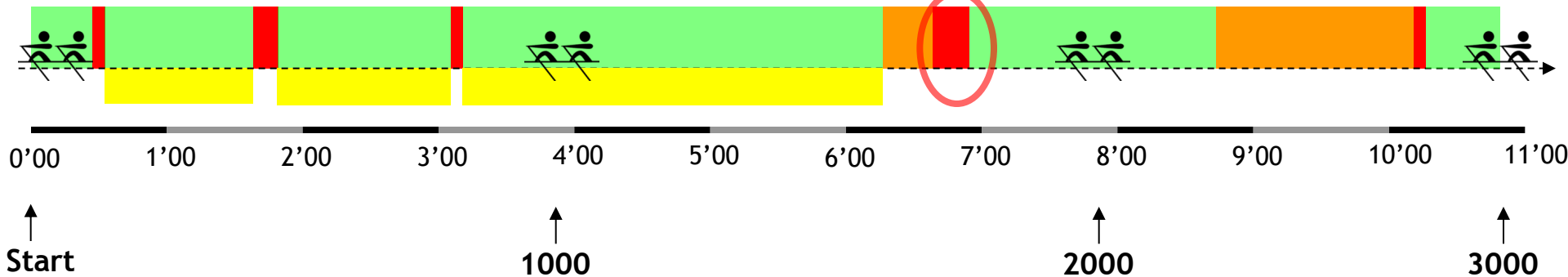
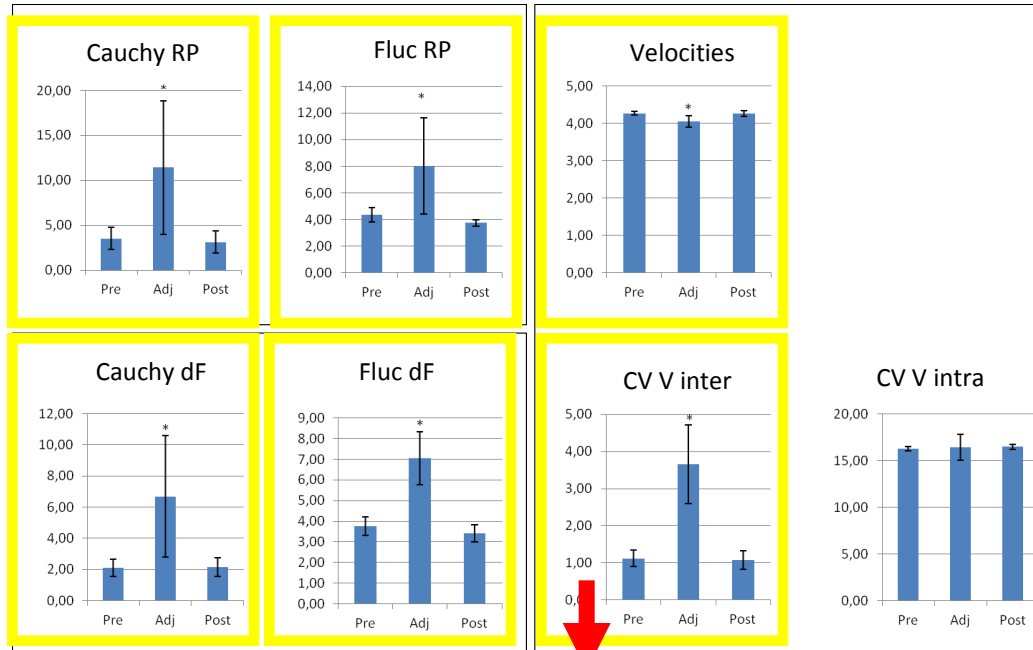
- No regularity in terms of significant differences in mechanical indicators  
→ Various effects (kinematics, kinetics, speed variations)

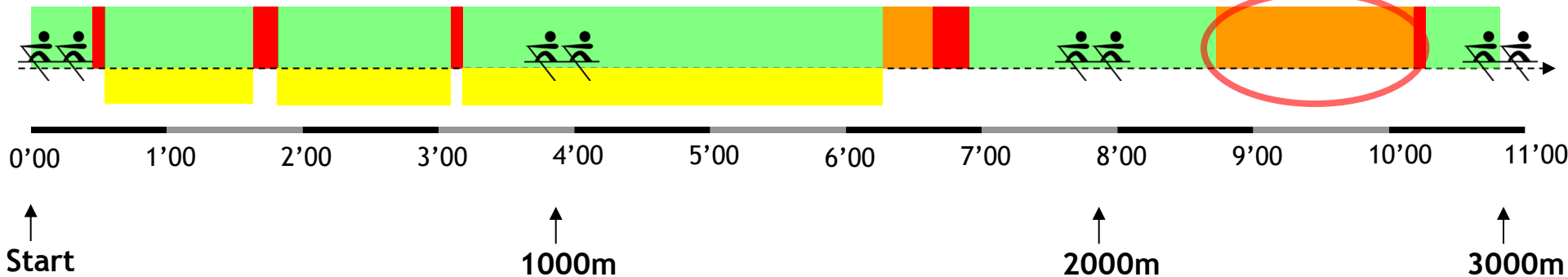
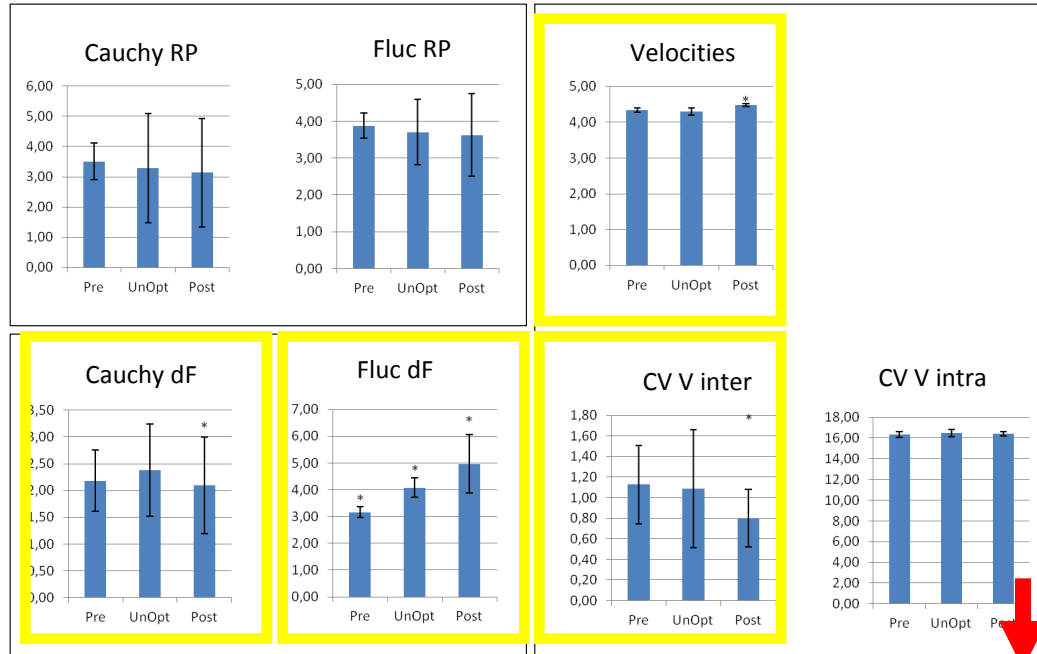






*External perturbation:  
unexpected wave*







# Mechanical indicators associated with changes in modalities of mutual adjustments

- No regularity in terms of significant differences in mechanical indicators: Various effects (kinematics, kinetics, speed variations)
- In the most cases: ↑ variability and unstability of coordination in the “post-” period (excepted the case of a major external perturbation: an unexpected wave)
- The speed variables show (consequently) a lower performance during the “post-” periods (excepted “unexpected wave” and the “final sprint”)



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# *Discussion*

## Hypotheses about coordination in expert rowing crews

No interference between rowers' activities: An optimal functioning in expert crews?

Interferences as a collective recovery of optimal functioning following a perturbation (excepted for the direction control)?

(Saury et al., 2010; Sève et al. 2013)

**The “boat-mediation” of coordination in rowing: an original phenomenon of team cognition**

(“transparency” of interpersonal coordination”)

The development of collective effectiveness in rowing: From mutual adjustments to joint adjustments with the boat ?

# Discussion about crossed analysis of courses of experience and mechanical indicators

Mechanical indicators: Indicators of effects or of constraints of coordination?

What are the relevant temporal frames to analyze changes in coordination between rowers?

The relevance to distinguish between internal and external perturbations to analyze mechanical indicators

**The need of comparative and more extended studies**



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***Thank you for your attention***



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# AN PACY

Analyse et optimisation de la performance



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