



scientific reports

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OPEN Human low-threshold mechanoafferent responses to pure changes in friction controlled using an ultrasonic haptic device

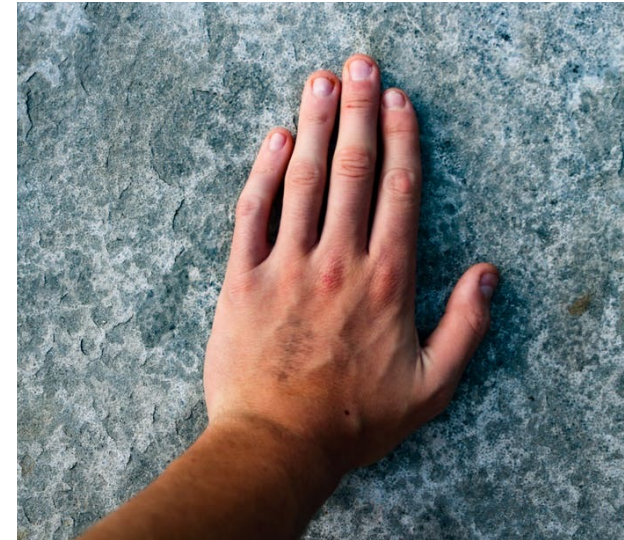
Mariama Dione^{1,2}, Roger Holmes Watkins¹, Eric Vezzoli², Betty Lemaire-Semail² & Johan Westberg¹

Réponses des afférences tactiles à un changement de friction généré par le Stimtac

Mariama Dione

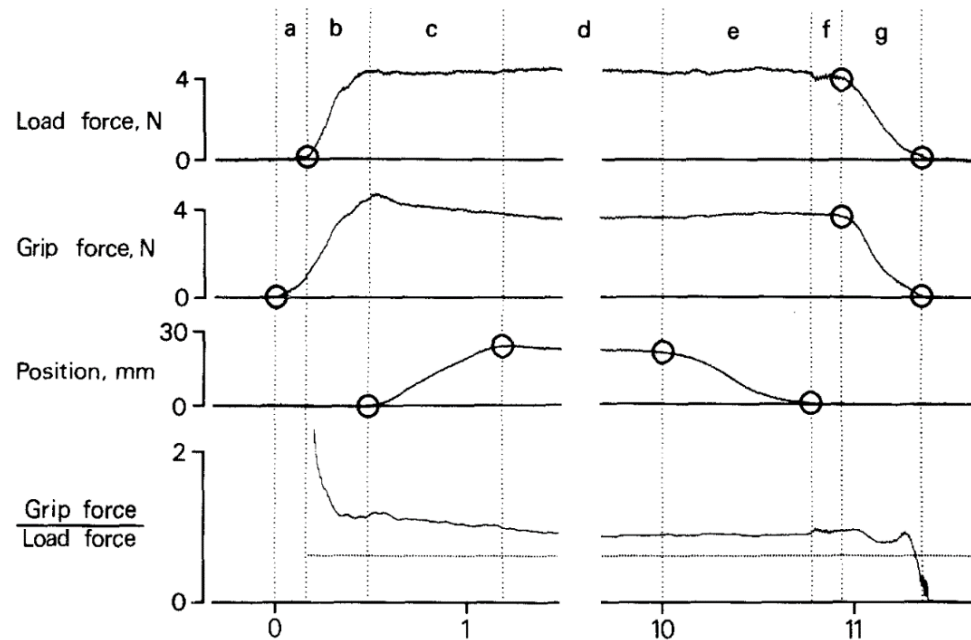
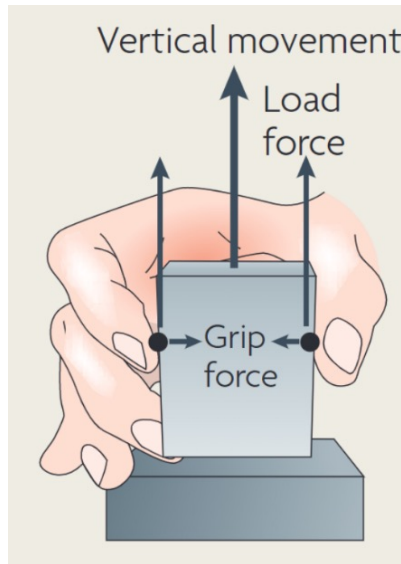
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Changements des niveaux de friction pour la Manipulation d'objets et l' Exploration de textures



$$\text{Coefficient de friction } (\mu) = \frac{\text{Force latérale}}{\text{Force normale}}$$

Ajustement des forces de préhension pour la saisie optimale d'objets texturés



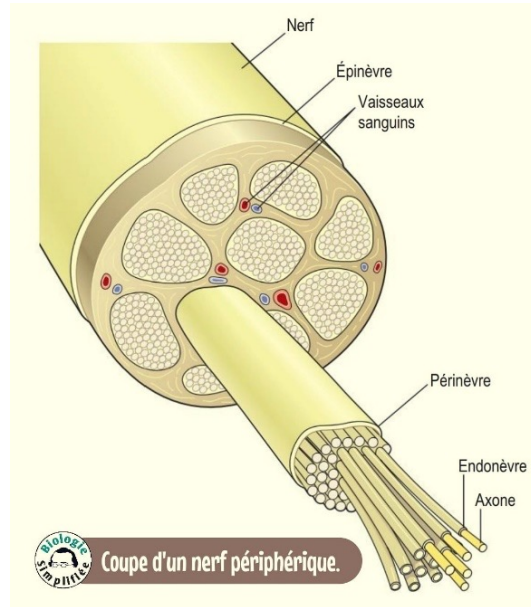
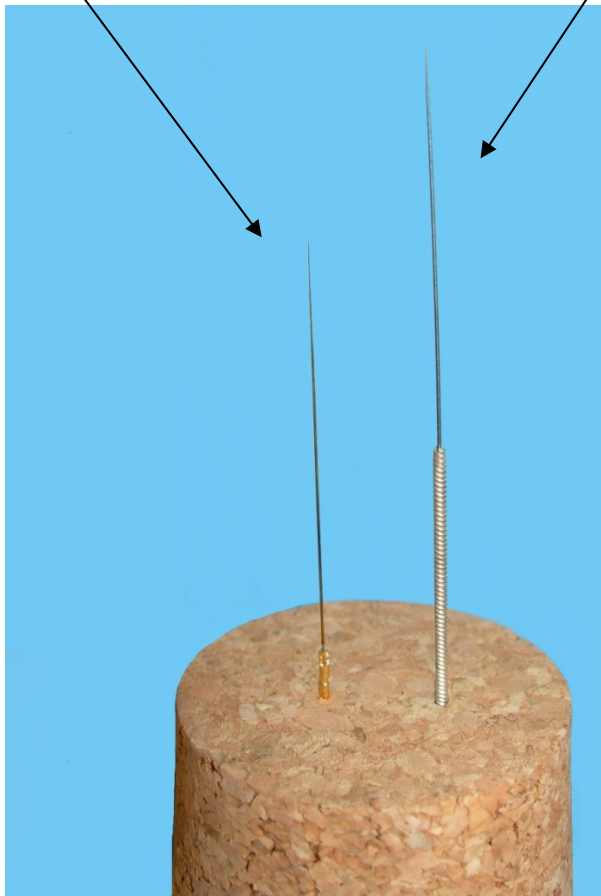
Ratio minimal
de force
nécessaire
à la saisie

Johansson & Westling (1984), Johansson & Flanagan (2009)

La microneurographie unitaire pour évaluer la transmission des informations nerveuses afférentes

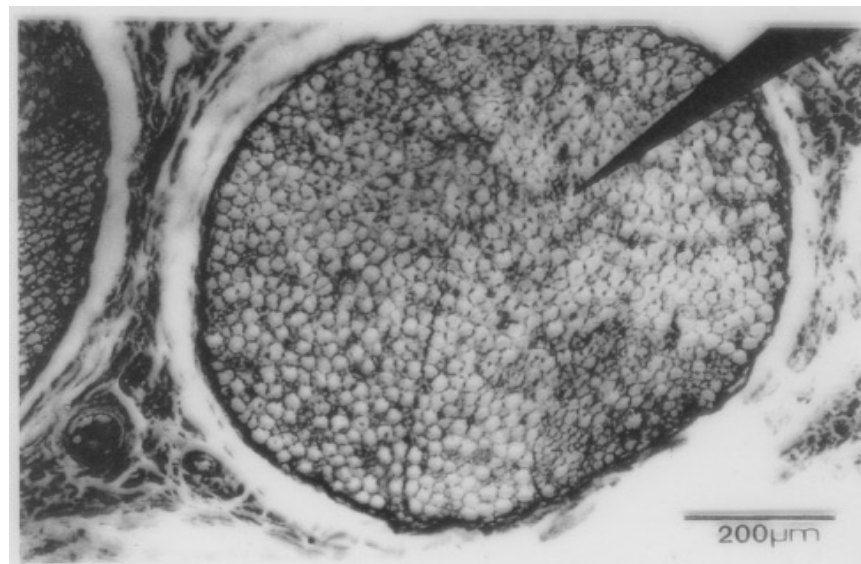
Microneurographie
(0.2mm à ~5 μ m)

Acupuncture
(0.32 mm)



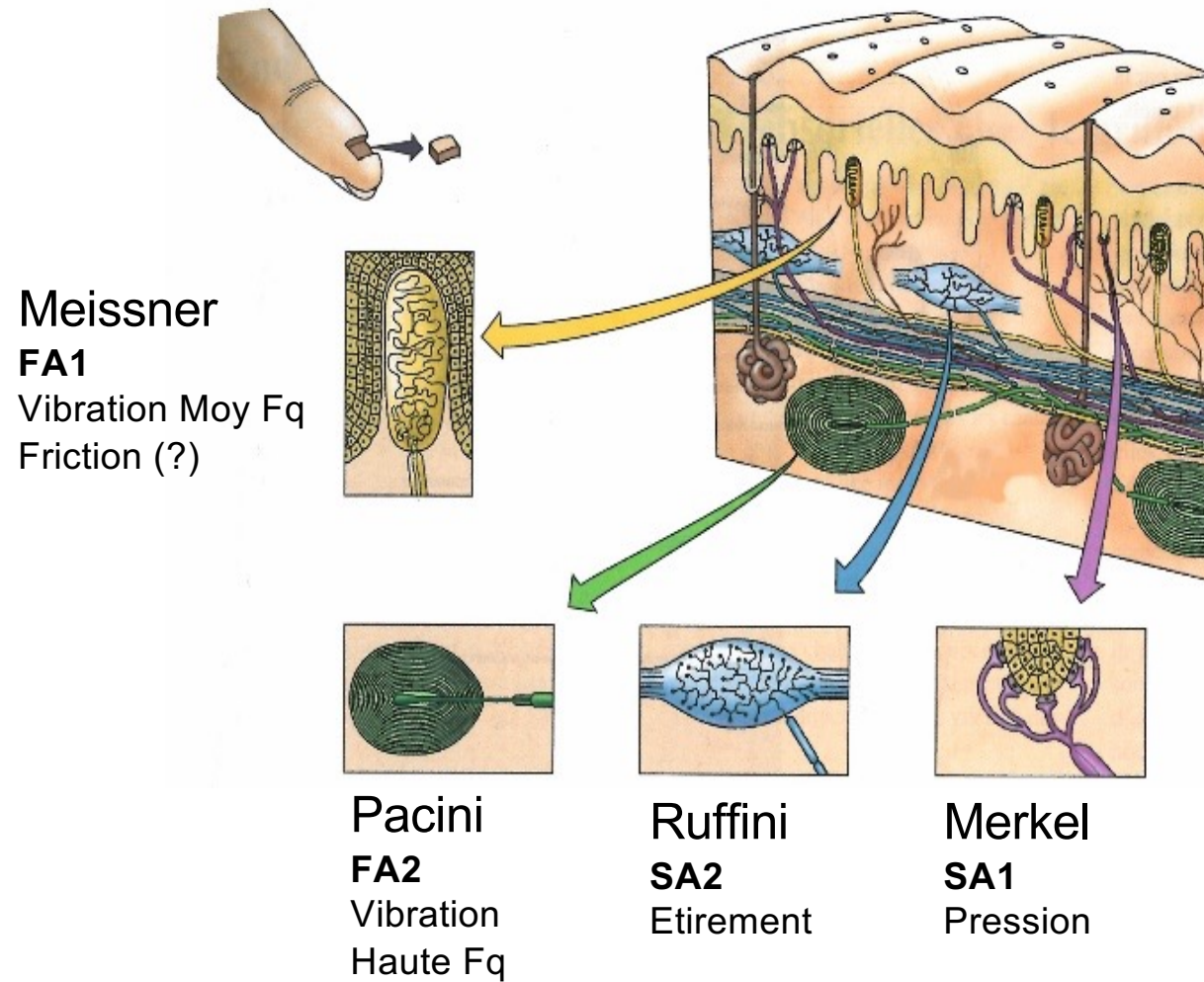
Coupe d'un nerf périphérique.

~17000 mécanorécepteurs
dans la peau glabre!
Johansson & Vallbo, 1979



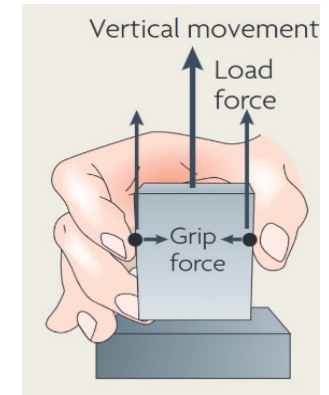
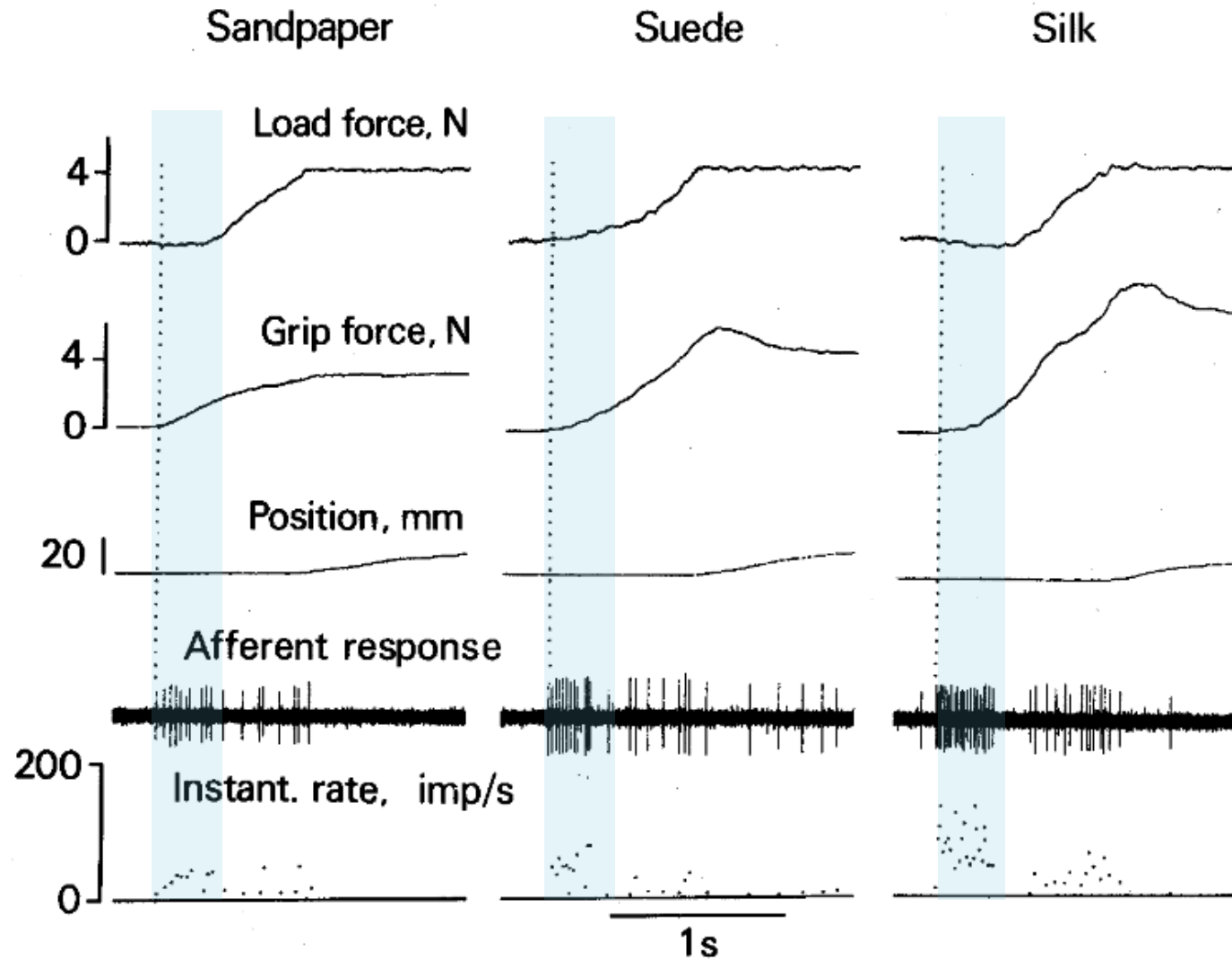
Bergenheim et al., 1999

Mécanorécepteurs dans la peau glabre de la main



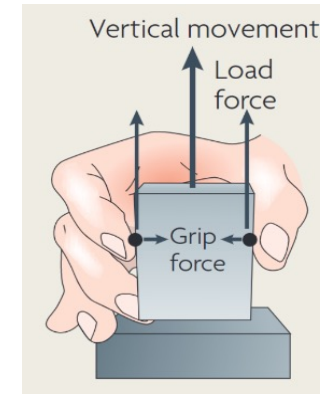
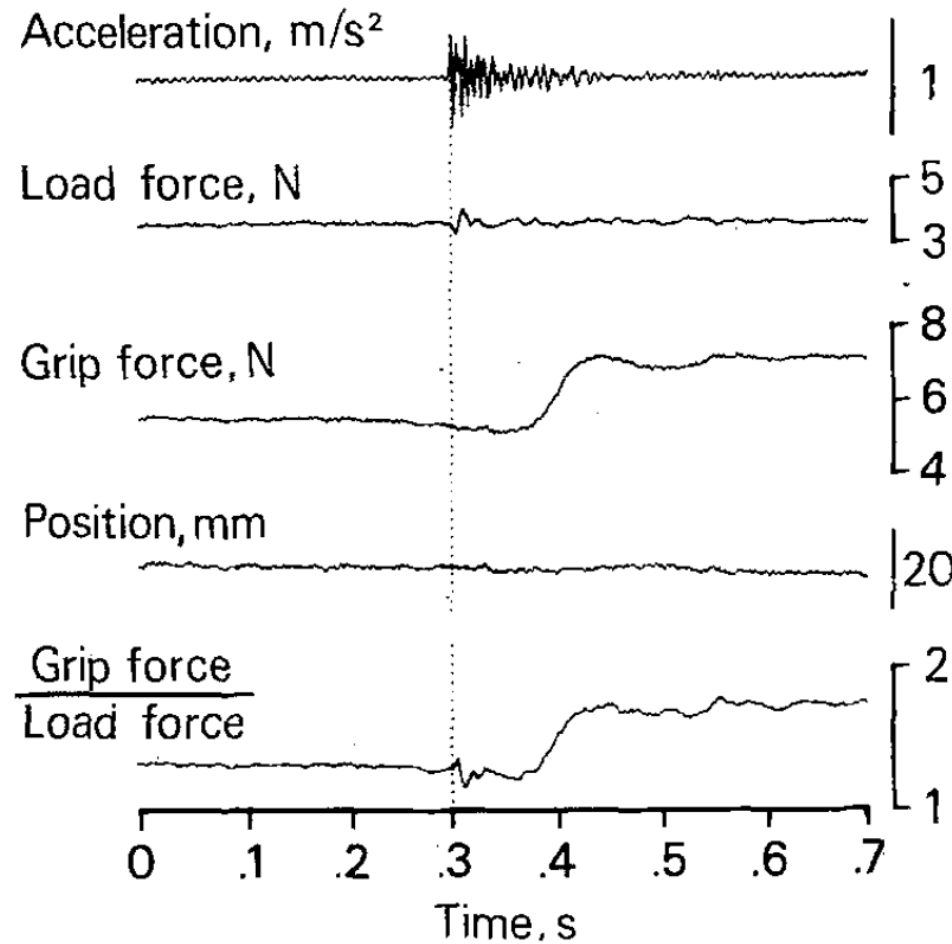
Adapté de Darian-Smith (1984)

Modulation de friction via une texture: un rôle spécifique pour les FA1?



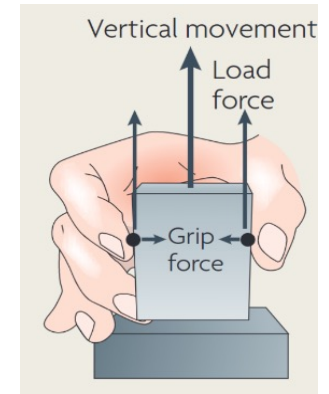
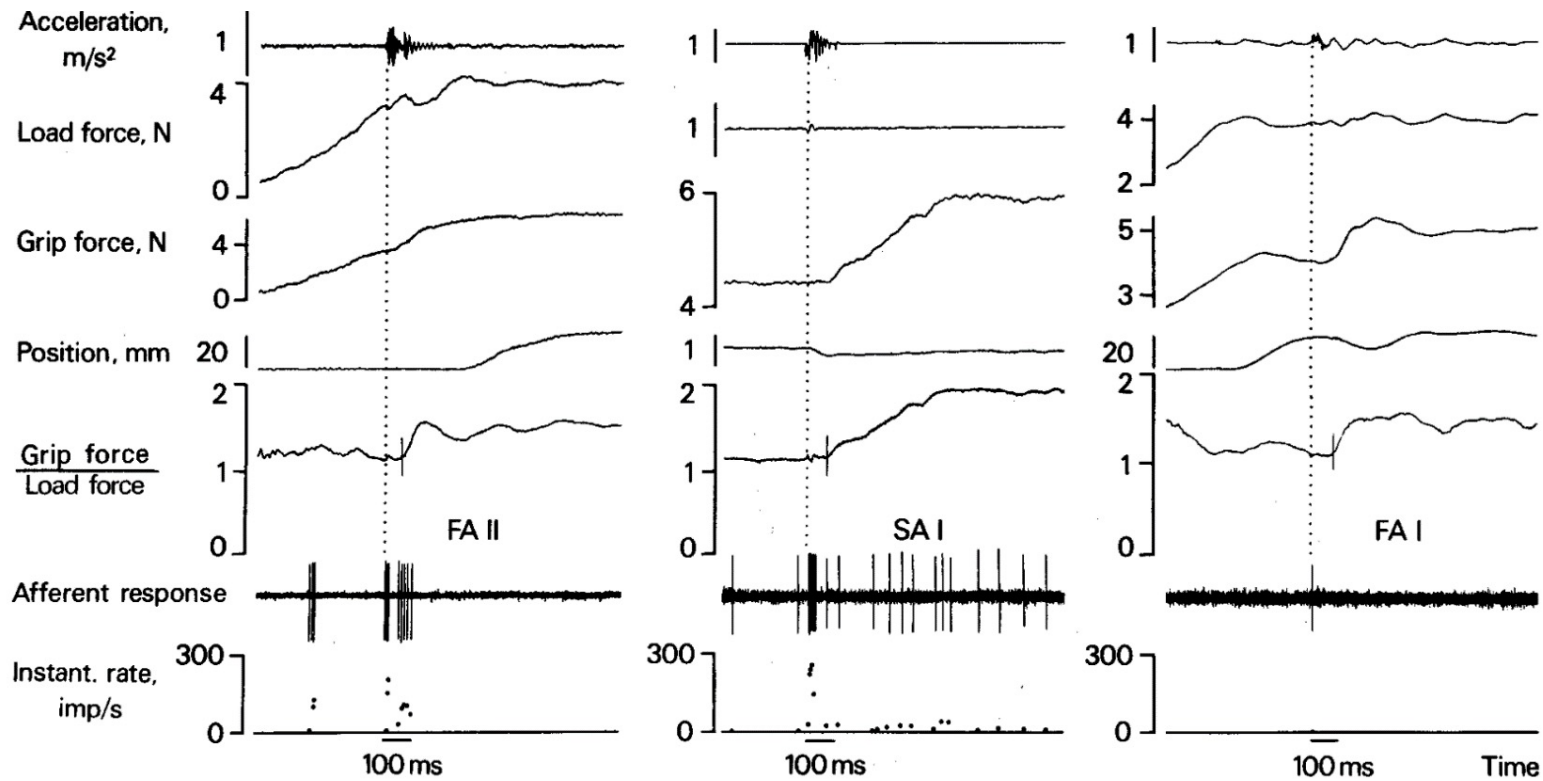
Décharge d'un FA1

Ajustements en cours de saisie (micro-glissements)



Johansson & Westling (1987)

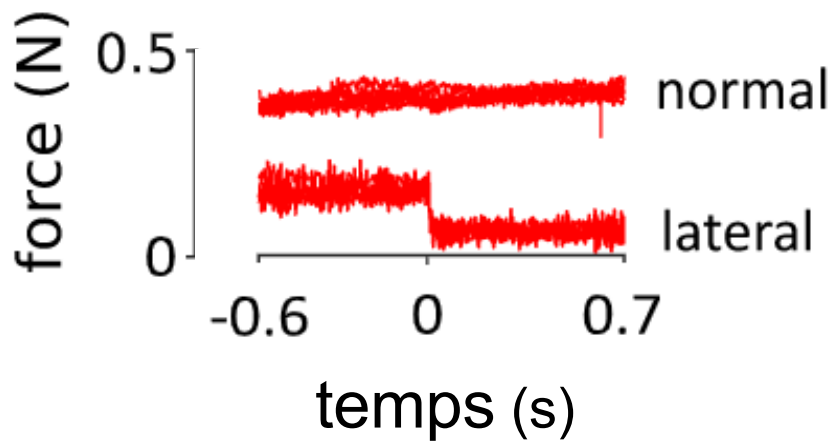
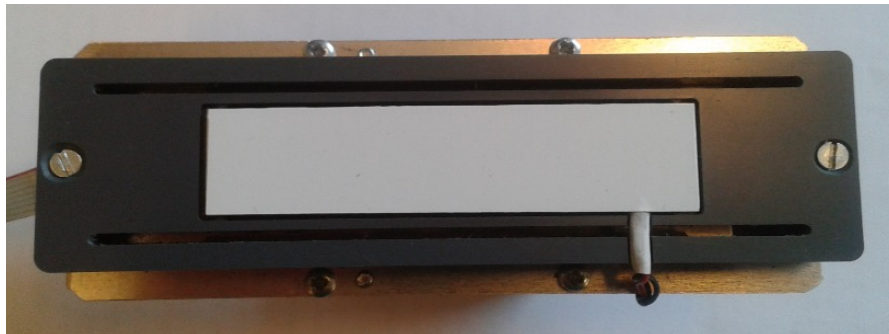
Réponses des mécanorécepteurs aux micro-glissements



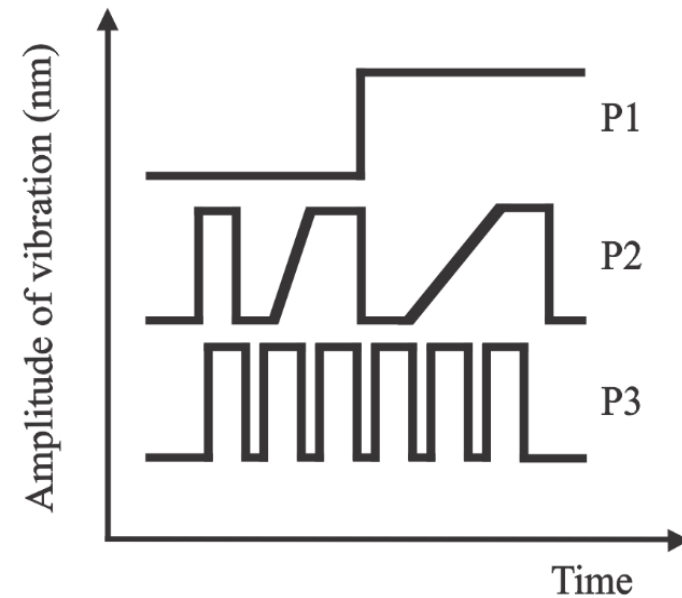
Johansson & Westling (1987)

Stimtac: une évaluation pure de la friction (sans modulation de texture)

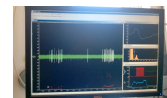
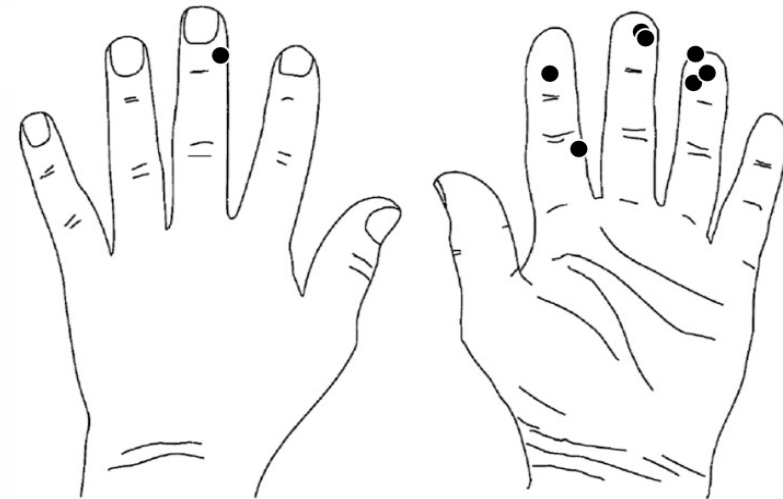
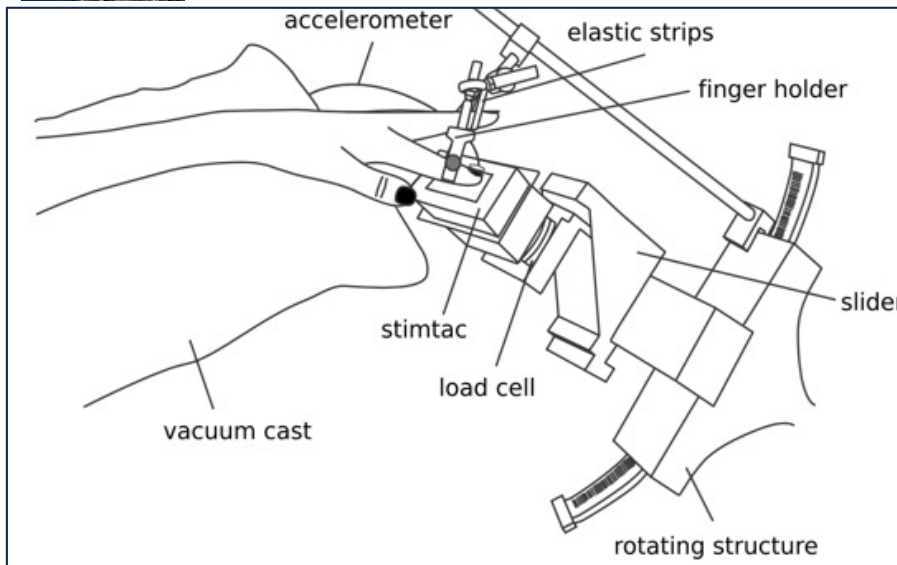
STIMTAC: un réducteur de friction



Protocoles



Stimtac: une évaluation pure de la friction (sans modulation de texture)



Movement latéral du robot
Normal force: 0.4N, Speed: 20 mm.s⁻¹

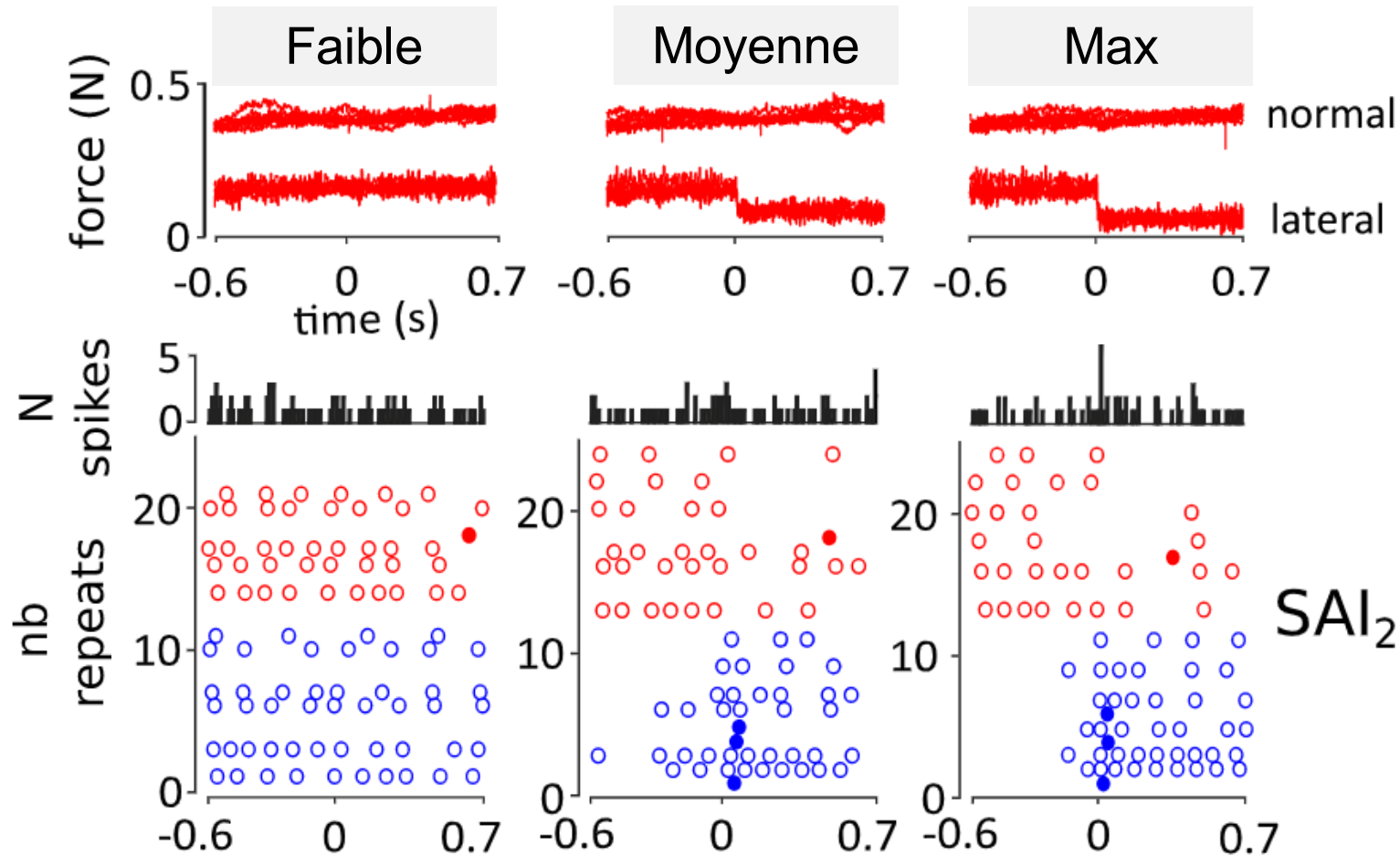
Unit label	FAI ₁	FAI ₂	FAII ₁	SAI ₁	SAI ₂	SAIL ₁	SAIL ₂	SAIL ₃
Location	4-prox	3-dist	2-prox	2-dist	4-mid	3-dor	4-dist	3-prox
VF threshold (mg)	166	166	<4.5	166	166	407	407	3000
Protocol N tested (& repeats if ≠ 6)	P1* P2 P3	P1(14) P2 P3(12)	P1(5*)	P1 P2(7) P3	P1 P2 P3	P1(4)	P1 P2 P3	P1 P2 P3

* last block unfinished

Niveaux de friction



Amplitude du changement de friction

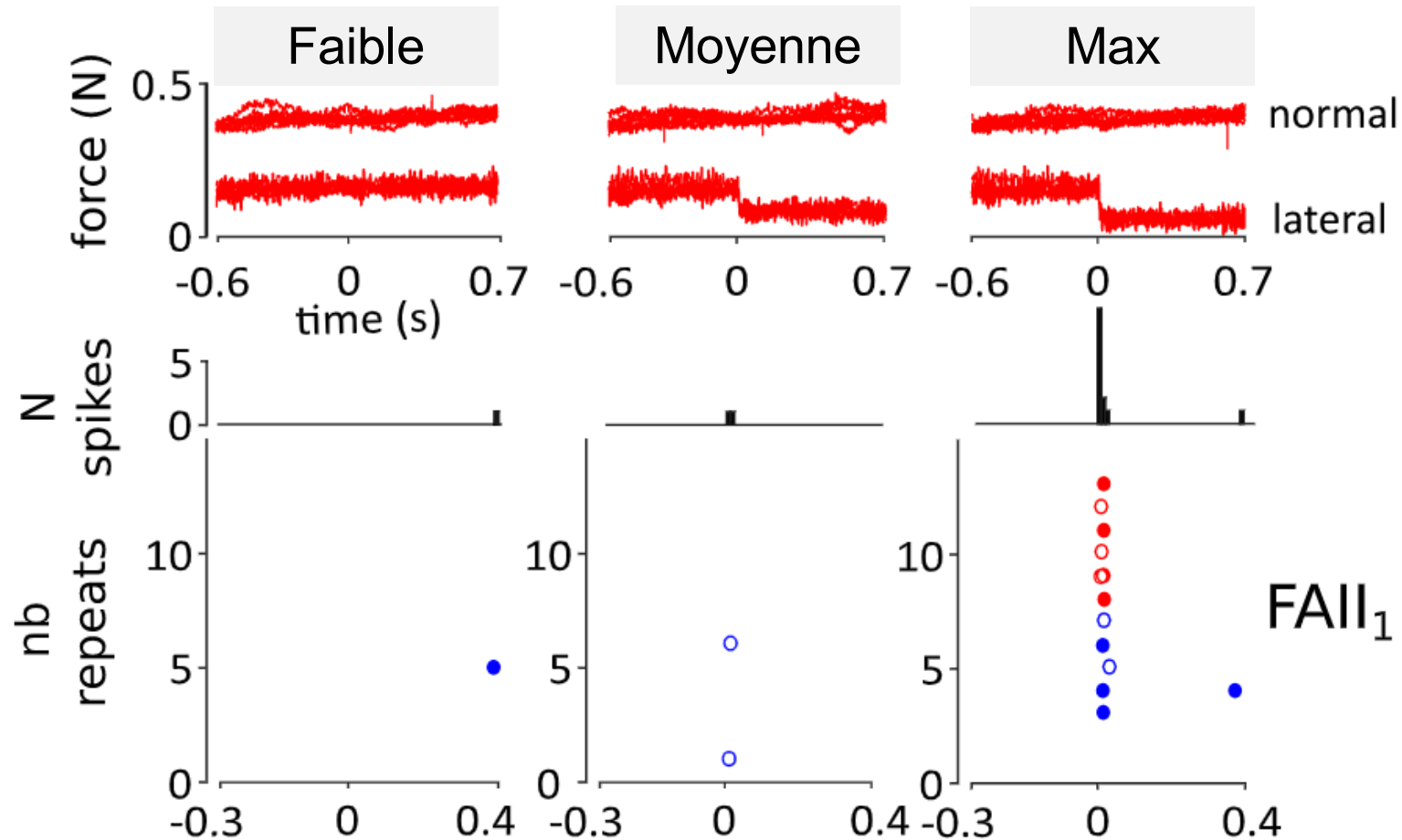


Moins de friction moins de spikes pour tous!

Changements abrupts dans la friction

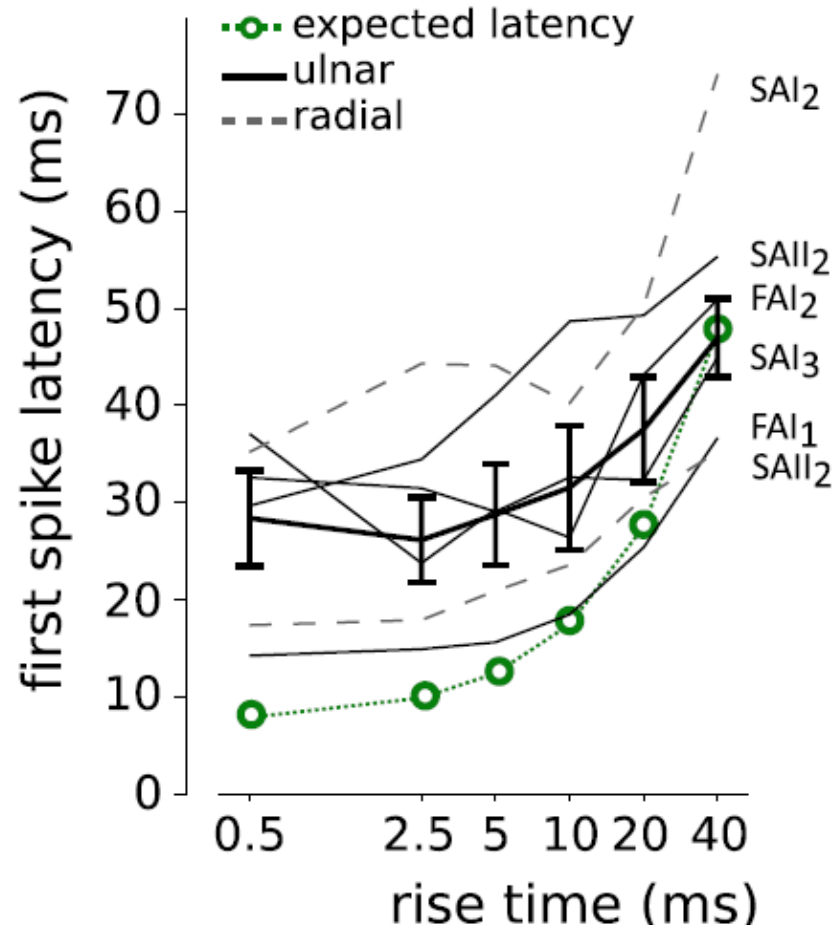
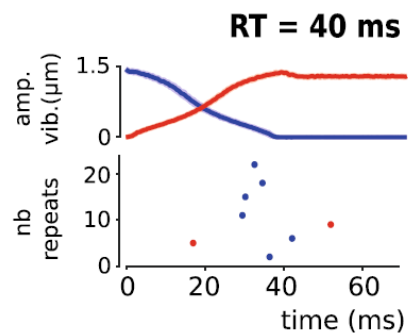
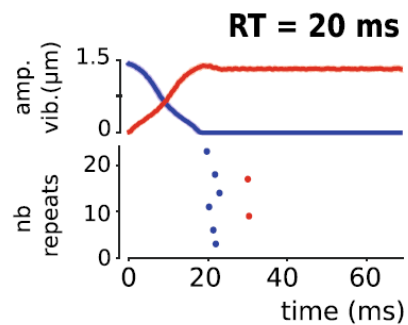
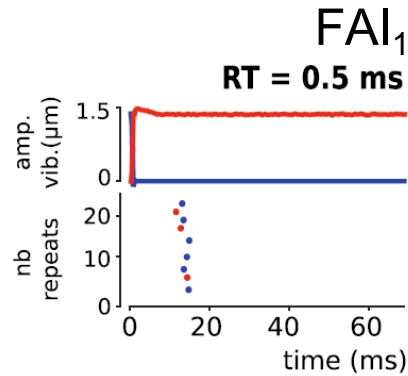


Amplitude du changement de friction



1 seul spike, pas de bouffées, pour tous!

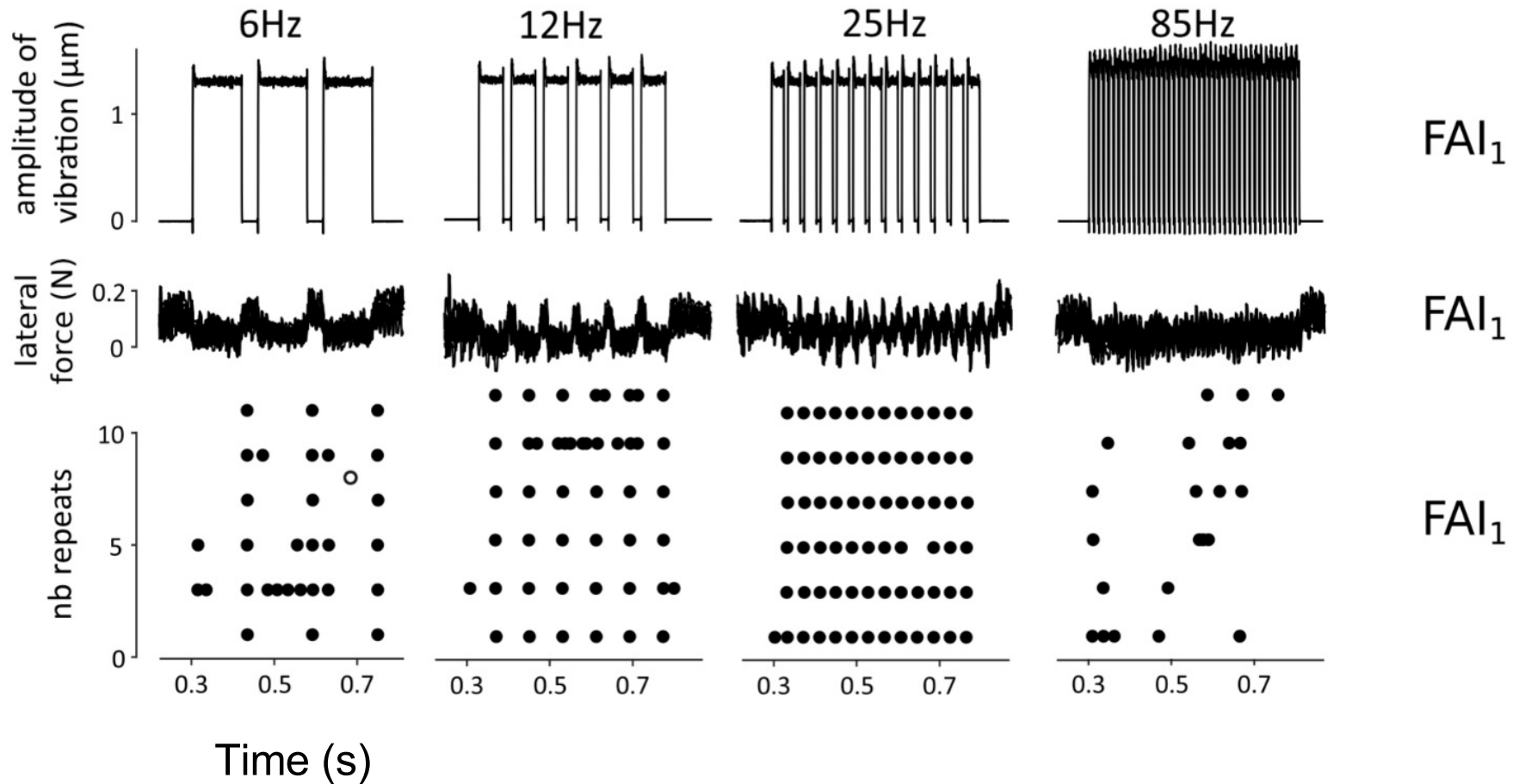
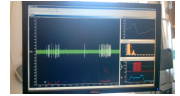
Modulation de la pente du changement



Toujours 1 spike, pour des sensations différentes...

N = 6 (2 FA1, 2 SA1, 2 SA2)

Création de textures basées sur la friction



70 Hz: limite de la modulation par la friction?

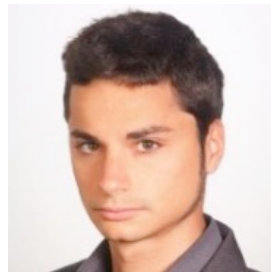
N = 6 (2 FA1, 2 SA1, 2 SA2)

Remerciements

Co-auteurs



Roger Watkins



Eric Vezoli

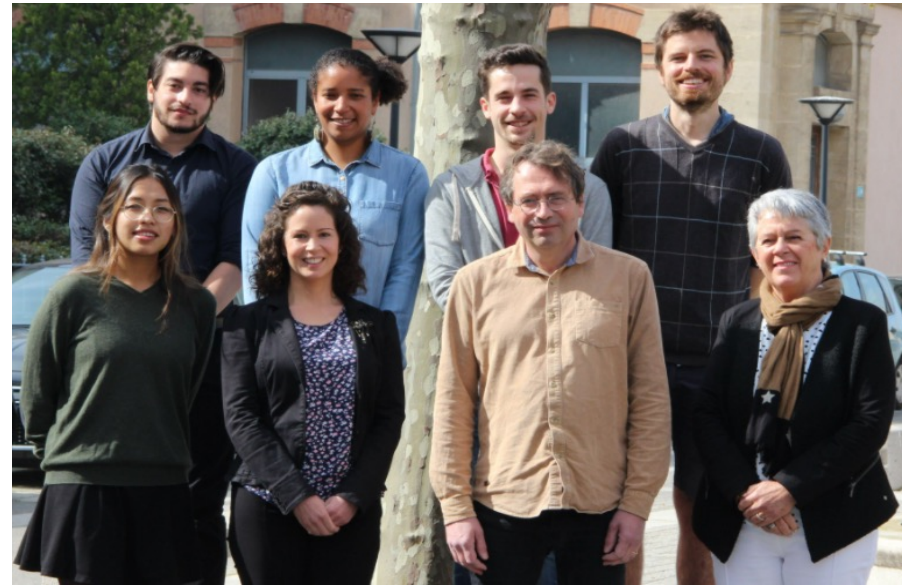


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Lemaire-Sémail



Johan Wessberg

Groupe microneuro Marseille



L2EP

