Study Of The Effects Of Thermosensory Aging By Cold Stimulations With High Temporal Resolution

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Background

Quantitative sensory testing (**QST**) is the most commonly used method for assessing and quantifying sensory nerve function noninvasively. Aging processes in the skin and the peripheral nervous system strongly suggest that thermal perception may change during aging. Cold stimuli applied on the skin are used to determine cool perception threshold **(CPT**) for assessing the integrity of A-delta fibers, which can be altered with the aging process.

In the assessment of thermal QST, the method of limits (**MLi**) is the most commonly used paradigm to measure the threshold of thermal stimuli. However, the measured threshold in MLi is reaction time (**RT**) dependent and may induce an overestimation of the thermal threshold in the elderly. The use of the method of levels (**MLe**), a method independent of RT would be more suitable for evaluating CPT in the elderly.

In previous studies, the thermode devices used to generate cold stimuli have a low cooling rate (usually between 1°C/s and 4°C/s). However, increasing the rate of temperature change of the thermode significantly increases the intensity of thermal sensations, suggesting that more rapid cooling leads to stronger afferent input in the cold thermal pathway.

Objective

The objective of this study was to determine whether the MLe, using a device capable of extremely rapid cooling rates (300 °C/s), can better determine the effects of aging on the perception of cold stimuli.

Methods

Participants

- 11 older patients (5 women; mean age, 68.64 years)
- 14 younger adults (8 women; mean age, 24.57 years)

Paradigm

Apparatus: A thermode device (TCS II; QST.Lab; France) that can generate thermal stimuli between 0°C and 60°C with a temperature ramp from 0.1°C/s to 300°C/s

Experimental conditions:

The MLi session - 2 experimental conditions: cooling ramps of 2°C/s and 4°C/s.

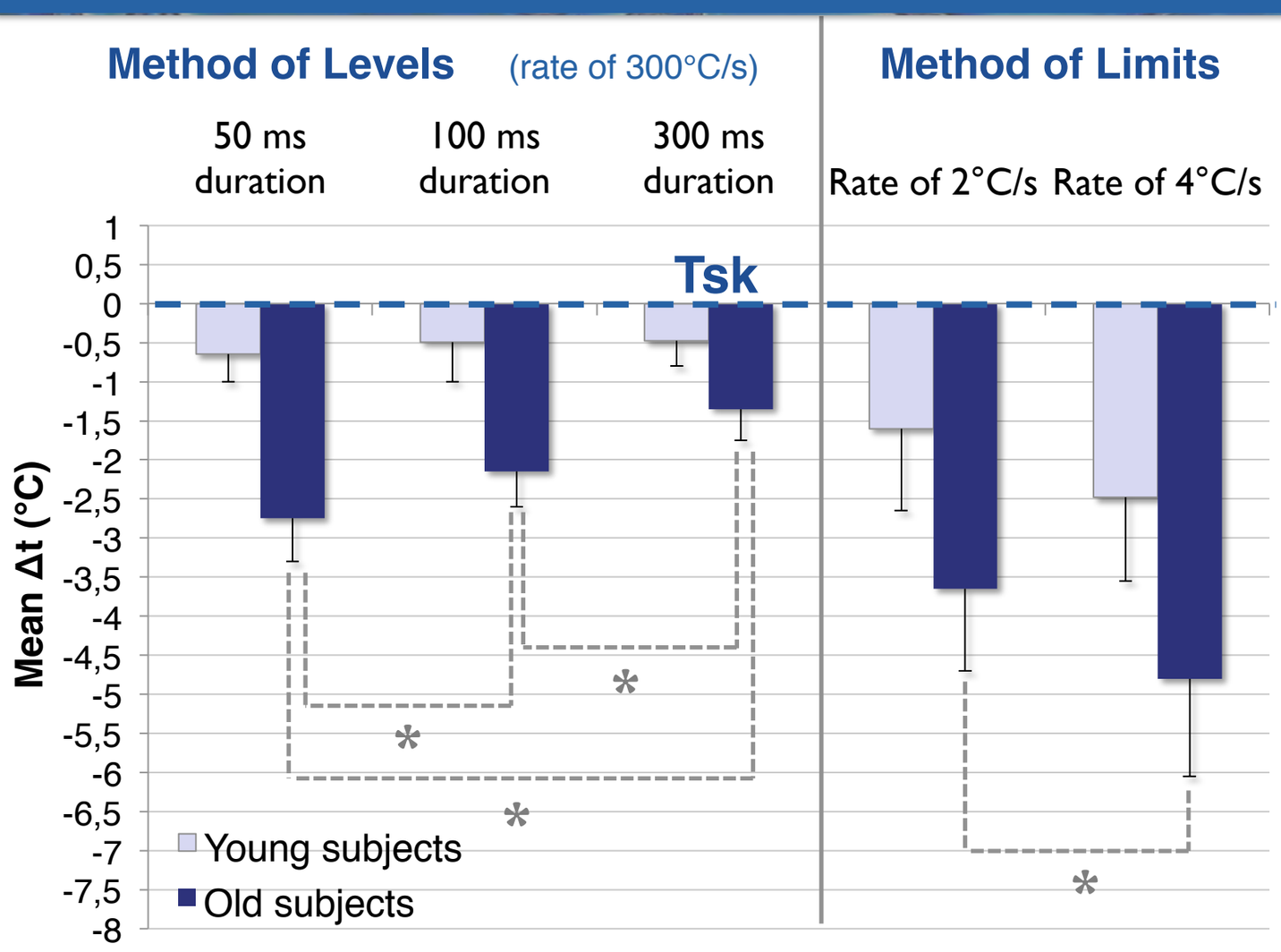
Stimulations for each temperature ramp were repeated 10 times, with CPT defined as the median of the 10 measurements. At each trial, participants were asked to press a button as soon as they felt the cold stimulation on their skin.

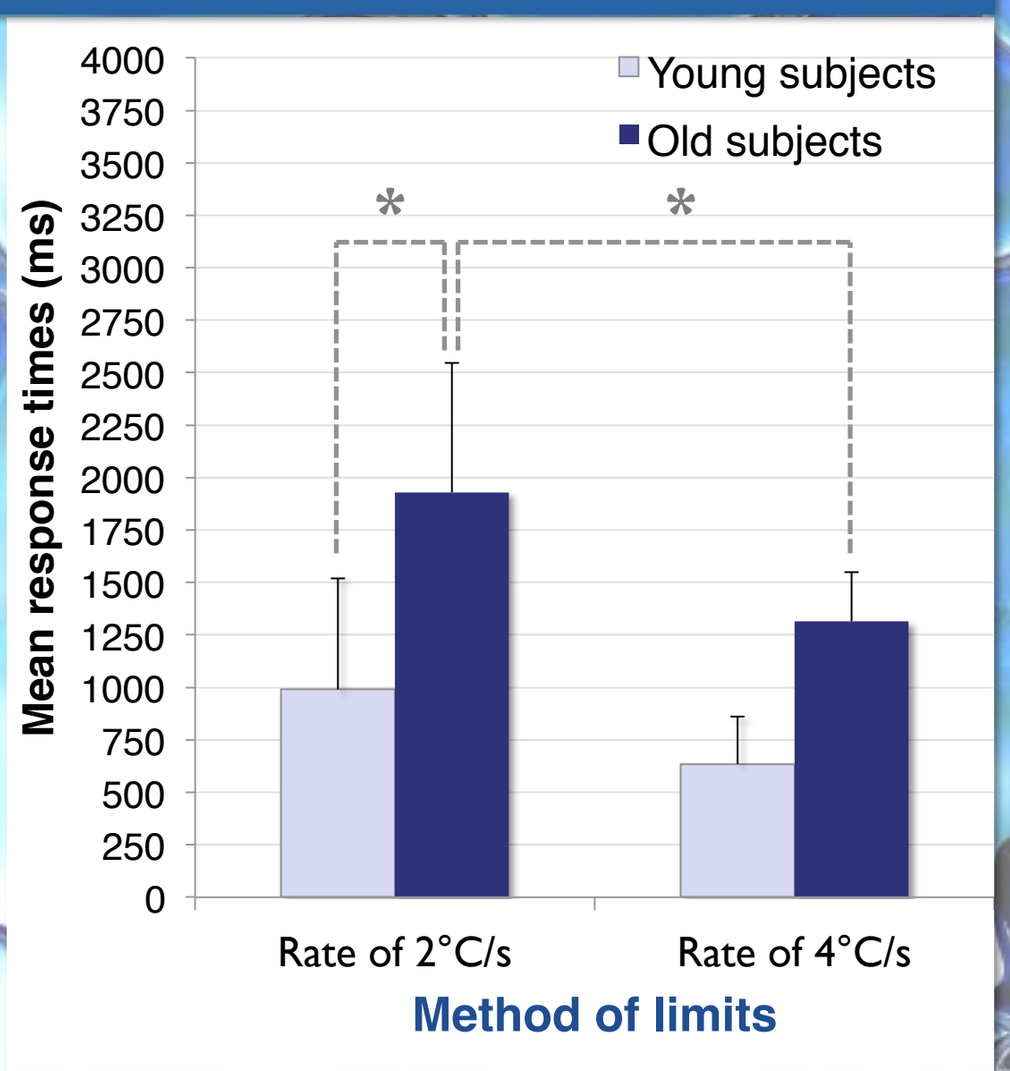
The MLe session - 3 experimental conditions: stimulation times of 50, 100, and 300 ms with a cooling rate of 300°C/s.

Each trial starting from the baseline temperature (Tsk) to a predetermined thermal intensity level (initial step of 1°C). The participant was subsequently asked whether a cool sensation was perceived. If a thermal sensation was perceived, the thermal intensity step size was halved. If no perception, the step was doubled. The CPT was defined as the mean of the last 10 trials when these were of minimum steps of 0.1°C.

Results

Tsk: baseline skin temperature Δt: difference between Tsk and the CPT ∗ : $p < 0.05$





Conclusions

The MLe with rapid cooling resulted in more accurate measurements :

- In older patients, the MLe showed smaller CPTs of almost 2°C compared with the optimal condition of the MLi (2°C/s).
- the influence of RT on the MLi results in a significantly greater overestimation of CPT in older compared with younger patients.

Our data with the MLe confirm the existence of a change in the CPT with age, but this modification seems less important than that measured with MLI.

The use of a very fast cooling technique in combination with the MLe can significantly improve the accuracy of evaluating CPT in older patients.

Acknowledgments

This work was funded by **the French National Research Agency (ANR)** through the “Programme d'Investissement d'Avenir” under contract ANR-17-EURE-0022.

This study was supported by **the Strasbourg Pain Initiative consortium.**

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