



HAL
open science

Neural correlates underlying local and global processing during visual search across adulthood

Gaëlle Doucet, Jordana Kruse, Noah Hamlin, Carole Peyrin, Nicolas Poirel

► To cite this version:

Gaëlle Doucet, Jordana Kruse, Noah Hamlin, Carole Peyrin, Nicolas Poirel. Neural correlates underlying local and global processing during visual search across adulthood. *CNS*, Mar 2023, San Francisco California, United States. hal-04043229

HAL Id: hal-04043229

<https://cnrs.hal.science/hal-04043229>

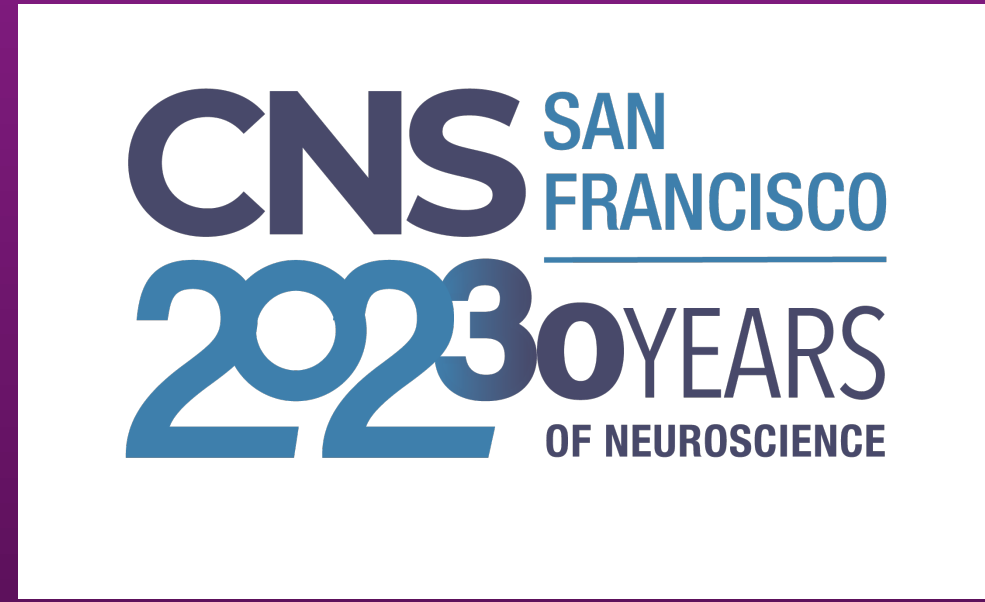
Submitted on 23 Mar 2023

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Neural correlates underlying local and global processing during visual search across adulthood

G.E. Doucet^{1,2}, J. A. Kruse¹, N. Hamlin¹, C. Peyrin³, & N. Poirel^{4,5,6}



¹ Institute for Human Neuroscience, Boys Town National Research Hospital, Omaha, NE, USA
² Department of Pharmacology and Neuroscience, Creighton University School of Medicine, Omaha, NE, USA
³ Univ. Grenoble Alpes, Univ. Savoie Mont Blanc, CNRS, LPNC, 38000 Grenoble, France
⁴ Université de Paris Cité, LaPsyDÉ, CNRS, F-75005 Paris, France
⁵ GIP Cycon, Caen, France ⁶ Institut Universitaire de France, Paris, France



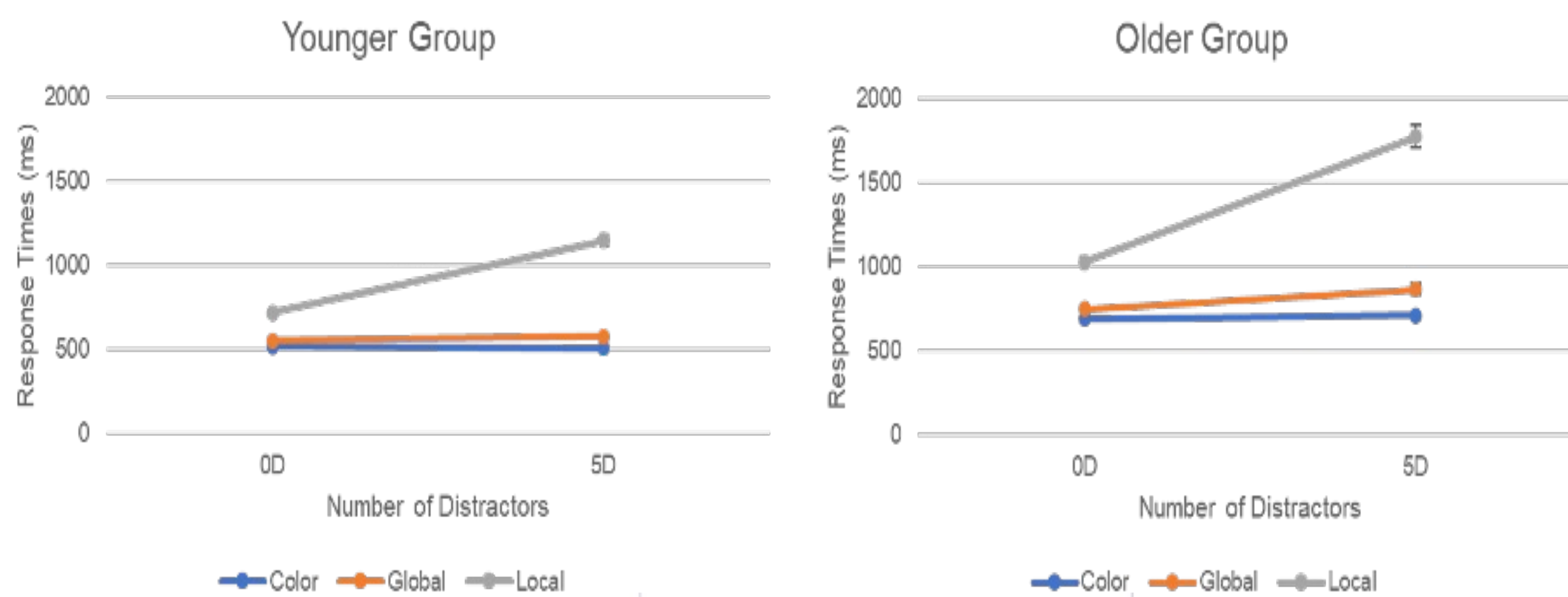
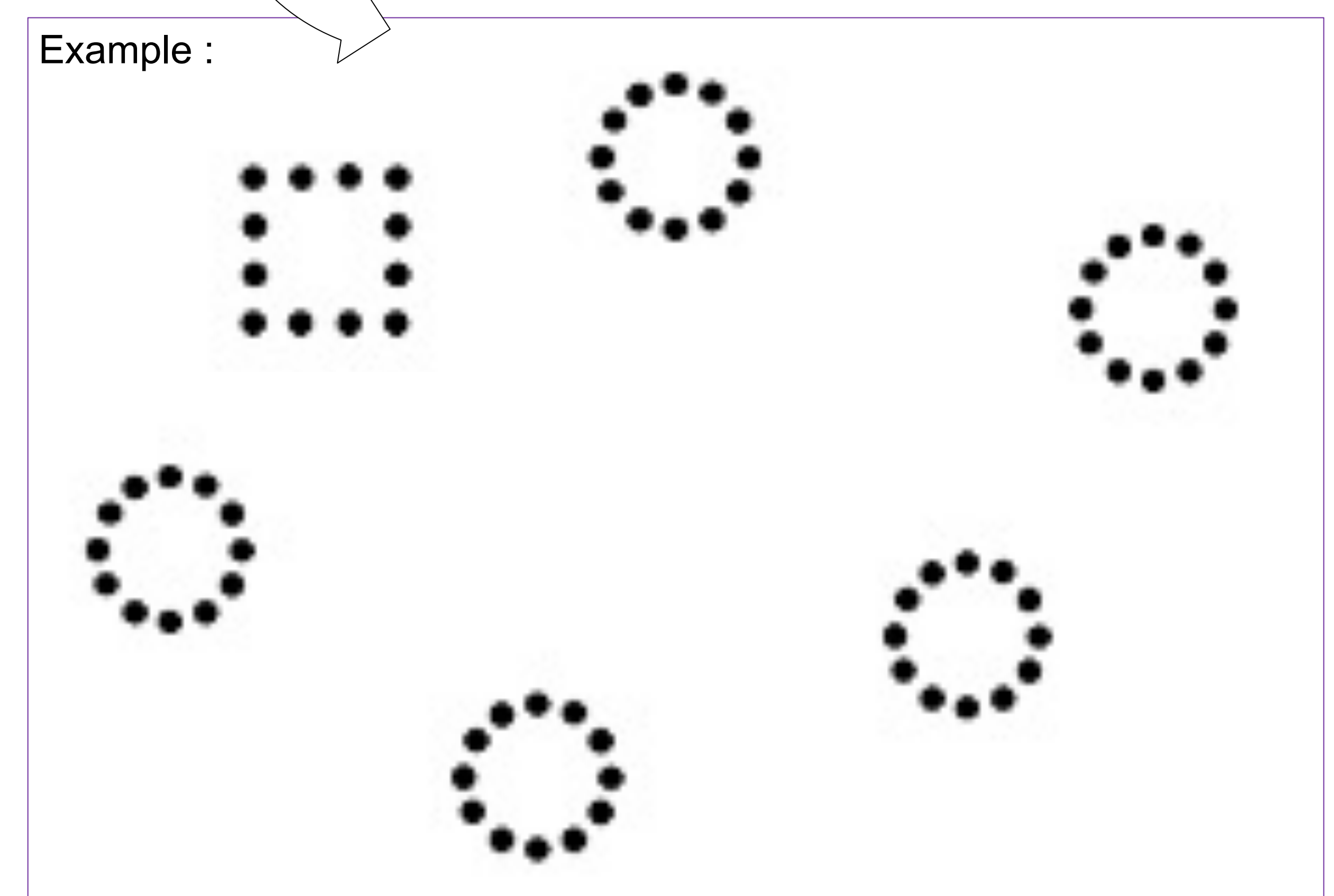
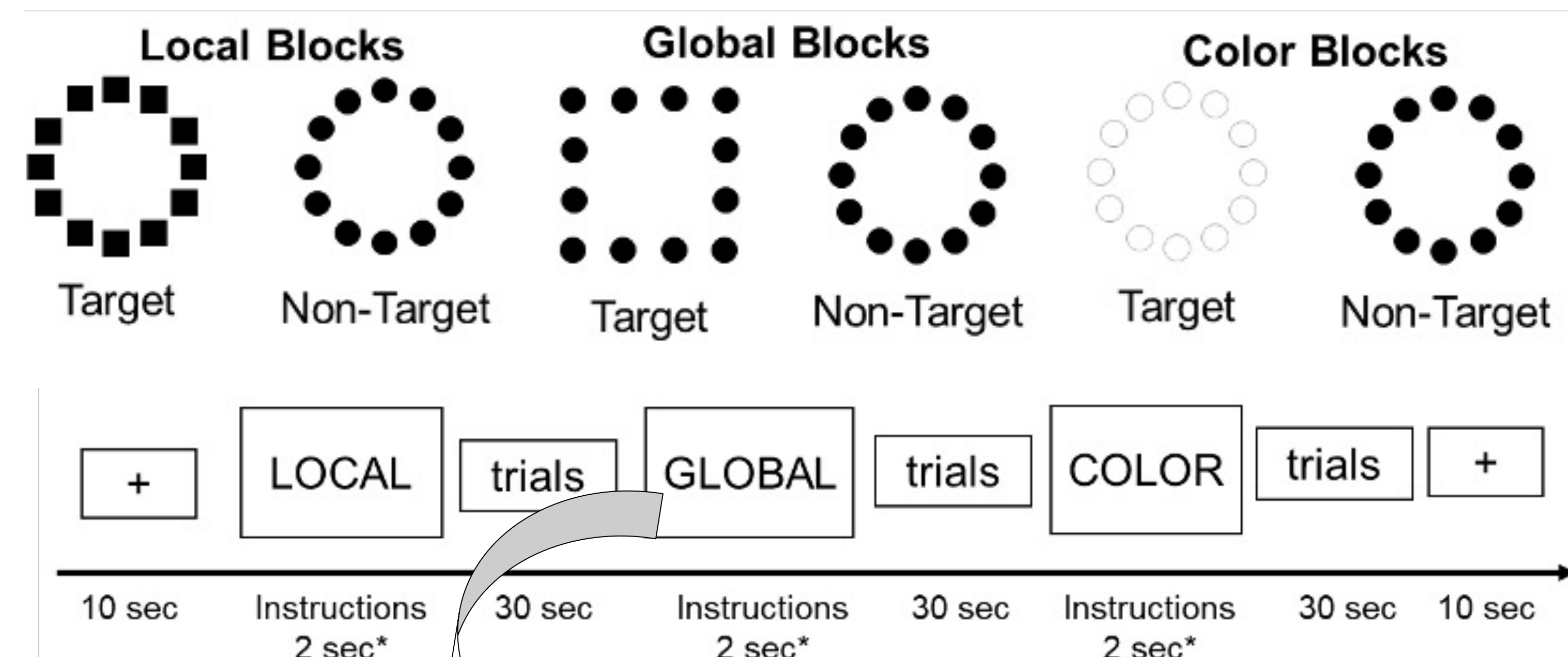
Introduction

Visual processing largely relies on the identification of the hierarchical levels of visual stimuli, from the largest global level (e.g., large circle) to the most local elements (e.g., small squares). People are (1) faster at detecting information at the global level, relative to the local level and (2) incongruent global information usually slows down the detection at the local level^{1,2}. We aimed to investigate for the first time the brain mechanisms behind local and global processing during a visual search task of compound hierarchical stimuli³ in early and late adulthood⁴.

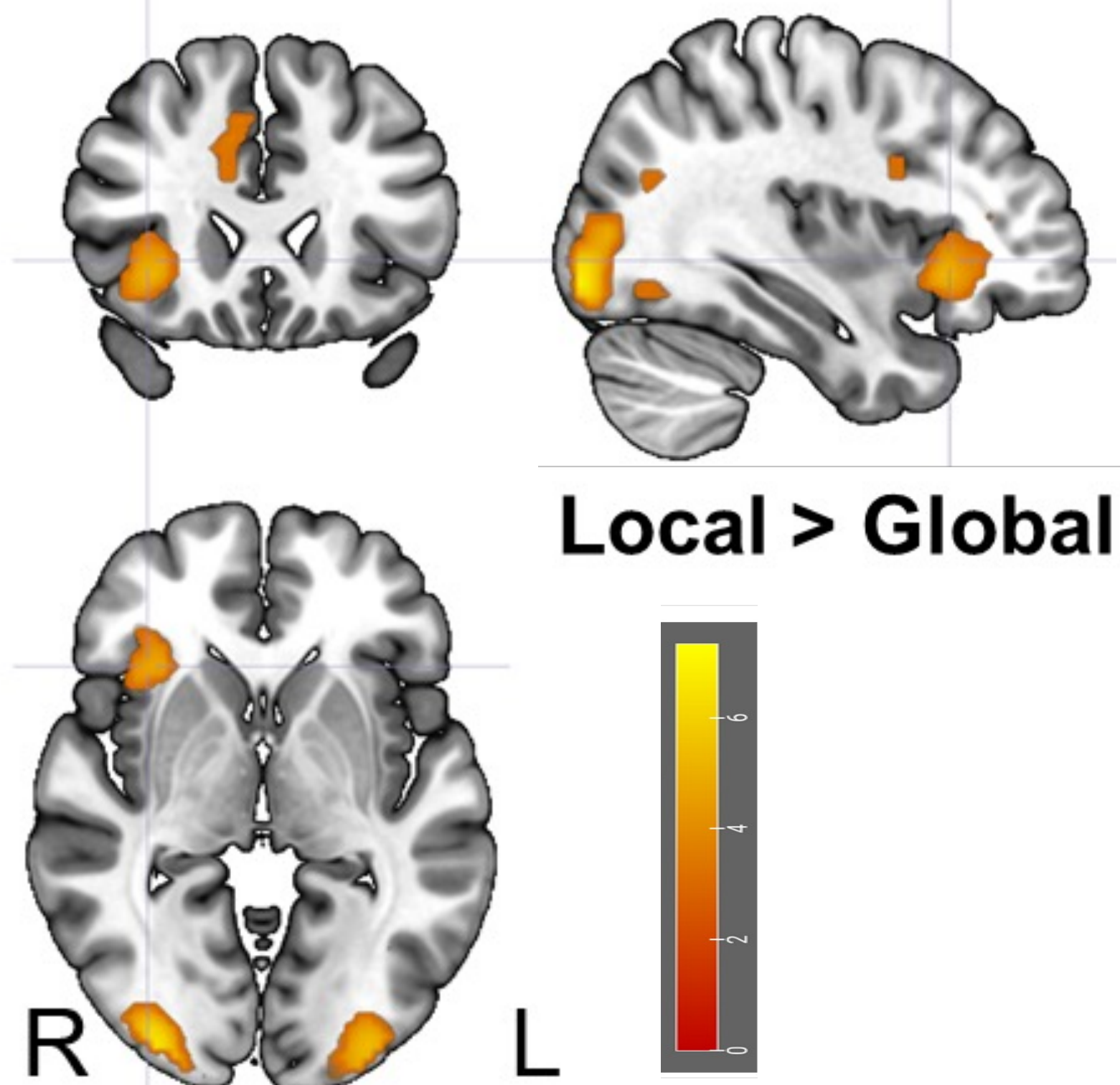
Method & Results

We recruited 77 healthy adults aged 19-77 who completed a visual search task based on 2-level hierarchical stimuli made of squares and/or circles. Participants (younger group of 39 participants aged 19-33 years-old and one older group of 38 participants aged 51-77 years-old) were instructed to detect a target (a square) at either a local (small) or global (large) level of a hierarchical geometrical form, in the presence or absence of other hierarchical geometrical forms (distractors). During the fMRI task, each block lasted approximately 30 sec. The order of the blocks was pseudo-randomized between subjects and between runs, with a total of 10 blocks within a run. Each functional scan started and ended with a 10-sec rest and a control "color" condition was also proposed, in which participant indicated the color of the stimuli.

At the behavioral level, we revealed high accuracy for all participants, but older participants were slower than younger participants to detect local targets, specifically in presence of distractors (i.e., no distractor on the screen (0D) vs. 5 distractors on the screen (5D), $p < 0.001$).

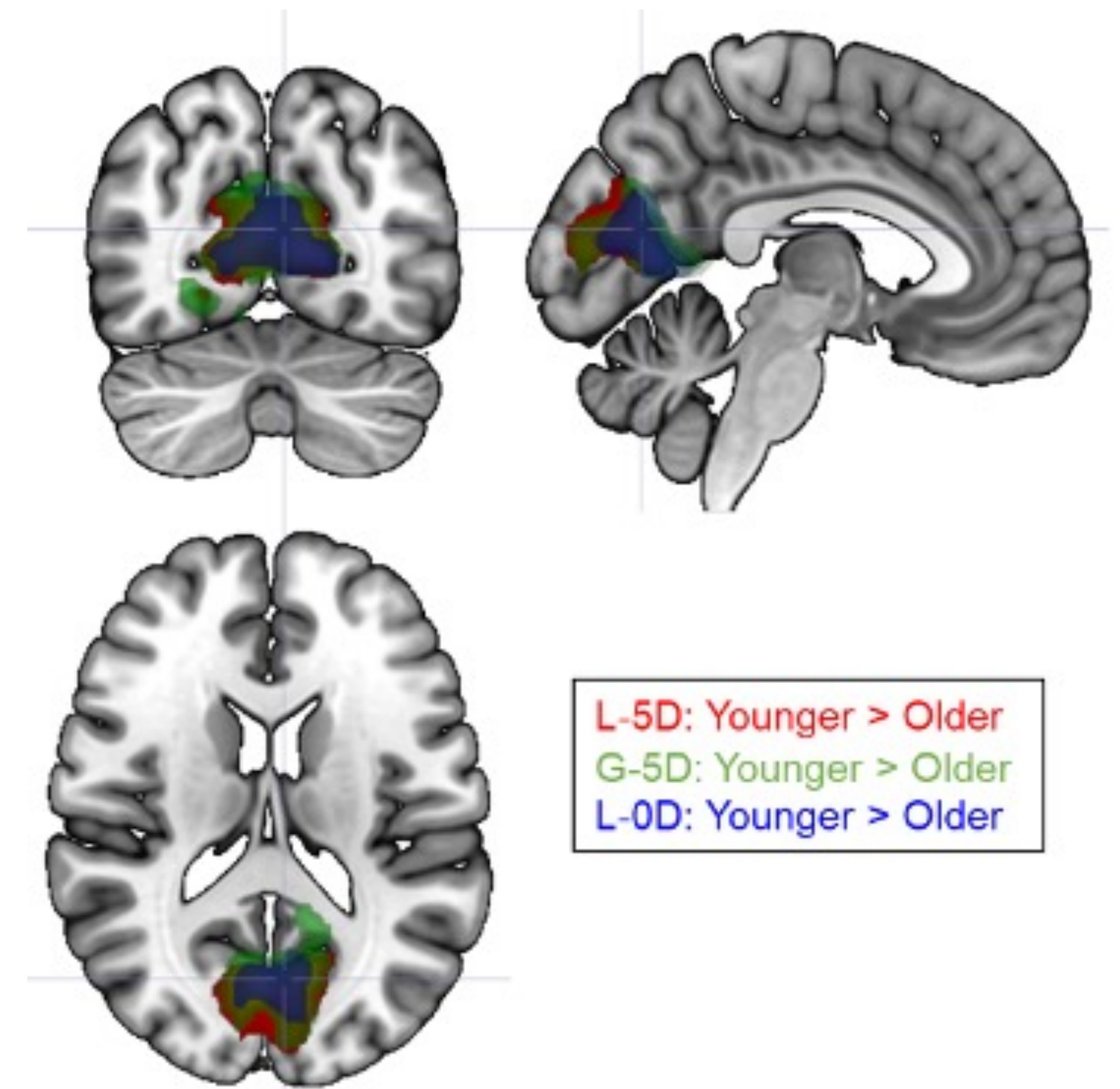


At the brain level ($p < 0.05$, FWE correction), across all participants, while both local and global processing were associated with occipital activation, local processing also recruited the anterior insula and dorsal anterior cingulate cortex, that are core regions of the salience network.



The between-group analysis revealed that while the presence of distractors in the local condition elicited specifically stronger activation within the right anterior insula for the young group, it was not observed for older participants.

In addition, older participants showed less activation than younger participants in the occipital cortex, especially for the most complex conditions.



Discussion

The current study investigated the neural correlates underlying local and global processing in early and late adulthood. Search for local target was less efficient as the number of visual distractors increased, an effect more pronounced in the older group. This was not the case for global processing. The current results support the view of a local disadvantage in a context of visual competition, with increased recruitment of frontal regions to resist to salient information during the local condition. Older participants showed reduced activation in the occipital lobe than younger participants, possibly due to variation of top-down effect from the insula that lead to reduced activity of the primary visual areas during the most complex conditions. Taken together, the present results suggest that even if the same stimulus is presented, variations in brain functioning due to age are present as soon as primary visual areas, depending on which information (local or global) has to be processed.

Contact

nicolas.poirel@u-paris.fr

Laboratoire LaPsyDÉ
 Centre Cycon, bd Becquerel
 14 000 Caen, France



LaPsyDÉ

¹Navon D. (1977) *Cognitive Psychology*

²Poirel N. (2008) *Acta Psychologica*

³Krakowski C.S. (2015) *Acta Psychologica*

⁴Bouhassoun S. (2022) *Attention, Perception & Psychophysics*