Effect of visuo-proprioceptive realignment on motor cortex excitability

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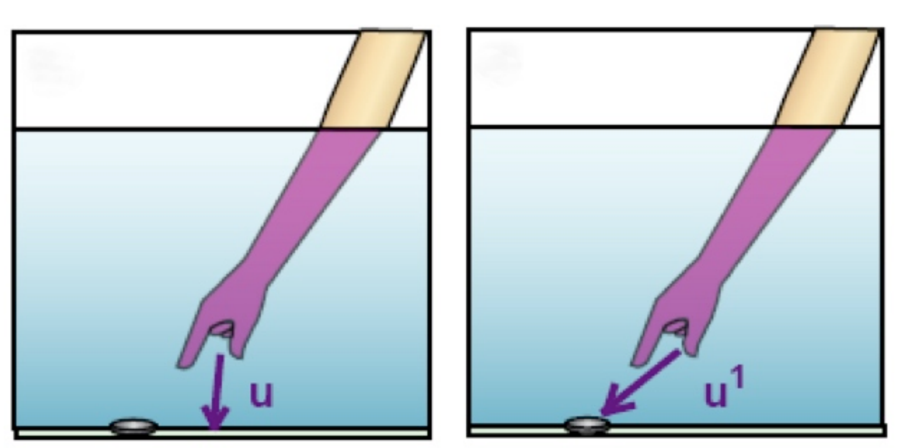
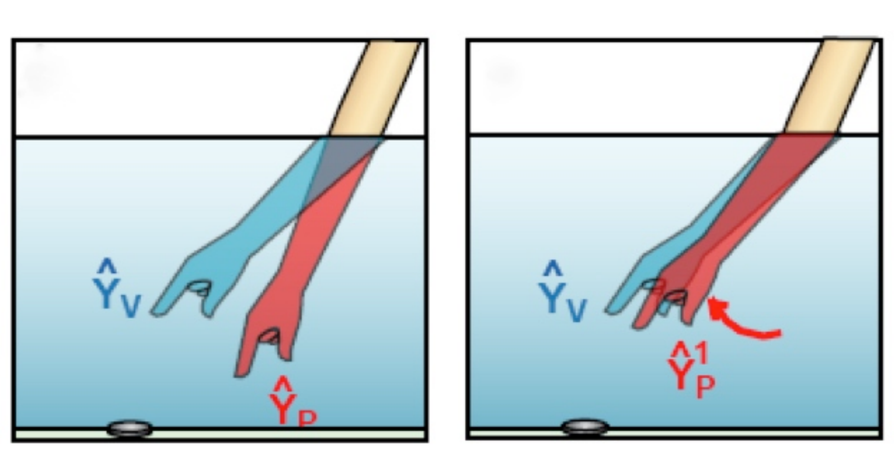
Background

Sensory and motor areas of the brain interact with each other to produce behavior, but how this happens is poorly understood. Recent literature suggest that motor learning causes the brain to recalibrate its sensory inputs, but we do not know if the reverse is true. Here we use non-invasive brain stimulation to examine the motor cortex before and after the subject performs a reaching task that requires the brain to recalibrate sensory information. The results will have implications for how we understand human movement control.

Motor adaptation: a change in movement in response to a systematic movement error.



Visuo-proprioceptive realignment: compensating for a mismatch between vision and position sense (proprioception).



- ➢ Research in motor adaptation shows that this process can result in sensory realignment (Ostry et al. 2010).
- ➢ Can sensory realignment affect motor cortex physiology?
- ➢ If so, it would suggest reciprocal connections between sensory and motor adaptive processes.

Materials and Methods

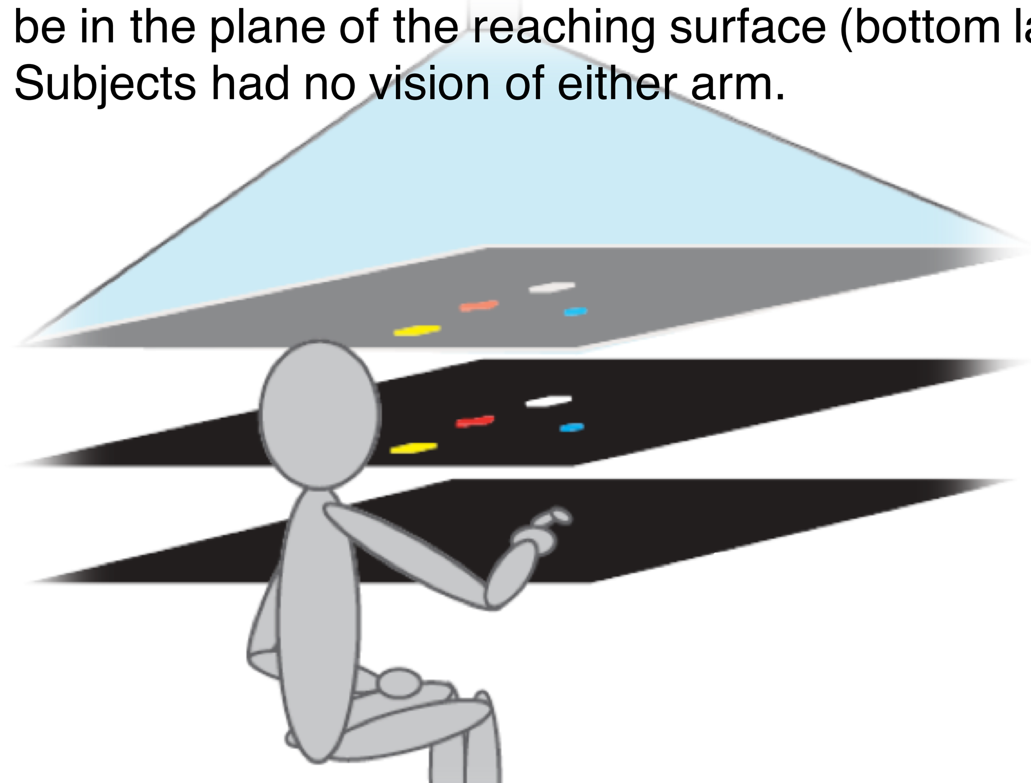
Subjects: ***8 healthy right-handed adults***

2 sessions each:

- **REAL:** visuo-proprioceptive misalignment of 70 mm
- **SHAM:** no misalignment

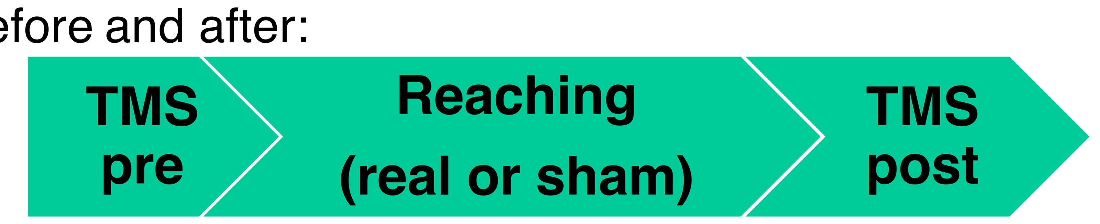
Reaching Task:

- Images viewed in the mirror (middle layer) appeared to be in the plane of the reaching surface (bottom layer).
- Subjects had no vision of either arm.



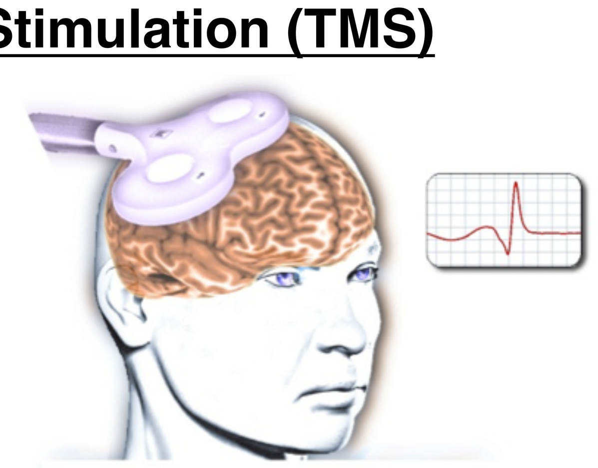
- Reached to a series of visual (V), proprioceptive (P), or combined (VP) targets
- Real session: V target shifts 1.67mm forward each trial.

Each session involves a reaching task with transcranial magnetic stimulation (TMS) measurement of motor cortex before and after:



Transcranial Magnetic Stimulation (TMS)

TMS coil was placed on the right side over the motor cortex to trigger the first dorsal interosseous (FDI) muscle of the left (target) hand.



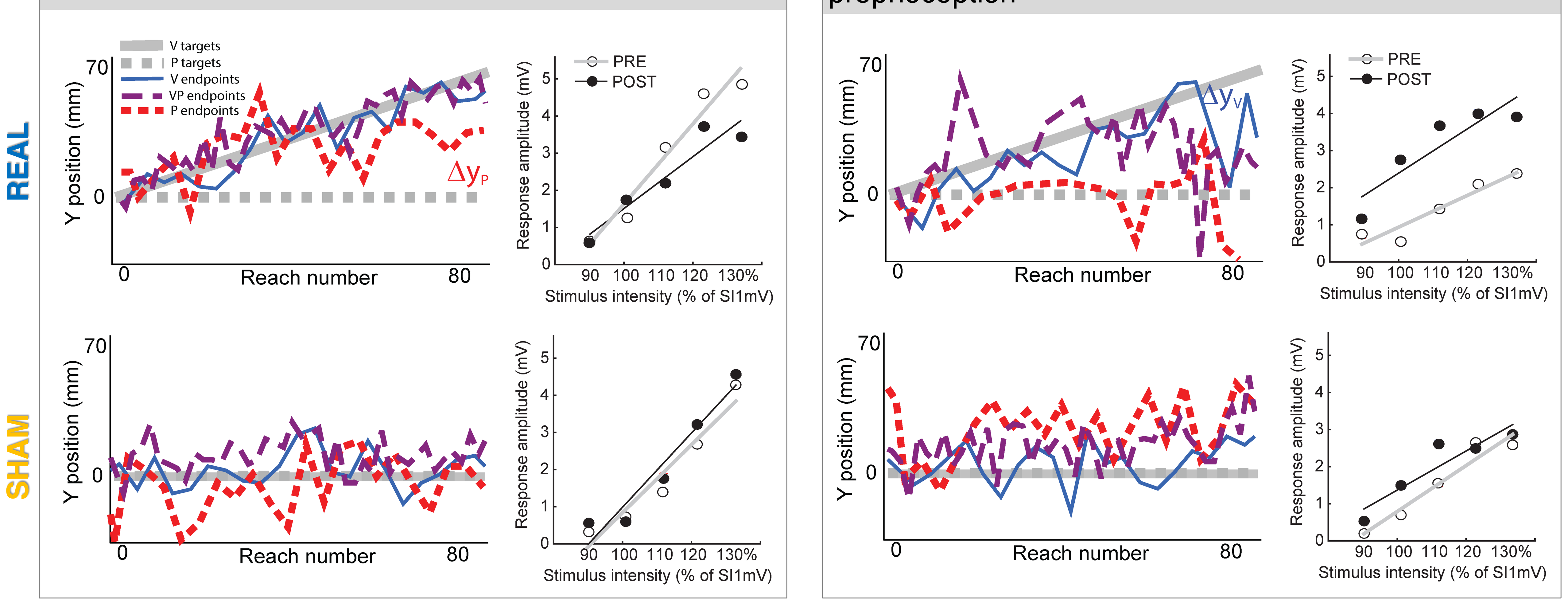
- *SI1mV:* Stimulus intensity needed to cause a motor evoked potential (MEP) of 1mV.
- *Input/Output (I/O) Curve*: how many neurons are recruited for a given TMS stimulus intensity. Measure of motor cortical excitability.

Results

Individual data

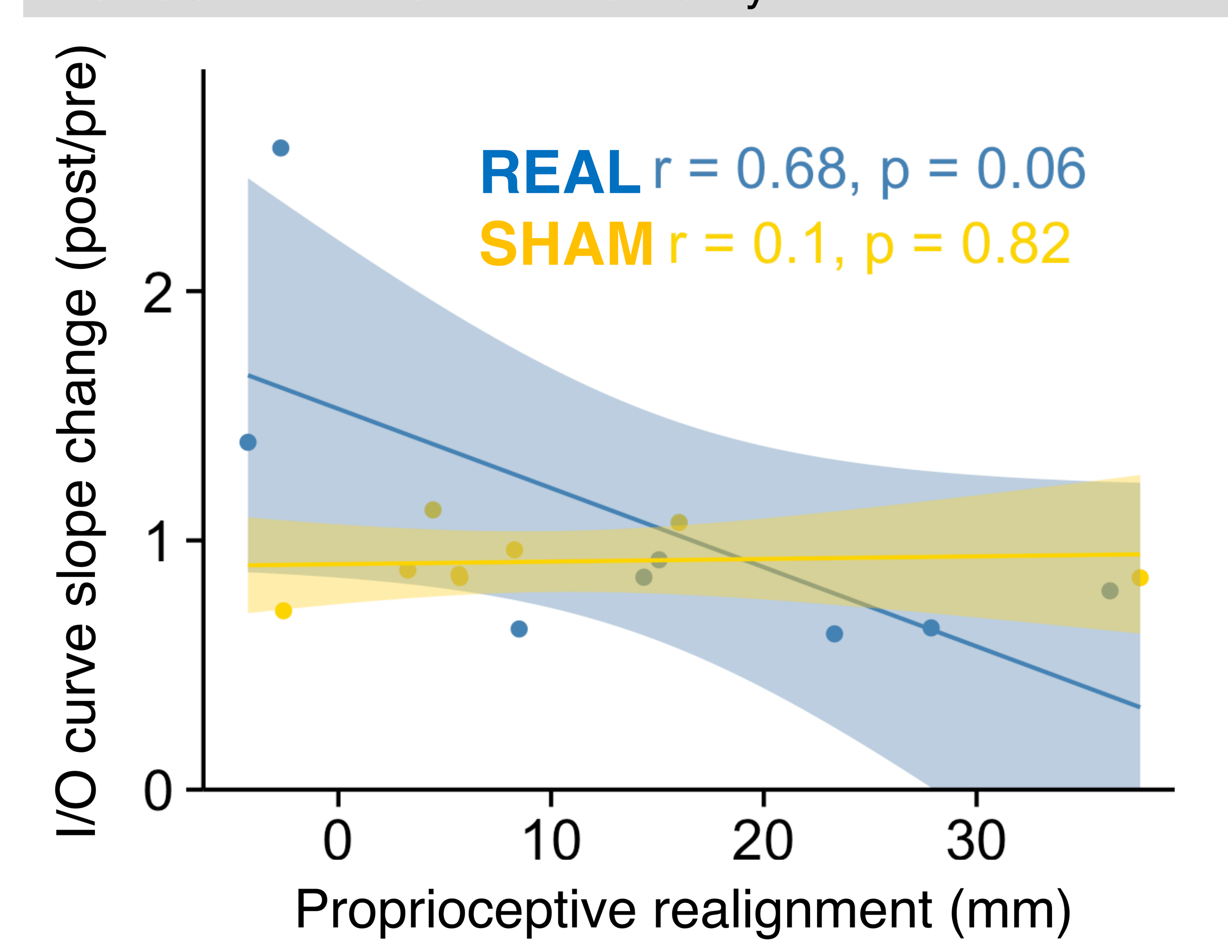
Example subject who realigned proprioception more than vision

Example subject who realigned vision more than proprioception

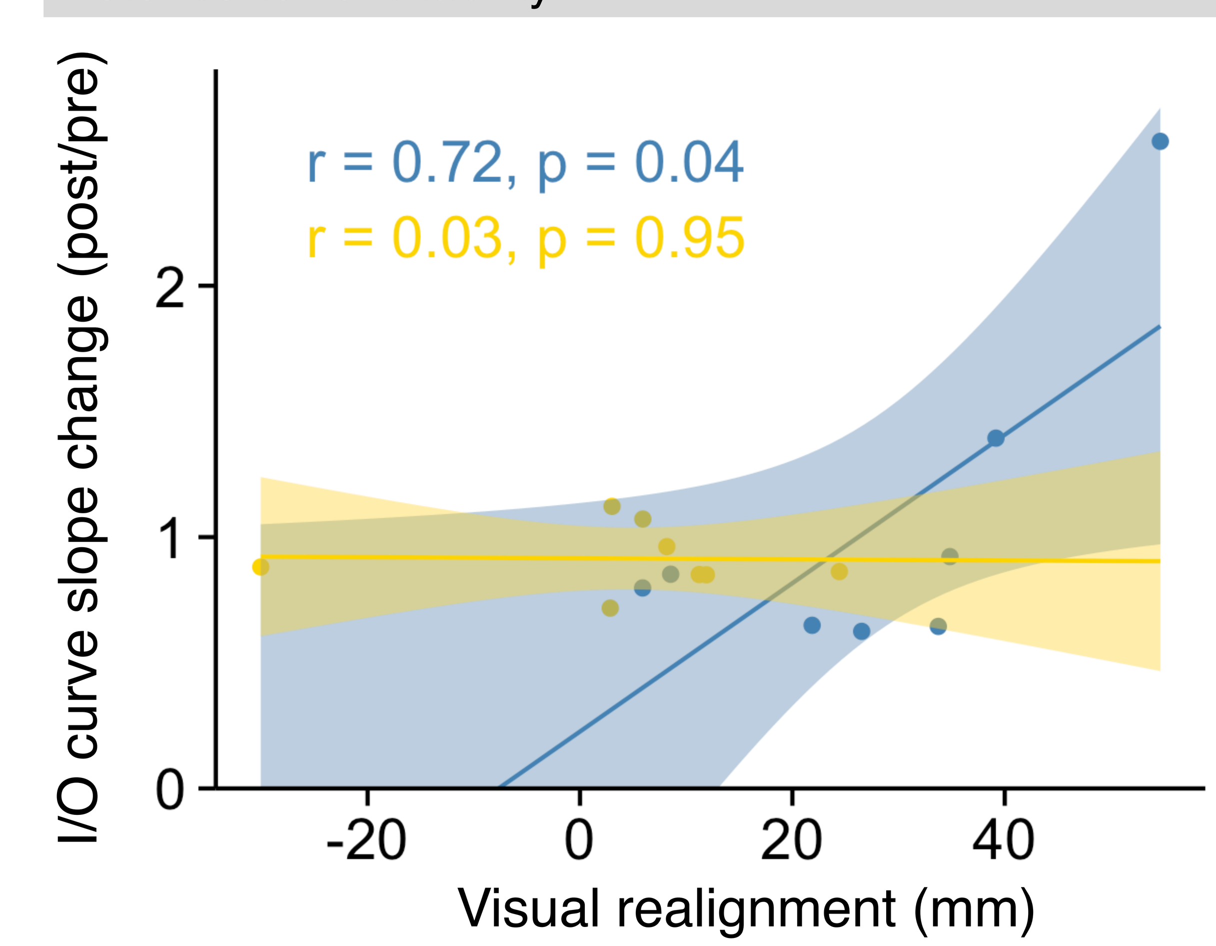


Group data

Large proprioceptive realignment is associated with decreased motor cortex excitability.



Large visual realignment is associated with increased motor cortex excitability.



Conclusions

- Visuo-proprioceptive realignment may have effect on motor cortex excitability.
- In combination with Ostry et al. (2010), suggests reciprocal links between multisensory integration and motor control.
- This could have implications for current models of multisensory integration and motor control, which do not account for these results.

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Reference

Ostry, D., Darainy, M., Mattar, A., Wong, J., & Gribble, P. (2010). Somatosensory Plasticity and Motor Learning. *Journal of Neuroscience,* 5384-5393.