Functional correlates of verbal and nonverbal memory in patients with temporal lobe epilepsy

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OBJECTIVE

Temporal lobe epilepsy is a disease that affects brain regions assumed to subserve memory formation. In order to elucidate the underlying mechanisms and consequences, we compared the neural correlates of verbal and nonverbal memory in patients with mesial temporal lobe epilepsy (mTLE) and healthy controls (HC).

METHODS

23 left-sided (lTLE) and 20 right-sided (rTLE) TLE-patients and 21 HC performed a blocked fMRI task of learning scenes, faces and words. Each modality was presented in a separate run. One run consisted of 72 items with every block of four items followed by a baseline condition (fixation on a randomly moving dot). Recognition performance was measured after scanning.

RESULTS BEHAVIORAL

Recognition Accuracy

Compared to HC, recognition scores for words and scenes were lower in lTLE- and rTLE-patients and for faces in only rTLE-patients (see Fig. 1).
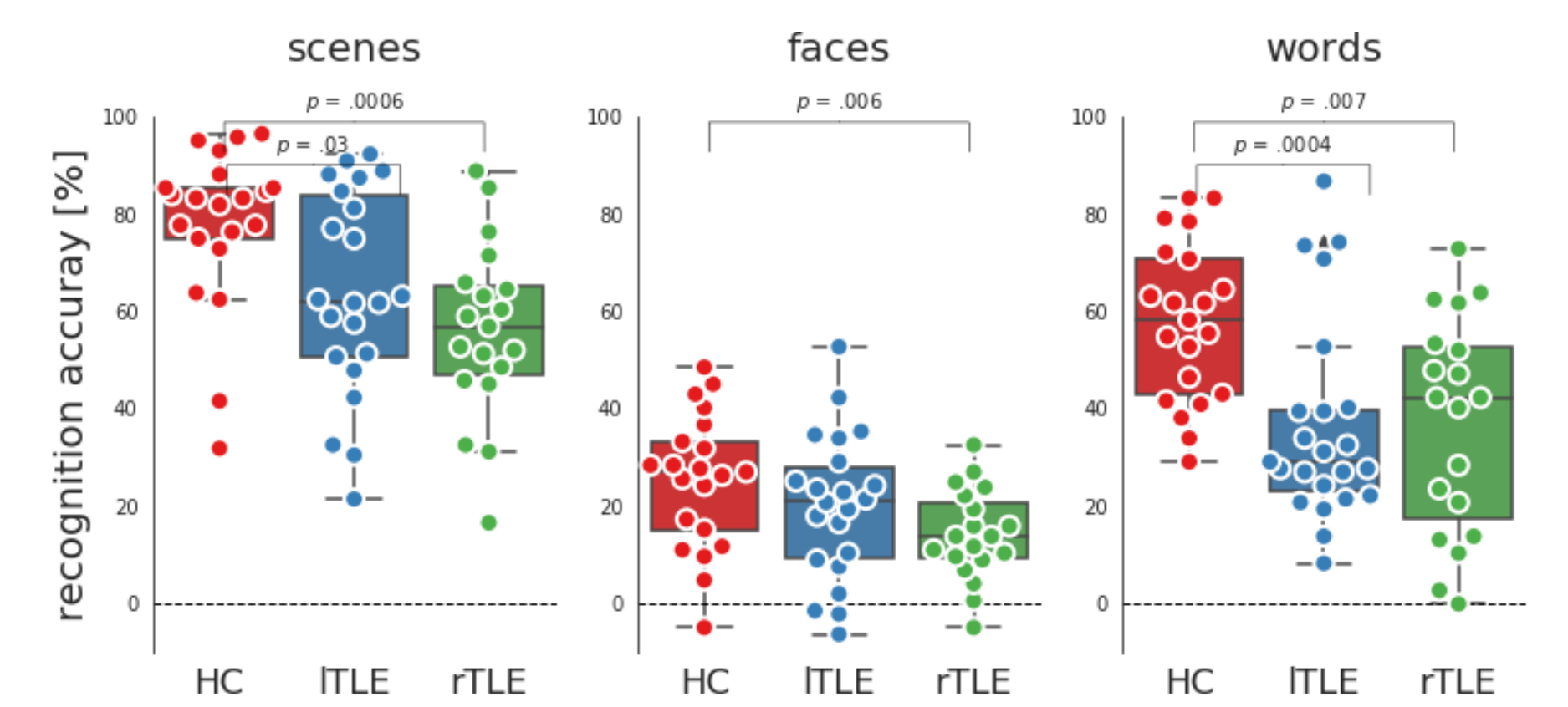

Fig. 1 **Recognition accuracy (%) [hits – false alarms] for scenes, words and faces of HC, lTLE- and rTLE-patients.**
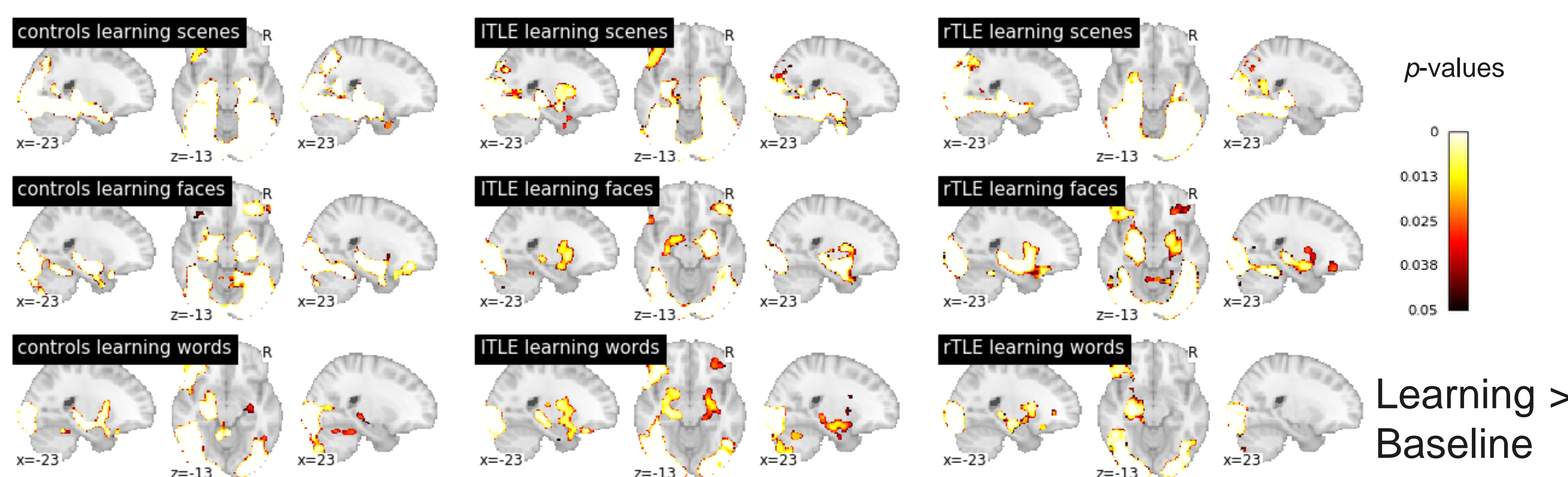
RESULTS FMRI Learning vs. Baseline

Fig. 2 **Within group contrasts of learning scenes/faces/words > baseline for HC, lTLE- and rTLE-patients (p_{permut} < .05, FWE and SVC in the mTL)**

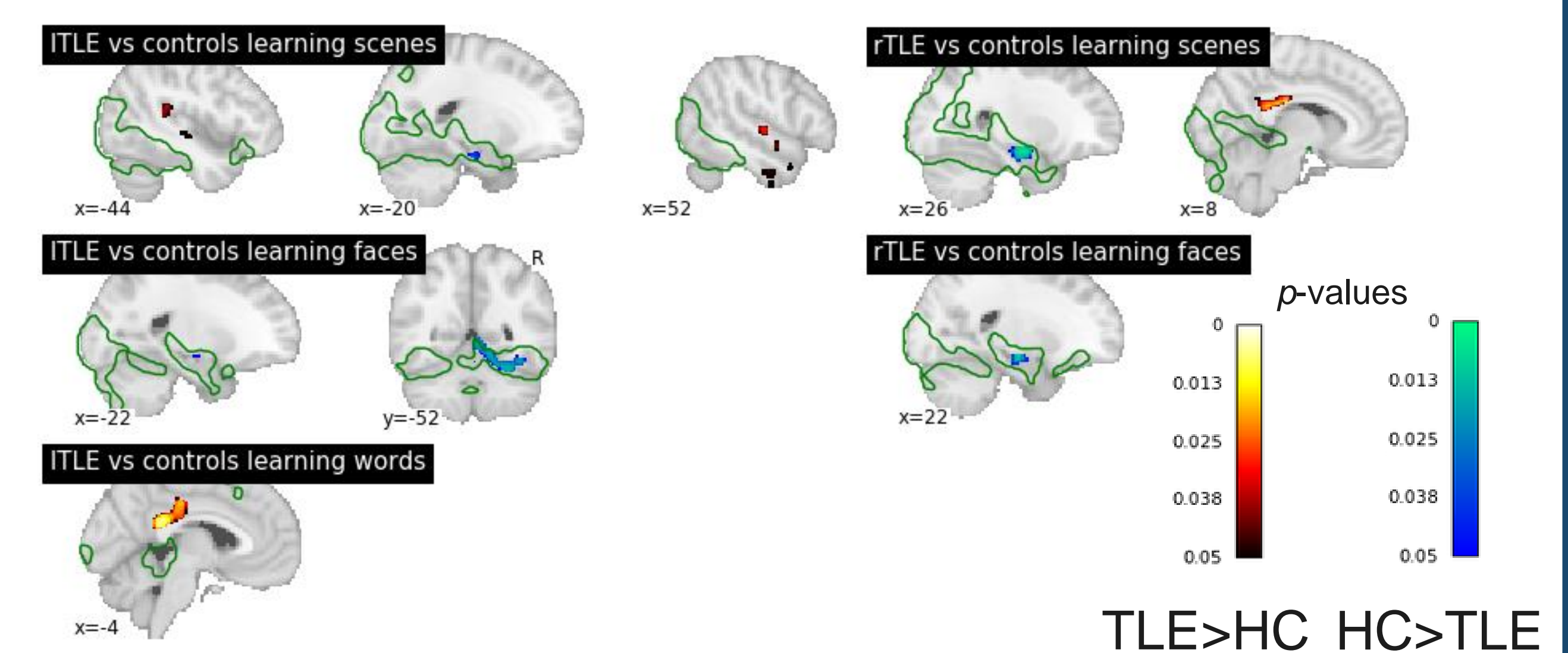Fig. 3 **Between group contrasts comparing lTLE- and rTLE-patients with HC of learning (p_{permut} < .05, FWE and SVC in the mTL). Green outlines indicate activations of HC for leaning > baseline.**

Fig. 2 shows the within group contrast learning > baseline in each group. Fig. 3 depicts between group differences comparing TLE-patients and HC. Compared to HC, rTLE- and lTLE-patients had reduced activation in the epileptogenic mesio-temporal lobe during non-verbal learning. Further only lTLE-patients had reduced occipital fusiform activation during learning of scenes. Increased activation was most prominent in the posterior cingulum.

Correlations with Recognition Accuracy
Scene and face recognition accuracy correlated positively with bilateral mesio-temporal activations. Only scene recognition further correlated positively with primary visual cortex and cerebellar activation. Word recognition correlated positively with left middle-frontal, orbito-frontal and cerebellar activation (see Fig. 4). There were no significant differences in region associated with better recognition accuracy in mTLE-patients and HC.
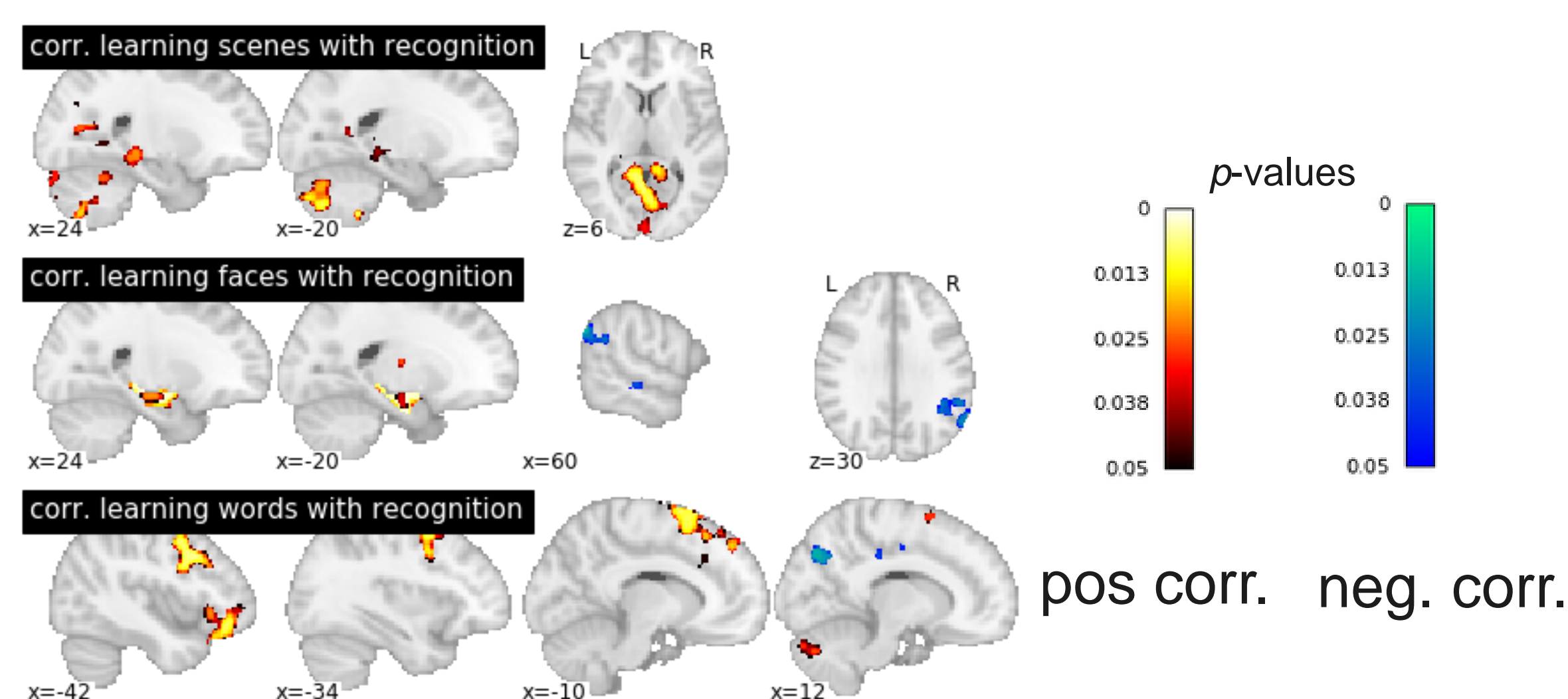
Subsequent Memory Effect
Subsequently remembered scenes (>forgotten) were associated with bilateral activations in the ventral stream and mesio-temporal lobe. Subsequently remembered faces activated right mesio-temporal and bilateral fusiform regions. Subsequently remembered words led to predominantly left-lateralized activations in the ventral stream and frontal region and bilateral mesio-temporal activation (see Fig. 5). Group comparison only revealed decreased right mesio-temporal activation for scenes in lTLE-patients compared to HC.
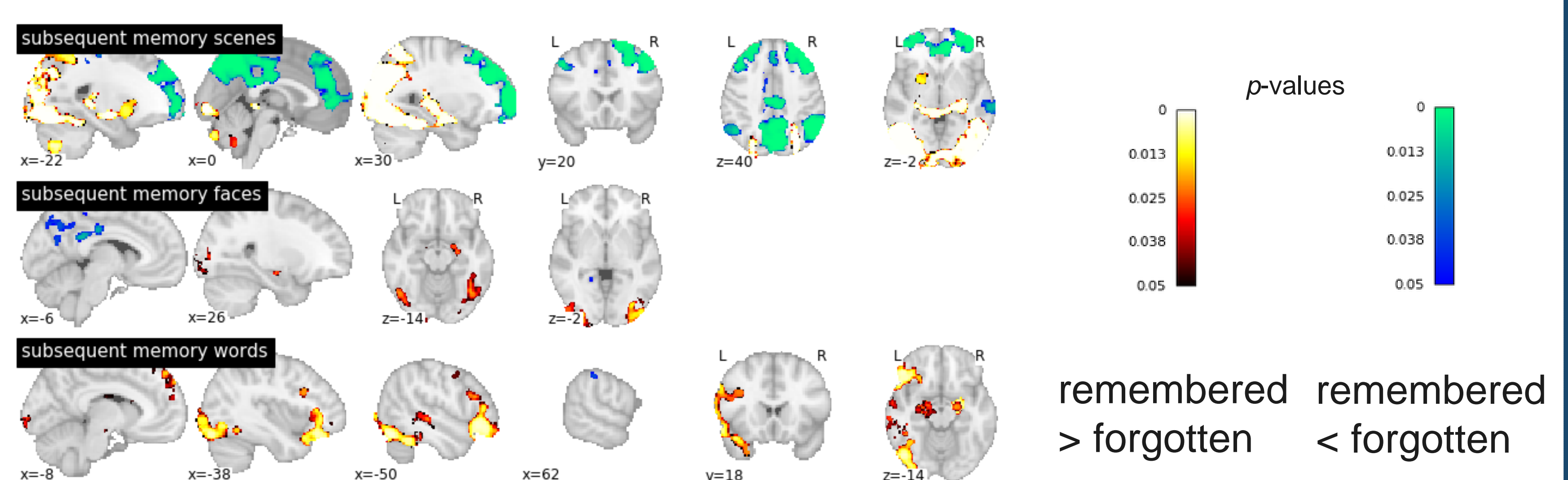

Fig. 4 **Correlations of the activations for learning scenes/faces/words > baseline with the corresponding recognition accuracy for the mixed group of HC, lTLE- and rTLE-patients (p_{permut} < .05, FWE and SVC in the mTL)**

Fig. 5 **Contrast of subsequently remembered vs. forgotten scenes/faces/words for the mixed group of HC, lTLE- and rTLE-patients (p_{permut} < .05, FWE and SVC in the mTL). Only participants who subsequently remembered 10 - 90% and with a recognition accuracy > 10 % were included in the analyses.**

CONCLUSION

Taken together, we found impaired recognition accuracy in mTLE-patients and lower activations in the epileptogenic mTL during learning. Increased activation was seen in the posterior cingulum and temporo-lateral regions. Moreover, at least at the group level, similar brain regions appear to subserve recognition performance and subsequent memory formation in both mTLE-patients and HC, with little evidence for systematic plasticity in mTLE-patients.