Supplementary results

Individual activation patterns of the three monkeys (Monkey K, Monkey R and Monkey J) for the fMRI activations to all sounds, rare sounds, local novelty and global novelty (see supplementary figures).

Overall, findings were consistent across monkeys for both local first order and global second order effects with minor differences:

Local effect

For the local effect (contrast between local deviants and local standards), all monkeys showed activations in the auditory cortex, the medial geniculate nucleus, the striatum, the thalamus, the medial superior temporal area and area V4. Only monkey R activated the anterior cingulate cortex for the local effect.

Global effect

For the global effect (contrasting rare trials minus frequent trials), all monkeys showed activations in the auditory cortex, prefrontal area 8A, premotor area 6V, parietal cortex (ventral intraparietal area, VIP), left temporoparietal area TPt and striatum. Only monkey J showed activations in the anterior cingulate cortex for the global effect. Monkey J had also activations for the global effect in the thalamus, the hippocampus and the cerebellar dentate nucleus. Monkey K showed also activations for the global effect in the thalamus, hippocampus and posterior cingulate cortex.

Supplementary discussion

Further discussion of novelty responses in anterior cingulate cortex, basal ganglia and area V4

Human event-related potential (ERP) studies have reported that the anterior cingulate cortex (ACC) is a dipole source of the frontally recorded MMN (Jemel et al., 2002; Oknina et al., 2005). The ACC, but also the basal ganglia, are known to play a role in the generation of the error-related activity. The error-related negativity (ERN) can be interpreted as an index of the mismatch between an expected and upcoming response (Gehring WJ et al., 1993; Falkenstein M et al., 1995) or the degree of conflict between competing erroneous and correct responses (Botvinick et al., 1999). Animal data show a specific error-related activity in the basal ganglia during error commission (Arkadir et al., 2004; Hong and Hikosaka, 2008) and a recent human

study showed the involvement of the internal globus pallidus in the early modulation of cortical error-related activity (Herrojo Ruiz et al., 2013).

As for Area V4, this is a surprising result. The only explanation that we could propose is based on anatomical connections between V4 and the striatum, a structure activated by the local effect in our study (Saint-Cyr et al., 1990).

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