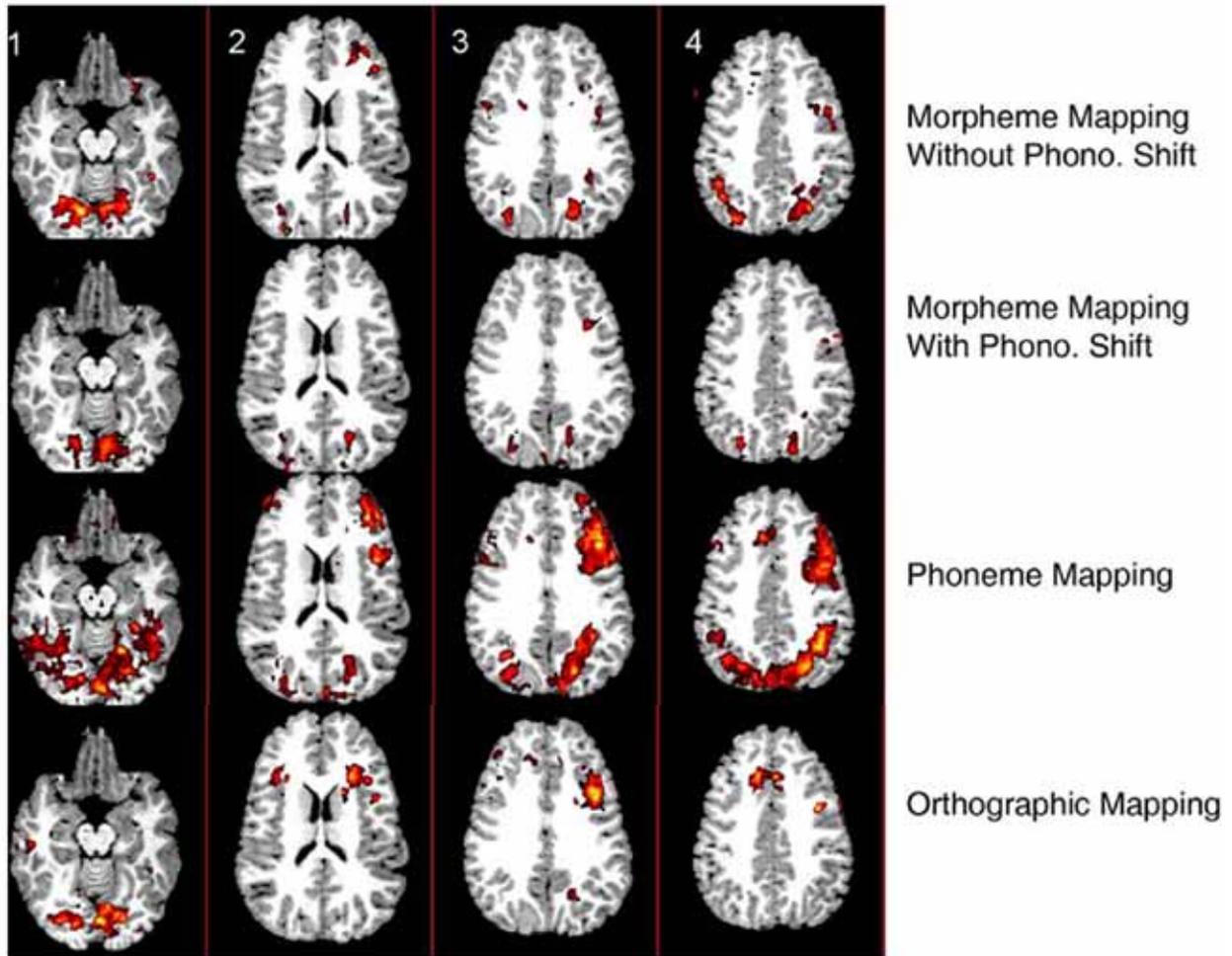


**FIGURE 17.1.** Unique blood-oxygen-level-dependent (BOLD) activation for three word-form storage and processing units (morphological, phonological, and orthographic) in the verbal WM system, the language learning mechanism. Each column contains the fMRI overlay onto structural MRI at the same two anatomical axial sections of the brain. The first column of brain images contains the fMRI during morpheme mapping, which is the contrast between the morphological task (Does the top word come from the bottom word?) and the synonym task (Do both words mean the same?). The second column of brain images contains the fMRI during phoneme mapping, which is the contrast between the phonological task (Can the pink letters in the top word sound the same as the pink letters in the bottom word?) and the letter strings task (Do the top and bottom letter strings match exactly?). The third column of brain images contains the fMRI during orthographic mapping, which is the contrast between the spelling task (Are the top and bottom words both spelled correctly?) and the letter strings task (already described). The red and yellow areas show the areas of brain activation that for morpheme mapping are in the occipital, parietal, and frontal lobes; for phoneme mapping they are in the parietal, frontal, and cingulate areas; and for orthographic mapping they are in the occipital, temporal, parietal, and frontal lobes. From Richards, Aylward, Raskind, et al. (2006). Copyright 2006 by Taylor & Francis. Reprinted by permission.



**FIGURE 17.2.** Unique BOLD activation for morpheme mapping with and without phonological shifts, phonological mapping, and orthographic mapping (mapping = coding in verbal WM). functional MRI of the controls (normal readers) at Time 1 for four different language tasks—morpheme mapping without phonological shift (row 1); morpheme mapping with phonological shift (row 2); phoneme mapping (row 3); and orthographic mapping (row 4). Each column shows a different anatomical axial section of brain in Talaraich space—column 1 is at the level of the fusiform and lingual gyrus; column 2 is at the level of the inferior frontal gyrus (triangularis), middle frontal gyrus, occipital gyrus; column 3 is at the level of the inferior frontal gyrus, middle frontal gyrus, parietal lobe, angular gyrus, precentral gyrus; and column 4 is at the level of the middle frontal gyrus, parietal lobe, angular gyrus, precentral gyrus, and anterior cingulate. From Richards et al. (2006a). Copyright 2006 by Elsevier. Reprinted by permission.