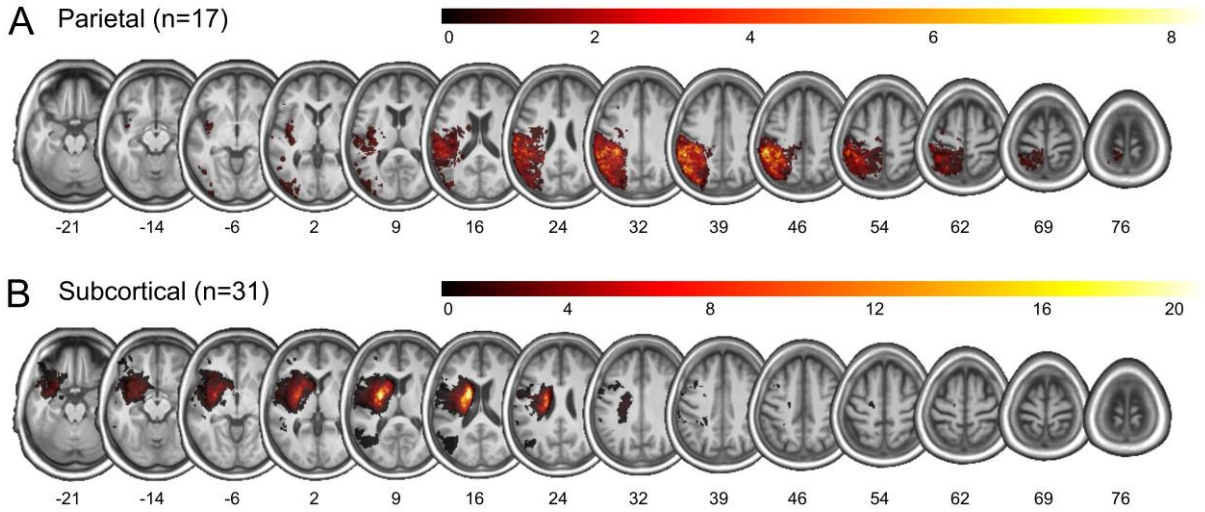
Supplementary Materials

S1 Separate Control Analyses for Stroke Controls with Parietal or Subcortical Lesions

The individual lesion overlays for the subsamples of patients with mainly parietal or subcortical lesions as reference group of stroke controls are depicted in Supplementary Figure 1-1A and 1-1B, respectively.



Supplementary Figure S1-1. Lesion overlays for the subsample of patients with lesions mainly (A) in left parietal cortex (n = 17, maximum overlap = 8) and (B) in left subcortical regions (n = 31, maximum overlap = 19).

S1.1 Patients with Left Parietal Lesions as Stroke Controls

The multi-factorial extension of the non-parametric Brunner-Munzel rank-order test with the between-subjects factor *lesion location* (left temporal vs. left frontal vs. left parietal), the within-subjects factor *cue type* (semantic vs. phonological), and the total number of words produced as dependent variable revealed a significant two-way interaction of *cue type* × *lesion location* ($F_{2,52}$ = 5.541, p = .004) whereas the main effects of *lesion location* ($F_{2,52}$ = 2.299, p = .105) and *cue type* ($F_{2,52}$ = 1.173, p = .279) failed to reach significance.

For the significant interaction effect as illustrated in Supplementary Figure 1-2A, we first tested whether the prespecified contrasts fulfilled the requirements for a ***classical double dissociation*** (cf. main manuscript): Patients with a left temporal lesion (red) as compared to patients with a left parietal

lesion (gray) produced significantly fewer words in the semantic fluency condition (rank mean ± standard error of the rank mean, $M_R \pm SEM_R$, , 48.54 ± 8.14 vs. 66.35 ± 5.61, p = .048) but showed no significant differences in the phonological fluency condition ($M_R \pm SEM_R$, 55.81 ± 9.67 vs. 67.50 ± 8.56, p = .118). The opposite pattern emerged for the patients with a left frontal lesion (blue) who – when compared to patients with a left parietal lesion (gray) - produced significantly fewer words in the phonological fluency condition ($M_R \pm SEM_R$, 37.13 ± 6.61 vs. 67.50 ± 8.56, p = .006), but showed no significant difference in the semantic fluency condition ($M_R \pm SEM_R$, 56.79 ± 5.06 vs. 66.35 ± 5.61, p = .139). In addition, we further computed the prespecified contrasts for the ***within-patient comparison*** (cf. main manuscript) of the two fluency types separately for the left frontal and the left temporal patients: Patients with a left temporal lesion (red) showed a strong trend for producing fewer words in the semantic as compared to the phonological fluency condition ($M_R \pm SEM_R$, 48.54 ± 8.14 vs. 55.81 ± 9.67, p = .054), whereas patients with a left frontal lesion (blue) produced significantly fewer words in the phonological as compared to the semantic fluency condition ($M_R \pm SEM_R$, 37.13 ± 6.61 vs. 56.79 ± 5.06, p < .001). For patients with a left parietal lesion (gray), no significant difference was found between the semantic compared to the phonological fluency condition ($M_R \pm SEM_R$, 66.35 ± 5.61 vs. 67.50 ± 8.56, p = .292) (see Supplementary Fig. 1-2A).

Thus, by using only patients with a left parietal lesion as stroke controls, results are essentially the same as compared to the results with the whole group of stroke controls. Again, results fully conform to the requirements for establishing a double dissociation both in the classical sense as well as based on significant within-patient comparisons. Lesions to the left temporal and left frontal lobe hence differentially affect performance in semantic and phonological fluency, respectively (Supplementary Fig. 1-2A). Notably, this double dissociation cannot be attributed to potential differences in task difficulty between the two types of verbal fluency as these were effectively controlled for (Supplementary Fig. 1-2A, left parietal).

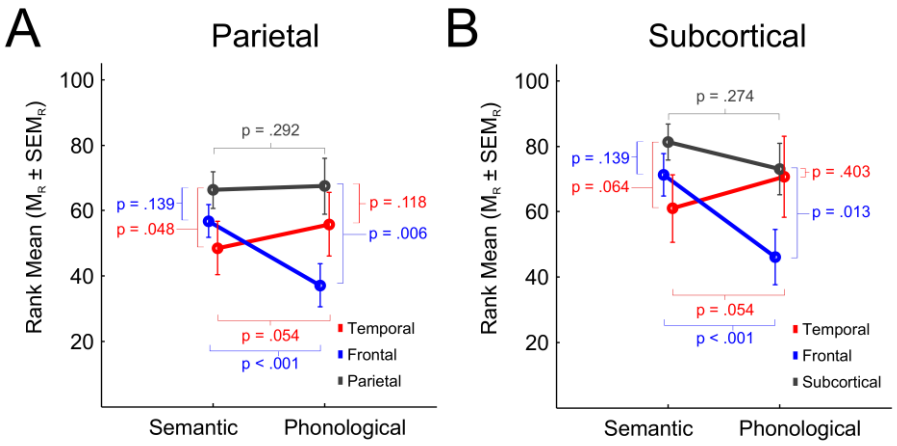
S1.2 Patients with Left Subcortical Lesions as Stroke Controls

The multi-factorial extension of the non-parametric Brunner-Munzel rank-order test with the between-subjects factor *lesion location* (left temporal vs. left frontal vs. left subcortical), the within-subjects factor *cue type* (semantic vs. phonological), and the total number of words produced as dependent variable revealed a trend for the main effect of *cue type* ($F_{2,66} = 2.495$, $p = .055$) and a significant two-way interaction of *cue type* × *lesion location* ($F_{2,66} = 5.996$, $p = .003$). The main effect of *lesion location* ($F_{2,66} = 1.335$, $p = .262$) did not reach significance.

For the significant interaction effect as illustrated in Supplementary Figure 1-2B, we first tested whether the prespecified contrasts fulfilled the requirements for a ***classical double dissociation*** (cf. main manuscript): Patients with a left temporal lesion (red) as compared to patients with left subcortical lesions (gray) showed a strong trend for producing fewer words in the semantic fluency condition ($M_R \pm SEM_R$, 60.96 ± 10.39 vs. 81.34 ± 5.57, $p = .064$) but showed no significant differences in the phonological fluency condition ($M_R \pm SEM_R$, 70.69 ± 12.35 vs. 73.08 ± 7.91, $p = .403$). The opposite pattern emerged for the patients with a left frontal lesion (blue) who – when compared to patients with left subcortical lesions (gray) - produced significantly fewer words in the phonological fluency condition ($M_R \pm SEM_R$, 46.10 ± 8.41 vs. 73.08 ± 7.91, $p = .013$), but showed no significant difference in the semantic fluency condition ($M_R \pm SEM_R$, 71.29 ± 6.57 vs. 81.34 ± 5.57, $p = .139$). In addition, we further computed the prespecified contrasts for the ***within-patient comparison*** (cf. main manuscript) of the two fluency types separately for the left frontal and the left temporal patients: Patients with a left temporal lesion (red) showed a strong trend for producing fewer words in the semantic as compared to the phonological fluency condition ($M_R \pm SEM_R$, 60.96 ± 10.39 vs. 70.69 ± 12.35, $p = .054$), whereas patients with a left frontal lesion (blue) produced significantly fewer words in the phonological as compared to the semantic fluency condition ($M_R \pm SEM_R$, 46.10 ± 8.41 vs. 71.29 ± 6.57, $p < .001$). For patients with left subcortical lesions (gray), no significant difference was found between the semantic compared to the phonological fluency condition ($M_R \pm SEM_R$, 81.34 ± 5.57 vs. 73.08 ± 7.91, $p = .274$) (see Supplementary Fig. 1-2B).

Thus, by using only patients with a left subcortical lesion as stroke controls, results are essentially the same as compared to the results with the whole group of stroke controls. Again, results fully conform

to the requirements for establishing a double dissociation both in the classical sense as well as based on significant within-patient comparisons. Lesions to the left temporal and left frontal lobe hence differentially affect performance in semantic and phonological fluency, respectively (Supplementary Fig. 1-2B). Notably, this double dissociation cannot be attributed to potential differences in task difficulty between the two types of verbal fluency as these were effectively controlled for (Supplementary Fig. 1-2B, left subcortical).



Supplementary Figure S1-2. Illustrations of the double dissociation in the region-based analysis based on the significant two-way interaction *cue type* × *lesion location* for patients with lesions mainly (A) in left parietal cortex and (B) in left subcortical regions as stroke controls.