

# Supplementary Materials: Speech and Language Errors During Awake Brain Surgery and Postoperative Language Outcome in Glioma Patients: A Systematic Review

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## Text S1: Search terms

### 1.1. Embase.com

('surgery'/de OR surgery:lnk OR 'surgical technique'/de OR 'neurosurgery'/exp OR 'cancer surgery'/de OR 'intraoperative period'/de OR 'brain mapping'/de OR 'electrostimulation'/de OR 'neuromonitoring'/de OR 'glioma'/exp OR 'brain tumor'/exp OR (map\* OR language\*-monitor\* OR neuromonitor\* OR neuro-monitor\* OR craniotom\* OR surg\* OR neurosurg\* OR operat\* OR intraoperat\* OR anesthes\* OR resect\* OR electrostimulation\* OR electro-stimulation\* OR glioma\* OR glioblastoma\* OR astrocytoma\* OR oligodendroglioma\* OR ((intracranial\* OR brain\*) NEAR/3 (neoplas\* OR tumor\* OR tumour\* OR cancer\*))) :ab,ti,kw) AND ('wakefulness'/de OR (awake\* OR waking\* OR wake\*) :ab,ti,kw) AND ('speech disorder'/exp OR 'perseveration'/de OR 'language ability'/de OR 'language disability'/de OR 'linguistics'/exp OR 'language processing'/de OR (aphasi\* OR paraphasi\* OR dysphasi\* OR perseveration\* OR anomia\* OR apraxia\* OR dysarthria\* OR semantic\* OR neologism\* OR linguistic\* OR ((language\* OR speech\*) NEAR/3 (error\* OR arrest\* OR perform\* OR mistake\* OR disturbance\* OR abilit\* OR disabilit\* OR dysfunction\* OR disorder\* OR process\*))) :ab,ti,kw)

### 1.2. Medline Ovid

(surgery.fs. OR Neurosurgery/ OR exp Neurosurgical Procedures/ OR Intraoperative Period/ OR Brain Mapping/ OR exp Glioma/ OR exp Brain Neoplasms/ OR (map\* OR language\*-monitor\* OR neuromonitor\* OR neuro-monitor\* OR craniotom\* OR surg\* OR neurosurg\* OR operat\* OR intraoperat\* OR anesthes\* OR resect\* OR electrostimulation\* OR electro-stimulation\* OR glioma\* OR glioblastoma\* OR astrocytoma\* OR oligodendroglioma\* OR ((intracranial\* OR brain\*) ADJ3 (neoplas\* OR tumor\* OR tumour\* OR cancer\*))) :ab,ti,kf.) AND (Wakefulness/ OR (awake\* OR waking\* OR wake\*) :ab,ti,kf.) AND (exp Speech Disorders/ OR Language Disorders/ OR Anomia/ OR Linguistics/ OR (aphasi\* OR paraphasi\* OR dysphasi\* OR perseveration\* OR anomia\* OR apraxia\* OR dysarthria\* OR semantic\* OR neologism\* OR linguistic\* OR ((language\* OR speech\*) ADJ3 (error\* OR arrest\* OR perform\* OR mistake\* OR disturbance\* OR abilit\* OR disabilit\* OR dysfunction\* OR disorder\* OR process\*))) :ab,ti,kf.)

### 1.3. Web of Science

TS=((((map\* OR language\*-monitor\* OR neuromonitor\* OR neuro-monitor\* OR craniotom\* OR surg\* OR neurosurg\* OR operat\* OR intraoperat\* OR anesthes\* OR resect\* OR electrostimulation\* OR electro-stimulation\* OR glioma\* OR glioblastoma\* OR astrocytoma\* OR oligodendroglioma\* OR ((intracranial\* OR brain\*) NEAR/2 (neoplas\* OR tumor\* OR tumour\* OR cancer\*)))) AND ((awake\* OR waking\* OR wake\*)) AND ((aphasi\* OR paraphasi\* OR dysphasi\* OR perseveration\* OR anomia\* OR apraxia\* OR dysarthria\* OR semantic\* OR neologism\* OR linguistic\* OR ((language\* OR speech\*) NEAR/2 (error\* OR arrest\* OR perform\* OR mistake\* OR disturbance\* OR abilit\* OR disabilit\* OR dysfunction\* OR disorder\* OR process\*))))))

### 1.4. Cochrane Central Register of Controlled Trials

((map\* OR (language\* NEXT/1 monitor\*) OR neuromonitor\* OR neuro-monitor\* OR craniotom\* OR surg\* OR neurosurg\* OR operat\* OR intraoperat\* OR anesthes\* OR resect\*

OR electrostimulation\* OR electro-stimulation\* OR glioma\* OR glioblastoma\* OR astrocytoma\* OR oligodendroglioma\* OR ((intracranial\* OR brain\*) NEAR/3 (neoplas\* OR tumor\* OR tumour\* OR cancer\*)))ab,ti,kw) AND ((awake\* OR waking\* OR wake\*):ab,ti,kw) AND ((aphasi\* OR paraphasi\* OR dysphasi\* OR perseveration\* OR anomia\* OR apraxia\* OR dysarthria\* OR semantic\* OR neologism\* OR linguistic\* OR ((language\* OR speech\*) NEAR/3 (error\* OR arrest\* OR perform\* OR mistake\* OR disturbance\* OR abilit\* OR disabilit\* OR dysfunction\* OR disorder\* OR process\*)))ab,ti,kw)

### 1.5. Google Scholar

craniotomy | mapping | surgery | neurosurgery | intraoperative | resection | resected | electrostimulation | glioma | glioblastoma | astrocytoma | oligodendroglioma  
awake | waking | wakefulness

aphasia | paraphasia | dysphasia | “language | speech errors | performance | disorders | processing”

### 1.6. Medline (Ovid)

Neurosurgery/  
Exp Brain Mapping/  
Exp Glioma/  
Wakefulness/  
Exp Speech Disorders/

**Table S1.** Intraoperative speech and language errors and their categories.

No	Speech and Language Errors	No	Speech and Language Errors
1	<b>Anomia/word-finding difficulties</b>	6	<b>Other errors</b>
	Anomia		<b>Comprehension errors</b>
	Circumlocutions		Comprehension difficulty
	Naming delay/delayed word retrieval		Impaired comprehension
	Word-finding/searching/retrieval difficulties		Auditory comprehension difficulty
2	<b>Phonemic errors</b>		Word deafness
	Phonemic disturbance		<b>Reading errors</b>
	Phonemic paraphasias in writing		Alexia
	Phonemic speech error/paraphasia		Reading deficit/disturbances/impairment
	Phonological paraphasia		Reading arrest
	Phonological processing/disturbance		Delayed (comprehensive) reading
3	<b>Production errors</b>		<b>Speech initiation difficulties</b>
	Anarthria		Delayed speech initiation
	Articulatory difficulty		Initiation difficulty
	Dysarthria		SMA aphasia
	Hesitation		Difficulty with sentence completion
	Slow speech		Reduction of spontaneous speech
	Slurred speech		<b>(Morpho-)syntactic errors</b>
	Speech delay		Syntactic disorders
	Stammering		Syntactic gender error
	Stuttering		Morphological overregularization (verbs)
4	<b>Semantic errors</b>		Inflection errors
	Non-verbal semantic processing problem		<b>Perseveration</b>
	Semantic association disturbance/error		<b>Writing errors</b>
	Semantic comprehension error		Writing arrest
	Semantic disorder/deficit/aphasia		Alterations of letter shapes in writing
	Semantic disturbance/error		Writing drift
	Semantic jargon aphasic language		Spelling errors
	Semantic paraphasias in writing		<b>Verbal apraxia</b>
	Semantic speech error/paraphasia		<b>Irrelevant paraphasia</b>
5	<b>Speech arrest</b>		<b>Neologism</b>

No = number; All errors grouped together in category 6 “Other errors” are displayed separately. The categories are in bold.