Supplementary Material: A Foundation Model for Brain Lesion Segmentation with Mixture of Modality Experts

Table I. Detailed average Dice scores of MoME and competing methods for each task, lesion type, and modality. The top results, excluding the task-specific nnU-Nets results, are highlighted in purple.

| Settings | Task | | | nnU-Net | SAM-Med3D | Multi-Talent | Hermes | MoME | Task Specific nnU-Nets |
	Dataset	Modality	Task ID						
Seen datasets	BraTS2021	T1	1	0.8344	0.7908	0.8192	0.8350	**0.8510**	0.8573
		T2	2	0.8868	0.8599	0.8690	0.8893	**0.8995**	0.8981
		T1ce	3	0.8816	0.8271	0.8708	0.8825	**0.8856**	0.8888
		FLAIR	4	0.9165	0.8956	0.9078	0.9146	**0.9220**	0.9229
	ATLAS2.0	T1	5	0.5685	0.3354	0.5561	0.5719	**0.6203**	0.5645
	WMH2017	FLAIR	6	0.6726	0.5124	0.6681	0.6723	**0.6909**	0.7341
		T1	7	0.5387	0.3684	0.5528	0.5511	**0.5773**	0.5677
	OASIS	T1	8	0.5638	0.4354	0.5932	0.5626	**0.5937**	0.6028
		FLAIR	9	0.7241	0.5753	0.7431	0.7261	**0.7737**	0.7970
	ISLES2022	DWI	10	0.7415	0.6510	0.7510	0.7368	**0.7723**	0.7824
	MSSEG	T1	11	0.4664	0.2426	**0.5408**	0.4630	0.5044	0.5512
		T2	12	0.4219	0.2501	0.4804	0.4781	**0.5384**	0.4933
		T1ce	13	0.4375	0.1874	**0.5445**	0.4646	0.5099	0.5586
		FLAIR	14	0.6619	0.4176	0.6584	0.6600	**0.6979**	0.7199
Unseen datasets	Tumour1	FLAIR	16	0.8358	0.8339	-	0.8446	**0.8545**	0.8518
	Tumour2	T2	15	0.7959	0.8146	-	0.7968	**0.8293**	0.8157
	WMHsMix	FLAIR	17	**0.7032**	0.5479	-	0.6968	0.7015	0.7508
Lesion level	Tumour		1,2,3,4 15,16	0.8710	0.8370	-	0.8732	**0.8825**	0.8838
	WMH		6,7,8,9,10, 11,12,13, 14,17	0.5767	0.3930	-	0.5861	**0.6208**	0.6417
	Stroke		5,10	0.6550	0.4932	0.6535	0.6544	**0.6963**	0.6734
Modality Level	T1		1,5,7,8,11	0.6082	0.4511	0.6273	0.6081	**0.6424**	0.6440
	T2		2,12,15	0.7015	0.6416	-	0.7214	**0.7557**	0.7357
	T1ce		3,13	0.6595	0.5072	**0.7076**	0.6736	0.6977	0.7237
	FLAIR		4,6,9, 14,16,17	0.7523	0.6305	-	0.7524	**0.7734**	0.7961

Table II. An overview of the public and in-house datasets used for brain lesion segmentation.

Datasets	Public datasets						In-house datasets		
	ATLAS2.0	ISLES2022	BraTS2021	WMH2017	MSSEG	OASIS	Tumour1	Tumour2	WMHsMix
Lesion type	Chronic stroke	Ischemic stroke	Glioma tumour	WMH	MS	Normal healthy	Glioma tumour	Glioma tumour	WMH Mixture[3]: PD, NMOSD, MS, SVD, AD
Modality	T1	DWI	T1, T1ce[1], T2, FLAIR	T1, FLAIR	T1, T1ce, T2, FLAIR	T1, FLAIR[2]	T2	FLAIR	FLAIR
#Training images	545	150	4168	60	36	200	29[4]	27[4]	20[4]
#Test images	110	100	836	60	24	100	40	40	40

[1] Annotations for tumour core.

[2] In-house expert annotations based on FLAIR.

[3] Parkinson's Disease (PD), Neuromyelitis Optica Spectrum Disorder (NMOSD), Multile Sclerosis (MS), Small Vessel Disease (SVD), Alzheimer's Disease (AD).

[4] Not used for foundation model training, but used for training task-specific models regarded as upperbound for generalisation onto unseen datasets.
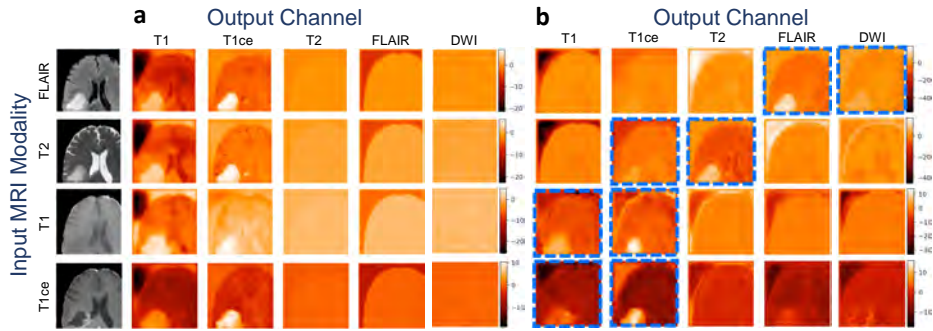

Fig. I. The output of each modality expert weighted by the gating mechanism achieved a) without or b) with the proposed anti-degeneration curriculum learning strategy. In a), some experts lose their acquired modality knowledge and the activation of the experts becomes imbalanced, whereas in b), expert degeneration is avoided and each expert is activated by its specialised modality or related modalities that correlate with the specialised modality (see blue dashed boxes).