

Extended Data Table. 1: Details of surgery performed for each experiment in the paper.

Figure	Purpose	Virus	Viral injection coordinates (all bilateral; unit 'mm')	Mouse line	Number of mice
Fig. 1c	No paAIP2 Control	N/A	N/A	C57BL/6J	7 light on + 6 light off control
	paAIP2 manipulation in ALM	AAV2/9 CaMKII promoter-mEGFP-P2A-paAIP2 (v1)	Bregma AP 2.5, ML \pm 1.5, DV 0.4 and 0.8, 75 nl at each depth	C57BL/6J	6 light on + 7 light off control
	paAIP2 manipulation in M1	AAV2/9 CaMKII promoter-mEGFP-P2A-paAIP2 (v1)	Bregma AP 2.5, ML \pm 1.5, DV 0.4 and 0.8, 75 nl at each depth	C57BL/6J	4 light on
Fig. 1d	paAIP2 manipulation in ALM during cue association	AAV2/9 CaMKII promoter-mEGFP-P2A-paAIP2 (v1)	Bregma AP 2.5, ML \pm 1.5, DV 0.4 and 0.8, 75 nl at each depth	C57BL/6J	3 light on + 5 light off control
Fig. 1e	Expert control, light off	N/A	N/A	C57BL/6J or Vgat-ChR2-EYFP	4 C57BL/6J + 6 Vgat-ChR2-EYFP, light off
	Expert with paAIP2 manipulation in ALM, light on	AAV2/9 CaMKII promoter-mEGFP-P2A-paAIP2 (v1)	Bregma AP 2.5, ML \pm 1.5, DV 0.4 and 0.8, 75 nl at each depth	C57BL/6J	4 light on
Fig. 1f	Control for CaMKII α conditional knockout	AAV2/5 hsyn promoter-cre (v4)	Bregma AP 2.5, ML \pm 1.5, DV 0.8, 110 nl	Wildtype littermates of CaMKII α -cKO mice	7
	CaMKII α conditional knockout in ALM	AAV2/5 hsyn promoter-cre (v4)	Bregma AP 2.5, ML \pm 1.5, DV 0.8, 110 nl	CaMKII α -cKO flox/flox	7
Fig 2c	paAIP2 manipulation in ALM PT neurons	AAV2/9 CaMKII promoter-DIO-mEGFP-P2A-paAIP2 (v3)	Bregma AP 2.5 mm, ML \pm 1.5 mm, DV 0.8 mm, 110 nl	Sim1-cre KJ18	4 light on + 5 light off control

	paAIP2 manipulation in ALM PT _{upper} neurons	AAVretro CamKII promoter-Cre, 50% dilution (v2) in thalamus	Bregma AP -1.5 mm, ML \pm 1.0 mm, DV 3.2 mm , 100 nl	C57BL/6J	11 light on + 7 light off control
		AAV2/9 CaMKII promoter-DIO-mEGFP-P2A-paAIP2 (v3)	Bregma AP 2.5 mm, ML \pm 1.5 mm, DV 0.4 mm and 0.8 mm, 75 nl at each depth (or 75 or 110 nl at DV 0.8 mm)		
	paAIP2 manipulation in ALM PT _{lower} neurons	AAVretro CamKII promoter-Cre, 50% dilution (v2) in Medulla	Bregma AP -6.65 mm, ML \pm 1.25 mm, DV 4.5 mm , 200 nl	C57BL/6J	6 light on + 7 light off control
		AAV2/9 CaMKII promoter-DIO-mEGFP-P2A-paAIP2 (v3)	Bregma AP 2.5 mm, ML \pm 1.5 mm, DV 0.4 mm and 0.8 mm, 75 nl at each depth (or 75 or 110 nl at DV 0.8 mm)		
paAIP2 manipulation in ALM layer 5 IT cells	AAV2/9 CaMKII promoter-DIO-mEGFP-P2A-paAIP2 (v3)	Bregma AP 2.5 mm, ML \pm 1.5 mm, DV 0.8 mm , 110 nl	TLx-Cre PL56	10 light on + 8 light off control	
paAIP2 manipulation in ALM layer 2/3 IT cells	AAV2/9 CaMKII promoter-DIO-mEGFP-P2A-paAIP2 (v3)	Bregma AP 2.5 mm, ML \pm 1.5 mm, DV 0.8 mm , 110 nl	GRP-Cre KH288	6 light on + 6 light off control	
Fig. 2e	CRISPR/Cas9 KO of CaMKII α in ALM PT cells	AAVretro CamKII promoter-Cre, 50% dilution (v2) in thalamus	Bregma AP -1.5 mm, ML \pm 1.0 mm, DV 3.2 mm , 100 nl	LSL-Cas9	9
		AAV2/9 U6 promoter CaMKII gRNA-hsyn promoter-mScarlet (v5)	Bregma AP 2.5 mm, ML \pm 1.5 mm, DV 0.8 mm , 110 nl		

	CRISPR Control in ALM PT cells	AAVretro CamKII promoter-Cre, 50% dilution (v2) in thalamus	Bregma AP -1.5 mm, ML \pm 1.0 mm, DV 3.2 mm , 100 nl	LSL-Cas9	8
		AAV2/1 hSyn promoter-mScarlet (v6)	Bregma AP 2.5 mm, ML \pm 1.5 mm, DV 0.8 mm , 110 nl		
	CRISPR/Cas9 KO of CaMKII α in ALM IT cells	AAV2/9 U6 promoter CaMKII gRNA-hsyn promoter-mScarlet (v5)	Bregma AP 2.5 mm, ML \pm 1.5 mm, DV 0.8 mm , 110 nl	TLx-Cre PL56 x LSL-Cas9	6
	CRISPR Control in ALM IT cells	AAV2/1 hSyn promoter-mScarlet (v6)	Bregma AP 2.5 mm, ML \pm 1.5 mm, DV 0.8 mm , 110 nl	TLx-Cre PL56 x LSL-Cas9	6
Fig. 2f	Cofilin-SuperNova in ALM PT _{upper} cells	AAVretro CamKII promoter-Cre, 50% dilution (v2) in thalamus	Bregma AP -1.5 mm, ML \pm 1.0 mm, DV 3.2 mm , 100 nl	C57BL/6J	6 light on + 7 light off control
		AAV2/9 Efla promoter-DIO-CFL-SN (v7)	Bregma AP 2.5 mm, ML \pm 1.5 mm, DV 0.8 mm , 110 nl		
	Supernova-Control in ALM PT _{upper} cells	AAVretro CamKII promoter-Cre, 50% dilution (v2) in thalamus	Bregma AP -1.5 mm, ML \pm 1.0 mm, DV 3.2 mm , 100 nl	C57BL/6J	6 light on
		AAV2/9 Efla promoter-DIO-SN (v8)	Bregma AP 2.5 mm, ML \pm 1.5 mm, DV 0.8 mm , 110 nl		
	Cofilin-SuperNova in ALM IT cells	AAV2/9 Efla promoter-DIO-CFL-SN (v7)	Bregma AP 2.5 mm, ML \pm 1.5 mm, DV 0.8 mm , 110 nl	TLx-Cre PL56	7 light on + 7 light off control
Supernova-	AAV2/9 Efla	Bregma AP	TLx-Cre PL56	5 light on	

	Control in ALM IT cells	promoter-DIO-SN (v8)	2.5mm, ML \pm 1.5mm, DV 0.8mm , 110 nl		
Fig 3 and 4	Recording during learning	N/A	N/A	C57BL/6J	6 light on + 2 light off
	Recording in expert mice	N/A	N/A	C57BL/6J or Vgat-ChR2-EYFP	4 C57BL/6J + 6 Vgat-ChR2-EYFP, light off
	Recording during learning with paAIP2 manipulation in ALM PT ^{upper} neurons	AAVretro CamKII promoter-Cre, 50% dilution (v2) in thalamus	Bregma AP -1.5 mm, ML \pm 1.0 mm, DV 3.2 mm , 100 nl	C57BL/6J	5 light on
		AAV2/9 CaMKII promoter-DIO-mEGFP-P2A-paAIP2 (v3)	Bregma AP 2.5 mm, ML \pm 1.5 mm, DV 0.8 mm, 110 nl		
	Recording during learning with paAIP2 manipulation in ALM PT ^{lower} neurons	AAVretro CamKII promoter-Cre, 50% dilution (v2) in Medulla	Bregma AP -6.65 mm, ML \pm 1.25 mm, DV 4.5 mm , 200 nl	C57BL/6J	7 light on
AAV2/9 CaMKII promoter-DIO-mEGFP-P2A-paAIP2 (v3)		Bregma AP 2.5 mm, ML \pm 1.5 mm, DV 0.8 mm, 110 nl			
EDF. 2	Acute slice recording of ALM PT ^{upper} neurons	AAVretro CamKII promoter-Cre, 50% dilution (v2) in thalamus	Bregma AP -1.5 mm, ML \pm 1.0 mm, DV 3.2 mm , 100 nl	C57BL/6J (P28 at the time of injection)	4
		AAV2/9 CaMKII promoter-DIO-mEGFP-P2A-paAIP2 (v3)	Bregma AP 2.5 mm, ML \pm 1.5 mm, 0.8 mm, 110 nl		