Inclusion of dlPFC and vlPFC inputs in cortico-amygdala topography

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BACKGROUND

- Primate amygdala is a collection of nuclei that interpret a range of salient stimuli, including social cues such as faces and social group hierarchies[1,2,3]
- Basal nucleus is disproportionately enlarged and complex in primates & receives bulk of prefrontal cortex (PFC) inputs
- Basal nucleus contains 3 subdivisions: the magnocellular (Bmc), intermediate (Bi,) and parvicellular (Bpc) divisions with different cytoarchitectural features (***Figure 1***).

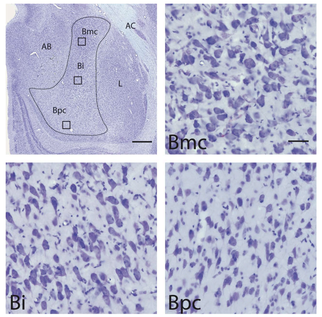
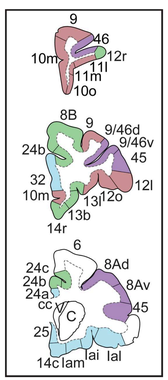


Figure 1: Pyramidal cell size and packing density of primate basal nucleus subdivisions visualized using Nissl stain. AB: accessory basal nucleus; AC: Anterior commissure; Bmc/Bi/Bpc: basal nucleus, magnocellular, intermediate, and parvicellular subdivisions; L: lateral nucleus. Top left scale bar = 1mm. Top right scale bar = 50 µm.

- Our lab previously found[4] that the topography of projections from "limbic cortex" (orbital and medial prefrontal cortex (omPFC) and insula) to basal nucleus subdivisions is determined by cortical granularity. Agranular cortices project throughout the basal nucleus (light blue), with successively more granular cortices overlapping inputs in a ventral to dorsal gradient (***Figure 2)***.

- Previously did not examine more highly differentiated "non-limbic" cortex (i.e. the dorsolateral prefrontal cortex (dlPFC) or the ventrolateral prefrontal cortex (vlPFC) (***Figure 3***)) & their relationship to "limbic" inputs



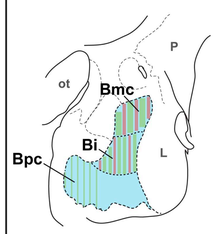
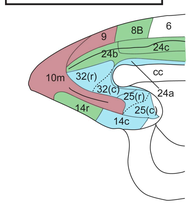


Figure 2: Summary image of previous work examining the distribution of agranular, dysgranular, and granular cortex.

Key
- = agranular cortex
- =dysgranular cortex
- =granular cortex
- ?=granular cortex (dlPFC/vlPFC)



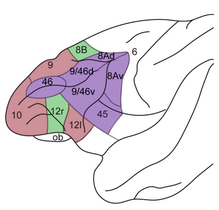


Figure 3: Medial and lateral view of the primate brain. Nomenclature of Carmichael & Price[5], and Petrides & Pandya[6,7]

HYPOTHESES:

1) **There will be an overall lower density of projections from dlPFC/vlPFC into the basal nucleus subdivisions compared to previously examined "limbic" cortices**
2) **Increasingly granular dlPFC/vlPFC will project preferentially to the dorsal-most part of the basal nucleus**

METHODS

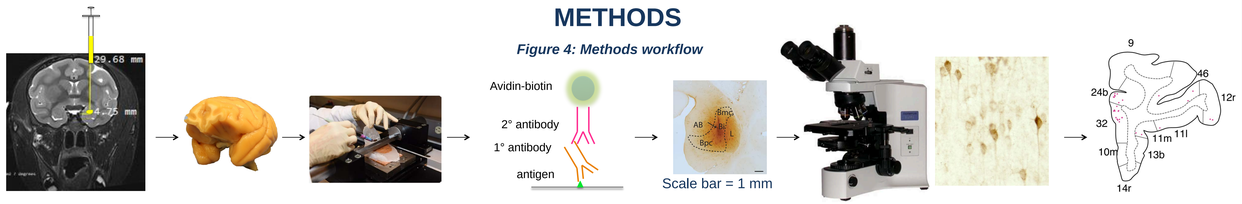


Figure 4: Methods workflow

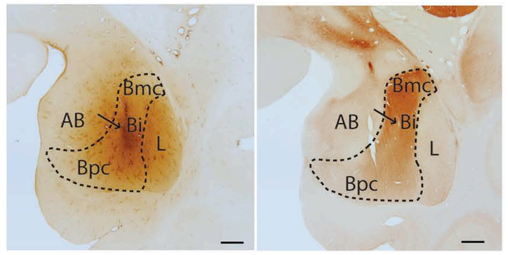


Figure 5: Sample Injection site placement (left) is confirmed by comparing landmarks in an adjacent Acetylcholinesterase (AChE)-stained section (right). Arrow points to core of injection. Scale bar = 1 mm

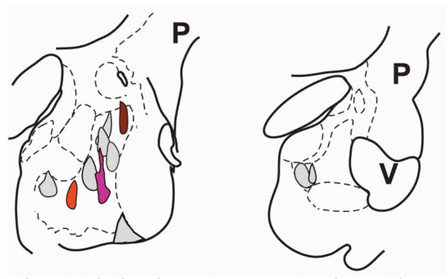
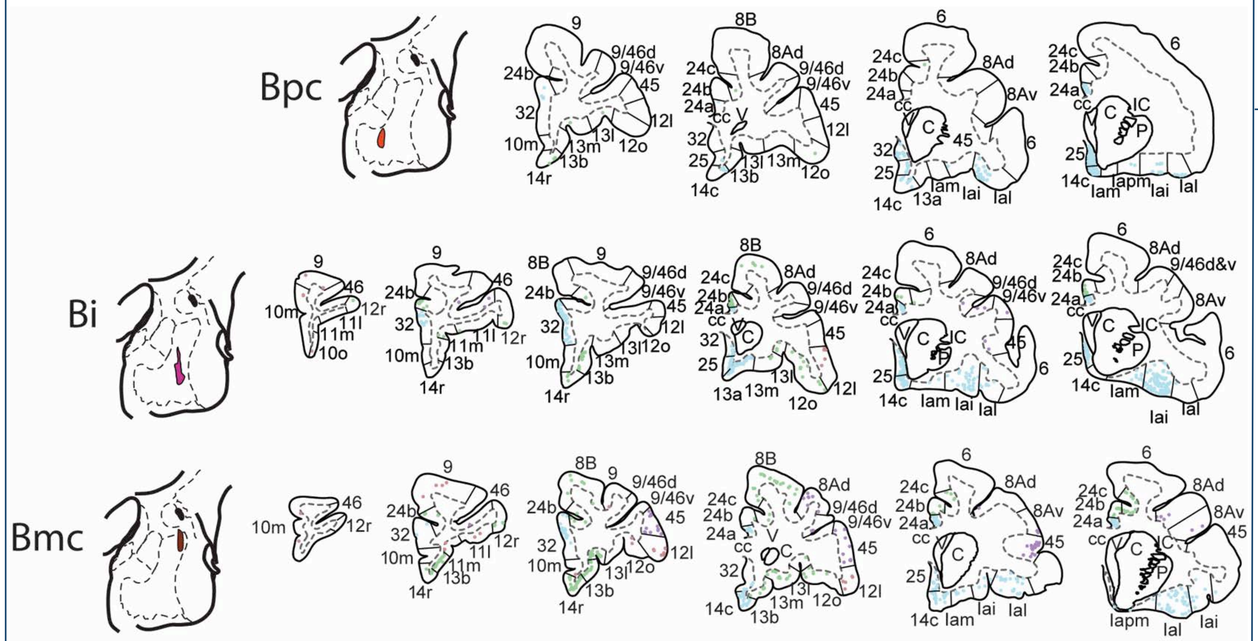


Figure 6: Injection placement summary. Sample Bpc, Bi, and Bmc cases are highlighted. P: putamen; V: ventricle

DISTRIBUTION OF LABELED CELLS IN THE DLPFC & VLPFC RESULTING FROM INJECTIONS INTO VARIOUS BASAL NUCLEUS SUBDIVISIONS



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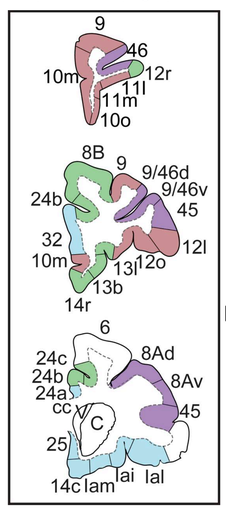
DENSITY OF RETROGRADELY LABELED CELLS ACROSS PREFRONTAL CORTEX

		Bmc			Bi			Bpc				
		J12FR	J12LY	J16LY	J44FR	J52LY	J47FS	J15LY	J20LY	J14FS	J15FS	J14FR
Insula	Iam	+	+		+	+	++		+		+	
	Iapm	+	+	+	++	+	++++	+	+++	++		+
	Iai	+++	++	+++	+	++++	++++	+	+++	++		++
	Ial	++	++	++	++	+++	+++	+++	++++	+	+++	+
	Iapl			+	+			+	+++			+
	Id	+	+		+	+	++	+	++			
	Ig		+						++			
mPFC	25	+++	+++	++++	+	++++	+++	++++		+	++	++
	32	++	++	+++	++	++++	+++	++			+	+
	24a	++++	++++	++++	+++	++	+++	++				
	14c	++	+++	+++	+	+++	+	+++	+		+	
	24b	++	+++	+	+++	+++	++					
	14r	+++	++	+++		+		+				
	10m	+		+	+							
OFC	13a	+	+	+		+++	+					
	13b	+++	++	+	+	++	+					
	13m	++	++	+	+	+	+					
	13l	+		+		+	+					
	12o	+	++	++	+	+	+					
	12m	+		+	+		+					
	11l	+		+	+	+	+					
	11m	+	+	+	+	+	+					
	10o	+		+								
vlPFC	12r	+	+			+						
	12l	+	+	+	+	+	+					
	45	+	+++	+	+	+	+					
dlPFC	24c	++	+	+	++	+						
	8B	++	++	+	++	+						
	9	+	+	+	+	+	+					
	8Ad	+	+	+	++	+						
	8Av	+	+	+	+							
	9/46d	+	+	+								
	9/46v	+		+	+	+						
	46	+	+	+	+	+						

++++ = High (150-500 cells); +++ = Moderately high (50-149 cells); ++ = Moderate (25-49 cells); + = Low (2-24 cells); blank = None (0-1 cell)

CONCLUSIONS

- **dlPFC and vlPFC inputs fit in with the pattern of cortical projections seen with "limbic" cortex projections**
- **Retrogradely labeled cells in the most differentiated PFC cortices predicted the most diverse cortical inputs, and correlate with a dorsal position in the basal nucleus**
- **The amygdala integrates not only "limbic" inputs, but also some "cognitive" inputs in a topographic manner**



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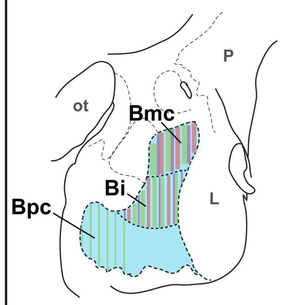

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