

**FUNCTIONAL NEUROANATOMY OF MORPHINE-INDUCED  
ABSTINENCE, TOLERANCE, AND SENSITISATION**

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A thesis submitted in fulfilment of the requirements for the degree of

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## **Statement of Authorship**

This thesis is submitted to the University of Sydney in fulfilment of the requirement for the degree of Doctor of Philosophy. All experiments were performed by the author except where acknowledged. The text presented in this thesis is original unless otherwise stated.

Signature\_\_\_\_\_ Date\_\_\_\_\_

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## Abbreviations

3V third ventricle

ac anterior commissure

AC anterior cingulate

AcbC nucleus accumbens core

AcbSh nucleus accumbens shell

ANOVA analysis of variance

AStr amygdalostriatal transition zone

BG basal ganglia

BLA basolateral amygdala

BST bed nucleus of the stria terminalis

BSTld lateral-dorsal bed nucleus of the stria terminalis

BSTv ventral bed nucleus of the stria terminalis

CALB calbindin

cAMP cyclic-AMP

cc corpus callosum

CeA central nucleus of the amygdala

CeC capsular central amygdala

CeL lateral central amygdala

CeM medial central amygdala

CGRP calcitonin gene-related peptide

CM centromedial thalamus

CRF corticotropin releasing factor

CRH corticotropin releasing hormone

ct commissural stria terminalis

CTX cortex

D1 dopamine type 1 receptor

D2 dopamine type 2 receptor

dl dorsolateral striatum

dm dorsomedial striatum

DOR delta-opioid receptor

dPAG dorsal periaqueductal gray

ENK enkephalin

FRA Fos-related-antigen

GABA Gamma-Aminobutyric Acid

GP globus pallidus

HPA-axis hypothalamic pituitary adrenal-axis

IC intercalated cell groups

IF interfascicular nucleus

IL infralimbic cortex

IL-1 $\beta$  interleukin 1 $\beta$

i.p. intraperitoneal

IP interpeduncular nucleus

IPAC interstitial nucleus of the posterior limb of the anterior commissure

IPACl lateral interstitial nucleus of the posterior limb of the anterior commissure

IPACm medial interstitial nucleus of the posterior limb of the anterior commissure

IR immunoreactivity

IPAG lateral periaqueductal gray

KOR kappa-opioid receptor

LA lateral amygdala

LPB lateral parabrachial nucleus  
LC locus coeruleus  
LH lateral hypothalamus  
LV lateral ventricle  
M/- morphine/no injection control  
M/M morphine/morphine  
M/N5 morphine/naloxone (5mg/kg)  
M/N0.05 morphine/naloxone (0.05mg/kg)  
MOR mu-opioid receptor  
M/S morphine/saline  
ot optic tract  
PAG periaqueductal gray  
PB phosphate buffer  
PBT-X phosphate buffer containing 2% normal horse serum/0.2% Triton-X-100  
PB parabrachial nucleus  
PBS phosphate buffer saline  
pDyn prodynorphin  
PFC prefrontal cortex  
PPN pedunclopontine nucleus  
PrL prelimbic cortex  
PV paraventricular thalamus  
PVN paraventricular nucleus of the hypothalamus  
NeuN anti-neuronal nuclei  
NHS normal horse serum  
NMDA *N*-Methyl-D-aspartate

NTS nucleus of the solitary tract  
RVM rostral ventromedial medulla  
S/- saline/no injection control  
s.c. subcutaneous  
SEM standard error of the mean  
SI substantia innominata  
SId dorsal substantia innominata  
S/N5 saline/naloxone (5mg/kg)  
S/N0.05 saline/naloxone (0.05mg/kg)  
SN substantia nigra  
SNc substantia nigra pars compacta  
SNr substantia nigra pars reticulata  
SpC spinal cord  
S/S saline/saline  
Str striatum  
TH tyrosine hydroxylase  
THAL thalamus  
vl ventrolateral striatum  
VLM ventrolateral medulla  
vlPAG ventrolateral periaqueductal gray  
vm ventromedial striatum  
VP ventral pallidum  
VTA ventral tegmental area.

## Publications

### Peer reviewed manuscripts:

Hamlin, A.S., McNally, G.P., and Osborne, P.B. Activation of the lateral central extended amygdala parallels abstinence hyperalgesia induced by naloxone in drug naïve rats after a brief exposure to morphine. *submitted*

Buller, K., Hamlin, A.S., and Osborne, P.B. Dissection of peripheral and central endogenous opioid modulation of systemic interleukin-1b responses using c-fos expression in the rat brain. *Neuropharmacology*, 49, 230-242.

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