Contents

1 General introduction 7
1.1 The medial prefrontal cortex is densely connected in a laminar and subtype specific manner 7
1.2 Synaptic transmission and plasticity in the prefrontal cortex 7
1.2.1 Long-term plasticity at glutamatergic synapses 7
1.2.2 Motifs and plasticity of cortical interneurons 7
1.3 The neuromodulators adenosine and acetylcholine in the PFC 7
1.3.1 Adenosine as a facilitatory and inhibitory neuromodulator 7
1.3.2 Adenosine in the human brain 7
1.3.3 Effects of adenosine on synaptic transmission and plasticity 7
1.3.4 Adenosine receptors in synaptic plasticity 7
1.3.5 Acetylcholine modulates mPFC activity 7
1.3.6 Modulation of network activity by acetylcholine 7
1.4 Aim of this thesis 7

2 Caffeine boosts synaptic function in the human neocortex 29

3 Adenosine A2A receptors control glutamatergic synaptic plasticity onto fast spiking interneurons in the prefrontal cortex 47

4 Lateral Inhibition by Martinotti Interneurons is Facilitated by Basal Forebrain Cholinergic Inputs in Human and Mouse Neocortex 67

5 General discussion 93
5.1 Caffeine affects cellular signaling in the human cortex 93
5.2 Endogenous release of the neuromodulators adenosine and acetylcholine affects mPFC 93
5.2.1 Adenosine affects plasticity at FS synapses 93
5.2.2 Acetylcholine-induced depolarization of Martinotti cells enhances disynaptic inhibition 93
5.2.3 Interaction acetylcholine and adenosine 93
5.3 Conclusion 93

6 References 107

7 Nederlandse samenvatting 129

8 English summary 133

9 Acknowledgements 137