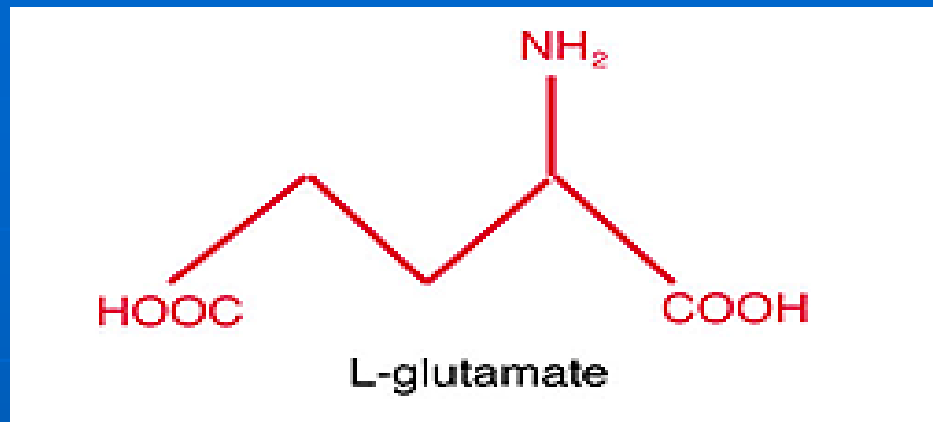


# GLUTAMATE RECEPTORS

SUBMITTED BY

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- Glutamate is the major excitatory neurotransmitter in the mammalian CNS, acting through both ligand gated ion channels (ionotropic receptors) and G-protein coupled (metabotropic) receptors
- Glutamate receptors play a vital role in the mediation of excitatory synaptic transmission

Glutamate acts on:

Iontropic receptors

NMDA-receptor family

{ NMDAR1  
NMDAR2A, ...

AMPA-receptor family

{ GluR1  
GluR2  
GluR3

Kainate-receptor family

{ GluR6

Metabotropic receptors

Group I  
(Phospholipase C activation)

{ mGlu1A  
mGlu5A

Group II  
(Adenylyl cyclase inhibition)

{ mGlu2  
mGlu3

Group III  
(Adenylyl cyclase inhibition)

{ mGlu4, mGlu8  
mGlu6, mGlu6

Receptor subunits

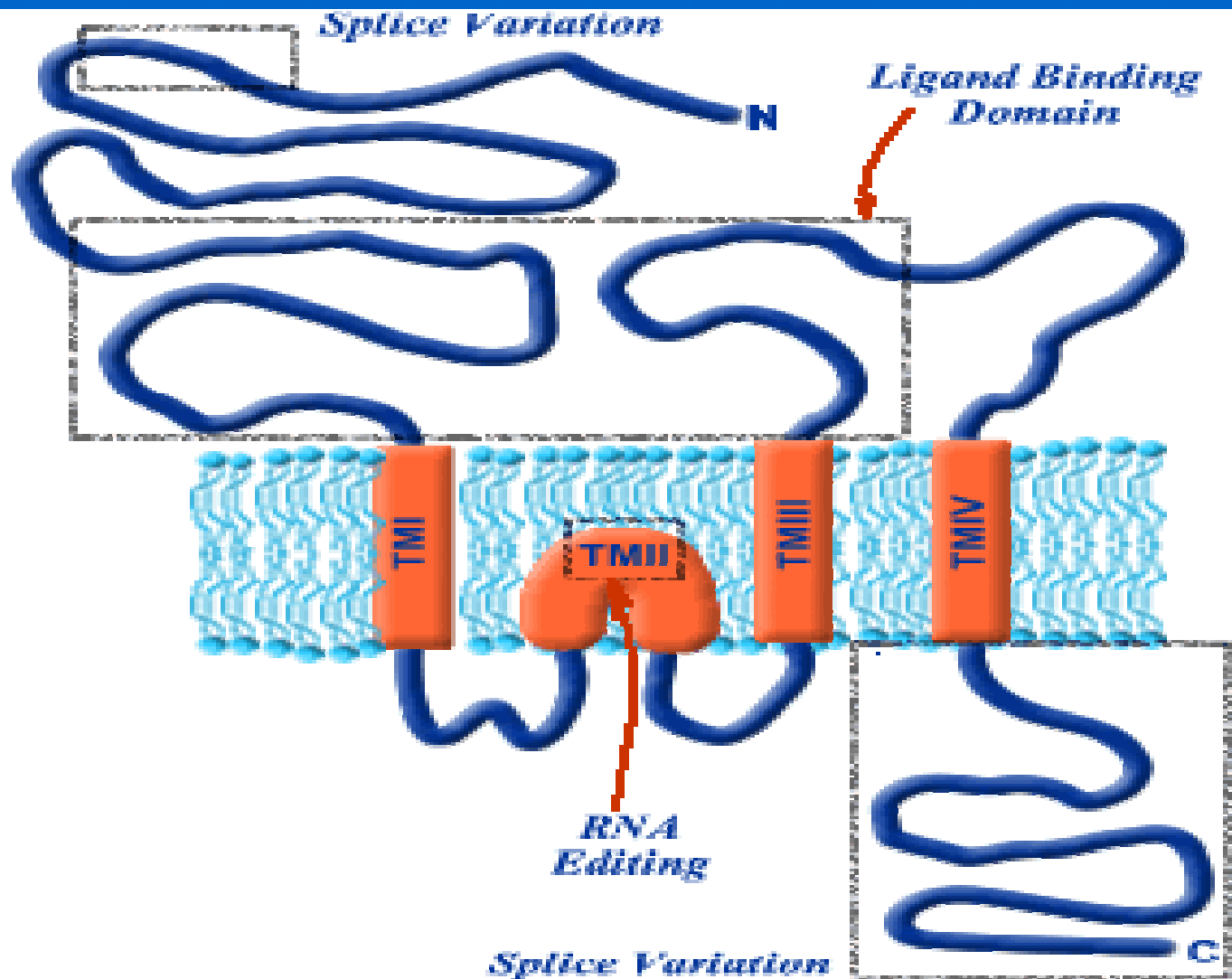


Figure 2. General structure of an ionotropic glutamate receptor subunit. Ionotropic glutamate receptor subunits follow the same basic structural pattern with an extracellular N-terminus and large loop that together form the ligand binding domain. The C-terminus is intracellular and is often the site of splice variation and interaction sites with intracellular proteins.

## non NMDA receptor

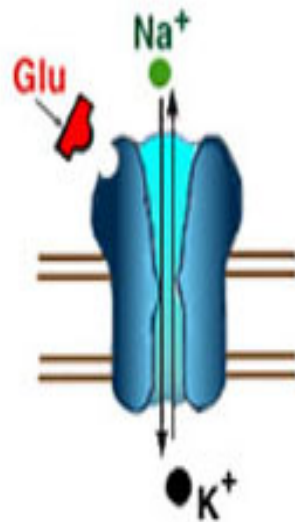


Fig. 6a. Non-NMDA receptors are selectively agonized by kainate, AMPA and quisqualate. The associated ion channels are more permeable to  $\text{Na}^+$  and  $\text{K}^+$  ions than  $\text{Ca}^{2+}$  (from Kandel et al., 1991).

## NMDA receptor

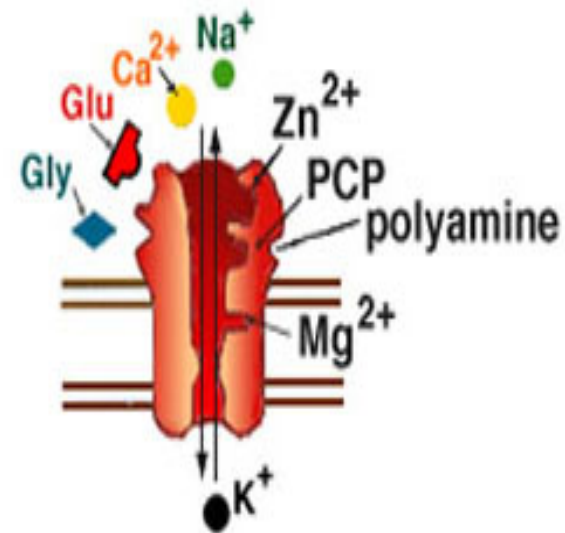


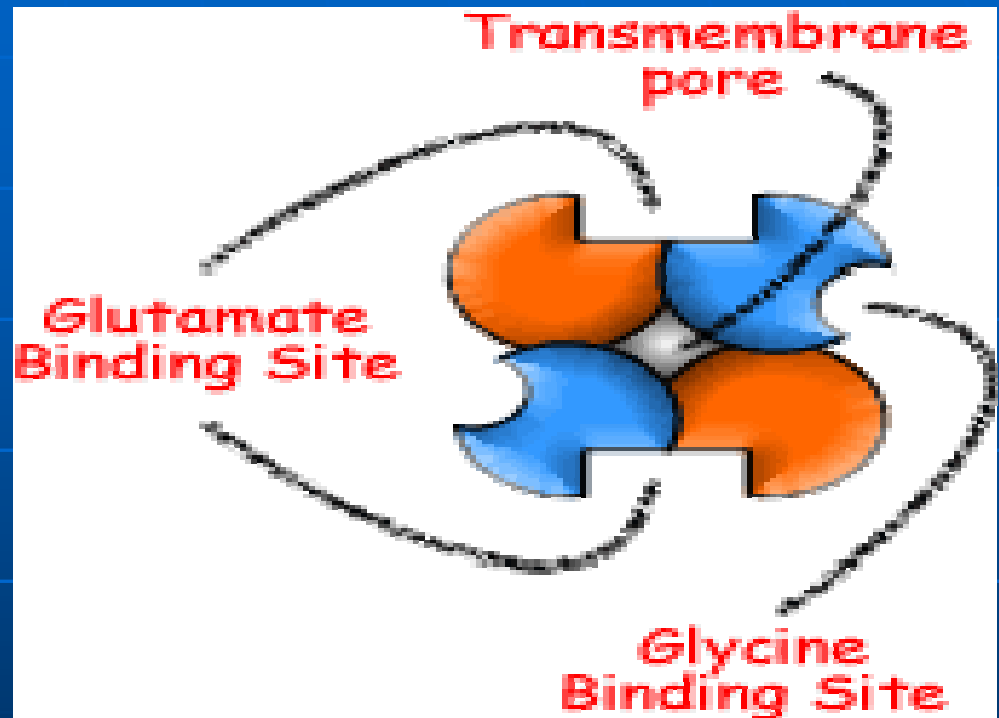
Fig. 6b. NMDA receptors are structurally complex, with separate binding sites for glutamate, glycine,  $\text{Mg}^{2+}$ ,  $\text{Zn}^{2+}$  and polyamines. NMDA-gated channels are more permeable to  $\text{Ca}^{2+}$  than  $\text{Na}^+$  ions (from Kandel et al., 1991).

# NON-NMDA RECEPTORS

- Give immediate response upon binding of glutamate
- More permeable to  $\text{Na}^+$  &  $\text{K}^+$  than  $\text{Ca}^{++}$
- Influx of  $\text{Na}^+$  causes depolarization of the membrane which is the major factor for activating NMDA type receptors

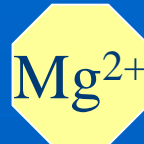
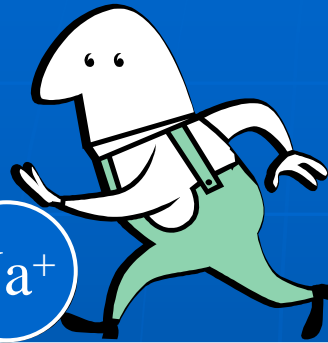
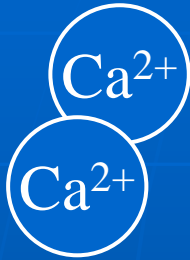
# NMDA RECEPTORS

- Unlike non NMDA receptors, they require a co-agonist  
**GLYCINE**



**Figure 3. Binding sites on the NMDA receptor. Note - the stoichiometry of the receptor complex is schematic only. It is not known as yet whether the complex is a tetramer or a pentamer**

Wait! You still can't get through.



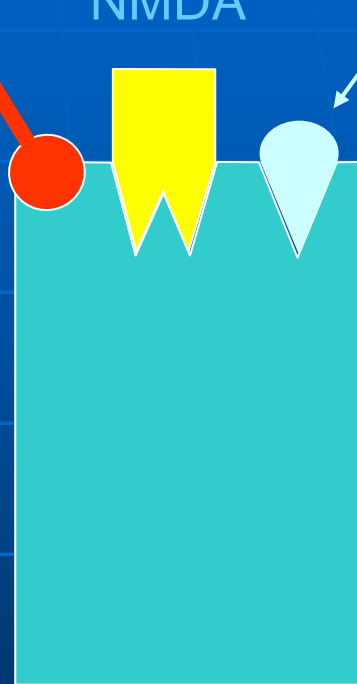
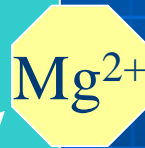
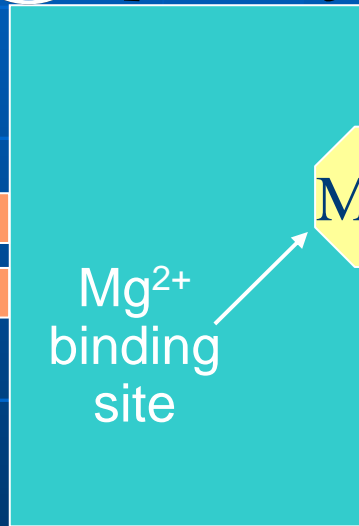
Glutamate  
NMDA

Glycine  
Co-agonist  
(activator)

OUT



IN



Because, as long as the membrane remains polarised, the pore of the channel is blocked by physiological, extracellular concentration of  $Mg^{2+}$ .



# Metabotropic Glutamate (mGlu) Receptors

- Metabotropic glutamate (mGlu) receptors are G-protein coupled receptors (GPCRs)

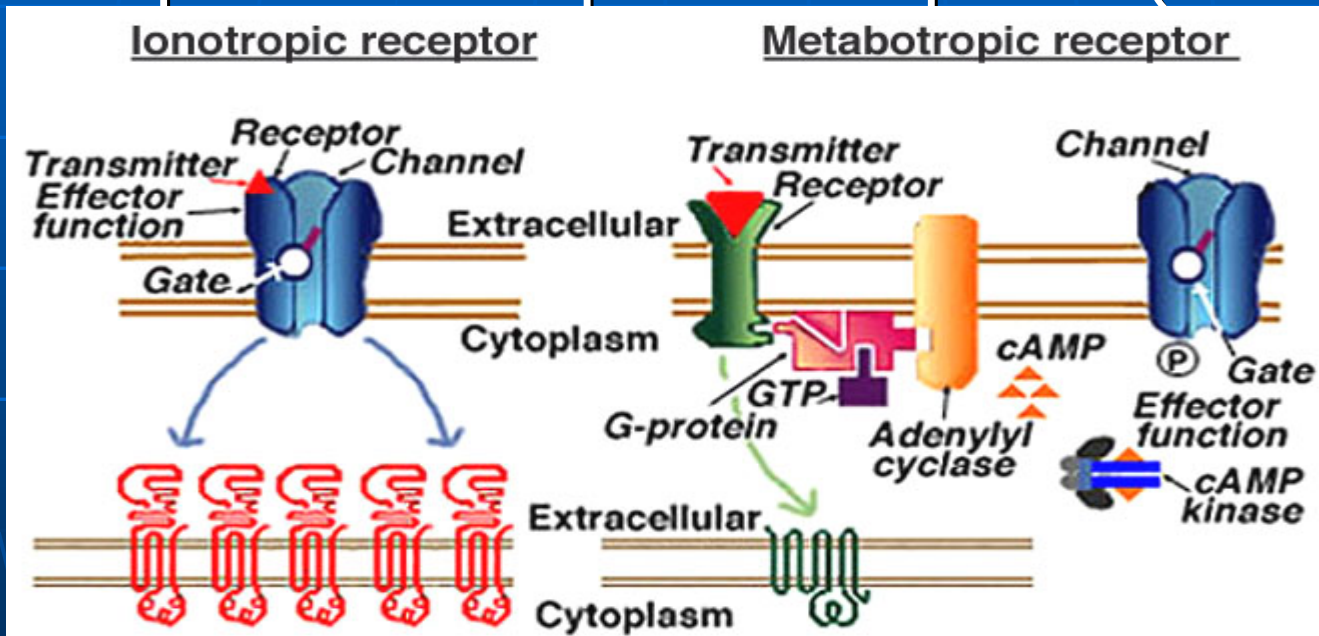
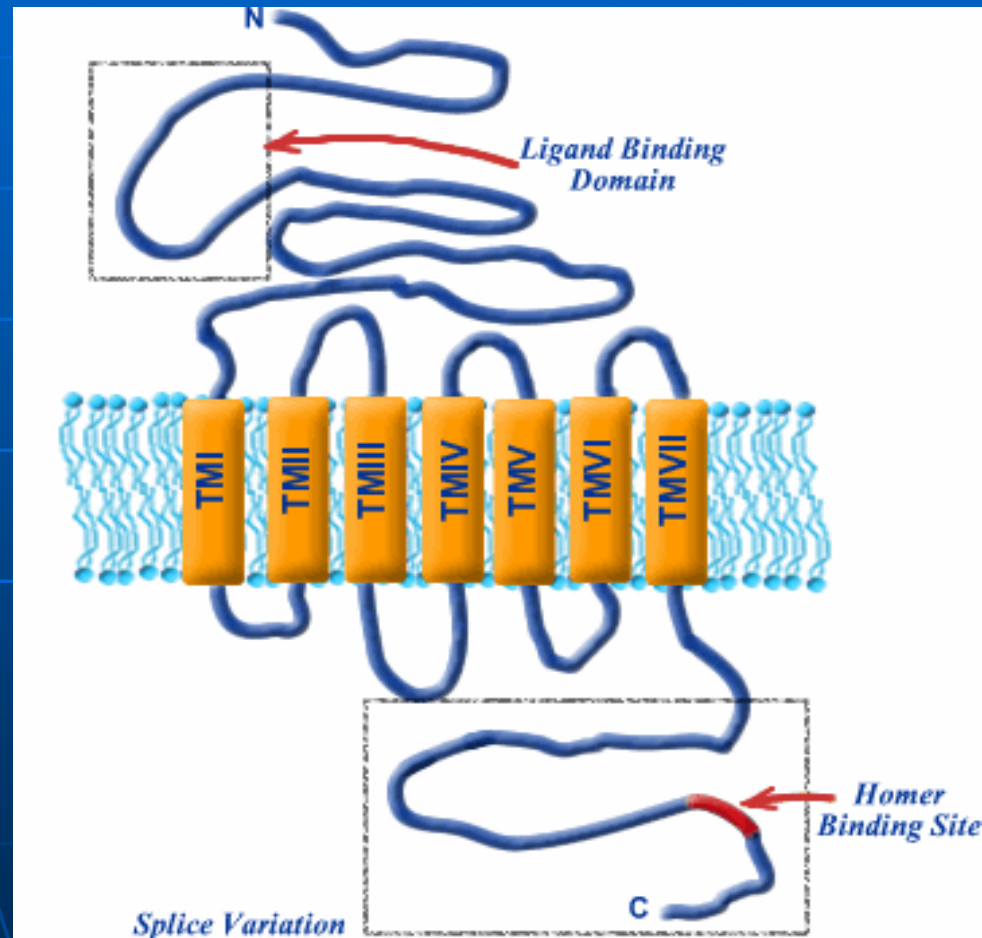


Fig. 5a. Ionotropic receptors and their associated ion channels form one complex (top). Each iGluR is formed from the co-assembly of multiple (4-5) subunits (From Kandel et al., 1991).

Fig. 5b. Metabotropic receptors are coupled to their associated ion channels by a second messenger cascade (top). Each mGluR is composed of one polypeptide, which is coupled to a G-protein (from Kandel et al., 1991).

- They are not co-assembled from multiple subunits, but are one polypeptide with common 7 transmembrane domain



**Figure 8. General structure of the metabotropic glutamate receptors.** The mGlu receptors are coupled to G-proteins and possess the common 7-transmembrane domain motif found in these receptor types. However, the N-terminus is much larger than in the adrenergic family of GPCRs and contains the ligand binding domain. The C-terminus generally undergoes extensive splice variation.

They have been subdivided into three groups, based on

- sequence similarity,
- pharmacology
- intracellular signalling mechanisms

# Metabotropic Glutamate Receptors

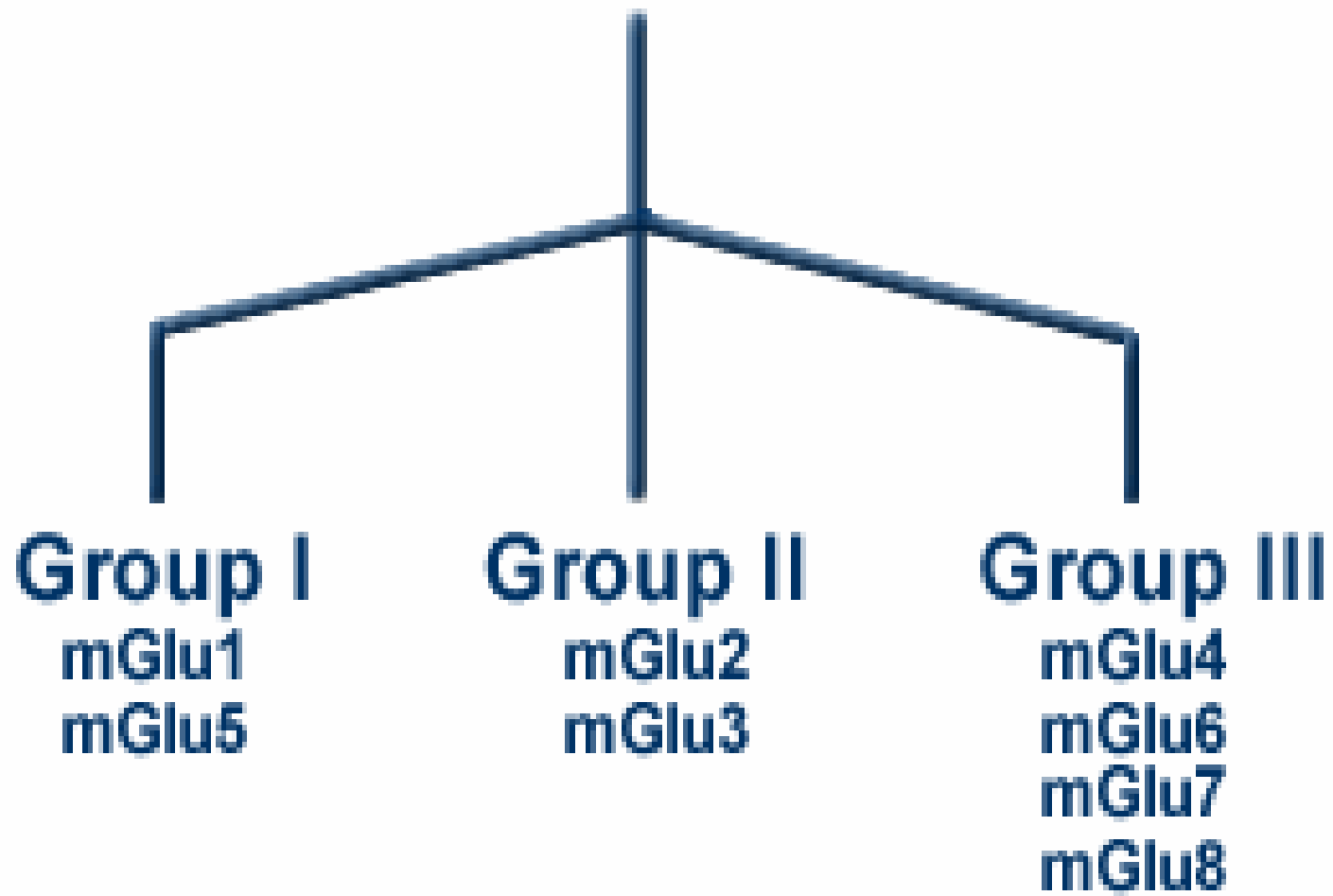


Figure 7. Classification of the metabotropic glutamate receptors.

## Metabotropic glutamate receptor groups (from Pin and Duvoisin, 1995).

group	mGluR	agonist(s)	intracellular pathway
I	mGluR1, mGluR5	quisqualate, ACPD	increase phospholipase C activity, increase cAMP levels, increase protein kinase A activity
II	mGluR2, mGluR3	L-CCG-1, ACPD	decrease cAMP levels
III	mGluR4, mGluR6, mGluR7, mGluR8	L-AP4 (APB)	decrease cAMP or cGMP levels

# REFERENCES

<http://www.webvision.med.utah.edu/GLU.html>

[http://www.bris.ac.uk/Depts/Synaptic/info/  
glutamate.html](http://www.bris.ac.uk/Depts/Synaptic/info/glutamate.html)

**THANK YOU FOR  
YOUR ATTENTION**