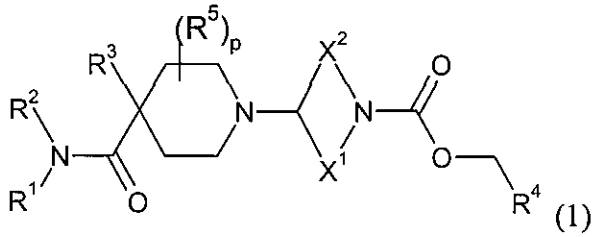
Claims

1. A compound of the formula (1):

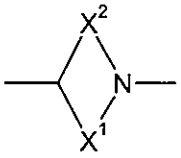


(1)

or a pharmaceutically acceptable salt thereof, wherein:

p is 0, 1 or 2;

X^1 and X^2 are saturated hydrocarbon groups which together contain a total of five to nine carbon atoms and which link together such that the moiety:



forms a bicyclic ring system;

R^1 is a C_{1-10} non-aromatic hydrocarbon group which is optionally substituted with one to six fluorine atoms and wherein one or two, but not all, carbon atoms of the hydrocarbon group may optionally be replaced by a heteroatom selected from O, N and S and oxidised forms thereof;

R^2 is hydrogen;

R^3 is selected from hydrogen; halogen; cyano; or C_{1-3} alkoxy;

R^4 is an acyclic C_{1-6} hydrocarbon group which is optionally substituted with one to six fluorine atoms and wherein one or two, but not all, carbon atoms of the hydrocarbon

group may optionally be replaced by a heteroatom selected from O, N and S and oxidised forms thereof; and

R^5 is fluorine.

2. A compound according to claim 1, wherein R^1 is selected from:
C_{1-6} alkyl optionally substituted with 1 to 6 fluorine atoms;
methoxy-C_{1-4} alkyl optionally substituted with 1 to 6 fluorine atoms;
C_{1-6} alkoxy;
C_{2-6} alkenyl;
C_{2-6} alkynyl;
C_{3-6} cycloalkyl optionally substituted with one or two methyl groups;
C_{4-5} cycloalkyl-CH_2- wherein the C_{4-5} cycloalkyl moiety is optionally substituted with one C_{1-2} alkyl group and wherein one carbon atom of the C_{4-5} cycloalkyl moiety may optionally be replaced by an oxygen atom;
cyclopropyl-C_{1-3} alkyl;
cyclopentenyl; and
methyl-bicyclo[2.2.2]octanyl.

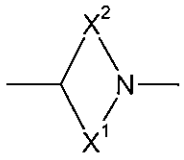
3. A compound according to claim 1 or claim 2, wherein R^1 is selected from 2-methyl propyl; 2,2-dimethylpropyl; tert-butyl; 2-methyl-but-2-yl; 2,3-dimethylbut-2-yl; cyclo-propylmethyl; cyclobutylmethyl; cyclopentyl; cyclopentylmethyl; 1-methylcyclo-butyl; 1-methylcyclopentyl; 1-methylcyclohexyl; 1-methylcyclopentylmethyl; cyclo-propyl-prop-2-yl; 1-methylcyclobutylmethyl and 1-ethyl-cyclobutylmethyl groups.

4. A compound according to any one of claims 1 to 3, wherein R^3 is selected from hydrogen, fluorine and methoxy.

5. A compound according to any one of claims 1 to 4, wherein R^4 is selected from methyl, ethyl, ethynyl and 1-propynyl.

6. A compound according to any one of claims 1 to 5, wherein p is 0.

7. A compound according to any one of claims 1 to 6, wherein the bicyclic ring system formed by the moiety:



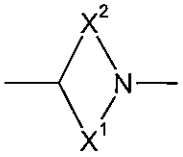
is selected from:

(a) an azabicyclo-octane or azabicyclo-nonane ring system;

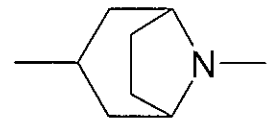
(b) a 2-aza-spiro[3.4]octane or a 6-aza-spiro[3.4]octane ring system; and

(c) a cyclopentanopyrrolidine ring system.

8. A compound according to claim 7, wherein the bicyclic ring system formed by the moiety:



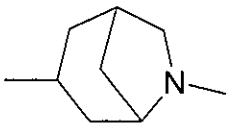
is selected from ring systems BA, BB, BC, CA, CB and DA below:



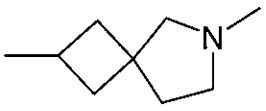
BA



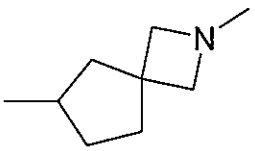
BB



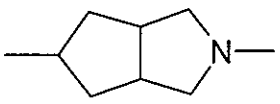
BC



CA

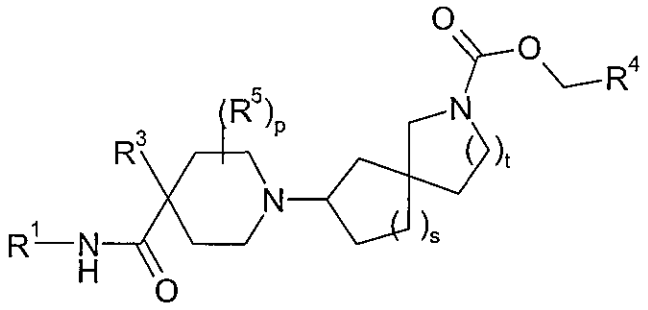


CB



DA

9. A compound according to claim 1, having the formula (3):



(3)

wherein R^1, R^3, R^4, R^5 and p are as defined in any one of claims 1 to 6~~7~~; s is 0 or 1 and t is 0 or 1.

10. A compound according to claim 9, wherein s = 0 and t = 1.

11. A compound according to claim 1, which is selected from
ethyl 3-{4-[(1-methylcyclobutyl)carbamoyl]piperidin-1-yl}-8-azabicyclo[3.2.1]octane-8-carboxylate,
ethyl 3-{4-[(1-methylcyclobutyl)carbamoyl]piperidin-1-yl}-9-azabicyclo[3.3.1]nonane-9-carboxylate,
ethyl 3-{4-[(1-methylcyclobutyl)carbamoyl]piperidin-1-yl}-6-azabicyclo[3.2.1]octane-6-carboxylate,
ethyl 5-{4-[(1-methylcyclobutyl)carbamoyl]piperidin-1-yl}hexahydrocyclopenta[c]-pyrrole-2(1H)-carboxylate,
ethyl 2-{4-fluoro-4-[(1-methylcyclobutyl)carbamoyl]piperidin-1-yl}-6-azaspiro[3.4]-octane-6-carboxylate,
ethyl 6-{4-[(1-methylcyclobutyl)carbamoyl]piperidin-1-yl}-2-azaspiro[3.4]octane-2-carboxylate,
prop-2-yn-1-yl 6-{4-[(1-methylcyclobutyl)carbamoyl]piperidin-1-yl}-2-azaspiro[3.4]-octane-2-carboxylate,
ethyl 2-{4-[(1-methylcyclobutyl)carbamoyl]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate,
ethyl (2r,4s)-2-{4-[(1-methylcyclobutyl)carbamoyl]piperidin-1-yl}-6-azaspiro[3.4]-octane-6-carboxylate,

ethyl (2s,4r)-2-{4-[(1-methylcyclobutyl)carbamoyl]piperidin-1-yl}-6-azaspiro[3.4]-octane-6-carboxylate,

ethyl 2-(4-{[1-(1,1,1-trideuteromethyl)cyclobutyl]carbamoyl}piperidin-1-yl)-6-aza-spiro[3.4]octane-6-carboxylate,

ethyl (2r,4s)-2-(4-{[1-(1,1,1-trideuteromethyl)cyclobutyl]carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,

ethyl (2s,4r)-2-(4-{[1-(1,1,1-trideuteromethyl)cyclobutyl]carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,

ethyl 2-(4-{[1-(1,1,1-trideuteromethyl)-2,2,3,3,4,4-hexadeuterocyclobutyl]carbamoyl}-piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,

ethyl (2r,4s)-2-(4-{[1-(1,1,1-trideuteromethyl)-2,2,3,3,4,4-hexadeuterocyclobutyl]-carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,

ethyl (2s,4r)-2-(4-{[1-(1,1,1-trideuteromethyl)-2,2,3,3,4,4-hexadeuterocyclobutyl]-carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,

ethyl 2-(4-{[1-(fluoromethyl)cyclobutyl]carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]-octane-6-carboxylate,

ethyl (2r,4s)-2-(4-{[1-(fluoromethyl)cyclobutyl]carbamoyl}piperidin-1-yl)-6-aza-spiro[3.4]octane-6-carboxylate,

ethyl (2s,4r)-2-(4-{[1-(fluoromethyl)cyclobutyl]carbamoyl}piperidin-1-yl)-6-aza-spiro[3.4]octane-6-carboxylate,

(2,2,2-trideutero)ethyl 2-{4-[(1-methylcyclobutyl)carbamoyl]piperidin-1-yl}-6-aza-spiro[3.4]octane-6-carboxylate,

(2,2,2-trideutero)ethyl (2r,4s)-2-{4-[(1-methylcyclobutyl)carbamoyl]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate,

(2,2,2-trideutero)ethyl (2s,4r)-2-{4-[(1-methylcyclobutyl)carbamoyl]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate,

(2,2,2-trideutero)ethyl 2-(4-{[1-(1,1,1-trideuteromethyl)cyclobutyl]carbamoyl}-piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,

(2,2,2-trideutero)ethyl (2r,4s)-2-(4-{[1-(1,1,1-trideuteromethyl)cyclobutyl]carbamoyl}-piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,

(2,2,2-trideutero)ethyl (2s,4r)-2-(4-{[1-(1,1,1-trideuteromethyl)cyclobutyl]carbamoyl}-piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,

(2,2,2-trideutero)ethyl 2-(4-{[1-(1,1,1-trideuteromethyl)-2,2,3,3,4,4-hexadeuterocyclobutyl]carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,
(2,2,2-trideutero)ethyl (2r,4s)-2-(4-{[1-(1,1,1-trideuteromethyl)-2,2,3,3,4,4-hexadeuterocyclobutyl]carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,
(2,2,2-trideutero)ethyl (2s,4r)-2-(4-{[1-(1,1,1-trideuteromethyl)-2,2,3,3,4,4-hexadeuterocyclobutyl]carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,
(2,2,2-trideutero)ethyl 2-(4-{[1-(fluoromethyl)cyclobutyl]carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,
(2,2,2-trideutero)ethyl (2r,4s)-2-(4-{[1-(fluoromethyl)cyclobutyl]carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,
(2,2,2-trideutero)ethyl (2s,4r)-2-(4-{[1-(fluoromethyl)cyclobutyl]carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,
(1,1,2,2,2-pentadeutero)ethyl 2-{4-[(1-methylcyclobutyl)carbamoyl]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate,
(1,1,2,2,2-pentadeutero)ethyl (2r,4s)-2-{4-[(1-methylcyclobutyl)carbamoyl]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate,
(1,1,2,2,2-pentadeutero)ethyl (2s,4r)-2-{4-[(1-methylcyclobutyl)carbamoyl]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate,
(1,1,2,2,2-pentadeutero)ethyl 2-(4-{[1-(1,1,1-trideuteromethyl)cyclobutyl]carbamoyl}-piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,
(1,1,2,2,2-pentadeutero)ethyl (2r,4s)-2-(4-{[1-(1,1,1-trideuteromethyl)cyclobutyl]-carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,
(1,1,2,2,2-pentadeutero)ethyl (2s,4r)-2-(4-{[1-(1,1,1-trideuteromethyl)cyclobutyl]-carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,
(1,1,2,2,2-pentadeutero)ethyl 2-(4-{[1-(1,1,1-trideuteromethyl)-2,2,3,3,4,4-hexadeuterocyclobutyl]carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,
(1,1,2,2,2-pentadeutero)ethyl (2r,4s)-2-(4-{[1-(1,1,1-trideuteromethyl)-2,2,3,3,4,4-hexadeuterocyclobutyl]carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,
(1,1,2,2,2-pentadeutero)ethyl (2s,4r)-2-(4-{[1-(1,1,1-trideuteromethyl)-2,2,3,3,4,4-hexadeuterocyclobutyl]carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate.

12. A compound according to claim 11, which is selected from
ethyl (2r,4s)-2-{4-[(1-methylcyclobutyl)carbamoyl]piperidin-1-yl}-6-azaspiro[3.4]-octane-6-carboxylate,
ethyl (2r,4s)-2-(4-{[1-(1,1,1-trideuteromethyl)cyclobutyl]carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,
ethyl (2r,4s)-2-(4-{[1-(1,1,1-trideuteromethyl)-2,2,3,3,4,4-hexadeuterocyclobutyl]-carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,
ethyl (2r,4s)-2-(4-{[1-(fluoromethyl)cyclobutyl]carbamoyl}piperidin-1-yl)-6-azaspiro-[3.4]octane-6-carboxylate,
(2,2,2-trideutero)ethyl (2r,4s)-2-{4-[(1-methylcyclobutyl)carbamoyl]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate,
(2,2,2-trideutero)ethyl (2r,4s)-2-(4-{[1-(1,1,1-trideuteromethyl)cyclobutyl]carbamoyl}-piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,
(2,2,2-trideutero)ethyl (2r,4s)-2-(4-{[1-(1,1,1-trideuteromethyl)-2,2,3,3,4,4-hexa-deuterocyclobutyl]carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,
(2,2,2-trideutero)ethyl (2r,4s)-2-(4-{[1-(fluoromethyl)cyclobutyl]carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,
(1,1,2,2,2-pentadeutero)ethyl (2r,4s)-2-{4-[(1-methylcyclobutyl)carbamoyl]piperidin-1-yl}-6-azaspiro[3.4]octane-6-carboxylate,
(1,1,2,2,2-pentadeutero)ethyl (2r,4s)-2-(4-{[1-(1,1,1-trideuteromethyl)cyclobutyl]-carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate,
(1,1,2,2,2-pentadeutero)ethyl (2r,4s)-2-(4-{[1-(1,1,1-trideuteromethyl)-2,2,3,3,4,4-hexadeuterocyclobutyl]carbamoyl}piperidin-1-yl)-6-azaspiro[3.4]octane-6-carboxylate.

13. A pharmaceutical composition comprising a compound as defined in any one of claims 1 to 12, and a pharmaceutically acceptable excipient.

14. A compound according to claims 1 to 12, for use in the treatment of a cognitive disorder or psychotic disorder or for the treatment or lessening the severity of acute, chronic, neuropathic, or inflammatory pain.