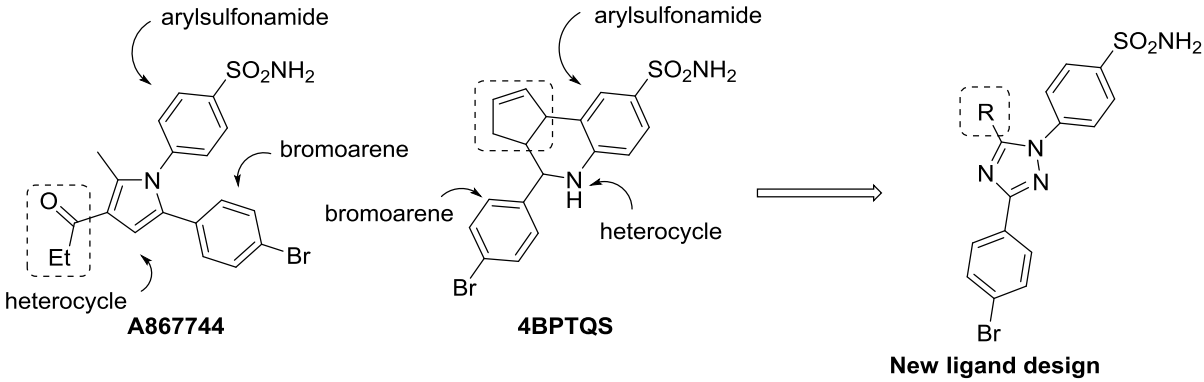
Supporting Information

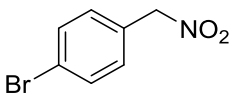
The influence of allosteric modulators and transmembrane mutations on desensitisation and activation of α7 nicotinic acetylcholine receptors.

Anna Chatzidaki, Jarryl M. D'Oyley, JasKiran K. Gill-Thind, Tom D. Sheppard and Neil S. Millar

A novel series of potential allosteric modulators was constructed involving a combination of structural elements from 4BP-TQS[1] and A867744[2]. Both compounds contain an arylsulfonamide unit linked to a heterocyclic core, which has both a bromoarene and a second lipophilic group attached. Five compounds were synthesised containing arylsulfonamide and bromoarene groups attached to a triazole ring but with a variety of groups attached at R (see figure).



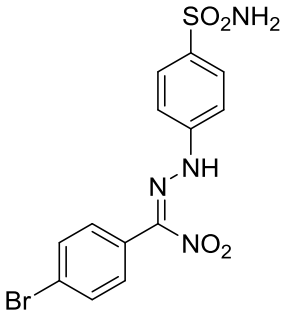
1-Bromo-4-(nitromethyl)benzene[3]



$AgNO_2$ (3 eq) was added to a solution of 4-bromobenzylbromide (1.5 g, 6.09 mmol) in Et_2O (20 mL). The solution was stirred in the dark for 18 h before the solid was filtered off and the solvent removed from the filtrate under reduced pressure. The residue was purified by flash chromatography to give the nitroalkane as a white solid.

White crystals, 720 mg, 55%; Mp 54–56 °C, [55–56 °C][3]; ν_{max} (film/cm^{-1}) 1552 (N-O), 1489 (Ar), 1370 (N-O); ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.58 (2H, d, *J* = 8.4, 2 × ArH), 7.34 (2H, d, *J* = 8.4, 2 × ArH), 5.39 (2H, s, CH_2); ^{13}C NMR (125MHz, $CDCl_3$) δ 132.4, 131.7, 128.6, 124.7, 79.3; LRMS: (CI): 169 ([M-NO_2]$^+$, 100)

(*Z*)-4-(2-((4-Bromophenyl)(nitro)methylene)hydrazinyl)benzenesulfonamide

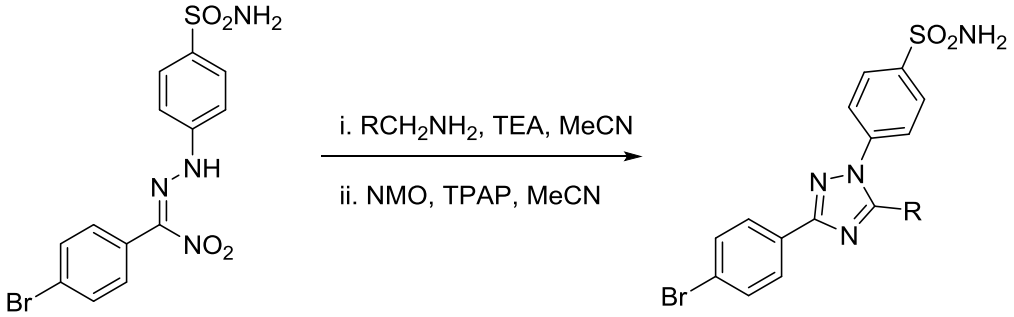


Prepared according to a modified literature procedure.[4]

Sulfanilamide (992 mg, 5.8 mmol) was added to stirring conc. HCl (5 mL) at RT then cooled to -5 °C. A solution of $NaNO_2$ (415 mg, 6.02 mmol) in water (3 mL) was added dropwise over 5 min, then the resulting solution allowed to stir for 30 mins. Sodium acetate (4.7 g, 58 mmol) was then added in one portion and the mixture stirred vigorously. An aliquot of the solution (7.5 mL) was added to a solution of 1-Bromo-4-(nitromethyl)benzene (300 mg, 1.40 mmol) and NaOH (58 mg, 1.4 mmol) in a solution of EtOH/H_2O (30 mL, 4:1). The solution was allowed to stir for 1 h before the precipitate was filtered and the solid was dried to give the *nitrohydrazone* as an orange solid.

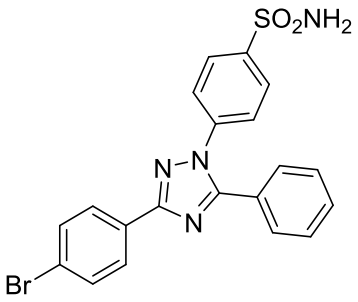
Orange solid; 437 mg, 79%; Mp 165–167 °C; ν_{max} (film/cm^{-1}) 3385 (N-H), 3265 (N-H), 1588 (N-O), 1492 (Ar), 1157 (S=O); ^{1}H NMR (500 MHz, DMSO-d_6) δ 12.03 (1H, s, NH) 7.97 (2H, d, *J* = 8.2, 2 × ArH) 7.63 (2H, d, *J* = 8.6, 2 × ArH) 7.57 (2H, d, *J* = 8.6, 2 × ArH) 7.45 (2H, d, *J* = 8.2, 2 × ArH) 4.76 (2H, s, NH_2); ^{13}C NMR (125 MHz, DMSO-d_6) δ 163.7, 143.4, 142.4, 131.9, 130.1, 127.6, 127.3, 124.0, 116.9; LRMS: (ES): 497 ([M-H]$^+$, 10), 369 (100); HRMS: Found (ES): [M-H]$^+$ 396.9619, $C_{13}H_{10}N_4O_4SBr$ requires 396.9606

General Procedure for synthesis of triazoles[5]



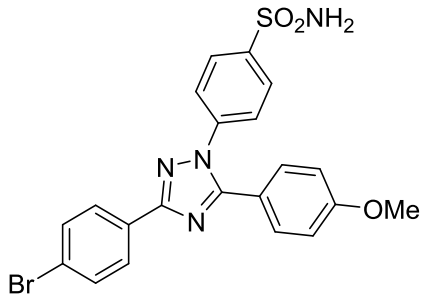
The nitrohydrazone (1 eq) was added to a solution of triethylamine (TEA) (1.2 eq) and primary amine (1.2 eq) in MeCN (1 M) and stirred at RT for 15 h. After this time, the solvent was removed by rotary evaporation, before addition of MeCN (2 mL), tetrapropylammonium perruthenate (TPAP) (0.2 eq) and *N*-methylmorpholine oxide (NMO) (1.5 eq). The solution was stirred for 3 h and then the solvent was removed and the residue purified by flash chromatography to give the triazole.

4-(3-(4-Bromophenyl)-5-phenyl-1*H*-1,2,4-triazol-1-yl)benzenesulfonamide (TBS-345)



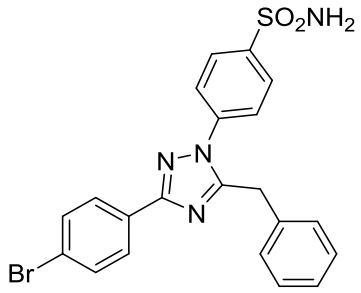
Yellow solid, 23 mg, 50%; Mp 182–186 °C; ν_{max} (film/cm^{-1}) 3315 (N-H), 2922 (C-H), 1599 (Ar), 1484 (Ar), 1342 (S=O), 1162 (S=O); ^{1}H NMR (500 MHz, DMSO-d$_6$) δ 8.06 (2H, d, *J* = 8.4, 2 × ArH), 7.92 (2H, d, *J* = 8.5, 2 × ArH), 7.73 (2H, d, *J* = 8.4, 2 × ArH), 7.67 (2H, d, *J* = 8.5, 2 × ArH), 7.53 (2H, s, NH_2), 7.43 - 7.55 (5H, m, 5 × ArH); ^{13}C NMR (125 MHz, DMSO-d$_6$) δ 160.2, 155.1, 144.3, 140.0, 132.0, 130.5, 129.4, 128.9, 128.8, 128.0, 127.3, 127.0, 126.0, 123.1; LRMS: (CI): 454 ([M]$^+$, 100), 353 (25), 170 (35), 106 (100); HRMS: Found (CI): [M]$^+$ 454.010788, $C_{20}H_{15}O_2N_4SBr$ requires 454.00991.

4-(3-(4-Bromophenyl)-5-(4-methoxyphenyl)-1*H*-1,2,4-triazol-1-yl)benzenesulfonamide (TBS-346)



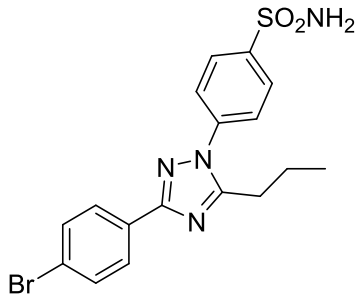
Yellow solid, 19 mg, 40%; Mp 290–294 °C; ν_{max} (film/cm^{-1}) 3400 (N-H), 1655 (Ar), 1023 (S=O); ^{1}H NMR (600 MHz, DMSO-d$_6$) δ 8.05 (2H, d, *J* = 8.3, 2 × ArH), 7.94 (2H, d, *J* = 8.5, 2 × ArH), 7.73 (2H, d, *J* = 8.3, 2 × ArH), 7.69 (2H, d, *J* = 8.5, 2 × ArH), 7.56 (2H, s, NH_2), 7.47 (2H, d, *J* = 8.7, 2 × ArH), 7.02 (2H, d, *J* = 8.7, 2 × ArH) 3.80 (3H, s, CH_3); ^{13}C NMR (150 MHz, DMSO-d$_6$) δ 160.8, 160.1, 155.0, 144.3, 140.3, 132.0, 130.5, 129.5, 128.1, 127.1, 126.0, 123.1, 119.4, 114.3, 55.4; LRMS: (CI): 485 ([M+H]$^+$, 30), 173 (35), 85 (100); HRMS: Found (CI): [M+H]$^+$ 485.026337, $C_{21}H_{18}O_3N_4SBr$ requires 485.02830.

4-(5-Benzyl-3-(4-bromophenyl)-1*H*-1,2,4-triazol-1-yl)benzenesulfonamide (TBS-516)



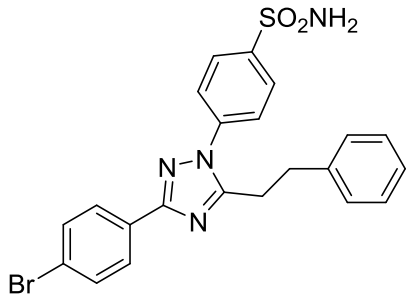
Yellow solid, 38 mg, 45%; Mp 203–205 °C; ν_{max} (film/cm^{-1}) 3365 (N-H), 3266 (N-H), 1595 (Ar), 1494 (Ar), 1328 (S=O), 1157 (S=O); ^{1}H NMR (600 MHz, DMSO-d$_6$) δ 7.99 (2H, d, *J* = 8.7, 2 × ArH), 7.98 (2H, *J* = 8.3, 2 × ArH), 7.83 (2H, d, *J* = 8.7, 2 × ArH), 7.70 (2H, d, *J* = 8.3, 2 × ArH), 7.57 (2H, s, NH_2), 7.28 (2H, t, *J* = 7.3, 2 × ArH), 7.22 (1H, t, *J* = 7.3, ArH), 7.17 (2H, d, *J* = 7.3, 2 × ArH), 4.34 (2H, s, CH_2); ^{13}C NMR (150 MHz, DMSO-d$_6$) δ 159.9, 156.1, 144.3, 139.3, 135.8, 132.0, 129.5, 128.7, 128.6, 128.0, 127.1, 126.9, 125.4, 123.0, 32.1; LRMS: (CI): 469 ([M]$^+$, 100); HRMS: Found (CI): [M]$^+$ 469.030795, $C_{21}H_{17}O_2N_4SBr$ requires 469.03338

4-(3-(4-Bromophenyl)-5-propyl-1*H*-1,2,4-triazol-1-yl)benzenesulfonamide (TBS-546)



Yellow solid, 24 mg, 29%; Mp 204–208 °C; ν_{max} (film/cm^{-1}) 3321 (N-H), 3073 (C-H), 1597 (Ar), 1497 (Ar), 1340 (S=O), 1161 (S=O); ^{1}H NMR (600 MHz, DMSO-d$_6$) δ 8.02 (2H, d, *J* = 8.7, 2 × ArH), 7.99 (2H, d, *J* = 8.5, 2 × ArH), 7.87 (2H, d, *J* = 8.7, 2 × ArH), 7.70 (2H, d, *J* = 8.5, 2 × ArH), 7.58 (2H, s, NH_2), 2.87 (2H, t, *J* = 7.5, C(N)CH_2), 1.75 (2H, sxt, *J* = 7.5, CH_2CH$_3$), 0.92 (3H, t, *J* = 7.5, CH_3); ^{13}C NMR (150 MHz, DMSO-d$_6$) δ 159.7, 157.4, 144.1, 139.4, 131.9, 129.7, 128.0, 127.1, 125.3, 122.9, 28.0, 20.3, 13.6; LRMS: (CI): 421 ([M+H]$^+$, 100), 343 (10); HRMS: Found (CI): [M+H]$^+$ 421.032564, $C_{17}H_{18}O_2N_4SBr$ requires 421.03338

4-(3-(4-Bromophenyl)-5-phenethyl-1*H*-1,2,4-triazol-1-yl)benzenesulfonamide (TBS-556)



Orange powder, 32 mg, 33%; Mp 184–186 °C; ν_{max} (film/cm^{-1}) 3282 (N-H), 3015 (C-H), 1495 (Ar), 1332 (S=O), 1159 (S=O); ^{1}H NMR (600 MHz, DMSO-d$_6$) δ 8.02 (2H, d, *J* = 8.7, 2 × ArH), 7.98 (2H, d, *J* = 8.7, 2 × ArH), 7.74 (2H, d, *J* = 8.5, 2 × ArH), 7.72 (2H, d, *J* = 8.5, 2 × ArH), 7.56 (2H, s, NH_2), 7.23 - 7.27 (2H, m, 2 × ArH), 7.16 - 7.20 (3H, m, 3 × ArH), 3.19 (2H, t, *J* = 7.8, C(N)CH_2), 3.09 (2H, t, *J* = 7.8, PhCH_2); ^{13}C NMR (150 MHz, DMSO-d$_6$) δ 159.7, 156.8, 144.1, 140.3, 139.3, 132.0, 129.6, 128.44, 128.38, 128.0, 127.1, 126.3, 125.2, 122.9, 32.7, 28.2; LRMS: (CI): 483 ([M+H]$^+$, 100), 111 (55); HRMS: Found (CI): [M+H]$^+$ 483.047112, $C_{22}H_{20}O_2N_4SBr$ requires 483.04903

References

(1) Gill, J. K.; Dhankher, P.; Sheppard, T. D.; Sher, E.; Millar, N. S. *Mol. Pharmacol.* **2012**, *81*, 710–718.

(2) Faghih, R.; Gopalakrishnan, S. M.; Gronlien, J. H.; Malysz, J.; Briggs, C. A.; Wetterstrand, C.; Ween, H.; Curtis, M. P.; Sarris, K. A.; Gfesser, G. A.; El-kouhen, R.; Robb, H. M.; Radek, R. J.; Marsh, K. C.; Bunnelle, W. H.; Gopalakrishnan, M. *In Vitro* **2009**, 3377–3384.

(3) Kornblum, N.; Brown, R. A. *J. Am. Chem. Soc.* **1964**, *86*, 2681–2687.

(4) Avramenko, G. V; Bezulglaya, Z. V; Stepanov, B. I.; Sheban, G. V. *J. Gen. Chem. USSR* **1990**, *60*, 364.

(5) El Kaim, L.; Gizzi, M.; Grimaud, L. *Synlett* **2010**, 1771–1774.