Nonconventional Carbon Additions to Azomethines. Aryl Amination/Indoline Synthesis by Direct Aryl Radical Addition to Azomethine Nitrogen.

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Supporting Information

Flame-dried (under vacuum) glassware was used for all non-aqueous reactions. All reagents and solvents were commercial grade and purified prior to use when necessary. Diethyl ether (Et_2O), tetrahydrofuran (THF), dichloromethane (CH_2Cl_2), and benzene (C_6H_6) were dried by passage through a column of activated alumina as described by Grubbs.[1] Benzene was additionally passed through a column containing activated Q-5 reactant. Solvents other than benzene were degassed using the freeze-pump-thaw method when necessary. All additional solvents were dried by distillation from calcium hydride when necessary. Molecular sieves (spheres, 4Å) were calcined at 400 °C and stored at room temperature in an air-tight container. AIBN was recrystallized prior to use, and tri-*n*-butyl tin hydride ($^nBu_3SnH$) was used as received from Aldrich.[2] Preparations for previously unreported phenethyl amine derivatives used in this study will be reported later in an Article after optimization.

Thin layer chromatography (TLC) was performed using glass-backed silica gel (250 μ) plates and flash chromatography utilized 230–400 mesh silica gel from Scientific Adsorbents. Neutral Alumina was used as received from Scientific Adsorbents for chromatography of acid-sensitive intermediates or products. Products were visualized by UV light, iodine, and/or the use of ceric ammonium molybdate, potassium permanganate, ninhydrin, *p*-anisaldehyde, and potassium iodoplatinate solutions.

IR spectra were recorded on a Nicolet Avatar 360 spectrophotometer. Liquids and oils were analyzed as neat films on a salt plate (transmission), whereas solids were applied to a diamond plate (ATR). Nuclear magnetic resonance spectra (NMR) were acquired on either a Varian Inova-400 or VXR-400 instrument. Chemical shifts are measured relative to

tetramethylsilane, as judged by the residual partially deuterated solvent peak. Mass spectra were obtained using a Kratos MS-80 spectrometer using the ionization technique indicated. Combustion analyses were performed on a Perkin-Elmer 2400 Series II CHNS/O Analyzer.

Ratios of diastereomers and isomeric products were measured directly from integration of ^{1}H NMR absorptions of protons common to the components. Precision was checked by varying the relaxation delay for measurements on the same compound. Where possible, ratios were corroborated using GC-mass spectrometry. Peak assignments were made from authentic samples in every case. Ratios reported generally represent a lower limit defined by multiple runs.

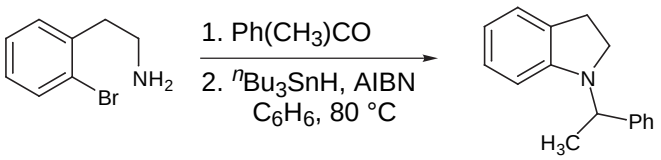
General Procedure for Ketimine Condensations

A rapidly stirred benzene solution of the amine (0.5 M), ketone (0.5 M), and 4Å MS (1:1 w/w) was stirred at 25 °C until complete conversion was achieved, as evidenced by ^{1}H NMR. The mixture was filtered through a pad of Celite and washed with Et_2O or benzene. The solvent was removed *in vacuo* to give the analytically pure ketimine which was used immediately.

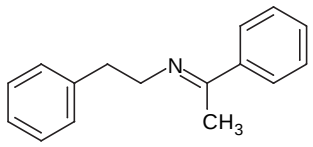
The same procedure was used when the benzophenone ketimine was desired, except benzophenone imine[3] was used in place of the ketone.[4]

General Procedure for Aryl Aminations

A benzene solution of the ketimine (0.01 M) was warmed to 85 °C in a round-bottomed flask equipped with a condenser. A benzene solution (1 mL) of ^{n}Bu$_3$SnH (1.1 equiv) and AIBN (0.4 equiv) was loaded into a gas-tight syringe and was attached to a syringe pump. The syringe needle was attached through a septum at the top of the condenser (w/N_2 line) so that the solution droplets would fall directly into the refluxing benzene. Following the addition, the reaction mixture was refluxed for an additional period (~1 h) and cooled to room temperature. At this point, an aliquot was removed, concentrated, and component ratios were measured by ^{1}H NMR and/or GC-MS. The solution was treated with $NaBH_4$ (1.1 equiv) and the slurry was stirred 4–5 hours. The mixture was concentrated *in vacuo*, diluted with Et_2O, and washed with water. The organic layer was separated, dried ($MgSO_4$), and concentrated to furnish an oil. Flash chromatography of the crude mixture provided the analytically pure targeted compounds.



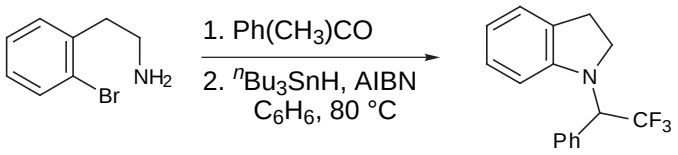
***N*-(1-Methylbenzyl)indoline (2a)**. Following the general procedure, *o*-bromophenethylamine (46 mg, 231 mmol), acetophenone (27 µL, 231 mmol), and 4Å MS were stirred in benzene (1 mL) at room temperature for 12 h. Filtering of the mixture through Celite and removal of the solvent provided the ketimine as a >95:5 mixture of stereoisomers. IR (film) 3056, 1633 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 (m, 2H), 7.57 (d, *J* = 6.9 Hz, 2H), 7.40 (t, *J* = 3.1 Hz, 3H), 7.34 (d, *J* = 6.0 Hz, 1H), 7.26 (t, *J* = 6.3 Hz, 1H), 7.10 (t, *J* = 6.0 Hz, 1H), 3.79 (dd, *J* = 7.8, 7.8 Hz, 2H), 3.22 (dd, *J* = 7.8, 7.8 Hz, 2H), 2.17 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 166.0, 142.0, 140.0, 133.0, 131.7, 129.7, 128.5, 128.1, 127.6, 126.9, 52.2, 37.8, 18.1; HRMS (EI): Exact mass calcd for $C_{16}H_{16}BrN$ $[M+H]^+$, 302.0544. Found 302.0516.



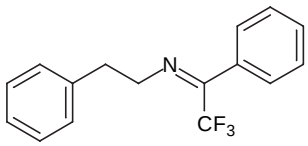
The phenethylamine ketimine was similarly prepared. IR (film): 3083, 1685 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 (m, 2H), 7.40 (t, *J* = 3.0 Hz, 3H), 7.31 (m, 5H), 3.76 (dd, *J* = 7.6, 7.6 Hz, 2H), 3.10 (dd, *J* = 7.6, 7.6 Hz, 2H), 2.14 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 165.9, 141.6, 140.9, 129.7, 129.3, 128.6, 128.5, 126.8, 126.3, 126.1, 54.4, 37.8, 15.7; HRMS (EI): Exact mass calcd for $C_{16}H_{17}N$ $[M]^+$, 223.1361. Found 223.1360.

A three hour addition of a $^{n}Bu_3SnH$ (68 µL, 0.25 mmol) and AIBN (15 mg, 93 µmol) solution in benzene (0.7 mL) to a refluxing solution of the unpurified ketimine (69.6 mg, 231 µmol) in benzene (23 mL) delivered, after flash chromatography (2% CH_2Cl_2 in hexanes), 44.9 mg (87%) of the desired indoline as a colorless oil. R_f = 0.62 (30% CH_2Cl_2/hexanes); IR (film) 3046, 1606 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.41 (d, *J* = 7.5 Hz, 2H), 7.29 (t, *J* = 7.2 Hz, 2H), 7.26 (t, *J* = 7.2 Hz, 1H), 7.08 (d, *J* = 7.2 Hz, 1H), 7.00 (t, *J* = 7.8 Hz, 1H), 6.6 (t, *J* = 7.2 Hz, 1H), 6.36 (d, *J* = 7.8 Hz, 1H), 4.68 (q, *J* = 6.8 Hz, 1H), 3.42 (ddd, *J* = 18.1, 9.1, 0 Hz,

1H), 3.35 (ddd, *J* = 15.7, 7.4, 0 Hz, 1H), 2.96 (dd, *J* = 8.5, 8.3 Hz, 2H), 2.58 (d, *J* = 6.8 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 151.1 143.0 128.7, 127.4, 127.3, 127.1, 124.6, 117.2, 107.5, 54.8, 48.2, 28.5, 16.8; HRMS (EI): Exact mass calcd for $C_{16}H_{17}N$ $[M]^+$, 223.1361. Found 223.1366.



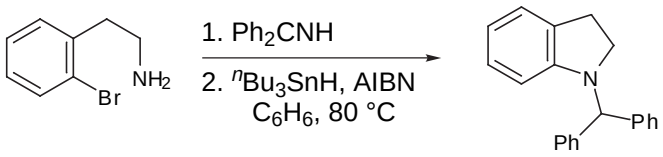
***N*-(1-Trifluoromethyl)benzyl indoline (2b).** Following the general procedure, *o*-bromophenethylamine (852 mg, 4.25 mmol), trifluoroacetophenone (590 µL, 4.21 mmol), and 4Å MS were stirred in toluene (10 mL) at room temperature for 12 h to provide the ketimine as a >95:5 mixture of stereoisomers. IR (film) 3062, 1669 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.49 (d, *J* = 7.9 Hz, 1H), 7.44 (t *J* = 7.4 Hz, 1H), 7.38 (t, *J* = 7.1 Hz, 2H), 7.24 (t, *J* = 7.4 Hz, 1H), 7.18 (d, *J* = 6.0 Hz, 1H), 7.10 (t, *J* = 6.0 Hz, 1H), 6.94 (d, *J* = 7.1 Hz, 2H), 3.69 (dd, *J* = 7.1, 7.1 Hz, 2H), 3.13 (dd, *J* = 7.1, 7.1 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 138.4, 133.0, 131.7, 130.3, 130.1, 128.8, 128.4, 127.7, 127.5, 124.9, 52.8 36.8; HRMS (EI): Exact mass calcd for $C_{16}H_{13}F_3N$ $[M–Br]^+$, 276.1000. Found 276.1003.



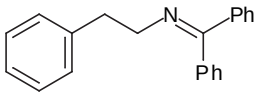
The phenethylamine ketimine was similarly prepared. IR (film) 3063, 1669 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.43 (t, *J* = 7.2 Hz, 1H), 7.37 (t, *J* = 7.6 Hz, 2H), 7.23 (m, *J* = 6.8 Hz, 3H), 7.10 (d, *J* = 6.7 Hz, 2H), 6.90 (d, *J* = 7.3 Hz, 2H), 3.65 (dd, *J* = 7.2, 7.2 Hz, 2H), 3.0 (dd, *J* = 7.1, 7.1 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 158.9, 139.3, 130.4, 130.1, 129.3, 128.8, 128.6, 127.8, 126.6, 121.3, 118.5, 55.0, 36.7; HRMS (CI) Exact mass calcd for $C_{16}H_{14}F_3N$ $[M]^+$, 277.1078. Found 277.1081

A three hour addition of ^{n}Bu_3SnH (184 µL, 682 µmol) and AIBN (41 mg, 248 µmol) solution in benzene (2.5 mL) to a refluxing solution of the unpurified ketimine (220 mg, 620 µmol) in benzene (62 mL) delivered, after flash chromatography (5% CH_2Cl_2 in hexanes), 133 mg

(77%) of the desired indoline as a colorless oil. R_f = 0.35 (5% EtOAc/hexanes); IR (film) 3031, 1607 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40 (m, 5H), 7.11 (t, *J* = 7.9 Hz, 1H), 7.09 (d, *J* = 7.4 Hz, 1H), 6.71 (t, *J* = 7.4 Hz, 1H), 6.62 (d, *J* = 7.9 Hz, 1H), 5.24 (q, *J* = 8.7 Hz, 1H), 3.62 (dd, *J* = 14.2, 8.7, Hz, 1H), 3.19 (dd, *J* = 10.1, 8.9, Hz, 1H), 3.01 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 150.5, 131.9, 129.3, 129.0, 127.6, 127.5, 125.1, 124.7, 118.5, 106.4, 62.0 (q, *J* = 30.5 Hz, 1C), 48.6, 28.5; HRMS (EI): Exact mass calcd for $C_{16}H_{14}F_3N$ $[M]^+$, 277.1078. Found 277.1071.

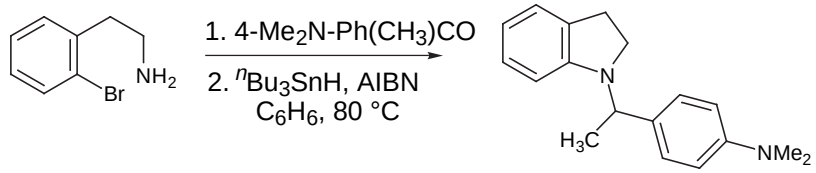


***N*-(1-Phenylbenzyl)indoline (2c).** Following the general procedure, *o*-bromophenethylamine (471 mg, 2.35 mmol) and benzophenone imine (426 mg, 2.35 mmol) were stirred for 12 h in dichloromethane (4 mL). Removal of the solvent provided the ketimine. IR (film) 3056, 1660, 1623 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.61 (d, *J* = 6.8 Hz, 2H), 7.49 (d, *J* = 7.0 Hz, 1H), 7.40 (m, *J* = 3.8 Hz, 3H), 7.35 (m, *J* = 7.0 Hz, 3H), 7.24 (t, *J* = 5.8 Hz, 1H), 7.19 (d, 6.8 Hz, 1H), 7.05 (t, *J* = 5.8 Hz, 1H), 6.98 (m, *J* = 3.8 Hz, 2H), 3.68 (dd, *J* = 7.2, 7.2 Hz, 2H), 3.14 (dd, *J* = 7.4, 7.4, Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 169.0, 140.0, 139.8, 136.9, 132.9, 131.6, 130.1, 128.65, 128.61, 128.4, 128.2, 127.9, 127.4, 125.0, 53.6, 37.9; HRMS (CI): Exact mass calcd for $C_{21}H_{18}BrN$ $[M+H]^+$, 364.0701. Found 364.0596.

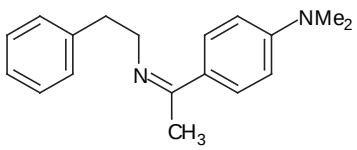


The phenethylamine ketimine was similarly prepared. IR (film) 3080, 1623 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.61 (d, *J* = 6.8 Hz, 2H), 7.40 (t, *J* = 3.5 Hz, 3H), 7.36 (t, *J* = 7.0 Hz, 3H), 7.25 (t, *J* = 7.0 Hz, 2H), 7.18 (d, *J* = 7.0 Hz, 1H), 7.16 (d, *J* = 7.0 Hz, 2H), 6.97 (d, *J* = 3.5 Hz, 2H), 3.66 (dd, *J* = 7.4, 7.4, Hz, 2H), 3.03 (dd, *J* = 7.5, 7.5, Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 168.7, 140.6, 140.1, 137.0, 130.1, 129.3, 128.6, 128.5, 128.4, 128.3, 127.9, 126.1, 55.8, 37.9; HRMS (EI): Exact mass calcd for $C_{21}H_{19}N$ 285.1517. Found 285.1517.

A three hour addition of a $^{n}Bu_3SnH$ (70 µL, 254 µmol) and AIBN (5 mg, 9.2 µmol) solution in benzene (1.0 mL) to a refluxing solution of the unpurified ketimine in benzene (23 mL) delivered, after flash chromatography (2% CH_2Cl_2 in hexanes), 56.8 mg (86%) of the desired indoline as a white solid. mp 62–63 °C. R_f = 0.53 (10% EtOAc in hexanes); IR (film) 3025, 1605 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.35 (m, 10H), 7.09 (d, *J* = 7.0 Hz, 1H), 6.92 (t, *J* = 7.5 Hz, 1H), 6.64 (t, *J* = 7.0 Hz, 1H), 6.20 (d, *J* = 7.5 Hz, 1H), 5.55 (s, 1H), 3.20 (dd, *J* = 8.3, 8.2 Hz, 2H), 2.96 (dd, *J* = 8.3, 8.2 Hz, 2H), ^{13}C NMR (100 MHz, $CDCl_3$) ppm 152.1, 141.5, 130.5, 128.7, 128.6, 127.4, 127.3, 124.5, 117.7, 66.8, 51.6, 28.5; HRMS (EI): Exact mass calcd for $C_{21}H_{19}N$ $[M]^+$, 285.1517. Found 285.1520.



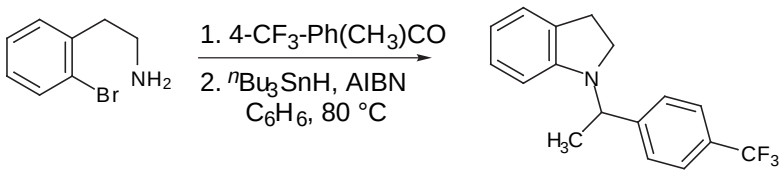
***N*-[(1-Methyl)-4-dimethylaminobenzyl]-indoline (2d).** According to the general procedure, *o*-bromophenethylamine (100 mg, 500 µmol), aceto(*p*-N,N'-dimethylamino)phenone (81.5 mg, 500 µmol), and 4Å MS were stirred in benzene (6 mL) at room temperature for 4 h to provide the ketimine as a >95:5 mixture of stereoisomers. IR (film) 3050, 1602 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.63 (d, *J* = 9.0 Hz, 2H), 7.46 (dd, *J* = 8.1, 1.1 Hz, 1H), 7.25 (dd, *J* = 7.6, 1.5 Hz, 1H), 7.15 (dt, *J* = 7.4, 1.1 Hz, 1H), 6.98 (dt, *J* = 6.7, 1.6 Hz, 1H), 6.61 (d, *J* = 9.0 Hz, 2H), 3.65 (t, *J* = 7.4 Hz, 2H), 3.10 (t, *J* = 7.4 Hz, 2H), 2.91 (s, 6H), 2.03 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 165.4, 151.6, 143.1, 140.3, 132.9, 131.6, 129.5, 128.0, 124.9, 111.7, 51.9, 40.6, 38.01, 15.09; HRMS (EI): Exact mass calcd for $C_{18}H_{21}BrN_2$ $[M]^+$, 334.0888. Found 344.0824.



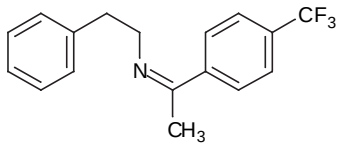
In a similar manner, the ketimine of phenethylamine was prepared as a colorless solid, mp 59–62 °C; IR (film) 3059, 1659 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.64 (d, *J* = 9.0 Hz, 2H),

7.22–7.18 (m, 4H), 7.13 (dd, *J* = 8.6, 4.5 Hz, 1H), 6.62 (d, *J* = 8.9 Hz, 2H), 3.64 (t, *J* = 7.7 Hz, 1H), 2.97 (t, *J* = 7.8 Hz, 1H), 2.92 (s, 6H), 2.01 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 165.2, 151.9, 141.2, 129.2, 128.5, 127.9, 126.1, 112.0, 54.1, 40.6, 38.0, 15.2; HRMS (EI): Exact mass calcd for $C_{18}H_{22}N_2$ $[M]^+$, 266.1783. Found 266.1790

A five hour addition of a $^nBu_3SnH$ (56 µL, 207 µmol) and AIBN (12 mg, 75 µmol) solution in benzene (1 mL) to a refluxing solution of the unpurified ketimine (65 mg, 188 µmol) in benzene (18 mL) delivered, after flash chromatography (50% CH_2Cl_2 in hexanes), 45 mg (90%) of the desired indoline as a crystalline solid, mp 79-82 °C; R_f = 0.15 (50% CH_2Cl_2/hexanes; IR (film) 2960, 1653 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.28 (t, *J* = 4.2 Hz, 2H), 7.03 (dd, *J* = 17.5, 7.2 Hz, 2H), 6.73 (d, *J* = 8.8 Hz, 2H), 6.50 (t, *J* = 7.3 Hz, 1H), 6.44 (d, *J* = 7.9 Hz, 1H), 4.71 (q, *J* = 6.8 Hz, 1H), 3.37 (q, *J* = 18.0, 9.2 Hz, 1H), 3.27 (q, *J* = 15.2, 8.4 Hz, 1H), 2.95 (s, 6H), 2.93 (t, *J* = 8.0 Hz, 2H), 1.51 (d, *J* = 6.9 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 128.2, 127.4, 124.8, 116.8, 112.6, 107.3, 92.1, 86.3, 53.9, 47.9, 41.0, 28.4, 16.3; HRMS (EI): Exact mass calcd for $C_{18}H_{22}N_2$ $[M]^+$, 266.1783. Found 266.1774.

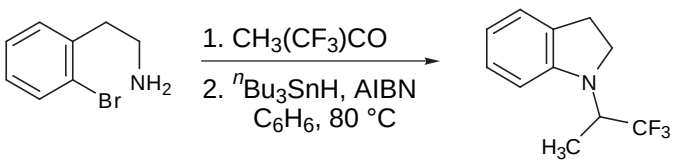


***N*-[(1-Methyl)-4-dimethylaminobenzyl]-indoline (2e).** Following the general procedure, *o*-bromophenethylamine (429 mg, 2.14 mmol), *p*-trifluoromethyl acetophenone (404 mg, 2.14 mmol), and 4Å MS were stirred in benzene (5 mL) at room temperature for 4.5 h to provide the ketimine as a 93:7 mixture of stereoisomers. IR (film) 3064, 1636 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87 (d, *J* = 8.2 Hz, 2H), 7.46 (d, *J* = 8.3 Hz, 2H), 7.57 (d, *J* = 7.8 Hz, 1H), 7.38 (s, 1H), 7.33-7.21 (m, 1H), 7.10 (t, *J* = 7.7 Hz, 1H), 3.81 (t, *J* = 7.3 Hz, 2H), 3.23 (t, *J* = 7.3 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 164.9, 144.6, 139.8, 133.0, 131.7, 128.6, 128.7, 129.6, 127.6, 127.2, 125.6, 124.9, 52.3, 37.7, 15.7; HRMS (FAB): Exact mass calcd for $C_{17}H_{16}BrF_3N$ $[M+H]^+$, 370.0418. Found 370.0428.



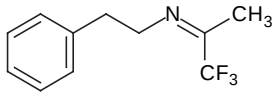
In a similar manner, the ketimine of phenethylamine was prepared as a colorless oil; IR (film) 3063, 1636 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.88 (d, *J* = 8.3 Hz, 2H), 7.65 (d, *J* = 8.3 Hz, 2H), 7.39 (s, 2H), 7.35-7.23 (m, 3H), 3.79 (t, *J* = 7.4 Hz, 2H), 3.11 (t, *J* = 7.5 Hz, 2H), 2.14 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 164.6, 144.6, 140.7, 129.2, 128.6, 128.6, 127.2, 126.4, 123.0, 54.4, 37.6, 15.7; HRMS (FAB): Exact mass calcd for $C_{17}H_{17}F_3N$ $[M+H]^+$, 292.1313. Found 292.1319.

A three hour addition of a $^nBu_3SnH$ (91 µL, 337 µmol) and AIBN (20 mg, 123 µmol) solution in benzene (1 mL) to a refluxing solution of the unpurified ketimine (113 mg, 307 µmol) in benzene (31 mL) delivered, after flash chromatography (20% CH_2Cl_2 in hexanes), 65 mg (72%) of the desired indoline as a colorless oil; R_f = 0.40 (10% EtOAc/hexanes; IR (film) 3048, 1606 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.61 (d, *J* = 8.3 Hz, 2H), 7.54 (d, *J* = 8.3 Hz, 2H), 7.10 (d, *J* = 6.9 Hz, 1H), 7.01 (t, *J* = 7.5 Hz, 1H), 6.65 (t, *J* = 7.1 Hz, 1H), 6.31 (d, *J* = 7.9 Hz, 1H), 4.73 (q, *J* = 6.8 Hz, 1H), 3.43 (dd, *J* = 17.9, 8.7 Hz, 1H), 3.37 (dd, *J* = 15.7, 7.4 Hz, 1H), 2.99 (t, *J* = 8.3 Hz, 2H), 1.57 (d, *J* = 6.9 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 151.3, 147.5, 130.4, 127.5, 127.4, 125.7, 125.6, 124.8, 54.9, 48.5, 28.5, 17.1; HRMS (EI): Exact mass calcd for $C_{17}H_{16}F_3N$ $[M]^+$, 291.1235. Found 291.1234.



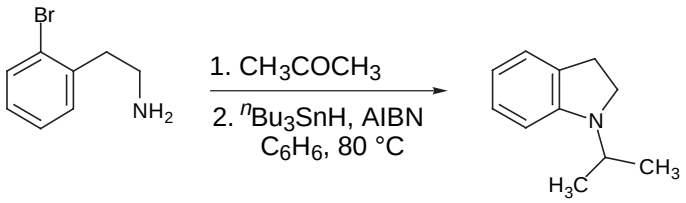
***N*-(1-Trifluoroethyl)-indoline (2f).** Following the general procedure, *o*-bromophenethylamine (200 mg, 999 µmol), trifluoroacetone (168 mg, 1.5 mmol), and 4Å MS were stirred in benzene (5 mL) at room temperature for 4 h to provide the ketimine as a >95:5 mixture of stereoisomers. IR (film) 3059, 1686 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.57 (d, *J* = 8.3 Hz, 1H), 7.29–7.22 (m, 2H), 7.13 (dt, *J* = 6.8, 2.4 Hz, 1H), 3.75 (t, *J* = 7.3 Hz, 2H), 3.17 (t, *J* = 7.3 Hz, 2H); 1.85 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 157.3 (q, *J* = 33.6 Hz),

138.6, 133.1, 131.8, 127.8, 124.7, 121.4, 118.6, 51.4, 36.6, 12.6; HRMS (EI): Exact mass calcd for $C_{11}H_{13}BrF_3N$ $[M+H]^+$, 296.0086. Found 296.0088.



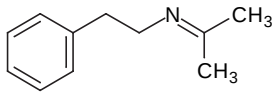
In a similar manner, the ketimine derived from phenethylamine was prepared. IR (film) 3088, 1686 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.34 (dd, *J* = 7.0, 7.0 Hz, 2H), 7.27 (t, *J* = 6.6 Hz, 1H), 7.26 (d, *J* = 6.9 Hz, 2H), 3.74 (t, *J* = 7.3 Hz, 2H), 3.06 (t, *J* = 7.3 Hz, 2H), 1.81 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 156.9 (q, *J* = 32.8 Hz), 139.6, 129.2, 128.8, 126.7, 120.1, 53.6, 36.4, 12.5; HRMS (EI): Exact mass calcd for $C_{11}H_{12}F_3N$ $[M]^+$, 215.0922. Found 215.0928.

A three hour addition of a $^nBu_3SnH$ (133 µL, 495 µmol) and AIBN (30 mg, 180 µmol) solution in benzene (1 mL) to a refluxing solution of the unpurified ketimine (132 mg, 450 µmol) in benzene (44 mL) provided, after flash chromatography (100% hexanes), 80 mg (83%) of the desired indoline as a colorless oil. R_f = 0.15 (hexanes); IR (film) 3050, 1490 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.07 (t, *J* = 7.9 Hz, 2H), 6.65 (t, *J* = 7.3 Hz, 1H), 6.44 (d, *J* = 7.8 Hz, 1H), 4.14 (m, 1H), 3.54 (t, *J* = 8.5 Hz, 2H), 3.03 (t, *J* = 8.6 Hz, 2H), 1.38 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 150.3, 129.3, 127.5, 125.0, 118.2, 114.0, 106.3, 52.8 (q, *J* = 28.2 Hz), 47.1, 28.5, 10.5; HRMS (EI): Exact mass calcd for $C_{11}H_{12}F_3N$ $[M]^+$, 215.0922. Found 215.0920.



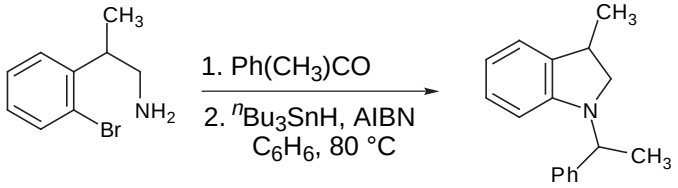
***N*-(*iso*-Propyl)-indoline (2g).** Following the general procedure, *o*-bromophenethylamine (150 mg, 750 µmol), acetone (44 mg, 750 µmol) and 4Å MS were stirred in benzene (5 mL) at room temperature for 4 h to provide the ketimine. IR (film) 3055, 1653 cm^{-1} ^1H NMR (400 MHz, $CDCl_3$) δ 7.50 (d, *J* = 8.3 Hz, 1H), 7.24–7.18 (m, 2H), 7.04 (td, *J* = 6.9, 2.3 Hz, 1H), 3.46 (t, *J* = 7.5 Hz, 2H), 3.06 (t, *J* = 7.7 Hz, 2H), 1.99 (s, 3H), 1.71 (s, 3H); ^{13}C NMR (100 MHz,

$CDCl_3$) ppm 168.3, 139.9, 133.0, 131.4, 128.1, 127.6, 124.9, 51.6, 37.7, 29.5, 18.6; HRMS (EI) Calcd for $C_{11}H_{15}BrN$ $[MH]^+$, 240.0310. Found 240.0389



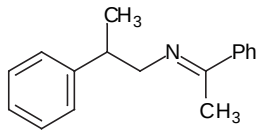
The analogous phenethylamine ketimine was similarly prepared. IR (film) 3080, 1665 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.33 (t, *J* = 8.1 Hz, 2H), 7.28–7.24 (m, 3H), 3.52 (t, *J* = 7.8 Hz, 2H), 3.00 (t, *J* = 7.8 Hz, 2H), 2.05 (s, 3H), 1.74 (s, 3H), ^{13}C NMR (100 MHz, $CDCl_3$) ppm 169.9, 140.8, 129.1, 128.8, 126.3, 53.7, 37.7, 29.5, 18.6; HRMS (EI) Exact mass calcd for $C_{11}H_{15}N$ $[M]^+$, 161.1204. Found 161.1200.

A three-hour addition of $^nBu_3SnH$ (154 µL, 573 µmol) and AIBN (34 mg, 208 µmol) solution in benzene (1 mL) to a refluxing solution of the unpurified ketimine (125 mg, 521 µmol) in benzene (50 mL) delivered, after flash chromatography (30% CH_2Cl_2/Hexanes) 0.024 g (30%) of the desired indoline as a colorless oil. R_f = 0.1 (30% CH_2Cl_2/Hexanes); IR (film) 3047, 1607 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.04 (t, *J* = 6.7 Hz, 2H), 6.59 (t, *J* = 7.4 Hz, 1H), 6.42 (d, *J* = 8.1 Hz, 1H), 3.83 (sep, *J* = 6.6 Hz, 1H), 3.33 (t, *J* = 8.5 Hz, 2H), 2.93 (t, *J* = 8.3 Hz, 2H), 1.15 (d, *J* = 6.7 Hz, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 151.5, 130.5, 127.5, 124.6, 117.1, 107.3, 46.0, 45.7, 28.4, 18.4; HRMS (EI) Exact mass calcd for $C_{11}H_{15}N$ $[M]^+$, 161.1204. Found 161.1201.



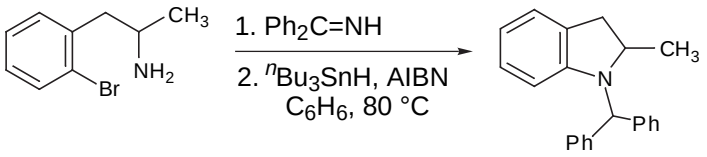
***N*-(1-Methylbenzyl)-3-methylindoline (5a).** Following the general procedure, 2-(*o*-bromophenyl)-2-methyl-ethylamine (353 mg, 1.65 mmol), acetophenone (192 µL, 1.64 mmol), and 4Å MS were stirred in toluene (5 mL) at room temperature for 12 h to provide the ketimine as a >95:5 mixture of stereoisomers. IR (film) 3057, 1633 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.80 (m, 2H), 7.59 (d, *J* = 6.9 Hz, 1H), 7.39 (m, 4H), 7.31 (t, *J* = 6.9 Hz, 1H), 7.08 (t, *J* = 6.1 Hz, 1H), 3.76 (dd, *J* = 10.5, 6.3, Hz, 2H), 3.57 (dq, *J* = 13.8, 6.9 Hz, 1H), 2.19 (s, 3H), 1.45 (d, *J*

= 6.7 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 165.5, 144.9, 141.4, 133.0, 129.6, 128.6, 128.4, 128.3, 127.8, 127.6, 126.8, 125.1, 58.1, 39.9, 18.8, 15.7; HRMS (EI): Exact mass calcd for $C_{17}H_{19}BrN$ $[M+H]^+$, 316.0701. Found 316.0588.

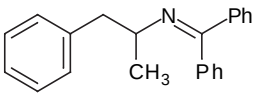


In a similar manner, the ketimine of 2-methyl-2-phenylethylamine was prepared. IR (film) 3083, 1634 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) 7.76 (m, 2H), 7.39 (t, *J* = 3.1 Hz, 3H), 7.30 (m, 4H), 7.24 (t, *J* = 3.9 Hz, 1H), 3.69 (dd, *J* = 13.9, 5.9 Hz, 1H), 3.59 (dd, *J* = 13.7, 7.9 Hz, 1H), 3.30 (dq, *J* = 13.8, 7.0 Hz, 1H), 2.13 (s, 3H), 1.44 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 165.4, 146.2, 141.6, 129.6, 128.5, 128.4, 127.6 126.8, 126.3, 60.1, 41.5, 19.5, 15.7; HRMS (EI): Exact mass calcd for $C_{17}H_{19}N$ $[M]^+$, 237.1517. Found 237.1521.

A three hour addition of ^{n}Bu$_3$SnH (84 µL, 314 µmol) and AIBN (18.7 mg, 114 µmol) benzene solution (1 mL) to a refluxing solution of the unpurified ketimine (90.3 mg, 286 µmol) in benzene (28 mL) afforded, after flash chromatography (1% ether in hexanes), 58.4 mg (86%) of the desired indoline as a yellow oil (58:42 mixture of diastereomers). R_f = 0.6 (10% EtOAc/hexanes); IR (film) 3024, 1605 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.43 (d, *J* = 7.5 Hz, 4H), 7.35 (t, *J* = 7.5 Hz, 6H), 7.03 (d, *J* = 8.0 Hz, 2H), 7.01 (t, *J* = 4.3 Hz, 2H), 6.65 (t, *J* = 7.4 Hz, 2H), 6.36 (d, *J* = 4.3 Hz, 2H), 4.74 (q, *J* = 6.9 Hz, 1H), 4.68 (q, *J* = 6.8 Hz, 1H), 3.62 (dd, *J* = 8.8, 8.8 Hz, 1H), 3.45 (dd, *J* = 8.6, 8.6 Hz, 1H), 3.30 (dq, *J* = 14.6, 7.3 Hz, 1H), 2.95 (dd, *J* = 8.8, 8.8 Hz, 2H), 1.57 (d, *J* = 7.0 Hz, 3H), 1.52 (d, *J* = 6.9 Hz, 3H), 1.33 (d, *J* = 6.7 Hz, 3H), 1.27 (d, *J* = 6.8 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 151.5, 150.8, 146.4, 143.5, 142.8, 135.4, 135.3, 128.68, 128.62, 127.57, 127.53, 127.2, 127.1, 123.5, 123.1, 117.3, 117.0, 107.5, 107.2, 56.5, 56.0, 54.9, 54.3, 35.0, 19.9, 18.3, 17.2, 16.5; HRMS (EI): Exact mass calcd for $C_{17}H_{19}N$ $[M]^+$, 237.1517. Found 237.1509.



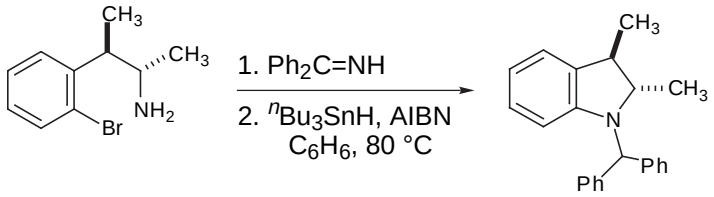
***N*-(1-Phenylbenzyl)-2-methylindoline (5b).** Following the general procedure, 2-(*o*-bromophenyl)-1-methylethylamine (50 mg, 234 µmol), benzophenone imine (42 mg, 233 µmol) and 4Å MS were stirred in dichloromethane (2.5 mL) at room temperature for 3 days under argon atmosphere to provide the ketimine as a solid (mp 59–61 °C); IR (film) 3057, 1726, 1661 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.59 (d, *J* = 6.9 Hz, 2H), 7.45 (d, *J* = 7.4 Hz, 1H), 7.37-7.30 (m, 6H), 7.20-7.14 (m, 2H), 7.03 (dt, *J* = 6.9, 1.4 Hz, 1H), 6.63 (d, *J* = 6.7 Hz, 2H), 3.81 (qd, *J* = 7.8, 6.2, Hz, 1H), 3.03 (d, *J* = 4.5 Hz, 1H), 3.01 (d, *J* = 7.1 Hz, 1H), 1.30 (d, *J* = 6.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 167.1, 140.2, 139.4, 137.3, 132.6, 130.3, 129.9, 128.6, 128.4, 128.2, 128.1, 127.8, 127.6, 127.1, 125.4, 57.4, 44.8, 22.4; HRMS (EI): Exact mass calcd for $C_{22}H_{20}BrN$ $[M]^+$, 377.0779. Found 377.0630.



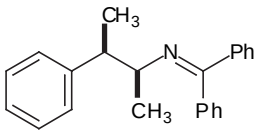
In a similar manner, the ketimine of 1-methyl-2-phenylethylamine was prepared. IR (film) 3080, 1661 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) 7.83 (d, *J* = 8.2 Hz, 1H), 7.55 (d, *J* = 7.5 Hz, 2H), 7.51 (dd, *J* = 7.5, 7.3 Hz, 1H), 7.36-7.27 (m, 5H), 7.19 (d, *J* = 7.6 Hz, 2H), 7.16 (dd, *J* = 7.3, 6.8 Hz, 1H), 7.03 (d, *J* = 7.4 Hz, 2H), 6.66 (d, *J* = 6.8 Hz, 2H), 3.60 (qd, *J* = 6.6, 6.0 Hz, 1H), 2.92 (dd, *J* = 13.0, 8.3 Hz, 1H), 2.78 (dd, *J* = 13.0, 5.1 Hz, 1H), 1.25 (d, *J* = 5.7 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 140.2, 132.7, 130.3, 129.9, 128.6, 128.2, 127.7, 126.0, 59.9, 45.1, 22.4; HRMS (EI): Exact mass calcd for $C_{22}H_{21}N$ $[M]^+$, 299.1674. Found 299.1667.

To a refluxing solution of the unpurified ketimine (20 mg, 53 µmol) in benzene (9 mL) was added $^{n}Bu_3SnH$ (15.6 µL, 58.2 µmol), followed by a four-hour addition of AIBN (10.4 mg, 63.5 µmol) dissolved in benzene (2 mL). After the first 2 h of the reaction, another lot of $^{n}Bu_3SnH$ (15.6 µL, 58.2 µmol) was added to the reaction mixture. After the complete addition of AIBN, the reaction mixture was refluxed for 1 h, followed by removal of solvent. Flash chromatography

(5% CH_2Cl_2 in hexanes) yielded the desired indoline (13.1 mg, 78%) as a solid (mp 58–61 °C); IR (film) 3060, 1635 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.41 (d, *J* = 7.6 Hz, 2H), 7.37-7.26 (m, 8H), 7.04 (d, *J* = 7.1 Hz, 1H), 6.82 (t, *J* = 7.5 Hz, 1H), 6.59 (t, *J* = 7.3 Hz, 1H), 5.97 (d, *J* = 7.9 Hz, 1H), 5.65 (s, 1H), 3.83 (qd, *J* = 15.0, 6.2 Hz, 1H), 3.25 (dd, *J* = 15.6, 9.0 Hz, 1H), 2.65 (dd, *J* = 15.4, 6.9 Hz, 1H), 1.16 (d, *J* = 6.0 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) ppm 138.9, 129.2, 129.0, 128.8, 127.6, 127.2, 124.7, 117.4, 109.4, 100.4, 65.5, 52.0, 37.6, 30.1, 21.0; HRMS (EI): Exact mass calcd for $C_{22}H_{21}N$ $[M]^+$, 299.1674. Found 299.1682.



***N*-(1-Phenylbenzyl)-2,3-*trans*-dimethylindoline (5c).** Following the general procedure, 2-(*o*-bromophenyl)-1,2-*cis*-dimethylethylamine (127 mg, 562 µmol), benzophenone imine (102 mg, 562 µmol), and 4Å MS were stirred in dichloromethane (1.5 mL) at room temperature for 7.5 days under argon atmosphere to provide the ketimine as an oil; IR (film) 3079, 1661 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.52-7.48 (m, 3H), 7.44-7.40 (m, 3H), 7.34-7.27 (m, 3H), 7.19 (q, *J* = 7 Hz, 1H), 7.18-7.16 (m, 1H), 7.00-6.95 (m, 3H), 3.64 (q, *J* = 6.3 Hz, 2H), 3.62 (q, *J* = 6.3 Hz, 1H), 1.44 (d, *J* = 6.6 Hz, 3H), 1.41 (d, *J* = 6.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 144.6, 140.6, 137.3, 132.7, 129.8, 129.6, 128.7, 128.4, 128.1, 127.5, 62.4, 53.6, 44.8, 19.7, 17.7; HRMS (EI): Exact mass calcd for $C_{23}H_{23}BrN$ $[M+H]^+$, 392.1016. Found 392.0913.

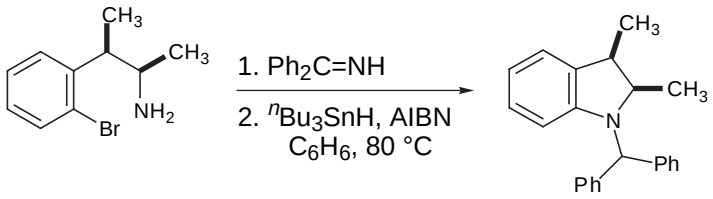


In a similar manner, the ketimine of 1,2-*cis*-dimethyl-2-phenylethylamine was prepared. IR (film) 3081, 1661 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) 7.60 (d, *J* = 7.2 Hz, 2H), 7.49-7.11 (series of m, 13H), 3.48 (dq, *J* = 6.4, 6.3 Hz, 1H), 2.97 (dq, *J* = 8.0, 7.2 Hz, 1H), 1.26 (d, *J* = 7.1 Hz, 3H), 1.24 (d, *J* = 7.5 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 166.2, 145.7, 140.6, 137.5, 130.6,

129.7, 128.6, 128.5, 128.3, 128.1, 128.0, 127.9, 126.1, 63.6, 46.9, 20.2, 17.8; HRMS (EI): Exact mass calcd for $C_{23}H_{23}N$ $[M]^+$, 313.1830. Found 313.1776.

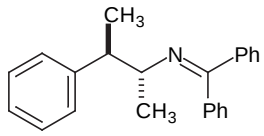
To a refluxing solution of the unpurified ketimine (12.6 mg, 32 µmol) in benzene (5.5 mL) was added $^nBu_3SnH$ (9.5 µL, 35 µmol), followed by a 6 h addition of AIBN (13 mg, 80 µmol) dissolved in benzene (1 mL). After the first 3 h of the reaction, another aliquot of $^nBu_3SnH$ (9.5 µL, 35.4 µmol) was added. After complete addition of AIBN, the reaction mixture was refluxed for further 1 h followed by evaporation of solvent under vacuum. Flash chromatography (5% CH_2Cl_2 in hexanes) yielded the desired indoline (7.9 mg, 79%) as a gum; IR (film) 2958, 1684 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.39 (d, *J* = 7.2 Hz, 2H), 7.35-7.26 (m, 8H), 7.02 (d, *J* = 7.2 Hz, 1H), 6.83 (t, *J* = 7.6 Hz, 1H), 6.61 (t, *J* = 7.3 Hz, 1H), 5.99 (d, *J* = 7.9 Hz, 1H), 5.69 (s, 1H), 3.28 (dq, *J* = 6.3, 6.3 Hz, 1H), 2.87 (dq, *J* = 6.9, 6.9 Hz, 1H), 1.27 (d, *J* = 6.4 Hz, 3H), 1.19 (d, *J* = 6.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 150.4, 141.1, 140.5, 134.3, 128.9, 128.6, 127.4, 123.2, 117.2, 109.2, 66.5, 65.0, 43.8, 20.0, 18.8; HRMS (EI): Exact mass calcd for $C_{23}H_{23}N$ $[M]^+$, 313.1830. Found 313.1838.

Relative stereochemistry assigned by NOE experiments (400 MHz NMR).



***N*-(1-Phenylbenzyl)-2,3-*cis*-dimethylindoline (5d).** Following the general procedure, 2-(*o*-bromophenyl)-1,2-*trans*-dimethylethylamine (18 mg, 79.7 µmol), benzophenone imine (14.4 mg, 79.7 µmol) and 4Å MS were stirred in dichloromethane (1 mL) at room temperature for 7.5 days under argon atmosphere to provide the ketimine as an oil; IR (film) 3059, 1624 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.83 (d, *J* = 7.1 Hz, 2H), 7.62 (dt, *J* = 7.4, 1.2 Hz, 2H), 7.51 (t, *J* = 7.7 Hz, 3H), 7.39-7.32 (m, 4H), 7.16 (t, *J* = 7.3 Hz, 1H), 7.03 (t, *J* = 7.7 Hz, 1H), 6.80-6.79 (m, 1H), 3.61 (q, *J* = 6.2 Hz, 1H), 3.54 (q, *J* = 6.7 Hz, 1H), 1.33 (d, *J* = 7.0 Hz, 3H), 1.13 (d, *J* = 6.3 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 137.2, 132.9, 132.7, 130.3, 129.9, 128.99,

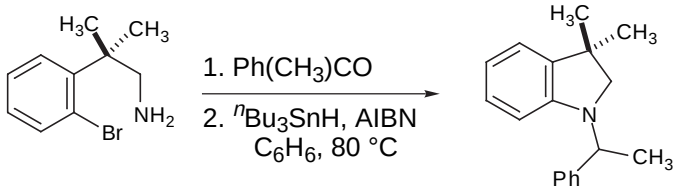
128.5, 128.3, 127.6, 127.3, 61.4, 29.9, 20.6, 16.7; HRMS (EI): Exact mass calcd for $C_{23}H_{22}BrN$ $[M+H]^+$, 392.1016. Found 392.1160.



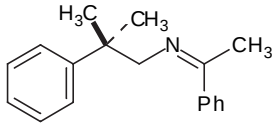
In a similar manner, the ketimine of 1,2-*trans*-dimethyl-2-phenylethylamine was prepared. IR (film) 3081, 1661 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) 7.60 (d, *J* = 7.2 Hz, 2H), 7.49-7.11 (series of m, 13H), 3.48 (dq, *J* = 6.4, 6.3 Hz, 1H), 2.97 (dq, *J* = 8.0, 7.2 Hz, 1H), 1.27 (d, *J* = 7.0 Hz, 3H), 1.02 (d, *J* = 6.3 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 166.7, 145.8, 140.5, 137.7, 130.3, 130.0, 128.7, 128.4, 128.3, 128.1, 128.0, 127.8, 126.1, 63.4, 47.5, 21.1, 18.6; HRMS (EI): Exact mass calcd for $C_{23}H_{23}N$ $[M+H]^+$, 314.1910. Found 314.1913.

To a refluxing solution of the unpurified ketimine (5.1 mg, 13 µmol) in benzene (3 mL) was added $^nBu_3SnH$ (4.6 µL, 16.9 µmol), followed by a 6 h addition of AIBN (6.4 mg, 39.0 µmol) dissolved in benzene (1 mL). After the first 3 h of reaction, another aliquot of $^nBu_3SnH$ (4.6 µL, 16.9 µmol), was added to the reaction mixture. After the complete addition of AIBN, the reaction mixture was refluxed for a further 2 h, followed by evaporation of solvent under vacuum. Flash chromatography (5% CH_2Cl_2 in hexanes) yielded the desired product (3.4 mg, 84%) as a gum; IR (film) 3061, 1605 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.45 (d, *J* = 6.8 Hz, 2H), 7.40 (d, *J* = 7.2 Hz, 2H), 7.34-7.23 (m, 6H), 7.03 (d, *J* = 7.1 Hz, 1H), 6.80 (t, *J* = 7.5 Hz, 1H), 6.63 (t, *J* = 7.3 Hz, 1H), 5.90 (d, *J* = 7.8 Hz, 1H), 5.51 (s, 1H), 3.78 (dq, *J* = 7.5, 6.4 Hz, 1H), 3.38 (dq, *J* = 7.3, 7.3 Hz, 1H), 1.22 (d, *J* = 7.1 Hz, 3H), 0.95 (d, *J* = 6.3 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 150.0, 142.4, 141.2, 135.5, 128.9, 128.7, 128.6, 127.9, 127.4, 127.2, 126.9, 123.1, 117.5, 109.9, 65.4, 62.4, 39.1, 13.6, 12.6; HRMS (FAB): Exact mass calcd for $C_{23}H_{23}N$ $[M]^+$, 313.1830. Found 313.1839.

Relative stereochemistry determined by NOE experiments (400 MHz NMR).



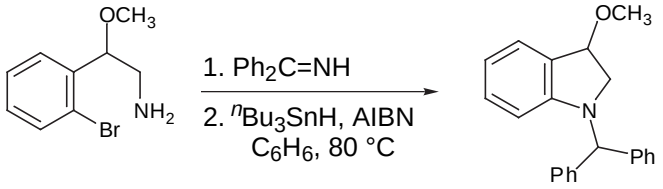
***N*-(1-Methylbenzyl)-3,3-dimethylindoline (5e).** According to the general procedure, 2-(*o*-bromophenyl)-2,2-dimethyl ethylamine (733 mg, 3.21 mmol), acetophenone (370 µL, 3.18 mmol), and 4Å MS were stirred in toluene (25 mL) at room temperature for 12 h to provide the ketimine as a >95:5 mixture of stereoisomers, IR (film) 3058, 1635 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.66 (m, 2H), 7.55 (d, *J* = 9.1 Hz, 1H), 7.50 (d, *J* = 9.8 Hz, 1H), 7.30 (t, *J* = 1.8 Hz, 3H), 7.23 (t, *J* = 4.3 Hz, 1H), 7.0 (t, *J* = 9.4 Hz, 1H), 3.98 (s, 2H), 2.20 (s, 3H), 1.64 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 164.3, 146.3, 141.5, 135.8, 130.0, 129.4, 128.2, 127.7, 127.3, 126.8, 122.8, 60.4, 41.8, 26.8, 26.5, 15.6; HRMS (CI): Exact mass calcd for $C_{18}H_{21}BrN$, $[M+H]^+$, 330.0857. Found 330.0818.



The ketimine of 2,2-dimethyl-2-phenyl ethylamine was similarly prepared. IR (film) 3085, 1636 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.81 (m, 2H), 7.50 (d, *J* = 8.1 Hz, 2H), 7.38 (m, 3H), 7.33 (d, *J* = 7.9 Hz, 2H), 7.21 (t, *J* = 7.4 Hz, 1H), 3.57 (s, 2H), 2.13 (s, 3H), 1.51 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 164.5, 149.3, 141.5, 129.5, 128.5, 128.3, 128.2, 126.8, 126.4, 125.9, 64.3, 39.8, 27.1, 15.4; HRMS (EI): Exact mass calcd for $C_{18}H_{21}N$ $[M]^+$, 251.1674. Found 251.1670.

A three hour addition of $^nBu_3SnH$ (72.0 µL, 267 µmol) and AIBN 16 mg, 97 µmol) benzene solution (1.0 mL) to a refluxing solution of the unpurified ketimine (80.2 mg, 243 µmol) in benzene (24 mL) furnished, after flash chromatography (1% Et_2O in hexanes) 48.8 mg (80%) of the desired indoline as a colorless oil. R_f = 0.63 (10% EtOAc/hexanes); IR (film) 3024, 1604 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.41 (d, *J* = 7.4 Hz, 2H), 7.35 (t, *J* = 7.2 Hz, 2H), 7.26 (d, *J* = 7.3 Hz, 1H), 7.01 (t, *J* = 7.2 Hz, 1H), 7.01 (t, *J* = 7.2 Hz, 1H), 6.66 (t, *J* = 8.1 Hz, 1H),

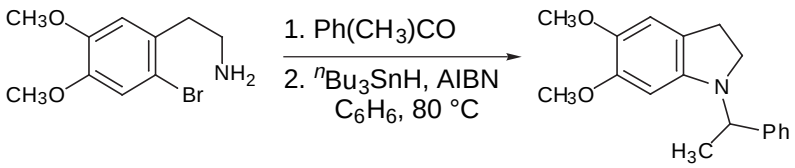
6.35 (d, *J* = 8.1 Hz, 1H), 4.73 (q, *J* = 6.9 Hz, 1H), 3.18 (d, *J* = 8.3 Hz, 1H), 3.08 (d, *J* = 8.3 Hz, 1H), 1.54 (d, *J* = 6.9 Hz, 3H), 1.33 (s, 3H), 1.27 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 150.1, 143.4, 139.2, 128.6, 127.5, 127.2, 127.1, 121.8, 117.2, 107.3, 62.6, 54.3, 39.9, 28.3, 27.4, 17.0; HRMS (EI): Exact mass calcd for $C_{18}H_{21}N$ $[M]^+$, 251.1674. Found 251.1672.



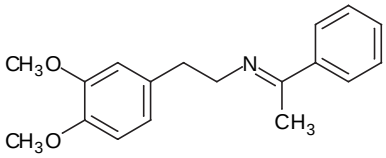
***N*-(1-Phenylbenzyl)-3-methoxyindoline (5f).** 2-(*o*-Bromophenyl)-2-methoxyethylamine (43.4 mg, 189 µmol), benzophenone imine (32 µL, 189 µmol), and 4Å MS were stirred in CH_2Cl_2 at room temperature for 7 h. Removal of the solvent provided the ketimine as a colorless oil. IR (film) 3058, 1626 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.63 (d, *J* = 8.3 Hz, 2H), 7.52 (dd, *J* = 8.1, 2.2 Hz, 1H), 7.45–7.28 (m, 8H), 7.13 (dt, *J* = 9.3, 1.6 Hz, 1H), 7.07 (dd, *J* = 7.5, 2.4 Hz, 2H), 5.05 (dd, *J* = 6.7, 4.5 Hz, 1H), 3.71 (dd, *J* = 14.0, 4.4 Hz, 1H), 3.64 (dd, *J* = 14.0, 6.9 Hz, 1H), 3.36 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 169.8, 140.1 (2C), 137.0, 132.82, 130.2, 129.1, 128.8 (2C), 128.65, 128.6, 128.54, 128.2, 127.7, 123.8, 82.8, 59.2, 57.6; HRMS (EI): Exact mass calcd for $C_{22}H_{21}BrNO$ $[M+H]^+$, 394.0808. Found 394.0795.

A three hour addition of ^{n}Bu$_3$SnH (38 µL, 143 µmol) and AIBN (8.5 mg, 52 µmol) in benzene (1 mL) to a refluxing solution of the unpurified ketimine (51.2 mg, 130 µmol) in benzene (13 mL) afforded, after flash chromatography on basic alumina (10% CH_2Cl_2 in hexanes), 29 mg (70%) of the desired indoline as a colorless oil. R_f = 0.15 (10% CH_2Cl_2/hexanes); IR (film) 3059, 1608 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40–7.26 (m, 11H), 7.10 (dt, *J* = 8.1, 1.2 Hz, 1H), 6.71 (t, *J* = 7.25 Hz, 1H), 6.34 (d, *J* = 7.9 Hz, 1H), 5.70 (s, 1H), 4.79 (dd, *J* = 6.7, 2.6 Hz, 1H), 3.35 (s, 3H), 3.33 (dd, *J* = 11.3, 2.7 Hz, 1H), 3.27 (dd, *J* = 11.2, 6.7 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 140.7, 130.1, 129.2, 128.8, 128.7, 128.4, 128.2, 127.7, 127.5,

126.1 78.9, 65.7, 56.4, 55.4; HRMS (EI): Exact mass calcd for $C_{22}H_{21}NO$ $[M]^+$, 315.1623. Found 315.1623.



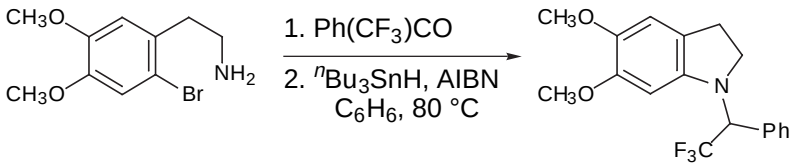
***N*-(1-Methylbenzyl)-5,6-dimethoxy indoline (8a).** Following the general procedure, (2-bromo-4,5-dimethoxyphenyl)ethylamine (1.95 g, 7.5 mmol), acetophenone (0.87 mL, 7.5 mmol), and 4Å MS were stirred in toluene (10 mL) at room temperature for 12 h to provide the ketimine as a >95:5 mixture of stereoisomers. IR (film) 3055, 1633 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.77 (m, 2H), 7.38 (m, 3H), 7.03 (s, 1H), 6.83 (s, 1H), 3.87 (s, 3H), 3.79 (s, 3H), 3.77 (dd, *J* = 7.2, 7.2 Hz, 2H), 3.14 (dd, *J* = 7.4, 7.4 Hz, 2H), 2.11 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 166.1, 158.0, 148.3, 148.2, 141.4, 131.9, 129.7, 128.5, 126.7, 115.6, 114.4, 56.3, 56.1, 52.2, 37.3, 15.6; HRMS (CI): Exact mass calcd for $C_{18}H_{21}BrNO_2$ $[MH]^+$, 362.0756. Found 362.0747.



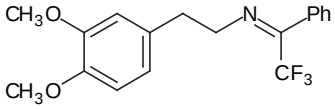
2-(3,4-Dimethoxyphenyl)ethylamine, ketimine was similarly prepared. IR (film) 3056, 1684 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.78 (m, 2H), 7.39 (m, 5H), 6.83 (s, 1H), 3.88 (s, 3H), 3.85 (s, 3H), 3.75 (dd, *J* = 7.2, 7.2, 2H), 3.04 (dd, *J* = 7.5, 7.5, 2H), 2.11 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 165.8, 148.9, 147.5, 141.5, 133.6, 129.6, 128.5, 128.4, 126.7, 121.0, 112.7, 111.4, 56.1, 56.0, 54.4, 37.2, 15.6; HRMS (CI): Exact mass calcd for $C_{18}H_{21}NO_2$ $[M]^+$, 283.1572. Found 283. 1567.

A three-hour addition of $^nBu_3SnH$ (120 µL), 448 µmol) and AIBM (26.7 mg, 163 µmol) solution in benzene (1.1 mL) to a refluxing solution of the unpurified ketimine (148 mg, 408 µmol) in benzene (41 mL) afforded, after flash chromatography (15% EtOAc in hexanes), 95.6 mg (83%) of the desired indoline as a yellow oil. R_f = 0.27 (20% EtOAc/hexanes); IR (film) 3059,

1614 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.45 (d, *J* = 7.6 Hz, 2H), 7.36 (t, *J* = 7.6 Hz, 2H), 7.27 (t, *J* = 7.4 Hz, 1H), 6.75 (s, 1H), 6.00 (s, 1H), 4.57 (q, *J* = 6.8 Hz, 1H), 3.80 (s, 3H), 3.70 (s, 3H), 3.34 (dd, *J* = 16.2, 7.3 Hz, 2H), 2.88 (dd, 7.9, 7.9 Hz, 2H), 1.53 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 149.0, 146.5, 143.6, 141.5, 128.6, 127.3, 127.1, 121.3, 111.2, 95.4, 57.6, 49.6, 28.4, 17.5; HRMS (EI): Exact mass calcd for $C_{18}H_{21}NO_2$ $[M]^+$, 283.1572. Found 283.1578.



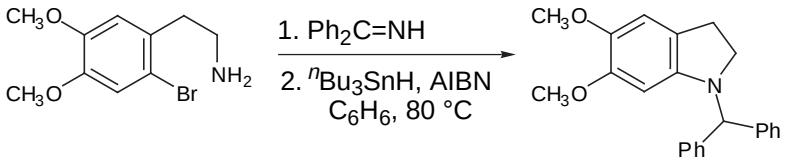
***N*-(1-Trifluoromethyl(benzyl)-5,6-dimethoxy indoline (8b).** Following the general procedure, (2-bromo-4,5-dimethoxy-phenyl)ethylamine (2.05 g, 7.88 mmol), trifluoroacetophenone (1.1 mL, 7.88 mmol), and 4Å MS were stirred in toluene (30 mL) at room temperature for 12 h to give the ketimine as a >95:5 mixture of stereoisomers. IR (film) 3061, 1669 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.43 (t, *J* = 7.2 Hz, 1H), 7.38 (t, *J* = 7.5 Hz, 2H), 6.95 (s, 1H), 6.91 (d, *J* = 7.1 Hz, 2H), 6.70 (s, 1H), 3.87 (s, 3H), 3.84 (s, 3H), 3.67 (dd, *J* = 8.2, 6.8 Hz, 2H), 3.05 (dd, *J* = 6.7, 6.7 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 159.5, 159.2, 148.5, 148.3, 130.4, 130.2, 130.1, 128.8, 128.5, 127.7, 121.1, 118.4, 115.5, 114.5, 114.2, 56.4, 56.1, 52.9, 36.4; HRMS (EI): Exact mass calcd for $C_{18}H_{17}BrF_3NO_2$ $[M]^+$, 415.0395. Found 415.0414.



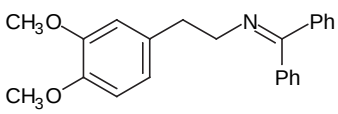
2-(3,4-Dimethoxyphenyl)ethylamine ketimine was similarly prepared. IR (film) 3061, 1669 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.42 (t, *J* = 7.2 Hz, 1H), 7.36 (t, *J* = 7.0 Hz, 2H), 6.88 (d, *J* = 7.0 Hz, 2H), 6.78 (d, *J* = 8.0 Hz, 1H), 6.63 (d, *J* = 8.0 Hz, 1H), 6.60 (s, 1H), 3.88 (s, 3H), 3.82 (s, 3H), 3.64 (dd, *J* = 6.7, 6.7 Hz, 2H), 2.95 (dd, *J* = 6.7, 6.7 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 158.8, (q, *J* = 33.5, 1C), 148.9, 147.8, 131.9, 130.4, 130.0, 128.7, 127.8, 121.1, 118.4, 112.5, 111.3, 56.1,

55.8, 55.1, 36.2; HRMS (EI): Exact mass calcd for $C_{18}H_{18}F_3NO_2$ $[M]^+$, 337.1290. Found 337.1274.

A three-hour addition of $^nBu_3SnH$ (110 µL, 412 µmol) and AIBN (25 mg, 150 µmol) solution in benzene 1.0 mL) to a refluxing solution of the unpurified ketimine (156 mg, 375 µmol) in benzene (37 mL) provided, after flash chromatography (10% EtOAc in hexanes), 113 mg (89%) of the desired indoline as a yellow oil. R_f = 0.37 (20% EtOAc/hexanes); IR (film) 2939, 1615 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.39 (m, 5H), 6.74 (s, 1H), 6.27 (s, 1H), 5.11 (q, *J* = 8.6 Hz, 1H), 3.87 (s, 3H), 3.81 (s, 3H), 3.57 (dd, *J* = 15.1, 8.8 Hz, 1H), 3.15 (dd, *J* = 18.4, 9.3 Hz, 1H), 2.89 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 149.3, 144.9, 142.4, 132.0, 128.9, 120.2, 111.2, 94.2, 62.8 (q, *J* = 29.7 Hz, 1C), 57.4, 56.6, 49.6, 28.5; HRMS (EI): Exact mass calcd for $C_{18}H_{18}F_3NO_2$ $[M]^+$, 337.1290. Found 337.1280.



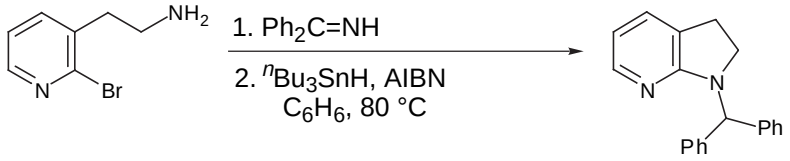
***N*-(1-Phenylbenzyl)-5,6-dimethoxy indoline (8c).** Following the general procedure, (2-bromo-4,5-dimethoxyphenyl)ethyl amine (343 mg, 1.32 mmol) and benzophenone imine (239 mg, 1.32 mmol) were stirred at room temperature in CH_2Cl_2 (3 mL) for 12 h to give the ketimine. IR (film) 3056, 1623 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.62 (d, *J* = 7.0 Hz, 2H), 7.40 (dd, *J* = 6.2, 3.4 Hz, 3H), 7.36 (t, *J* = 7.6 Hz, 3H), 6.95 (s, 1H), 6.94 (d, *J* = 2.3 Hz, 2H), 6.73 (s, 1H), 3.84 (s, 3H), 3.76 (s, 3H), 3.67 (dd, *J* = 7.0, 7.0 Hz, 2H), 3.07 (dd, *J* = 7.2, 7.2 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 168.9, 148.2, 139.9, 136.8, 131.8, 128.5, 128.4, 128.3, 127.9, 115.5, 114.5, 114.2, 56.3, 56.1, 53.8, 37.4; HRMS (CI): Exact mass calcd for $C_{23}H_{23}BrNO_2$ $[M+H]^+$, 424.0912. Found 424.0910.



The analogous ketimine from 2-(3,4-dimethylphenyl)ethyl amine was similarly prepared. IR (Film) 3056, 1623 cm^{-1}; ^1H NMR

(400 MHz, $CDCl_3$) δ 7.59 (d, *J* = 6.8 Hz, 2H), 7.39 (m, 3H), 7.35 (m, 3H), 6.93 (dd, *J* = 7.1, 3.5 Hz, 2H), 6.75 (d, *J* = 8.1 Hz, 1H), 6.67 (d, *J* = 8.0 Hz, 1H), 6.65 (s, 1H), 3.85 (s, 3H), 3.77 (s, 3H), 3.65 (dd, *J* = 7.1, 7.1 Hz, 2H), 2.96 (dd, *J* = 7.1, 7.1 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 168.6, 148.9, 147.5, 140.1, 137.0, 133.3, 130.1, 128.6, 128.4, 128.3, 128.0, 121.2, 112.7, 111.4, 56.2, 55.9, 37.5; HRMS (CI): Exact mass calcd for $C_{23}H_{23}NO_2$ $[M]^+$, 345.1729. Found 345.1734.

A three-hour addition of $^nBu_3SnH$ (75 µL, 278 µmol) and AIBN (17 mg, 101 µmol) solution in benzene (1.0 mL) to refluxing solution of the unpurified ketimine (107 mg, 252 µmol) in benzene (25 mL) provided, after flash chromatography (5% EtOAc in hexanes), 46 mg (64%) of the desired indoline as a white solid. mp 105–106 °C; R_f = 0.20 (10% EtOAc/hexanes); IR (film) 2931, 1597 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.45 (d, *J* = 7.1 Hz, 4H), 7.35 (t, *J* = 7.1 Hz, 4H), 7.27 (t, *J* = 4.7 Hz, 2H), 6.75 (s, 1H), 5.79 (s, 1H), 5.33 (s, 1H), 3.80 (s, 3H), 3.51 (s, 3H), 3.16 (dd, *J* = 8.3, 8.3, Hz, 2H), 2.87 (dd, *J* = 8.1, 8.1, Hz, 2H); ^{13}C NMR (100 MHZ, $CDCL_3$) ppm 148.4, 146.9, 142.1, 141.8, 128.7, 128.5, 127.4, 121.7, 110.4, 96.5, 69.3, 57.3, 55.9, 53.6, 28.5; HRMS (CI): Exact mass calcd for $C_{23}H_{23}NO_2$ $[M]^+$, 345.1729. Found 345.1713.



***N*-(1-Phenylbenzyl)-6-azaindoline (8d).** 2-Bromo-3-(2-aminoethyl) pyridine (104 mg, 517 µmol) and benzophenone imine (94 mg, 517 µmol) were stirred in CH_2Cl_2 at room temperature for 8 h to provide the ketimine. IR (film) 3056, 1622 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 8.20 (dd, *J* = 4.7, 0.9 Hz, 1H), 7.56 (t, *J* = 7.8 Hz, 3H), 7.43–7.40 (m, 3H), 7.37 (d, *J* = 6.6 Hz, 1H), 7.32 (t, *J* = 7.9 Hz, 2H), 7.16 (dd, *J* = 7.4, 5.2 Hz, 1H); 6.96 (t, *J* = 3.4 Hz, 2H), 3.69 (t, *J* = 6.9 Hz, 2H), 3.10 (t, *J* = 6.9 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm

169.2, 158.1, 147.7, 144.5, 139.5, 137.0, 136.5, 130.0, 128.5, 128.4, 128.3, 127.5, 122.6, 52.4, 36.8; HRMS (EI): Exact mass calcd for $C_{20}H_{17}BrN_2$ $[M]^+$, 364.0575. Found 364.0587.

A two-hour addition of $^nBu_3SnH$ (58 µL, 214 µmol) and AIBN (39 mg, 235 µmol) solution in benzene (2 mL) to a refluxing solution of the unpurified ketimine (36 mg, 98 µmol) in benzene (10 mL) delivered, after flash chromatography (5% EtOAc/Hexanes), 14 mg (50%) of the desired indoline as an orange crystalline solid. mp 101 °C; R_f = 0.1 (5% EtOAc/Hexanes); IR (film) 3058, 1611 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.87 (d, *J* = 5.2 Hz, 1H), 7.34–7.26 (m, 10H), 7.17 (d, *J* = 7.0 Hz, 1H), 6.81 (s, 1H), 6.42 (t, *J* = 6.5 Hz, 1H), 3.34 (t, *J* = 8.5 Hz, 2H), 2.97 (t, *J* = 8.5 Hz, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) ppm 162.8, 146.1, 140.2, 131.2, 122.8, 129.1, 128.5, 127.4, 112.4, 60.0, 45.6, 25.9; HRMS (EI) Calcd for $C_{20}H_{18}N_2$ $[M]^+$, 286.1470. Found 286.1468.

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