SUPPORTING INFORMATION

Supporting Information

A Systematic Study of the Hydride Reduction of Cyclopropyl Ketones with Structurally Simplified Substrates. Highly Stereoselective Reductions of *Trans*-Substituted Cyclopropyl Ketones via the Bisected *s*-Cis-Conformation

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Scheme S1

Scheme S2

General Procedure for Preparing MTPA-Esters. A mixture of a secondary alcohol **14** or **10** (0.025 mmol), (*S*)-(-)- or (*R*)-(-)-MTPA (7 mg, 0.030 mmol), EDC-HCl (5.8 mg, 0.030 mmol) and DMAP (1 mg, 8 μmol) in CH_2Cl_2 (1 mL) was stirred at room temperature for 2 h, and then MeOH was added. The mixture was evaporated, and the residue was partitioned between AcOEt and H_2O . The organic layer was washed with brine, dried (Na_2SO_4), evaporated, and purified by column chromatography (silica gel; AcOEt/hexane 1:49) to give the corresponding MTPA-ester as a colorless oil.

(*R*)-MTPA-Ester of 14a (1S): 98% yield; $^1\text{H-NMR}$ (500 MHz, CDCl_3) δ 0.33825 (1 H, m,

H-3a), 0.62627 (1 H, m, H-3b), 1.06126 (9 H, s, $-\text{C}(\text{CH}_3)_3$), 1.10938 (1 H, m, H-2), 1.26479 (1 H, m, H-1), 1.59495 (3 H, d, H-2', $J_{2',1'} = 6.4$ Hz), 3.53110 (1 H, dd, H-1''a, $J_{1''a,2} = 9.2$, $J_{1''a,1''b} = 11.4$ Hz), 3.57300 (3 H, s, -OMe), 3.94780 (1 H, dd, H-1''b, $J_{1''b,2} = 5.4$, $J_{1''b,1''a} = 11.4$ Hz), 4.98840 (1 H, m, H-1'), 7.36200-7.45340 (9 H, m, aromatic), 7.54240-7.55780 (2 H, m, aromatic), 7.66680-7.70380 (4 H, m, aromatic); ^{13}C -NMR (125 MHz, CDCl_3) δ 8.32, 18.66, 19.20, 21.21, 21.40, 26.84, 55.34, 64.00, 75.58, 84.60 ($J_{\text{C,F}} = 28$ Hz), 123.41 ($J_{\text{C,F}} = 288$ Hz), 127.41, 127.68, 127.74, 128.25, 129.45, 129.69, 129.70, 132.65, 133.55, 133.69, 135.54, 135.60, 166.06; HR-MS (ESI) calcd for $\text{C}_{32}\text{H}_{37}\text{F}_3\text{NaO}_4\text{Si}$ 593.2311, found 593.2321 ((M+Na) $^+$).

(S)-MTPA-Ester of 14a (2S): quantitative yield; ^1H -NMR (500 MHz, CDCl_3) δ 0.37996 (1 H, m, H-3a), 0.72007 (1 H, m, H-3b), 1.05942 (9 H, s, $-\text{C}(\text{CH}_3)_3$), 1.20963 (1 H, m, H-2), 1.29115 (1 H, m, H-1), 1.50662 (3 H, d, H-2', $J_{2',1'} = 6.2$ Hz), 3.55400 (1 H, dd, H-1''a, $J_{1''a,2} = 9.3$, $J_{1''a,1''b} = 11.4$ Hz), 3.59320 (3 H, s, -OMe), 3.95420 (1 H, dd, H-1''b, $J_{1''b,2} = 5.3$, $J_{1''b,1''a} = 11.4$ Hz), 4.97530 (1 H, m, H-1'), 7.36520-7.44820 (9 H, m, aromatic), 7.55800-7.57320 (2 H, m, aromatic), 7.66540-7.70140 (4 H, m, aromatic); ^{13}C -NMR (125 MHz, CDCl_3) δ 8.40, 18.41, 19.19, 20.92, 21.50, 26.83, 55.38, 63.91, 75.60 (C-1'), 84.52 ($J_{\text{C,F}} = 28$ Hz), 123.40 ($J_{\text{C,F}} = 288$ Hz), 127.30, 127.68, 127.74, 128.28, 129.44, 129.69, 132.72, 133.53, 133.67, 135.53, 135.59, 166.03; HR-MS (ESI) calcd for $\text{C}_{32}\text{H}_{37}\text{F}_3\text{NaO}_4\text{Si}$ 593.2311, found 593.2321 ((M+Na) $^+$).

(R)-MTPA-Ester of 14b (3S): yield 99%; ^1H -NMR (500 MHz, CDCl_3) δ 0.39697 (1 H, m, H-3a), 0.62072 (1 H, m, H-3b), 0.98716 (3 H, t, H-3', $J_{3',2'} = 7.4$ Hz), 1.05794 (9 H, s, $-\text{C}(\text{CH}_3)_3$), 1.10285 (1 H, m, H-2), 1.23760 (1 H, m, H-1), 1.89690 (1 H, m, H-2'a), 2.07110 (1 H, m, H-2'b), 3.56630 (1 H, dd, H-1''a, $J_{1''a,2} = 9.2$, $J_{1''a,1''b} = 11.5$ Hz), 3.57380 (3 H, s, -OMe), 3.93620 (1 H, dd, H-1''b, $J_{1''b,2} = 5.4$, $J_{1''b,1''a} = 11.5$ Hz), 4.90820 (1 H, m, H-1'), 7.37520-7.45120 (9 H, m, aromatic), 7.56000-7.57520 (2 H, m, aromatic), 7.66480-7.69680 (4 H, m, aromatic); ^{13}C -NMR (125 MHz, CDCl_3) δ 8.14, 9.91, 18.82, 19.17, 20.04, 26.80, 28.17, 55.42, 64.08, 80.16, 84.76 ($J_{\text{C,F}} = 27$ Hz), 123.43 ($J_{\text{C,F}} = 288$ Hz), 127.54, 127.67, 127.73, 128.23, 129.43, 129.67, 129.68, 132.55, 133.59, 133.72, 135.53, 135.58, 166.52; HR-MS (FAB) calcd for $\text{C}_{33}\text{H}_{40}\text{F}_3\text{O}_4\text{Si}$ 585.2648, found 585.2642 ((M+H) $^+$).

(S)-MTPA-Ester of 14b (4S): yield 99%; ^1H -NMR (500 MHz, CDCl_3) δ 0.44778 (1 H, m, H-3a), 0.70548 (1 H, m, H-3b), 0.83968 (3 H, t, H-3', $J_{3',2'} = 7.4$ Hz), 1.05800 (9 H, s, $-\text{C}(\text{CH}_3)_3$), 1.20710 (1 H, m, H-2), 1.28270 (1 H, m, H-1), 1.82990 (1 H, m, H-2'a), 2.03840 (1 H, m, H-2'b), 3.57880 (1 H, dd, H-1''a, $J_{1''a,2} = 9.2$, $J_{1''a,1''b} = 11.4$ Hz), 3.60780 (3 H, s, -OMe), 3.95900 (1 H, dd, H-1''b, $J_{1''b,2} = 5.3$, $J_{1''b,1''a} = 11.4$ Hz), 4.92740 (1 H, m, H-1'), 7.35900-7.44820 (9 H, m, aromatic), 7.59620-7.61140 (2 H, m, aromatic), 7.66740-7.69860 (4 H, m, aromatic); ^{13}C -NMR (125 MHz, CDCl_3) δ 8.19, 9.60, 19.10, 19.16, 20.28, 26.80, 28.16, 55.40, 64.03, 80.00 (C-1'), 84.48 ($J_{\text{C,F}} = 27$ Hz), 123.48 ($J_{\text{C,F}} = 288$ Hz), 127.33, 127.67, 127.74, 128.23, 129.44, 129.68, 132.81, 133.57, 133.71, 135.53, 135.58, 166.49; HR-MS (FAB) calcd for $\text{C}_{33}\text{H}_{40}\text{F}_3\text{O}_4\text{Si}$ 585.2648, found 585.2676 ((M+H) $^+$).

(R)-MTPA-Ester of 14e (5S): yield 97%; ^1H -NMR (500 MHz, CDCl_3) δ 0.43614 (1 H, m, H-3a), 0.61195 (1 H, m, H-3b), 0.88614 (3 H, d, H-4'a, $J_{4'a,3'} = 6.6$ Hz), 0.89296 (3 H, d, H-4'b, $J_{4'b,3'}$

= 6.6 Hz), 1.06962 (9 H, s, -C(CH₃)₃), 1.08552 (1 H, m, H-2), 1.18270 (1 H, m, H-1), 1.77569 (1 H, m, H-3'), 1.77569 (1 H, m, H-2'a), 1.89228 (1 H, m, H-2'b), 3.55680 (3 H, s, -OMe), 3.59140 (1 H, dd, H-1''a, $J_{1''a,2} = 9.2$, $J_{1''a,1''b} = 11.5$ Hz), 3.90640 (1 H, dd, H-1''b, $J_{1''b,2} = 5.3$, $J_{1''b,1''a} = 11.5$ Hz), 5.02040 (1 H, m, H-1'), 7.35620-7.44600 (9 H, m, aromatic), 7.55420-7.56980 (2 H, m, aromatic), 7.65540-7.70140 (4 H, m, aromatic); ¹³C-NMR (125 MHz, CDCl₃) δ 8.34, 18.78, 19.19, 21.05, 21.10, 23.60, 24.39, 26.91, 44.06, 55.41, 63.97, 77.21, 84.76 ($J_{C,F} = 28$ Hz), 123.41 ($J_{C,F} = 286$ Hz), 127.55, 127.66, 127.70, 128.21, 129.43, 129.66, 132.46, 133.69, 133.74, 135.53, 135.61, 166.53; HR-MS (FAB) calcd for C₃₅H₄₃F₃NaO₄Si 635.2780, found 635.2763 ((M+Na)⁺).

(S)-MTPA-Ester of 14e (6S): yield 98%; ¹H-NMR (500 MHz, CDCl₃) δ 0.48092 (1 H, m, H-3a), 0.67872 (1 H, m, H-3b), 0.78541 (3 H, d, H-4'a, $J_{4'a,3'} = 6.8$ Hz), 0.81822 (3 H, d, H-4'b, $J_{4'b,3'} = 6.8$ Hz), 1.06610 (9 H, s, -C(CH₃)₃), 1.19014 (1 H, m, H-2), 1.24860 (1 H, m, H-1), 1.41239 (1 H, m, H-3'), 1.74035 (1 H, m, H-2'a), 1.83428 (1 H, m, H-2'b), 3.60760 (3 H, s, -OMe), 3.60920 (1 H, dd, H-1''a, $J_{1''a,2} = 9.2$, $J_{1''a,1''b} = 11.6$ Hz), 3.93680 (1 H, dd, H-1''b, $J_{1''b,2} = 5.2$, $J_{1''b,1''a} = 11.6$ Hz), 5.05650 (1 H, m, H-1'), 7.36080-7.43240 (9 H, m, aromatic), 7.58440-7.60020 (2 H, m, aromatic), 7.66560-7.70280 (4 H, m, aromatic); ¹³C-NMR (125 MHz, CDCl₃) δ 8.20, 19.11, 19.19, 20.94, 21.30, 23.50, 23.97, 26.91, 44.01, 55.44, 63.95, 76.88, 84.40 ($J_{C,F} = 28$ Hz), 123.46 ($J_{C,F} = 286$ Hz), 127.22, 127.66, 127.70, 128.19, 129.43, 129.66, 132.77, 133.67, 133.74, 135.52, 135.60, 166.50; HR-MS (FAB) calcd C₃₅H₄₃F₃NaO₄Si 635.2780, found 635.2775 ((M+Na)⁺).

(R)-MTPA-Ester of 10a (7S): quantitative yield; ¹H-NMR (500 MHz, CDCl₃) δ 0.43758 (1 H, m, H-3a), 0.54022 (1 H, m, H-3b), 0.92310 (1 H, m, H-2), 1.02118 (9 H, s, -C(CH₃)₃), 1.12302 (1 H, m, H-1), 1.37750 (3 H, d, H-2', $J_{2',1'} = 6.4$ Hz), 3.27570 (1 H, dd, H-1''a, $J_{1''a,2} = 6.1$, $J_{1''a,1''b} = 10.7$ Hz), 3.51600 (3 H, s, -OMe), 3.66010 (1 H, dd, H-1''b, $J_{1''b,2} = 4.8$, $J_{1''b,1''a} = 10.7$ Hz), 4.69690 (1 H, m, H-1'), 7.26880-7.42500 (9 H, m, aromatic), 7.50090 (2 H, d, aromatic, $J = 7.3$ Hz), 7.61220-7.64140 (4 H, m, aromatic); ¹³C-NMR (125 MHz, CDCl₃) δ 7.55, 19.20, 19.31, 19.62, 20.43, 26.82, 55.29, 65.24, 76.80, 84.47 ($J_{C,F} = 28$ Hz), 123.37 ($J_{C,F} = 288$ Hz), 127.26, 127.61, 128.26, 129.42, 129.57, 129.60, 132.54, 133.77, 135.53, 165.92; HR-MS (ESI) calcd for C₃₂H₃₇F₃NaO₄Si 593.2311, found 593.2321 ((M+Na)⁺).

(S)-MTPA-Ester of 10a (8S): yield 98%; ¹H-NMR (500 MHz, CDCl₃) δ 0.47972 (1 H, m, H-3a), 0.58298 (1 H, m, H-3b), 1.00420 (1 H, m, H-2), 1.02962 (9 H, s, -C(CH₃)₃), 1.16104 (1 H, m, H-1), 1.28985 (3 H, d, H-2', $J_{2',1'} = 6.4$ Hz), 3.43180 (1 H, dd, H-1''a, $J_{1''a,2} = 6.1$, $J_{1''a,1''b} = 10.7$ Hz), 3.49220 (3 H, s, -OMe), 3.68550 (1 H, dd, H-1''b, $J_{1''b,2} = 4.8$, $J_{1''b,1''a} = 10.7$ Hz), 4.64010 (1 H, m, H-1'), 7.29000-7.42440 (9 H, m, aromatic), 7.51060 (2 H, d, aromatic, $J = 7.4$ Hz), 7.62880-7.64460 (4 H, m, aromatic); ¹³C-NMR (125 MHz, CDCl₃) δ 7.79, 19.37, 19.41, 19.77, 20.79, 26.99, 55.48, 65.49, 77.30, 84.65 ($J_{C,F} = 27$ Hz), 123.52 ($J_{C,F} = 288$ Hz), 127.38, 127.38, 128.44, 129.57, 129.77, 132.74, 133.86, 135.70, 166.10; HR-MS (ESI) calcd for C₃₂H₃₇F₃NaO₄Si 593.2311, found 593.2321 ((M+Na)⁺).

(R)-MTPA-Ester of 10b (9S): quantitative yield; ¹H-NMR (500 MHz, CDCl₃) δ 0.46034 (1 H, m, H-3a), 0.57973 (1 H, m, H-3b), 0.91346 (1 H, m, H-2), 0.95970 (3 H, t, H-3', $J_{3',2'} = 7.4$ Hz), 1.01754 (9 H, s, -C(CH₃)₃), 1.13621 (1 H, m, H-1), 1.75793 (2 H, d, H-2'), 3.21530 (1 H, dd, H-1''a,

$J_{1''a,2} = 6.5$, $J_{1''a,1''b} = 10.6$ Hz), 3.50540 (3 H, s, -OMe), 3.69520 (1 H, dd, H-1''b, $J_{1''b,2} = 4.2$, $J_{1''b,1''a} = 10.6$ Hz), 4.53600 (1 H, m, H-1'), 7.26160-7.42300 (9 H, m, aromatic), 7.50880 (2 H, m, aromatic), 7.60980-7.63360 (4 H, m, aromatic), 7.63350 (4 H, m, aromatic, $J = 7.1$ Hz); ^{13}C -NMR (125 MHz, CDCl_3) δ 8.09, 9.76, 18.71, 18.88, 19.21, 26.82, 27.43, 55.36, 65.15, 81.82, 84.59 ($J_{\text{C,F}} = 28$ Hz), 123.39 ($J_{\text{C,F}} = 288$ Hz), 127.34, 127.61, 127.62, 128.26, 129.42, 129.57, 129.60, 132.48, 133.77, 135.54, 166.24; HR-MS (FAB) calcd for $\text{C}_{33}\text{H}_{39}\text{F}_3\text{NaO}_4\text{Si}$ 607.2467, found 607.2477 ($(\text{M}+\text{Na})^+$).

(S)-MTPA-Ester of 10b (10S): yield 99%; ^1H -NMR (500 MHz, CDCl_3) δ 0.50309 (1 H, m, H-3a), 0.63271 (1 H, m, H-3b), 0.83468 (3 H, t, H-3', $J_{3',2'} = 7.4$ Hz), 1.00692 (1 H, m, H-2), 1.02776 (9 H, s, $-\text{C}(\text{CH}_3)_3$), 1.20090 (1 H, m, H-1), 1.69373 (2 H, m, H-2'), 3.37100 (1 H, dd, H-1''a, $J_{1''a,2} = 6.3$, $J_{1''a,1''b} = 10.6$ Hz), 3.49200 (3 H, s, -OMe), 3.75270 (1 H, dd, H-1''b, $J_{1''b,2} = 4.3$, $J_{1''b,1''a} = 10.6$ Hz), 4.50350 (1 H, m, H-1'), 7.25240-7.42860 (9 H, m, aromatic), 7.52430 (2 H, d, aromatic, $J = 7.7$ Hz), 7.63350 (4 H, m, aromatic, $J = 7.1$ Hz); ^{13}C -NMR (125 MHz, CDCl_3) δ 8.14, 9.45, 18.97, 19.19, 19.23, 26.84, 27.17, 55.35, 65.15, 81.99, 84.44, ($J_{\text{C,F}} = 27$ Hz), 123.42 ($J_{\text{C,F}} = 288$ Hz), 127.23, 127.65, 128.25, 129.42, 129.62, 132.63, 133.67, 133.71, 135.55, 166.22; HR-MS (FAB) calcd for $\text{C}_{33}\text{H}_{39}\text{F}_3\text{NaO}_4\text{Si}$ 607.2467, found 607.2487 ($(\text{M}+\text{Na})^+$).

(R)-MTPA-Ester of 10e (13S): yield 97%; ^1H -NMR (500 MHz, CDCl_3) δ 0.45170 (1 H, m, H-3a), 0.56925 (1 H, m, H-3b), 0.88450 (1 H, m, H-2), 0.90070 (3 H, d, H-4'a, $J_{4'a,3'} = 6.4$ Hz), 0.90408 (3 H, d, H-4'b, $J_{4'b,3'} = 6.4$ Hz), 1.01638 (9 H, s, $-\text{C}(\text{CH}_3)_3$), 1.17109 (1 H, m, H-1), 1.47199 (1 H, d, H-2'a), 1.67696 (1 H, m, H-2'b), 1.68665 (1 H, m, H-3'), 3.20110 (1 H, dd, H-1''a, $J_{1''a,2} = 6.5$, $J_{1''a,1''b} = 10.6$ Hz), 3.49800 (3 H, s, -OMe), 3.69380 (1 H, dd, H-1''b, $J_{1''b,2} = 4.2$, $J_{1''b,1''a} = 10.6$ Hz), 4.67450 (1 H, m, H-1'), 7.25480-7.44580 (9 H, m, aromatic), 7.50260 (2 H, d, aromatic, $J = 7.4$ Hz), 7.60360-7.63420 (4 H, m, aromatic); ^{13}C -NMR (125 MHz, CDCl_3) δ 8.11, 19.11, 19.22, 19.65, 22.11, 23.04, 24.47, 26.82, 43.57, 55.36, 65.08, 79.03, 84.55 ($J_{\text{C,F}} = 28$ Hz), 123.37 ($J_{\text{C,F}} = 288$ Hz), 127.33, 127.61, 127.62, 128.24, 129.41, 129.56, 129.60, 132.40, 133.76, 133.79, 135.54, 166.24; HR-MS (FAB) calcd for $\text{C}_{35}\text{H}_{42}\text{F}_3\text{O}_4\text{Si}$ 611.2804, found 611.2794 ($(\text{M}-\text{H})^+$).

(S)-MTPA-Ester of 10e (14S): quantitative yield; ^1H -NMR (500 MHz, CDCl_3) δ 0.49564 (1 H, m, H-3a), 0.62946 (1 H, m, H-3b), 0.81677 (3 H, d, H-4'a, $J_{4'a,3'} = 6.4$ Hz), 0.82804 (3 H, d, H-4'b, $J_{4'b,3'} = 6.4$ Hz), 1.01868 (1 H, m, H-2), 1.02904 (9 H, s, $-\text{C}(\text{CH}_3)_3$), 1.24974 (1 H, m, H-1), 1.37766 (1 H, m, H-2'a), 1.46950 (1 H, m, H-3'), 1.65331 (1 H, m, H-2'b), 3.36800 (1 H, dd, H-1''a, $J_{1''a,2} = 6.2$, $J_{1''a,1''b} = 10.6$ Hz), 3.48760 (3 H, s, -OMe), 3.75520 (1 H, dd, H-1''b, $J_{1''b,2} = 4.3$, $J_{1''b,1''a} = 10.6$ Hz), 4.65520 (1 H, m, H-1'), 7.24760-7.42980 (9 H, m, aromatic), 7.52160 (2 H, d, aromatic, $J = 7.6$ Hz), 7.62480-7.64060 (4 H, m, aromatic); ^{13}C -NMR (125 MHz, CDCl_3) δ 8.11, 19.24, 19.41, 19.96, 21.79, 23.11, 24.09, 26.84, 43.29, 55.89, 65.04, 79.07, 84.91 ($J_{\text{C,F}} = 28$ Hz), 122.69 ($J_{\text{C,F}} = 288$ Hz), 126.92, 127.65, 128.68, 129.63, 130.09, 132.60, 133.66, 133.73, 135.55, 166.24; HR-MS (FAB) calcd for $\text{C}_{35}\text{H}_{42}\text{F}_3\text{O}_4\text{Si}$ 611.2804, found 611.2784 ($(\text{M}-\text{H})^+$).