Supporting Information

Merging Regiodivergent Catalysis with Atom-Economical Radical Arylation

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1. General Information

All Reactions involving air- and moisture sensitive substances were carried out in flame dried glassware under argon atmosphere using standard Schlenk technique. The THF used in the reactions was freshly distilled over Na before use. All reactions were monitored by thin-layer chromatography (TLC) on Merck silica gel F$_{254}$ plates using UV light as visualizing agent (if applicable) and a solution of ammoniummolybdate tetrahydrate (25g/L) and Ce(SO$_4$)$_2$•4H$_2$O (10g/L) in 10% aqueous H$_2$SO$_4$ followed by heating as developing agents. The crude products were purified by Flash column chromatography on Merck silica gel 50 if not stated otherwise.

1.1 Instruments

$^1$H NMR and $^{13}$C NMR spectra were measured on Bruker AMX 300 MHz, 400 MHz or 500 MHz spectrometers. $^1$H NMR chemical shifts ($\delta_H$) are given in ppm and calibrated by using the residual peak of the undeuterated solvent (CHCl$_3$ 7.26 ppm or C$_6$H$_5$D 7.16 ppm) as internal reference. $^{13}$C NMR shifts are noted in ppm ($\delta_C$) using the solvent peak as internal reference (CDCl$_3$ 77.0 ppm or C$_6$D$_6$ 128.0 ppm). Coupling constants are reported in Hz and represent $J_{H,H}$ couplings, unless explicitly stated otherwise. The diastereomeric and regioisomeric ratios of the products were determined by $^{13}$C NMR spectroscopy of the crude mixtures. It has been demonstrated that the NMR techniques used here are accurate for the determination of diastereomeric and regioisomeric ratios.$^{[1]}$ Compared to $^1$H NMR spectroscopy the errors of the ratios in $^{13}$C NMR spectroscopy are typically less than 2% and therefore within experimental error. IR spectra were recorded on Nicolet ATR-IR-Spectrometer TM 380 as neat films on KBr plates. High resolution mass spectra were measured using a Thermo Fisher Scientific Orbitrap XL mass spectrometer by ESI (+) measurement. Enantiomeric ratios were determined by chiral HPLC on a Daicel Chiralpak IC-U column. The $\alpha_{D}^{20}$ values were measured in chloroform (10 g/L) on the MCP 150 polarimeter by Anton Paar.

The data collection for the single crystal x-Ray analysis was performed on a Bruker D8-Venture diffractometer using multi-layer optics monochromated Cu-$K\alpha$ irradiation ($\lambda = 1.54178 \text{ Å}$). The diffractometer was equipped with a low-temperature device (Oxford Cryostream 800er series, Oxford Cryosystems, 100(2) K). Intensities were measured by fine-slicing $\omega$ and $\varphi$-scans and
corrected for background, polarization and Lorentz effects. For all data sets an empirical absorption correction was applied. The structures were solved by intrinsic phasing methods and refined anisotropically by the least-square procedure implemented in the SHELX program system. All hydrogen atoms were included using the riding model on the bound carbon atoms.

CCDC numbers 1910522 (2g) and 1910523 (3a) contain the supplementary crystallographic data for this paper, which can be obtained free of charge from the Cambridge Crystallographic Data Centre via www.ccdc.cam.ac.uk/data_request/cif.

2. General Procedures

2.1 General procedure for bromination-epoxidation reaction sequence of allylic alcohols (GP1).

\[
\begin{align*}
\text{HO-}R' & \quad \xrightarrow{\text{Br}_2, \text{DCM}, -78^\circ\text{C}} \quad \text{HO-}^\text{Br}R' \\
\text{K}_2\text{CO}_3 & \quad \text{MeOH} \\
\text{O} & \quad \text{Br}R'
\end{align*}
\]

A solution of allylic alcohol (1.0 eq.) in CH$_2$Cl$_2$ (0.5 mmol/mL) is cooled to -78°C. Over a period of 1h bromine (1.0 eq.) is added via dropping funnel and the reaction is stirred for 1h at -78°C. The reaction is quenched by addition of saturated NaHSO$_3$ solution (2 mL/mmol substrate). After warming up to room temperature ¾ of the solvent is removed, phases are separated, and the aqueous phase is extracted twice with CH$_2$Cl$_2$. The combined organic extracts are dried over MgSO$_4$ and the solvent is removed under reduced pressure. The product was used without further purification. $^3$α-bromo alcohol (1.0 eq.) is dissolved in methanol (2 mL/mmol) and finely ground K$_2$CO$_3$ (2.0 eq.) is added. The mixture is stirred for 3 h and the reaction progress is monitored by TLC. After complete conversion ¾ of the methanol is removed in vacuo and the residue is mixed with ethyl acetate (2 mL/mmol). K$_2$CO$_3$ is removed via vacuum filtration and the solvent is evaporated. The crude product is purified via flash column chromatography (silica, Eluent: CH : MTBE 98:2) or distillation (60°C, 10 mbar) depending on reaction scale. $^4$
2.2 General procedure for the hydrolytic kinetic resolution of terminal epoxides (GP2).

(S,S)- or (R,R)-oligomeric Jacobsen catalyst (0.05 mg/mmol substrate) is added to the racemic terminal epoxide (1.0 eq.). H\textsubscript{2}O (0.53 eq.) is added dropwise and after completed addition the reaction mixture is stirred for 16h. The crude product is purified via flash column chromatography (silica, Eluent: CH \textsubscript{2}CH \textsubscript{2}MTBE 98:2).\textsuperscript{[5]} The er of the product is determined via chiral HPLC.

2.3.1 General procedure for the addition of anilinide derivatives to terminal epoxides (GP3a).

A solution of aniline derivative (1.0 eq.) in THF (0.5 mmol/mL) is cooled down to -78°C and nBuLi solution (2.5M in hexane, 1.2 eq.) is added dropwise. The mixture is stirred for 30 min followed by addition of the terminal syn-bromo-epoxide (1.2 eq.). The reaction is allowed to warm to room temperature over 16h. The reaction is quenched by addition of saturated NH\textsubscript{4}Cl solution (2 mL/mmol aniline). The phases are separated, and the aqueous layer is extracted with diethylether three times. The combined organic extracts are washed with water and brine, then dried over Na\textsubscript{2}SO\textsubscript{4} and the solvent is removed. The crude product is purified via flash column chromatography (silica, Eluent: CH \textsubscript{2}CH \textsubscript{2}MTBE, 98:2). The resulting compounds can be air sensitive.\textsuperscript{[6]}
2.3.2 General procedure for the aminolysis-epoxidation reaction sequence (GP3b).

\[
\begin{array}{cccccc}
\text{R}^1 & \text{Br} & \text{SiO}_2 & \text{K}_2\text{CO}_3 & \text{MeOH, r.t., 1h} \\
\text{R}^2 & \text{N} & \text{OH} & \text{R}^1 & \\
\text{R}^3 & \text{N} & \text{O} & \text{R}^1 & \\
\end{array}
\]

A round bottom flask is charged with Aniline derivative (1.0 eq.), terminal syn-bromo-epoxide (1.0 eq.) and SiO\textsubscript{2} (20\% of the weight of both reactants). If not stated otherwise the reaction mixture is stirred at room temperature for 24-48h and progress is monitored via TLC. 5 mL of DCM are added, and the suspension is allowed to stir for another 30 min. The mixture is filtered, and all volatiles are removed \textit{in vacuo}. The crude is purified via flash column chromatography (SiO\textsubscript{2}, Eluent: CH\textsubscript{2}Cl\textsubscript{2}:MTBE, 97:3). The obtained syn-bromo-alcohol (1.0 eq.) is dissolved in 5 mL MeOH and freshly ground K\textsubscript{2}CO\textsubscript{3} (2.0 eq.) is added. The mixture is heated to 40°C and is stirred for 1h. The reaction progress is monitored via TLC. After cooling to room temperature 50 mL of Et\textsubscript{2}O are added, K\textsubscript{2}CO\textsubscript{3} is removed via filtration and the solution is concentrated \textit{in vacuo}. The crude product is purified via flash column chromatography (SiO\textsubscript{2}, eluent: CH\textsubscript{2}Cl\textsubscript{2}:MTBE 99:1).\textsuperscript{[7]}

2.4 General procedures for the regiodivergent arylation of epoxides.

2.4.1 General procedure for the formation of tetrahydroquinolines GP4.

\[
\begin{array}{cccccc}
\text{R}^1 & \text{N} & \text{R}^2 & \text{O} & \text{L-Kagan-OTs} & \text{Zn} \\
\text{R}^3 & \text{N} & \text{R}^1 & \text{OH} & \text{THF} & \\
\end{array}
\]

A Schlenk tube is charged with cat-(OTs)\textsubscript{2} (= L-Kagan-(OTs)\textsubscript{2}) (L-cat-OTs\textsubscript{2} 40 mg, 0.05 mmol, 0.1 eq.) and zinc powder (10 mg, 0.15 mmol, 0.3 eq.). The tube is evacuated for 15 min and then flushed with argon. Afterwards 1 mL of dry THF is added, which results in a red solution. The solution is stirred for at least five minutes. Once the color of the solution has changed from red to turquoise the substrate (0.5 mmol, 1.0 eq.) is added via syringe. The syringe is flushed with 1.5 mL of THF and the reaction mixture is allowed to stir for 48 h at room temperature. Afterwards the reaction mixture is filtered through a silica plug and flushed with Diethylether. The solvent is removed under reduce pressure and the crude product is purified via flash column chromatography (silica, Eluent: CH\textsubscript{2}Cl\textsubscript{2}:MTBE 9:1). The diastereoselectivity and the regioselectivity is determined by \textsuperscript{13}C NMR analysis of the crude product.
2.4.2 General procedure for the formation of indolines (GP5).

A Schlenk tube is charged with lutidine hydrochloride (Lut•HCl 22 mg, 0.15 mmol, 0.3 eq.), which is resublimed in vacuo. Zinc powder (10 mg, 0.15 mmol, 0.3 eq.) and ent-cat-Cl₂ (= D-Kagens-complex) 18.4 mg, 0.035 mmol, 0.07 eq.) are added and the Schlenk tube is evacuated for 15 min. Afterwards 1 mL of dry THF is added, which results in a red solution. The solution is stirred until the color of the solution has changed from red to green. Then the substrate (0.5 mmol, 1.0 eq.) is added via syringe. The syringe is flushed with 1.5 mL of THF and the reaction mixture is allowed to stir for 48 h at room temperature. Afterwards the reaction mixture is filtered through a silica plug and flushed with Diethylether. The solvent is removed under reduce pressure and the crude product is purified via flash column chromatography (silica, Eluent: CH₂:MTBE 9:1). The diastereoselectivity and the regioselectivity is determined by ¹³C NMR analysis of the crude product.

3. Characterization of compounds

3.1 Synthesis of α-bromo-epoxides

3.1.1. Synthesis of syn-3-bromo-1,2-epoxy-hexane

20.0 g of (E)-hex-2-en-1-ol (200 mmol, 1.0 eq.) are reacted with 32.0 g of bromine (10.3 mL, 200 mmol, 1.0 eq.) following GP1. After workup, the crude product is reacted with 55.3 g K₂CO₃ (400 mmol, 2.0 eq.) in MeOH. After distillation (60°C, 10 mbar), 25.8 g (144 mmol, 72%) of syn-3-bromo-1,2-epoxyhexane are obtained as a colorless liquid.

R₁ = 0.40 (10% Et₂O in CH);¹H-NMR (500 MHz, CDCl₃, RT): δ [ppm] = 0.95 (t, 3H, J = 7.4 Hz), 1.36-1.71 (m, 1H), 1.52-1.65 (m, 1H), 1.86 (q, 2H, J = 7.5 Hz), 2.74 (dd, 1H, J = 4.8, J = 2.5 Hz), 2.97 (dd, 1H, J = 4.8 Hz, J = 3.8), 3.21 (ddd, 1H, J = 7.6 Hz, J = 3.8 Hz, J = 2.4 Hz), 3.65-3.71 (m, 1H). ¹³C-NMR (125 MHz, CDCl₃, RT): δ [ppm] = 13.6, 20.8, 37.1, 49.0, 55.8, 55.9. IR ν [cm⁻¹] = 517, 525, 611, 693, 749, 761, 798, 854, 873, 928, 1193, 1252, 1465, 2933, 2961.
3.1.2. Synthesis of syn-3-bromo-1,2-epoxy-octane.

According to GP1: 12.1 g (E)-oct-2-en-1-ol (1.00 eq., 120.0 mmol), 19.2 g bromine (1.00 eq., 120.0 mmol, 6.15 mL) are reacted for 30 minutes at -78 °C in DCM. After workup, the crude product is reacted with 33.2 g K₂CO₃ (2.00 eq., 240 mmol) in MeOH. Flash chromatography (SiO₂, Eluent: Ch : Et₂O = 99 : 1) afforded 13.8 g (syn)-3-bromo-1,2-epoxyoctane 56 % as a light yellow oil.

\begin{align*}
\text{R} & = 0.50 \text{ (10\% Et}_2\text{O in CH)} , \\
\text{^1H-NMR (500 MHz, CDCl}_3\text{, RT): } & \delta \text{ [ppm]} = 0.83-0.92 \text{ (m, 3H), 1.22-1.35 (m, 4H), 1.36-1.46 (m, 1H), 1.54 (ddddd, 1H, } J = 15.4, J = 12.3 \text{ Hz, } \\
& J = 9.3 \text{ Hz, } J = 4.5 \text{ Hz), 1.80-1.92 (m, 2H), 2.72 (dt, 1H, } J = 4.2, J = 2.0 \text{ Hz), 2.92-2.97} \\
& \text{ (m, 1H), 3.19 (ddt, 1H, } J = 7.8 \text{ Hz, } J = 4.0 \text{ Hz, } J = 1.9 \text{j Hz), 3.62-3.68 (m, 1H).} \\
\text{^13C-NMR (125 MHz, CDCl}_3\text{, RT): } & \delta \text{ [ppm]} = 14.0, 22.5, 27.1, 31.2, 35.1, 49.0, 55.8, 62.2. \text{ IR } \tilde{\nu} \text{ [cm}^{-1}] = 613, 807, 856, 924, 1227, 1251, 1466, 1740, 2860, 2929, 2957.
\end{align*}
3.1.3. Synthesis of syn-3-brom-1,2-epoxy-5-methyl-hexane.

According to GP1: 3.19 g (E)-5-methyl-hex-2-en-1-ol (1.00 eq., 31.9 mmol), 5.10 g bromine (1.00 eq., 31.9 mmol, 1.63 mL) are reacted for 30 minutes at -78 °C in DCM. After workup, the crude product is reacted with 8.81 g K₂CO₃ (2.00 eq., 63.8 mmol) in MeOH. Flash chromatography (SiO₂, Eluent: CH₂Cl₂ : Et₂O = 99 : 1) afforded 4.45 g (syn)-3-bromo-1,2-epoxy-5-methyl-hexane 78% as a light colorless oil.

$$\text{R}_{f} = 0.40 \, (10\% \text{ Et}_2\text{O in CH}), \quad ^1\text{H-NMR} \, (500 \text{ MHz, CDCl}_3, \text{RT}): \, \delta \, [\text{ppm}] = 1.09 \, (\text{ddd, } 6\text{H, } J = 11.4 \text{ Hz, } J = 6.7 \text{ Hz, } J = 1.9 \text{ Hz}), \quad 2.05 \, (\text{hept, } 1\text{H, } J = 6.7 \text{ Hz}), \quad 2.73 \, (\text{dt, } 1\text{H, } J = 4.5, \quad J = 2.1 \text{ Hz}), \quad 3.01 \, (\text{ddd, } 1\text{H, } J = 6.0 \text{ Hz, } J = 4.1 \text{ Hz, } J = 1.9 \text{ Hz}), \quad 3.20 \, (\text{ddt, } 1\text{H, } J = 8.6 \text{ Hz, } J = 3.7 \text{ Hz, } J = 2.3 \text{ Hz}), \quad 3.47 \, (\text{ddd, } 1\text{H, } J = 8.5 \text{ Hz, } J = 5.4 \text{ Hz, } J = 1.7 \text{ Hz}). \quad ^{13}\text{C-NMR} \, (125 \text{ MHz, CDCl}_3, \text{RT}): \, \delta \, [\text{ppm}] = 19.9, \, 20.6, \, 33.5, \, 50.1, \, 54.8, \, 64.8. \quad \text{IR } \tilde{\nu} \, [\text{cm}^{-1}] = 407, \, 471, \, 678, \, 692, \, 808, \, 819, \, 838, \, 857, \, 921, \, 1198, \, 1255, \, 1369, \, 1388, \, 1465, \, 2967. \quad \text{HRMS (ESI): } m/z \, \text{berechnet für } \text{C}_{6}\text{H}_{11}\text{BrONa}^+: \, 200.9885 \text{ u; found: } 200.9877 \text{ u.}
3.2 Kinetic resolution of α-bromo-epoxides (rac-A→A)

3.2.1 Kinetic resolution of syn-3-bromo-1,2-epoxy-hexane.

According to GP2 25.8 g of syn-3-bromo-1,2-epoxy-hexane (144 mmol, 1.0 eq) are mixed with 10 mg (0.01 mmol, 0.00007 eq.) (S,S)-oligomeric Jacobsen catalyst. 1.37 g H₂O (76.3 mmol, 0.53 eq.) is added dropwise and the mixture is stirred for 16h at room temperature. The crude mixture is purified without further workup by flash column chromatography (SiO₂, Eluent: CH₂Cl₂:MTBE 98:2). 11.0 g (2R,3R)-3-bromo-1,2-epoxy-hexane (61.2 mmol, 43% yield) are isolated.

Rf = 0.40 (10% Et₂O in CH), ¹H-NMR (500 MHz, CDCl₃, RT): δ [ppm] = 0.95 (t, 3H, J = 7.4 Hz), 1.36-1.71 (m, 1H), 1.52-1.65 (m, 1H), 1.86 (q, 2H, J = 7.5 Hz), 2.74 (dd, 1H, J = 4.8, J = 2.5 Hz), 2.97 (dd, 1H, J = 4.8 Hz, J = 3.8), 3.21 (dd, 1H, J = 7.6 Hz, J = 3.8 Hz, J = 2.4 Hz), 3.65-3.71 (m, 1H). ¹³C-NMR (125 MHz, CDCl₃, RT): δ [ppm] = 13.6, 20.8, 37.1, 49.0, 58.8, 55.9. IR ν [cm⁻¹] = 517, 525, 611, 693, 749, 761, 798, 854, 873, 928, 1193, 1252, 1465, 2933, 2961; [α]D²⁰ = −7.9° (c 1.0, CHCl₃); HPLC: DAICEL Chiralpak AS-3; n-Heptane/2-Propanol (98:2); flowrate 1.0 mL/min; tₘ = 6.1 min (minor, 2S,3S), tₘ = 7.1 min (major, 2R, 3R); er = >99:<1.

3.2.2 Kinetic resolution of syn-3-bromo-1,2-epoxy-octane.

According to GP2 13.6 g of syn-3-bromo-1,2-epoxy-octane (65.6 mmol, 1.0 eq) are mixed with 10 mg (0.01 mmol, 0.0002 eq.) (S,S)-oligomeric Jacobsen catalyst. 0.65 g H₂O (36.1 mmol, 0.55 eq.) is added dropwise and the mixture is stirred for 16h at room temperature. The crude mixture is purified without further workup by flash column chromatography (SiO₂, Eluent: CH₂Cl₂:MTBE 98:2). 4.65 g (2R,3R)-3-bromo-1,2-epoxy-octane (36.1 mmol, 35% yield) are isolated.

Rf = 0.50 (10% Et₂O in CH), ¹H-NMR (500 MHz, CDCl₃, RT): δ [ppm] = 0.83-0.92 (m, 3H), 1.22-1.35 (m, 4H), 1.36-1.46 (m, 1H), 1.54 (dddd, 1H, , J = 15.4, J = 12.3 Hz, J = 9.3 Hz, J = 4.5 Hz), 1.80-1.92 (m, 2H), 2.72 (dt, 1H, J = 4.2, J = 2.0 Hz), 2.92-2.97
(m, 1H), 3.19 (ddt, 1H, J = 7.8 Hz, J = 4.0 Hz, J = 1.9 Hz), 3.62-3.68 (m, 1H). \textsuperscript{13}C-NMR (125 MHz, CDCl\textsubscript{3}, RT): \(\delta\) [ppm] = 14.0, 22.5, 27.1, 31.2, 35.1, 49.0, 55.8, 62.2. IR \(\tilde{\nu}\) [cm\textsuperscript{-1}] = 613, 807, 856, 924, 1227, 1251, 1466, 1740, 2860, 2929, 2957; \([\alpha]_D^{20}= -7.6^\circ\) (c 1.0, CHCl\textsubscript{3}); HPLC: DAICEL Chiralpak AS-3; n-Heptane/2-Propanol (98:2); flowrate 1.0 mL/min; \(t_\text{R}\) = 4.9 min (minor, 2S,3S), \(t_\text{R}\) = 5.5 min (major, 2R, 3R); \(\text{er}= >99:<1\).

3.2.3 Kinetic resolution of (syn)-3-bromo-1,2-epoxy-5-methyl-hexane.

\[
\begin{align*}
\text{Br} & \quad \text{(S,S)-olig.} \quad \text{Jacobsen-cat} \\
\text{H}_2\text{O} & \quad \text{Br}
\end{align*}
\]

According to GP2 7.54 g of (syn)-3-bromo-1,2-epoxy-5-methyl-hexane (39.1 mmol, 1.0 eq) are mixed with 20 mg (0.02 mmol, 0.0004 eq.) (S,S)-oligomeric Jacobsen catalyst. 0.373 g H\textsubscript{2}O (20.7 mmol, 0.53 eq.) is added dropwise and the mixture is stirred for 16h at room temperature. The crude mixture is purified without further workup by flash column chromatography (SiO\textsubscript{2}, Eluent: CH\textsubscript{3}OH:Et\textsubscript{2}O 98:2). 2.62 g (2R,3R)-3-bromo-1,2-epoxy-hexane (13.6 mmol, 35% yield) are isolated.

\[
\begin{align*}
\text{R}_i & = 0.40 \quad (10\% \text{ Et}_2\text{O in CH}), \quad \text{\textsuperscript{1}H-NMR (500 MHz, CDCl\textsubscript{3}, RT):} \quad \delta \ [\text{ppm}] = 1.09 \ (\text{ddd, 6H, } J = 11.4 \text{ Hz, } J = 6.7 \text{ Hz, } J = 1.9 \text{ Hz}), \quad 2.05 \ (\text{hept, 1H, } J = 6.7 \text{ Hz}), \quad 2.73 \ (\text{dt, 1H, } J = 4.5, \ J = 2.1 \text{ Hz}), \quad 3.01 \ (\text{ddd, 1H } J = 6.0 \text{ Hz, } J = 4.1 \text{ Hz, } J = 1.9 \text{ Hz}), \quad 3.20 \ (\text{ddt, 1H, } J = 8.6 \text{ Hz, } J = 3.7 \text{ Hz, } J = 2.3 \text{ Hz}), \quad 3.47 \ (\text{ddd, 1H, } J = 8.5 \text{ Hz, } J = 5.4 \text{ Hz, } J = 1.7 \text{ Hz}). \quad \text{\textsuperscript{13}C-NMR (125 MHz, CDCl\textsubscript{3}, RT):} \quad \delta \ [\text{ppm}] = 19.9, \ 20.6, \ 33.5, \ 50.1, \ 54.8, \ 64.8. \quad \text{IR} \ \tilde{\nu} \ [\text{cm}^{-1}] = 407, \ 471, \ 678, \ 692, \ 808, \ 819, \ 838, \ 857, \ 921, \ 1198, \ 1255, \ 1369, \ 1388, \ 1465, \ 2967. \quad \text{HRMS (ESI):} \ m/z \text{ calculated for C}_7\text{H}_{14}\text{BrO}^+: \ 193.0223 \ u; \text{ found: 193.0227 u.} \quad [\alpha]_D^{20}= -8.0^\circ\ \text{c 1.0, CHCl\textsubscript{3}}; \quad \text{HPLC: DAICEL Chiralpak IC-U; n-Heptane/2-Propanol (98:2);} \quad \text{flowrate 0.85 mL/min;} \quad \text{t}_\text{s} = 1.4 \text{ min (minor, 2S,3S),} \quad \text{t}_\text{R} = 1.7 \text{ min (major, 2R, 3R);} \quad \text{er= >99:<1.}
3.3 Base mediated aminolysis of bromo-epoxides to aniline-epoxides (A→1)

3.3.1. Synthesis of N-(((2R,3S)-3-pentyloxiran-2-yl)methyl)-N-phenylaniline (1b).

\[
\begin{align*}
\text{Ph} & \quad + \quad \text{O} & \quad \text{GP3a} & \quad \text{Ph} \\
\text{N} & \quad \text{N} & \quad & \quad \text{1b}
\end{align*}
\]

According to GP3a: 1.53 g diphenylamine (1.00 eq., 8.0 mmol), 2.49 g (2R,3R)-3-bromo-1,2-epoxyoctane (1.50 eq., 12.0 mmol) and 3.52 mL nButyllithium (1.1 eq., 8.8 mmol, 2.5 M in hexane) are reacted for 20 hours (-78 °C to RT) in dry THF. Remaining (2R,3R)-3-bromo-1,2-epoxyoctane was removed under reduced pressure (5 mbar, 80 °C). Flash chromatography (SiO₂, Eluent: CH₂O : Et₂O = 98 : 2) yielded 1.89 g 1b 80 % as a colorless liquid.

**Rf** = 0.8 (20% Et₂O in CH), **¹H-NMR (500 MHz, C₆D₆, RT):** δ [ppm] = 0.84 (t, 3H, J = 7.1 Hz), 1.08-1.33 (m, 8H), 2.61 (dt, 1H, J = 6.8 Hz, J = 4.3 Hz), 3.06 (ddd, 1H, J = 6.8 Hz, J = 4.3 Hz, J = 4.3 Hz), 3.64 (dd, 1H, J = 15.7 Hz, J = 5.5 Hz), 3.76 (dd, 1H, J = 15.8 Hz, J = 4.3 Hz), 6.85 (tt, 2H, J = 7.3 Hz, J = 1.3 Hz), 7.06 (dd, 4H, J = 8.4 Hz, J = 1.4 Hz), 7.12 (tt, 4H, J = 8.6 Hz, J = 7.1 Hz). **¹³C-NMR (125 MHz, C₆D₆, RT):** δ [ppm] = 14.2, 22.9, 26.7, 28.4, 31.9, 51.5, 54.6, 56.8, 121.7, 122.0, 129.7, 148.5. IR ν [cm⁻¹] = 513, 593, 607, 692, 730, 746, 1222, 1249, 1362, 1460, 1494, 1589, 2926, 2955. **HRMS (ESI):** m/z calculated for C₂₀H₂₆NO⁺: 296.2009 u, found: 296.2014 u; [α]₀²⁰ = -80.4° (c 1.0, CHCl₃)
3.3.2. Synthesis of N-(((2R,3S)-isobutylxiran-2-yl)methyl)-N-phenylaniline (1c).

![Chemical structure](image)

According to GP3a: 846 mg diphenylamine (1.00 eq., 6.0 mmol), 1.16 g (2R,3R)-3-bromo-1,2-epoxy-5-methyl-hexane (1.20 eq., 6.0 mmol) and 2.2 mL nButyllithium (1.1 eq., 5.5 mmol, 2.5 M in hexane) are reacted for 20 hours (-78 °C to RT) in dry THF. Flash chromatography (SiO₂, Eluent: CH₂O : Et₂O = 99 : 1) yielded 693 mg (N,N-Diphenyl)(2R,3R)-3-bromo-5-methyl-hexanamine-1c 49% as a colorless, viscous liquid.

R<sub>f</sub> = 0.8 (20% Et₂O in CH), <sup>1</sup>H-NMR (500 MHz, C₆D₆, RT): δ [ppm] = 0.78 (d, 3H, J = 6.7 Hz), 0.86 (d, 3H, J = 6.7 Hz), 0.98-1.15 (m, 2H), 1.55 (hept, 1H, J = 6.7 Hz), 2.63 (dt, 1H, J = 7.1 Hz, J = 4.6 Hz), 3.03 (dd, 1H, J = 5.8 Hz, J = 4.0 Hz, J = 4.0 Hz), 3.59 (dd, 1H, J = 15.7 Hz, J = 5.8 Hz), 3.77 (dd, 1H, J = 15.7 Hz, J = 3.9 Hz), 6.85 (tt, 2H, J = 7.3 Hz, J = 1.3 Hz), 7.05-7.14 (m, 8H). <sup>13</sup>C-NMR (125 MHz, C₆D₆, RT): δ [ppm] = 22.6, 22.8, 27.1, 37.1, 51.8, 54.3, 55.6, 121.7, 122.0, 129.7, 148.6. IR ν [cm<sup>-1</sup>] = 513, 608, 692, 729, 746, 1248, 1362, 1463, 1493, 1589, 2955. HRMS (ESI): m/z calculated for C<sub>19</sub>H<sub>24</sub>NO⁺: 282.1852 u, found: 282.1857 u. [α]<sub>D</sub> = −68.0 (c 1.0, CHCl₃).
3.3.3. Synthesis of N-isopropyl-N-(((2R,3S)-3-propyloxiran-2-yl)methyl)aniline (1e).

According to GP3a: 1.53 g N-isopropylaniline (1.00 eq., 5.0 mmol), 2.49 g (2R,3R)-3-bromo-1,2-epoxyhexane (1.20 eq., 6.0 mmol) and 2.2 mL nButyllithium (1.1 eq., 5.5 mmol, 2.5 M in hexane) are reacted for 20 hours (-78 °C to RT) in dry THF. Flash chromatography (Al₂O₃, Eluent: CH₂O : Et₂O = 95 : 5) yielded 540 mg 1e 46% as a colorless liquid.

\[ \text{Rf} = 0.35 \ (10\% \text{ Et}_2\text{O in CH}, \quad ^1\text{H-NMR (500 MHz, C}_6\text{D}_6, \text{RT}): \delta [\text{ppm}] = 0.86 \ (t, \ 3\text{H, } J = 7.2 \text{ Hz}), 0.94 \ (d, \ 3\text{H, } J = 6.7 \text{ Hz}), 1.04 \ (d, \ 3\text{H, } J = 6.6 \text{ Hz}), 1.25-1.45 \ (m, \ 4\text{H}), 2.65 \ (ddd, \ 1\text{H, } J = 6.5 \text{ Hz}, \ J = 5.4 \text{ Hz}, \ J = 4.1 \text{ Hz}), 2.86 \ (ddd, \ 1\text{H, } J = 5.0 \text{ Hz}, \ J = 4.1 \text{ Hz}, \ J = 3.1 \text{ Hz}), 3.07 \ (dd, \ 1\text{H, } J = 16.1 \text{ Hz}, \ J = 5.1 \text{ Hz}), 3.33 \ (dd, \ 1\text{H, } J = 16.1 \text{ Hz}, \ J = 3.1 \text{ Hz}), 3.84 \ (hept, \ 1\text{H, } J = 6.6 \text{ Hz}), 6.80 \ (tt, \ 1\text{H, } J = 7.3 \text{ Hz}, \ J = 1.0 \text{ Hz}), 6.88 \ (dd, \ 2\text{H, } J = 8.9 \text{ Hz}, \ J = 1.0 \text{ Hz}), \ 7.26 \ (dd, \ 2\text{H, } J = 8.9 \text{ Hz}, \ J = 7.2 \text{ Hz}) \].

\[ ^{13}\text{C-NMR (125 MHz, C}_6\text{D}_6, \text{RT)}: \delta [\text{ppm}] = 14.1, 19.9, 20.4, 20.6, 30.7, 43.5, 48.5, 56.6, 56.7, 114.3, 117.5, 129.7, 149.5. \quad \text{IR } \tilde{\nu} \ [\text{cm}^{-1}] = 475, 491, 745, 827, 988, 1041, 1104, 1122, 1159, 1159, 1248, 1297, 1350, 1364, 1392, 1464, 1504, 1598, 2963. \]

\text{HRMS (ESI)}: m/z calculated for C₁₅H₂₄NO⁺: 234.1852 u, found: 234.1852 u; [\alpha]_D^{20} = -18.3° (c 1.0, CHCl₃)
3.3.4 Synthesis of N-Cyclopropyl-N-(((2R,3S)-3-propyloxirane-2-yl)methyl)aniline (1f).

1.04 g (7.8 mmol, 1.0 eq.) of N-cyclopropylaniline are reacted with 3.4 mL of 2.5M nBuLi-solution in Hexane (8.6 mmol, 1.1 eq.) and 1.95 g (2R,3R)-3-bromo-1,2-epoxyhexane (10.9 mmol, 1.2 eq.) following GP3a. After flash column chromatography (SiO₂, CH₂Cl₂ : MTBE 98:2) the product is obtained as a colorless oil in 63% yield (1.14 g, 5.5 mmol) and is stored under argon atmosphere.

\[ \text{R} = 0.7 \text{ (20% EE in CH)}; \text{H NMR (300.1 MHz, C}_6\text{D}_6, \text{RT}) \delta \text{ [ppm]} 0.42-0.60 \text{ (m, 4H), 0.81-0.89 \text{ (m, 3H), 1.22-1.48 (m, 4H), 2.28 (tt, } J = 6.2 \text{ Hz, } J = 4.0 \text{ Hz, 1H), 2.56-2.65 (m, 1H), 2.89 (dt, } J = 5.8 \text{ Hz, } J = 4.2 \text{ Hz, 1H), 3.30 (dd, } J = 15.5 \text{ Hz, } J = 5.6 \text{ Hz, 1H), 3.43 (dd, } J = 15.5 \text{ Hz, } J = 4.2 \text{ Hz, 1H), 6.86 (tt, } J = 7.2 \text{ Hz, } J = 1.1 \text{ Hz, 1H), 7.06-7.13 \text{ (m, 2H), 7.23-7.33 (m, 2H); C NMR (75 MHz, C}_6\text{D}_6, \text{RT}) \delta \text{ [ppm]} = 9.6, 9.6, 14.1, 20.5, 30.5, 32.6, 51.3, 54.8, 56.3, 115.1, 118.5, 129.3, 150.2; \text{IR } \nu_{\text{max}} \text{ (neat) [cm}^{-1}] = 691, 719, 748, 824, 1024, 1231, 1300, 1338, 1366, 1452, 1498, 1598, 2958; \text{HRMS (ESI) } m/z \text{ calculated for } [\text{M+H}]^+ 232.1696 \text{ u found 232.1697 u; } \alpha_0^{20}(\text{CHCl}_3) = -18.2^\circ.\]
3.3.5 Synthesis of 4-chloro-N-cyclohexyl-N-(((2R,3S)-3-propyloxirane-2-yl)methyl)aniline (1h).

1.01 g (4.8 mmol, 1.0 eq.) of 4-Chloro-N-cyclohexylaniline are reacted with 3.6 mL of 1.6M nBuLi-solution in Hexane (5.8 mmol, 1.2 eq.) and 1.04 g (2R,3R)-3-bromo-1,2-epoxyhexane (5.8 mmol, 1.2 eq.) following GP3a. After flash column chromatography (Al₂O₃, CH : MTBE 98:2) the product is obtained as a colorless oil in 53% yield (786 mg, 2.55 mmol) and is stored under argon atmosphere.

Rₚ = 0.7 (20% EE in CH); ¹H NMR (500.1 MHz, C₆D₆, RT) δ [ppm] = 0.84-0.97 (m, 4H), 1.04-1.51 (m, 9H), 1.56-1.64 (m, 3H), 1.70-1.77 (m, 1H), 2.66 (ddd, J = 6.7 Hz, J = 5.1 Hz, J = 4.1 Hz, 1H), 2.75 (ddd, J = 5.3 Hz, J = 4.1 Hz, J = 2.9 Hz, 1H), 3.01 (dd, J = 16.2 Hz, J = 5.3 Hz, 1H), 3.26-3.33 (m, 2H), 6.66-6.71 (m, 2H), 7.20-7.25 (m, 2H); ¹³C NMR (125.5 MHz, C₆D₆, RT) δ [ppm]=14.1, 20.6, 26.1, 26.2, 26.4, 30.6, 30.7, 31.4, 44.5, 56.5, 56.6, 57.8, 115.2, 122.1, 129.5, 147.9; IR ν max (neat)[cm⁻¹]= 511, 669, 770, 806, 1006, 1100, 1147, 1172, 1234, 1283, 1450, 1496, 1593, 2855, 2930; HRMS (ESI) m/z calculated for [M+H]⁺ 308.1776 u found 308.1773 u; αD²⁰(CHCl₃)= -23.8°
3.3.6 Synthesis of 4-chloro-N-cyclopentyl-N-(((2R,3S)-3-propyloxirane-2-yl)methyl)aniline (1i).

913 mg (4.7 mmol, 1.0 eq.) of 4-Chloro-N-cyclopentylaniline are reacted with 3.5 mL of 1.6M nBuLi-solution in Hexane (5.6 mmol, 1.2 eq.) and 1.00 g (2R,3R)-3-bromo-1,2-epoxyhexane (5.6 mmol, 1.2 eq.) following GP3a. After flash column chromatography (Al₂O₃, CH : MTBE 98:2) the product is obtained as a colorless oil in 40% yield (549 mg, 1.9 mmol) and is stored under argon atmosphere.

R₉ = 0.7 (20% EE in CH); ¹H NMR (400.1 MHz, C₆D₆, RT) δ [ppm]= 0.85 (t, J= 7.2 Hz, 3H), 1.20-1.54 (m, 10H), 1.57-1.67 (m, 1H), 1.68-1.78 (m, 1H), 2.64 (td, J= 5.9 Hz, J= 4.1 Hz, 1H), 2.77 (dd, J= 5.5 Hz, J= 4.1 Hz, J= 2.9 Hz, 1H), 2.96 (dd, J= 16.0 Hz, J= 5.5 Hz, 1H), 3.23 (dd, J= 16.0 Hz, J= 2.9 Hz, 1H), 3.66-3.76 (m, 1H), 6.64-6.70 (m, 2H), 7.17-7.22 (m, 2H); ¹³C NMR (101 MHz, C₆D₆, RT) δ [ppm]= 14.1, 20.5, 23.9, 24.0, 29.6, 30.1, 30.6, 46.4, 56.2, 56.5, 60.3, 116.6, 122.8, 129.3, 149.0; IR νmax (neat) [cm⁻¹]= 511, 807, 976, 1098, 1188, 1244, 1277, 1350, 1397, 1455, 1495, 1594, 2870, 2957; HRMS (ESI) m/z calculated for [M+H]⁺ 294.1619 u found 294.1616 u; αD²⁰(CHCl₃)= -38.9°.
3.3.7 Synthesis of 4-chloro-N-isopropyl-N-(((2R,3S)-3-propyloxirane-2-yl)methyl)aniline (1j).

848.3 mg (5 mmol, 1.0 eq.) of 4-chloro-N-isopropylaniline are reacted with 2.4 mL of 2.5M nBuLi-solution in Hexane (6 mmol, 1.2 eq.) and 1.07 g (2R,3R)-3-bromo-1,2-epoxyhexane (6 mmol, 1.2 eq.) following GP3a. After flash column chromatography (Al₂O₃, CH : MTBE 98:2) the product is obtained as a colorless oil in 30% yield (386 mg, 1.55 mmol) and is stored under argon atmosphere.

Rf= 0.7 (20% EE in CH); ¹H NMR (400.1 MHz, C₆D₆, RT) δ [ppm]= 0.84-0.88 (m, 6H), 0.94 (d, J= 6.6 Hz, 3H), 1.22-1.46 (m, 4H), 2.63 (ddd, J= 6.6 Hz, J= 5.4 Hz, J= 4.1 Hz, 1H), 2.72 (ddd, J= 5.4 Hz, J= 4.1 Hz, J= 2.9 Hz, 1H), 2.91 (dd, J= 16.2 Hz, J= 5.4 Hz, 1H), 3.20 (dd, J= 16.2 Hz, J= 2.9 Hz, 1H), 3.61 (hept, J= 6.6 Hz, 1H), 6.58-6.22 (m, 2H) 7.18-7.22 (m, 2H); ¹³C NMR (125.5 MHz, C₆D₆, RT) δ [ppm]= 14.1, 19.6, 20.3, 20.5, 30.6, 43.5, 48.6, 56.2, 56.6, 115.2, 122.2, 129.5, 147.9; IR vₘₐₓ (neat)[cm⁻¹]= 510, 753, 807, 1101, 1161, 1188, 1246, 1283, 1393, 1465, 1496, 1596, 2963; HRMS (ESI) m/z calculated for [M+H]⁺ 268.1463 u found 268.1462 u; αₒ(CHCl₃)= -27.0°.
3.3.8 Synthesis of 4-fluoro-N-isopropyl-N-(((2R,3S)-3-propyloxirane-2-yl)methyl)aniline (1k).

2.45 g (16 mmol, 1.0 eq.) of 4-fluoro-N-cyclopentylaniline are reacted with 7.0 mL of 2.5M nBuLi-solution in Hexane (17.6 mmol, 1.1 eq.) and 4.33 g (2R,3R)-3-bromo-1,2-epoxyhexane (24.2 mmol, 1.5 eq.) following GP3a. After flash column chromatography (Al₂O₃, CH: MTBE 98:2) the product is obtained as a colorless oil in 31% yield (1.23 g, 4.9 mmol) and is stored under argon atmosphere.

R<sub>f</sub> = 0.4 (10% MTBE in CH); <sup>1</sup>H NMR (400.1 MHz, C<sub>6</sub>D<sub>6</sub>, RT) δ [ppm]= 0.83-0.88 (m, 3H), 0.90 (d, J= 6.6 Hz, 3H), 0.95 (d, J= 6.6 Hz, 3H), 1.23-1.46 (m, 4H), 2.64 (td, J= 5.9 Hz, J= 4.1 Hz, 1H), 2.79 (ddd, J= 5.2 Hz, J= 4.1 Hz, J= 3.2 Hz, 1H), 2.96 (dd, J= 15.8 Hz, J= 5.3 Hz, 1H), 3.20 (dd, J= 15.8 Hz, J= 3.2 Hz, 1H), 3.60 (hept, J= 6.6 Hz, 1H), 6.64-6.70 (m, 2H), 6.88-6.95 (m, 2H); <sup>13</sup>C NMR (101 MHz, C<sub>6</sub>D<sub>6</sub>, RT) δ [ppm]= 14.1, 19.5, 20.4, 20.5, 30.6, 44.3, 49.7, 56.4, 56.6, 115.9 (d, J<sub>CF</sub>= 21.9 Hz), 116.5 (d, J<sub>CF</sub>= 7.2 Hz), 146.0 (d, J<sub>CF</sub>= 2.0 Hz), 156.5 (d, J<sub>CF</sub>= 235.9 Hz); <sup>19</sup>F NMR (470 MHz, C<sub>6</sub>D<sub>6</sub>, RT) δ [ppm]= -127.6; IR ν<sub>max</sub> (neat)[cm<sup>-1</sup>] = 515, 557, 809, 1169, 1189, 1230, 1464, 1508, 2965; HRMS (ESI) m/z calculated for [M+H]<sup>+</sup> 252.1758 u found 252.1755 u; α<sup>20</sup><sub>(CHCl₃)</sub> = -27.1°.
3.3.9 Synthesis of N-cyclopropyl-4-fluoro-N-(((2R,3S)-3-propyloxiran-2-yl)methyl)aniline (1l).

![Chemical structure]

357 mg (2.36 mmol, 1.0 eq.) of 4-fluoro-N-cyclopropylaniline are reacted with 1.05 mL 2.5M nBuLi-solution in Hexane (2.6 mmol, 1.1 eq.) and 507 mg (2R,3R)-3-bromo-1,2-epoxyhexane (1.2 eq., 2.83 mmol) following GP3a. After flash column chromatography (SiO₂, CH : MTBE 98:2) the product is obtained as a light yellow oil in 66% yield (386 mg, 1.55 mmol) and is stored under argon atmosphere.

Rᵣ= 0.7 (20% EE in CH); ¹H NMR (300.1 MHz, C₆D₆, RT) δ [ppm]= 0.34-0.51 (m, 4H), 0.82-0.89 (m, 3H), 1.21-1.46 (m, 4H), 2.13-2.22 (m, 1H), 2.61 (ddd, J= 6.4 Hz, J= 5.3 Hz, J= 4.1 Hz, 1H), 2.81 (dt, J= 5.9 Hz, J= 4.1 Hz, 1H), 3.19 (dd, J= 15.5 Hz, J= 5.9 Hz, 1H), 3.32 (dd, J= 15.5 Hz, J= 4.1 Hz, 1H), 6.18-6.81 (m, 2H), 6.89-6.98 (m, 2H); ¹³C NMR (75.5 MHz, C₆D₆, RT) δ [ppm]= 9.6, 9.6, 14.1, 20.5, 30.5, 32.9, 51.9, 54.7, 56.3, 115.6 (d, JCF= 21.9 Hz), 116.3 (d, JCF= 7.2 Hz), 146.7 (d, JCF= 2.1 Hz), 156.9 (d, JCF= 236.2 Hz); ¹⁹F NMR (470 MHz, C₆D₆, RT) δ [ppm]= -127.3; IR νₘₐₓ (neat)[cm⁻¹]= 771, 817, 1223, 1364, 1455, 1507, 2962; HRMS (ESI) m/z calculated for [M+H]⁺ 250.1602 u found 250.1602 u; αₒ(CHCl₃)= -10.0°.
3.3.10 **Synthesis of methyl 4-(methyl((2R,3S)-3-propyloxiran-2-yl)methyl)amino)benzoate (1n).**

1.34 g (8.1 mmol, 1.0 eq.) of Methyl-4-(methylamino)benzoate are reacted with 3.6 mL of 2.5M nBuLi-solution in Hexane (8.9 mmol, 1.1 eq.) and 1.74 g (2R,3R)-3-bromo-1,2-epoxyhexane (9.7 mmol, 1.2 eq.) following GP3a. After flash column chromatography (SiO₂, CH : MTBE 98:2) the product is obtained as a colorless oil in 29% yield (613 mg, 2.8 mmol) and is stored under argon atmosphere.

R<sub>f</sub> = 0.4 (30% Et₂O in CH);<sup>1</sup>H NMR (300.1 MHz, C<sub>6</sub>D<sub>6</sub>, RT) δ [ppm] = 0.83 (t, J = 7.1 Hz, 3H), 1.13-1.40 (m, 4H), 2.53 (s, 3H), 2.65 (dt, J = 6.5 Hz, J = 3.9 Hz, 1H), 2.87 (ddd, J = 15.7 Hz, J = 6.5 Hz, J = 1.0 Hz, 1H), 3.16 (dd, J = 15.5 Hz, J = 3.7 Hz, 1H), 3.62 (s, 3H), 6.47-6.54 (m, 2H), 8.21-8.29 (m, 2H);<sup>13</sup>C NMR (75 MHz, C<sub>6</sub>D<sub>6</sub>, RT) δ [ppm] = 14.1, 20.4, 30.3, 38.2, 51.0, 51.2, 54.2, 55.6, 111.6, 131.9, 152.7, 167.1; IR <i>v<sub>max</sub></i> (neat)[cm<sup>-1</sup>] = 700, 752, 767, 839, 946, 1097, 1145, 1175, 1188, 1252, 1261, 1279, 1378, 1523, 1599, 1702, 2981; HRMS (ESI) m/z calculated for [M+H]<sup>+</sup> 264.1594 u found 264.1591 u; α<sub>0</sub><sup>20</sup>(CHCl<sub>3</sub>) = -1.9°.
3.4 SiO$_2$-catalyzed aminolysis of bromo-epoxides to bromo-alcohols and subsequent formation of aniline-epoxides (A→1).

3.4.1. Synthesis of N-phenyl-N-(((2R,3S)-3-propyloxiran-2-yl)methyl)aniline (1a).

According to GP3: I. aminolysis: 1.69 g of diphenylamine (1.00 eq., 10.0 mmol), 1.79 g (2R,3R)-3-bromo-1,2-epoxyhexane (1.00 eq., 10.0 mmol) and 696 mg SiO$_2$ are reacted for 1 hour at 40 °C in MeOH. Flash chromatography (SiO$_2$, Eluent: Ch : Et$_2$O = 95 : 5) yielded 1.04 g (2R,3R)-3-bromo-1-(diphenylamino)-hexan-2-ol 30 % as a colorless liquid. II. epoxide formation: 880 mg of (2R,3R)-3-bromo-1-(diphenylamino)-hexan-2-ol (1.00 eq., 2.53 mmol) and 698 mg K$_2$CO$_3$ (2.00 eq., 5.05 mmol) are reacted for 1 hour at 40 °C in MeOH. Flash chromatography (SiO$_2$, Eluent: Ch : Et$_2$O = 98 : 2) yielded 613 g 1a (84%) as colorless liquid.

R$_f$ = 0.35 (20% Et$_2$O in CH), $^1$H-NMR (300 MHz, C$_6$D$_{6}$, RT): δ [ppm] = 0.67 (t, $J$ = 7.3 Hz, 3H), 1.03-1.21 (m, 1H), 1.31-1.43 (m, 1H), 1.44-1.58 (m, 1H), 1.77 (dtd, $J$ = 14.1 Hz, $J$ = 9.8 Hz, $J$ = 4.5 Hz, 1H), 1.89-1.95 (m,1H), 3.65-3.73 (m, 1H), 3.77-3.81 (m, 2H), 3.92 (dd, $J$ = 9.7 Hz, $J$ = 4.5 Hz, $J$ = 2.2 Hz, 1H), 6.85 (tt, $J$ = 7.4 Hz, $J$ = 1.4 Hz, 1H), 7.03-7.15 (m, 8H); $^{13}$C-NMR (75 MHz, C$_6$D$_{6}$, RT): δ [ppm] = 13.4, 21.4, 37.7, 57.4, 61.4, 70.7, 121.9, 122.2, 129.7, 148.8. IR $\tilde{\nu}$ [cm$^{-1}$] = 408, 419, 498, 543, 594, 694, 747, 1031, 1072, 1204, 1247, 1355, 1493, 1587. HRMS (ESI): m/z calculated for C$_{19}$H$_{24}$BrO: 348.0958 u; found: 348.0948 u. [α]$_D^{20}$ = -14.4° (c 0.5, CHCl$_3$).

R$_f$ = 0.8 (20% Et$_2$O in CH), $^1$H-NMR (300 MHz, C$_6$D$_{6}$, RT): δ [ppm] = 0.77 (t, $J$ = 7.2 Hz 3H), 1.03-1.33 (m, 4H), 2.58 (ddd, $J$ = 6.9 Hz, $J$ = 4.9 Hz, $J$ = 4.0 Hz, 1H), 3.04 (dt, $J$ = 5.6 Hz, $J$ = 4.2 Hz, 1H), 3.61 (dd, $J$ = 15.7 Hz, $J$ = 5.5 Hz, 1H), 3.74 (dd, $J$ = 15.7 Hz, $J$ = 4.2 Hz, 1H), 6.84-6.87 (m, 2H), 7.04-7.12 (m, 8H); $^{13}$C-NMR (75 MHz, C$_6$D$_{6}$, RT): δ [ppm] = 14.1, 20.3, 30.3, 51.5, 54.6, 56.6, 121.7, 122.0, 129.7, 148.5. IR $\tilde{\nu}$ [cm$^{-1}$] = 692, 747, 1223, 1249, 1362, 1493, 1589. HRMS (ESI): m/z calculated for C$_{19}$H$_{22}$NO: 268.1696 u; found: 268.1690 u. [α]$_D^{20}$ = -88.0° (c 0.5, CHCl$_3$).
3.4.2. Synthesis of N-cyclohexyl-N-(((2R,3S)-3-propyloxiran-2-yl)methyl)aniline (1d).

According to GP3b: I. aminolysis: 1.75 g of N-cyclohexylaniline (1.00 eq., 10.0 mmol), 1.79 g (2R,3R)-3-bromo-1,2-epoxyhexane (1.00 eq., 10.0 mmol) and 696 mg SiO₂ are reacted for 7 days hours at RT (without solvent). Flash chromatography (SiO₂, Eluent: CH₂O : Et₂O = 95 : 5) yielded 847 mg (2R,3R)-3-bromo-1-(cyclohexyl(phenyl)amino)-hexan-2-ol (24%) as a colorless liquid. II. epoxide formation: 788 mg of (2R,3R)-3-bromo-1-(cyclohexyl(phenyl)amino)-hexan-2-ol (1.00 eq., 2.22 mmol) and 614 mg K₂CO₃ (2.00 eq., 4.44 mmol) are reacted for 1 hour at 40 °C in MeOH. Flash chromatography (SiO₂, Eluent: CH₂O : Et₂O = 98 : 2) yielded 392 g 1d (65%) as a colorless liquid.

**Rf = 0.4 (20% Et₂O in CH), **\(^1^H\)-NMR (300 MHz, C₆D₆, RT): δ [ppm] = 0.70 (t, 3H, J = 7.3 Hz), 0.79-1.35 (m, 8H), 1.45-1.76 (m, 1H), 1.94 (dtd, 1H, J = 14.1 Hz, J = 9.8 Hz, J = 4.7 Hz), 2.26-2.37 (m, 1H), 3.18-3.32 (m, 2H), 3.55-3.62 (m, 1H), 4.07 (ddd, 1H, J = 9.7 Hz, J = 4.6 Hz, J = 2.0 Hz), 6.93 (d, 1H, J = 6.9 Hz), 6.17-7.22 (m, 2H). *signal integrates to 3H caused by impurity. **\(^1^C\)-NMR (75 MHz, C₆D₆, RT): δ [ppm] = 13.5, 21.5, 26.1, 26.4, 26.5, 27.3, 31.1, 31.3, 38.1, 50.5, 61.5, 62.8, 70.2, 119.4, 120.5, 129.4, 149.6. IR ν [cm⁻¹] = 504, 691, 868, 1027, 1147, 1254, 1319, 1449, 1502, 1600, 2852, 2926. HRMS (ESI): m/z calculated for C₁₈H₂₉NBrO⁺: 354.1427 u; found: 354.1426 u. \([α]_D^{20} = 6.0 (c 0.2, CHCl₃)\).

**Rf = 0.7 (20% Et₂O in CH), **\(^1^H\)-NMR (500 MHz, C₆D₆, RT): δ [ppm] = 0.84-0.90 (m, 3H), 0.96 (tt, 2H, J = 12.8 Hz, J = 3.7 Hz), 1.08-1.53 (m, 10H), 1.60-1.73 (m, 2H), 1.84 (d, 1H, J = 16.7 Hz), 2.68 (dt, 1H, J = 6.6 Hz, J = 4.4 Hz), 2.85-2.90 (m, 1H), 3.15 (dd, 1H, J = 16.3 Hz, J = 5.5 Hz), 3.41 (dd, 1H, J = 16.2 Hz, J = 3.0 Hz), 3.49 (dd, 1H, J = 12.0 Hz, J = 3.4 Hz), 6.79-6.84 (m, 1H), 6.94 (d, 1H, J = 6.1 Hz), 7.25-7.30 (m, 2H). **\(^1^C\)-NMR (125 MHz, C₆D₆, RT): δ [ppm] = 14.2, 20.6, 26.2, 26.4, 26.5, 30.8, 30.9, 31.5, 44.5, 56.7, 56.8, 57.7, 114.2, 117.5, 129.7, 149.4. IR ν [cm⁻¹] = 691, 744, 1174, 1234, 1345, 1503, 1595, 2929. HRMS (ESI): m/z calculated for C₁₈H₂₉NO⁺: 274.2165 u; found: 274.2158 u. \([α]_D^{20} = -20.9 (c 0.1, CHCl₃)\).
3.4.3. Synthesis of N-methyl-N-(((2R,3S)-3-propyloxiran-2-yl)methyl)aniline (1g).

According to GP3b: I. aminolysis: 2.38 g of N-methylaniline (1.00 eq., 22.2 mmol), 3.63 g (2R,3R)-3-bromo-1,2-epoxyhexane (1.00 eq., 22.2 mmol) and 1.20 g SiO₂ are reacted for 2 days hours at RT (without solvent). Flash chromatography (SiO₂, Eluent: CH₂O = 95 : 5) yielded 4.24 g (2R,3R)-3-bromo-1-(methyl(phenyl)amino)-hexan-2-ol (67%) as a colorless liquid. II. epoxide formation: 4.20 g of (2R,3R)-3-bromo-1-(methyl(phenyl)amino)-hexan-2-ol (1.00 eq., 14.7 mmol) and 4.05 g K₂CO₃ (2.00 eq., 29.3 mmol) are reacted for 1 hour at 40 °C in MeOH. Flash chromatography (SiO₂, Eluent: CH₂O = 98 : 2) yielded 3.03 g 1g (100%) as a colorless liquid.

\[ \text{Rf} = 0.3 \text{ (20% Et₂O in CH₃OH)} \]

\( ^1H \text{-NMR (300 MHz, C₆D₆, RT): } \delta \text{ [ppm]} = 0.70 \text{ (t, 3H, } J = 7.2 \text{ Hz), 1.07-1.22 \text{ (m, 1H), 1.34-1.58 \text{ (m, 2H), 1.68-1.86 \text{ (m, 2H), 2.64 \text{ (s, 3H), 3.16-3.32 \text{ (m, 2H), 3.50-3.59 \text{ (m, 1H), 3.83 \text{ (ddd, 1H, } J = 9.8 \text{ Hz, } J = 4.4 \text{ Hz, } J = 2.3 \text{ Hz), 6.68-6.73 \text{ (m, 2H), 6.75-6.82 \text{ (m, 1H), 7.18-7.26 \text{ (m, 2H).} \text{ } ^{13}C \text{-NMR (75 MHz, C₆D₆, RT): } \delta \text{ [ppm]} = 13.5, 21.5, 37.8, 39.5, 58.0, 61.9, 71.7, 113.2, 117.6, 129.6, 149.9. IR (Film) } \tilde{\nu} \text{ [cm}^{-1}] = 412, 422, 488, 513, 692, 746, 991, 1034, 1075, 1119, 1204, 1241, 1343, 1449, 1505, 1599, 2959. HRMS (ESI): m/z calculated for C₁₆H₂₁BrNO⁺ [M+H]^+: 286.0801 u; found: 286.0786 u. [α]D₂⁰ = -23.5 ° (c 0.2, CHCl₃).}

\[ \text{Rf} = 0.5 \text{ (20% Et₂O in CH₃OH)} \]

\( ^1H \text{-NMR (300 MHz, C₆D₆, RT): } \delta \text{ [ppm]} = 0.84 \text{ (t, 3H, } J = 7.0 \text{ Hz), 1.18-1.42 \text{ (m, 4H), 2.57 \text{ (ddd, 1H, } J = 6.3 \text{ Hz, } J = 4.9 \text{ Hz, } J = 3.0 \text{ Hz), 2.69 \text{ (s, 3H), 2.83 \text{ (ddd, 1H, } J = 6.2 \text{ Hz, } J = 4.0 \text{ Hz, } J = 4.0 \text{ Hz), 3.06 \text{ (dd, 1H, } J = 15.4 \text{ Hz, } J = 6.4 \text{ Hz), 3.29 \text{ (dd, 1H, } J = 15.4 \text{ Hz, } J = 3.9 \text{ Hz), 6.74 \text{ (d, 2H, } J = 8.8 \text{ Hz); 6.80 \text{ (tt, 1H, } J = 7.3 \text{ Hz, } J = 1.1 \text{ Hz), 7.24 \text{ (ddt, 2H, } J = 8.7 \text{ Hz, } J = 7.1 \text{ Hz, } J = 0.9 \text{ Hz).} \text{ } ^{13}C \text{-NMR (75 MHz, C₆D₆, RT): } \delta \text{ [ppm]} = 14.1, 20.4, 30.4, 38.6, 51.8, 54.6, 55.7, 112.6, 113.5, 117.5, 129.5, 150.1. IR (Film) } \tilde{\nu} \text{ [cm}^{-1}] = 406, 512, 690, 746, 775, 827, 860, 957, 990, 1034, 1120, 1208, 1244, 1365, 1451, 1504, 1599, 2871, 2959; HRMS (ESI): m/z calculated for C₁₆H₂₁NO⁺ [M+H]^+: 206.1539 u; found: 206.1540 u. [α]D₂⁰ = -18.2 (c 0.5, CHCl₃), determination of e.r. by HPLC: KNAUER Eurocel 01; n-hexane/2-propanol (90:10); flowrate 1.0 mL/min; tR = 7.9 min (major, 2R3S), tR = 9.2 min (minor, 2S3R); e.r. = > 99 : < 1.} \)
3.4.4. Synthesis of 4-chloro-N-methyl-N-(((2R,3S)-3-propyloxiran-2-yl)methyl)aniline (1m).

According to GP3b: I. aminolysis: 389 mg of 4-chloro-N-methylaniline (1.10 eq., 2.75 mmol), 448 mg (2R,3R)-3-bromo-1,2-epoxyhexane (1.00 eq., 2.50 mmol) and 250 mg SiO₂ are reacted for 2 days hours at RT (without solvent). Flash chromatography (SiO₂, Eluent: Ch: Et₂O = 95 : 5) yielded 360 mg (2R,3R)-3-bromo-1-(cyclohexyl(4-chloro-phenyl)amino)-hexan-2-ol (45%) as a colorless liquid. II. epoxide formation: 1.64 g of (2R,3R)-3-bromo-1-(cyclohexyl(4-chloro-phenyl)amino)-hexan-2-ol (1.00 eq., 5.13 mmol) and 1.42 g K₂CO₃ (2.00 eq., 10.3 mmol) are reacted for 1 hour at 40 °C in MeOH. Flash chromatography (SiO₂, Eluent: Ch: Et₂O = 98 : 2) yielded 943 mg 1m (77%) as a colorless liquid.

**Rᵣ = 0.3 (20% Et₂O in CH₃), **³H-NMR (500 MHz, C₆D₆, RT): δ [ppm] = 0.71 (dtt, 3H, J = 7.3 Hz, J = 4.1 Hz, J = 1.9 Hz), 1.15 (ddddd, 1H, J = 13.1 Hz, J = 9.9 Hz, J = 7.1 Hz, J = 5.3 Hz, J = 2.7 Hz), 1.41 (dtddd, 1H, J = 17.3 Hz, J = 7.1 Hz, J = 5.0 Hz, J = 2.3 Hz), 1.50 (ddd, 1H, J = 13.8 Hz, J = 6.5 Hz, J = 5.2 Hz J = 3.9 Hz), 1.71-1.80 (m, 1H), 2.50 (s, 3H), 3.05-3.16 (m, 2H), 3.40-3.47 (m, 1H), 3.74 (ddt, 1H, J = 9.8 Hz, J = 4.3 Hz, J = 2.1 Hz), 6.38-6.43 (m, 2H), 7.16-7.19* (m, 2H). **¹³C-NMR (75 MHz, C₆D₆, RT): δ [ppm] = 13.5, 21.4, 37.6, 39.5, 57.8, 61.6, 71.0, 114.1, 122.6, 129.4, 148.3. IR ν [cm⁻¹] = 505, 627, 807, 1076, 1100, 1190, 1239, 1364, 1498, 1596. HRMS (ESI): m/z calculated for C₁₃H₁₉BrClNO⁺: 320.0419 u; found: 320.0411 u. [α]₀²⁰ = -28.4 (c 1.0, CHCl₃).

**Rᵣ = 0.8 (40% EE in CH₃), **¹H-NMR (500 MHz, C₆D₆, RT): δ [ppm] = 0.84 (t, 3H, J = 7.1 Hz), 1.14-1.43 (m, 4H), 2.53 (s, 3H), 2.54-2.59 (m, 1H), 2.70 (dt, 1H, J = 6.4 Hz, J = 4.0 Hz, J = 1.7 Hz), 2.89 (dd, 1H, J = 15.4 Hz, J = 6.4 Hz), 3.12 (dd, 1H, J = 15.4 Hz, J = 3.8 Hz), 6.38-6.44 (m, 2H), 7.14-7.20 (m, 2H). **¹³C-NMR (125 MHz, C₆D₆, RT): δ [ppm] = 14.1, 20.4, 30.8, 38.5, 51.8, 54.3, 55.6, 114.4, 122.2, 129.3, 148.5. IR ν [cm⁻¹] = 507, 629, 764, 808, 957, 1097, 1120, 1190, 1206, 1243, 1368, 1455, 1498, 1596, 2960. HRMS (ESI): m/z calculated for C₁₃H₁₉ClNO⁺: 240.1150 u; found: 240.1147 u. [α]₀²⁰ = -12.6 (c 0.5, CHCl₃).
3.5.1. Synthesis of 4-iodo-N-methyl-N-(((2R,3S)-3-propyloxiran-2-yl)methyl)aniline (1o).

513 mg of 1g (1.00 eq., 2.50 mmol) are dissolved in 3.0 mL DMF and cooled to 0 °C. Under vigorous stirring 563 mg N-iodosuccinimide NIS (1.00 eq., 2.50 mmol) is added in three portions after 0, 15 and 30 minutes. The mixture is stirred for 1 h at 0 °C and for 1 h at rt. The reaction is quenched by addition of 5 mL saturated Na$_2$S$_2$O$_3$-solution and 10 mL cyclohexane are added. After phase separation the aqueous-solution is extracted with cyclohexane (4 * 15 mL cyclohexane). The combined organic solutions are washed with H$_2$O (2 * 5 mL) and brine (1 * 5 mL) and dried under Na$_2$SO$_4$. After removal of solvents under reduced pressure, the crude product is purified by flash chromatography (SiO$_2$, Eluent: CH : MTBE = 95 : 5) to yield 643 mg 1o (78%) as a colorless solution.

$	extbf{R}_f = 0.8$ (40% EE in CH), $^1$H-NMR (300 MHz, C$_6$D$_6$, RT): $\delta$ [ppm] = 0.83 (t, 3H, $J = 7.1$ Hz), 1.12-1.45 (m, 4H), 2.49 (s, 3H), 2.68 (dt, 1H, $J = 6.4$ Hz, $J = 4.0$ Hz), 2.86 (dd, 1H, $J = 15.4$ Hz, $J = 6.4$ Hz), 3.10 (dd, 1H, $J = 15.4$ Hz, $J = 3.7$ Hz), 6.22-6.29 (m, 2H), 7.44-7.51 (m, 2H). $^{13}$C-NMR (75 MHz, C$_6$D$_6$, RT): $\delta$ [ppm] = 14.1, 20.4, 30.4, 38.3, 51.5, 54.3, 55.6, 78.3, 115.5, 138.1, 149.3. IR $\tilde{\nu}$ [cm$^{-1}$] = 505, 754, 803, 957, 1119, 1203, 1243, 1314, 1368, 1456, 1496, 1587, 2959. HRMS (ESI): $m/z$ calculated for C$_{13}$H$_{19}$INO$: 332.0506 u, found: 332.0503 u. $[\alpha]_b$ = -10.8 (c 0.5, CHCl$_3$).
3.5.2 Synthesis of *N*-cyclohexyl-4-iodo-*N*-(((2R,3S)-3-propyloxiran-2-yl)methyl)aniline (1p).

273 mg of 1d (1.00 eq., 1.0 mmol) are dissolved in 1.5 mL DMF and cooled to 0 °C. Under vigorous stirring 225 mg *N*-iodosuccinimide NIS (1.00 eq., 1.0 mmol) is added in three portions after 0, 15 and 30 minutes. The mixture is stirred for 1 h at 0 °C and for 1 h at rt. The reaction is quenched by addition of 2 mL saturated NaHSO₃-solution and 5 mL cyclohexane are added. After phase separation the aqueous layer is extracted with cyclohexane (4 * 10 mL cyclohexane). The combined organic extracts are washed with H₂O (2 * 5 mL) and brine (1 * 5 mL) and dried over Na₂SO₄. After removal of solvents under reduced pressure, the crude product is purified by flash chromatography (Al₂O₃, Eluent: CH : MTBE = 98 : 2) to yield 389 mg 1p (97%) as a light yellow oil.

Rᵣ = 0.4 (10% MTBE in CH); ¹H NMR (400.1 MHz, C₆D₆, RT) δ [ppm] = 0.83-0.97 (m, 4H), 1.01-1.51 (m, 9H), 1.54-1.64 (m, 3H), 1.73 (ddt, J = 12.3 Hz, J = 3.4 Hz, J = 1.7 Hz, 1H), 2.65 (ddd, J = 6.6 Hz, J = 5.2 Hz, J = 4.1 Hz, 1H), 2.73 (ddd, J = 5.2 Hz, J = 4.1 Hz, J = 2.8 Hz, 1H), 2.99 (dd, J = 16.2 Hz, J = 5.2 Hz, 1H), 3.23-3.34 (m, 2H), 6.50-6.56 (m, 2H), 7.48-7.55 (m, 2H); ¹³C NMR (101 MHz, C₆D₆, RT) δ [ppm] = 14.1, 20.5, 26.3, 26.2, 26.4, 30.6, 30.7, 31.3, 44.2, 56.4, 56.6, 57.5, 78.0, 116.1, 138.4, 148.8; IR (KBr) ν_max (neat)[cm⁻¹] = 767, 801, 1007, 1148, 1173, 1234, 1282, 1348, 1361, 1450, 1491, 1584, 2854, 2928; HRMS (ESI) m/z calculated for [M+H]⁺ 400.1132 u found 400.1128 u; αₒ²⁰(CHCl₃) = -18.6°.
4. REO-ArS<sub>R</sub>

4.1 Investigation of different catalysts for the REO-ArS<sub>R</sub> with epoxide 1a.

Table 1: Investigation on the performance of different catalysts in the REO-ArS<sub>R</sub> of 1a. Reaction conditions: 10 mol% catalyst, 30 mol% Zn, entries 1,3,4: 30 mol% Lut-HCl, 0.2 M in THF, 48 h, rt. Regioisomeric ratios (r.r.) and diastereoisomeric ratios (d.r.) were determined by integration of the signals of the C-OH-group in the $^{13}$C-NMR of the crude-mixture. [a]: d.r. (2a) = cis-2a : trans-2a; [b]: d.r. (3a) = (R,S)-3a : (S,S)-3a; signals of the C-OH-group: cis-2a 67.3 ppm, trans-2a 67.9 ppm, (R,S)-3a 72.1 ppm, (S,S)-3a 73.9 ppm. n.d. = not determined.

| Catalyst          | Conversion of 1a in % | r.r. 2a : 3a | d.r. 2a<sup>[a]</sup> | Yield 2a<sup>[b]</sup> | d.r. 3a<sup>[b]</sup> | Yield 3a<sup>[b]</sup> |
|-------------------|-----------------------|--------------|------------------------|------------------------|------------------------|------------------------|
| Cp<sub>2</sub>Ti-Cl<sub>2</sub> | 98                    | 78 : 22      | 31 : 69                | 90 : 10                |                        |                        |
| Cp<sub>2</sub>Ti-(OTs)<sub>2</sub> | 93                    | 79 : 21      | 25 : 75                | 90 : 10                |                        |                        |
| ent-Kat-Cl<sub>2</sub> (5 mol%) | 98                    | 10 : 90      | n.d.                   | 92 : 8                 | 72% (>98 : <2)         |                        |
| Kat-Cl<sub>2</sub> | 98                    | 93 : 7       | 33 : 67                | 72% (15 : 85)          | n.d.                   |                        |
| Kat-(OTs)<sub>2</sub> | 98                    | 94 : 6       | 24 : 76                | 73% (10 : 90)          | n.d.                   |                        |
4.2 Structural assignment of the tetrahydroquinoline-scaffold and configurational analysis with tetrahydroquinolines 2a and 2g.

The constitution of the THQ scaffold was elucidated by single crystal X-ray diffraction of purified N-methyl-tetrahydroquinoline 2g (pure trans-isomer: trans-2g). The X-ray also revealed the trans-configuration and the axial orientation of the hydroxy group in the pseudo-chairlike 1,2,3,4-tetrahydro-pyridine ring of the THQ 2g.

In the $^1$H-NMR-spectra of cis-2g and trans-2g, the signal of the equatorially oriented proton $H_a$ features three types of couplings: the geminal $^2J$-coupling to $H_a'$, the $^3J$-coupling to $H_b$ and the $^4J$- or so called 'W-coupling' to $H_c$. The signal of $H_a'$ does not feature the 'W-coupling' and is therefore easily identified. In cis-2g as well as in trans-2g $H_a'$ shows a $^3J$-coupling with $H_b$. In the case of cis-2g, $H_a'$ and $H_b$ are trans to each other leading to a large $^3J_{\text{trans}}$ of 6.0 Hz. In the case of trans-2g, $H_a'$ and $H_b$ are cis to each other leading to a small $^3J_{\text{cis}}$ of 2.5 Hz.
In addition to THQ 2g, the coupling behavior of N-phenyl-substituted tetrahydroquinoline 2a is very similar. For the mainly occurring isomer trans-2a, the \(^3J\) coupling constant between \(H_a\) and \(H_b\) is small, while it is big for the side product cis-2a.
4.3 Synthesis of tetrahydroquinolines by REO-ArSR

4.3.1 Synthesis of (3S,4R)-1-Phenyl-4-propyl)-1,2,3,4-tetrahydroquinoline-3-ol (2a).

According to GP4: 134 mg of 1a (1.00 eq., 0.50 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 40 mg cat-(OTs)₂ (0.10 eq., 0.05 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by ¹³C-NMR of the crude product. Flash chromatography (SiO₂, Eluent: Ch : Mtbe = 87 : 13) yielded 98 mg 2a (d.r. = 90 : 10, 73%) as a viscous, colorless liquid.

Rᵣ = 0.63 (40% EE in Ch), ¹H-NMR (500 MHz, C₆D₆, RT): δ [ppm] = 0.82 (t, 3H, J = 7.1 Hz), 1.20-1.45 (m, 4H), 1.65-1.75 (sbr, 1H), 2.65-2.70 (m, 1H), 3.33-3.36 (m, 2H), 3.75 (dd, 1H, J = 3.3 Hz, J = 3.1 Hz), 6.76 (td, 1H, J = 7.3 Hz, J = 1.3 Hz), 6.85 (dd, 1H, J = 8.3 Hz, J = 1.3 Hz), 6.88-6.91 (m, 1H), 6.92-6.96 (m, 1H), 7.01 (dd, 1H, J = 7.5 Hz, J = 1.6 Hz), 7.07-7.11 (m, 2H), 7.11-7.15 (m, 2H). ¹³C-NMR (75 MHz, C₆D₆, RT): δ [ppm] = 14.4, 20.5, 38.8, 45.3, 53.5, 67.6, 116.0, 119.1, 124.3, 125.3, 125.6, 127.3, 129.8, 131.3, 143.3, 148.3. IR (Film) ν [cm⁻¹] = 461, 499, 559, 610, 698, 745, 957, 1061, 1094, 1127, 1204, 1239, 1299, 1377, 1492, 1574, 1592, 2870, 2927, 2956. HRMS (ESI): m/z calculated for C₁₈H₂₂NO⁺: 268.1696 u, found: 268.1699 u. [α]D²⁰ = -43.2 (c 0.25, CHCl₃). Determination of d.r. (2a, isolated) by HPLC: Knauer Eurospher II 100-2 C18, H₂O/MeCN (65 : 35), flowrate 0.6 mL/min; tᵣ = 2.8 min (major, trans), tᵣ = 1.5 min (minor, cis), d.r. = 90 : 10. Determination of e.r. (2a, isolated) by HPLC: DAICEL Chiralpak IC-U01; nHexane/iPrOH (95 : 5); flowrate 0.43 mL/min; tᵣ = 1.5 min (major, 3S,4R), tᵣ = 2.0 min (minor, 3R,4S), er = > 99 : < 1.
4.3.2 Synthesis of (3S,4R)-4-isobutyl-1-phenyl-4-propyl)-1,2,3,4-tetrahydroquinoline-3-ol (2c).

According to GP4: 141 mg of 1c (1.00 eq., 0.50 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 40 mg cat-(OTs)₂ (0.10 eq., 0.05 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by ¹³C-NMR of the crude product. Flash chromatography (SiO₂, Eluent: Ch : Mtbe = 87 : 13) yielded 104 mg 2c (d.r. = 81 : 19, 74%) as a viscous, colorless liquid.

R_f = 0.25 (30% Et₂O in Ch), ¹H-NMR (500 MHz, C₆D₆, RT): δ [ppm] = 0.86 (d, 6H, J = 6.5 Hz), 1.10-1.20 (m, 1H), 1.63 (sept., 1H, J = 6.5 Hz), 2.83 (td, 1H, J = 7.4 Hz, J = 2.8 Hz), 3.30-3.37 (m, 2H), 3.76 (d, 1H, J = 4.0 Hz), 6.76 (td, 1H, J = 7.3 Hz, J = 1.3 Hz), 6.74-6.79 (m, 1H), 6.96-6.84 (m, 3H), 7.02-7.14 (m, 4H). ¹³C-NMR (75 MHz, C₆D₆, RT): δ [ppm] = 22.7, 23.1, 25.2, 43.0, 46.7, 53.1, 67.7, 115.9, 119.2, 123.5, 124.4, 125.4, 127.3, 129.9, 131.3, 143.3, 148.3. IR (Film) ν [cm⁻¹] = 698, 745, 1037, 1063, 1205, 1242, 1274, 1302, 1462, 1493, 1574, 1592, 2953. HRMS (ESI): m/z calculated for C₁₉H₂₄NO⁺: 282.1852 u, found: 282.1849 u. [α]D²⁰ = -47.0 (c 1.00, CHCl₃).
4.3.3 Synthesis of (3S,4R)-1-cyclohexyl-4-propyl)-1,2,3,4-tetrahydroquinoline-3-ol (2d).

According to GP4: 137 mg of 1d (1.00 eq., 0.50 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 40 mg cat-(OTs)$_2$ (0.10 eq., 0.05 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by $^{13}$C-NMR of the crude product. Flash chromatography (SiO$_2$, Eluent: Ch : Mtbe = 87 : 13) yielded 114 mg 2d (d.r. = 97 : 3, 83%) as a viscous, colorless liquid.

R$_f$ = 0.7 (40% EE in CH); $^1$H-NMR (300 MHz, C$_6$D$_6$, RT): $\delta$ [ppm] = 0.83 (t, 3H, $J$ = 7.0 Hz), 1.10-1.44 (m, 10H), 1.51-1.74 (m, 4H), 1.99-2.17 (sbr, 1H), 2.62-2.69 (m, 1H), 2.89 (dd, 1H, $J$ = 12.1 Hz, $J$ = 2.5 Hz), 3.00 (ddd, 1H, $J$ = 12.2 Hz, $J$ = 3.4 Hz, $J$ = 1.6 Hz), 3.46 (tt, 1H, $J$ = 8.1 Hz, $J$ = 3.3 Hz), 3.75-3.82 (m, 1H), 6.67 (d, 1H, $J$ = 8.4 Hz), 6.72 (td, 1H, $J$ = 7.3 Hz, $J$ = 1.0 Hz); 7.01 (dd, 2H, $J$ = 7.4 Hz, $J$ = 1.7 Hz), 7.10-7.14 (m, 1H). $^{13}$C-NMR (75 MHz, C$_6$D$_6$, RT): $\delta$ [ppm] = 14.5, 20.5, 26.3, 26.3, 26.5, 27.3, 29.6, 29.7, 39.2, 44.3, 45.5, 55.7, 66.5, 111.0, 116.4, 123.9, 127.8, 131.7, 144.0. IR $\tilde{\nu}$ [cm$^{-1}$] = 497, 741, 1049, 1174, 1242, 1303, 1455, 1601, 2856, 2929. HRMS (ESI): m/z calculated for C$_{18}$H$_{28}$NO$^+$: 274.2165 u, found: 274.2167 u. $[a]_D^{20}$ = -36.0 ° (c 0.5, CHCl$_3$). Determination of d.r. (2c, isolated) by HPLC: DAICEL Chiralpak IC-U; nHexane/iPrOH (95 : 5); flowrate 1.0 mL/min; $t_R$ = 1.0 min (minor, 3S4S), $t_R$ = 1.5 min (minor, 3S4R); d.r. = 97 : 3.
4.3.4 Synthesis of (3S,4R)-1-isopropyl-4-propyl)-1,2,3,4-tetrahydroquinoline-3-ol (2e).

According to GP4: 117 mg of 1e (1.00 eq., 0.50 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 40 mg cat-\{OTs\}_2 (0.10 eq., 0.05 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by \(^{13}\)C-NMR of the crude product. Flash chromatography (SiO\(_2\), Eluent: Ch : Mtbe = 87 : 13) yielded 82 mg 2e (d.r. = 95 : 5, 70%) as a viscous, colorless liquid.

\[ \text{R}_f = 0.6 \text{ (40\% EE in CH), } \text{\(^1\)H-NMR (300 MHz, C}_6\text{D}_6\text{, RT): } \delta \text{ [ppm]} = 0.80 \text{ (t, 3H, } J = 7.0 \text{ Hz), 0.87 (d, 3H, } J = 6.6 \text{ Hz), 0.91 (d, 3H, } J = 6.6 \text{ Hz), 1.12-1.40 (m, 4H), 1.51-1.74 (m, 4H), 1.66-1.74 (s, 1H), 2.60-2.68 (m, 1H), 2.78 (dd, 1H, } J = 12.0 \text{ Hz, } J = 2.4 \text{ Hz), 2.91 (ddd, 1H, } J = 12.1 \text{ Hz, } J = 3.4 \text{ Hz, } J = 1.7 \text{ Hz), 3.73-3.88 (m, 2H), 6.60 (dt, 1H, } J = 8.4 \text{ Hz, } J = 0.9 \text{ Hz), 6.75 (td, 1H, } J = 7.3 \text{ Hz, } J = 1.1 \text{ Hz), 7.01 (dd, 2H, } J = 7.4 \text{ Hz, } J = 1.8 \text{ Hz), 7.10-7.18 (m, 1H).} \text{\(^{12}\)C-NMR (75 MHz, C}_6\text{D}_6\text{, RT): } \delta \text{ [ppm]} = 14.4, 18.4, 19.1, 20.5, 39.3, 42.7, 45.6, 46.2, 66.4, 111.2, 116.6, 124.0, 127.9, 131.8, 144.1. \text{IR (Film) } \tilde{\nu} \text{ [cm}^{-1}] = 453, 741, 1051, 1088, 1119, 1168, 1190, 1302, 1363, 1456, 1495, 1601, 2871, 2928, 2957. \text{HRMS (ESI): } m/z \text{ calculated for C}_{15}\text{H}_{26}\text{NO}\text{+: 236.2009 u, found: 234.1855 u. [\(\alpha\)]}_0^{20} = -50.0 \text{ (c 0.1, CHCl}_3\text{). d.r. = 95 : 5 (2d, isolated).} \]
4.3.5 Synthesis of (3S,4R)-1-cyclopropyl-4-propyl-1,2,3,4-tetrahydroquinolin-3-ol (2f).

According to GP4: 116 mg of 1f (1.00 eq., 0.50 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 40 mg cat-\((\text{OTs})_2\) (0.10 eq., 0.05 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by \(^{13}\text{C}-\text{NMR}\) of the crude product. Flash chromatography (SiO\(_2\), Eluent: Ch : Mtbe = 90 : 10) yielded 94 mg 2f (d.r. = 98 : 2, 81\%) as a viscous, colorless liquid.

\(R_f = 0.6\) (30 % EE in CH); \(^1\text{H NMR}\) (300.1 MHz, \(\text{C}_6\text{D}_6\), RT) \(\delta\) [ppm] = 0.27-0.53 (m, 4H), 0.80 (t, \(J = 7.0\) Hz, 3H), 1.11-1.45 (m, 4H), 1.66-1.88 (m, 1H), 2.03 (tt, \(J = 5.3\) Hz, \(J = 4.5\) Hz, 1H), 2.65 (td, \(J = 6.6\) Hz, \(J = 5.6\) Hz, \(J = 2.7\) Hz, 1H), 2.98-3.03 (m, 2H), 3.75 (q, \(J = 2.9\) Hz, 1H), 6.84 (ddd, \(J = 7.7\) Hz, \(J = 4.9\) Hz, \(J = 3.6\) Hz, 1H), 7.03 (dq, \(J = 7.6\) Hz, \(J = 0.8\) Hz, 1H), 7.18-7.22 (m, 2H); \(^{13}\text{C NMR}\) (75.5 MHz, CDC\(_3\), RT) \(\delta\) [ppm] = 8.0, 9.5, 14.4, 20.6, 31.9, 39.7, 45.2, 51.4, 66.9, 113.3, 118.4, 125.1, 127.3, 130.9, 145.5; \(\text{IR} \nu_{\text{max}}\) (neat) [cm\(^{-1}\)] = 491, 527, 745, 778, 939, 1023, 1046, 1181, 1234, 1301, 1362, 1450, 1495, 1601, 2928, 2954; \(\text{HRMS}\) (ESI): m/z calculated for [M+H]\(^+\) 232.1696 u found: 232.1702 u. \([\alpha]_{D}^{20}\) = +12.4 °(c 1, CHCl\(_3\))
4.3.6 Synthesis of (3S,4R)-1-methyl-4-propyl)-1,2,3,4-tetrahydroquinoline-3-ol (2g).

According to GP4: 103 mg of 1g (1.00 eq., 0.50 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 40 mg cat-(OTs)₂ (0.10 eq., 0.05 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by ¹³C-NMR of the crude product. Flash chromatography (SiO₂, Eluent: Ch : Mtbe = 87 : 13) was performed rapidly and yielded 91 mg 2g (d.r. = 96 : 4, 89%) as a transparent-yellow solid (m.p. = 36 °C).

R_f = 0.6 (40% EE in CH), ¹H-NMR (500 MHz, C₆D₆, RT): δ [ppm] = 0.79 (t, 3H, J = 7.1 Hz), 1.11-1.35 (m, 4H), 1.96-2.08 (sbroa, 1H), 2.48 (s, 3H), 2.62-2.67 (m, 1H), 2.78 (dd, 1H, J = 11.9 Hz, J = 3.4 Hz, J = 1.7 Hz), 2.98 (dd, 1H, J = 11.9 Hz, J = 2.4 Hz), 3.72 (dd, 1H, J = 2.9 Hz, J = 2.9 Hz), 6.50 (d, 1H, J = 8.3 Hz), 6.75 (dd, 1H, J = 7.4 Hz, J = 1.2 Hz), 6.98 (dd, 1H, J = 7.4 Hz, J = 1.6 Hz), 7.13 (dddd, 1H, J = 8.5 Hz, J = 7.3 Hz, J = 1.7 Hz). ¹³C-NMR (125 MHz, C₆D₆, RT): δ [ppm] = 14.4, 20.5, 38.5, 39.5, 45.3, 53.5, 66.9, 111.2, 117.2, 123.9, 127.8, 131.1, 145.1. IR ṽ [cm⁻¹] = 452, 499, 744, 1056, 1116, 1211, 1294, 1336, 1454, 1505, 1603, 2871, 2930, 2956. HRMS (ESI): m/z calculated for C₁₃H₂₀NO⁺: 206.1539 u, found: 206.1536 u. [α]_D²⁰ = -28.0 (c 0.2, CHCl₃); determination of d.r. by HPLC: DAICEL Chiralpak 1A; n-Hexane/IPrOH (95:5); flowrate 1.0 mL/min; t_R = 8.7 min (minor, 3S4R), t_R = 9.6 min (major, 3R4S); d.r. = 4 : 96 (cis : trans, 2g isolated).
4.3.7 Synthesis of (3S,4R)-6-chloro-1-cyclohexyl-4-propyl-1,2,3,4-tetrahydroquinolin-3-ol (2h).

According to GP4: 154 mg of 1h (1.00 eq., 0.50 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 40 mg cat-\(\text{OTs}\)\(_2\) (0.10 eq., 0.05 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by \(^{13}\text{C}-\text{NMR}\) of the crude product. Flash chromatography (SiO\(_2\), Eluent: Ch : Mtbe = 90 : 10) yielded 119 mg 2h (d.r. = >98 : <2, 77\%) as a viscous, colorless liquid.

\[ R_f = 0.4 \text{ (20 \% EE in CH)}; \]  \(^1\text{H NMR (500.1 MHz, C}_6\text{D}_6, \text{RT}) \delta [ppm]= 0.75 \text{ (t, } J = 6.9 \text{ Hz, 3H)}, 0.86-0.98 \text{ (m, 1H), 1.02-1.27 \text{ (m, 8H), 1.45-1.66 \text{ (m, 6H), 2.47 (ddt, } J = 8.6 \text{ Hz, } J = 5.7 \text{ Hz, } J = 2.3 \text{ Hz, 1H)}, 2.90 \text{ (ddd, } J = 12.2 \text{ Hz, } J = 3.2 \text{ Hz, } J = 1.7 \text{ Hz, 1H)}, 3.28 \text{ (tq, } J = 11.2 \text{ Hz, } J = 3.8 \text{ Hz, 1H)}, 3.69 \text{ (q, } J = 2.7 \text{ Hz, 1H}), 6.42 \text{ (d, } J = 8.9 \text{ Hz, 1H)}, 7.05 \text{ (d, } J = 2.6 \text{ Hz, 1H)}, 7.12 \text{ (dt, } J = 9.0 \text{ Hz, } J = 1.8 \text{ Hz, 1H}); \]  \(^{13}\text{C NMR (125 MHz, CDCl}_3, \text{RT}) \delta [ppm]= 14.1, 20.4, 26.2, 26.3, 29.4, 29.5, 38.9, 44.1, 45.4, 55.8, 66.1, 112.2, 120.9, 125.8, 127.6, 131.2, 142.6; \]  IR \(\nu_{max} \text{ (neat) [cm}^{-1}]\) = 405, 445, 546, 605, 654, 750, 791, 835, 871, 891, 956, 1062, 1107, 1171, 1241, 1263, 1299, 1343, 1378, 1421, 1451, 1494, 1596, 1659, 2854, 2928, 3348;  HRMS (ESI): \(m/z\) calculated for [M+H]+ 308.1776 u found: 308.1772 u. \([\alpha]_D^{20} = -22.3 ^\circ(c 1, \text{CHCl}_3)\)
4.3.8 Synthesis of (3S,4R)-6-chloro-1-isopropyl-4-propyl-1,2,3,4-tetrahydroquinolin-3-ol (2j).

According to GP4: 134 mg of 1j (1.00 eq., 0.50 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 40 mg cat(OTs)₂ (0.10 eq., 0.05 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by ¹³C-NMR of the crude product. Flash chromatography (SiO₂, Eluent: CH₂Cl₂ : Mtbe = 90 : 10) yielded 112 mg 2j (d.r. = >98 : <2, 84%) as a viscous, colorless liquid.

Rᵣ= 0.3 (30 % MTBE in CH₂Cl₂); ¹H NMR (300.1 MHz, C₆D₆, RT) δ [ppm]= 0.70-0.76 (m, 3H), 0.79 (d, J = 6.6 Hz, 3H), 0.85 (d, J = 6.5 Hz, 3H), 0.91-1.28 (m, 4H), 1.72 (sbr, 1H), 2.44 (tt, J = 6.6 Hz, J = 2.2 Hz, 1H), 2.66 (dd, J = 12.2 Hz, J = 2.5 Hz, 1H), 2.81 (dd, J = 12.2 Hz, J = 3.3 Hz, J = 1.7 Hz, 1H), 3.60 (h, J = 6.6 Hz, 1H), 3.67 (q, J = 9.7 Hz, 1H), 6.29 (dd, J = 8.8 Hz, J = 0.8 Hz, 1H), 7.03 (dd, J = 2.6 Hz, J = 0.7 Hz, 1H), 7.10 (dd, J = 8.9 Hz, J = 2.6 Hz, 1H); ¹³C NMR (75 MHz, CDCl₃, RT) δ [ppm]=14.3, 18.3, 18.9, 20.4, 38.9, 42.4, 45.5, 46.4, 65.9, 112.3, 121.0, 125.9, 127.6, 131.1, 142.6; IR νmax (neat) [cm⁻¹]= 538, 629, 785, 796, 874, 1051, 1195, 1264, 1306, 1494; HRMS (ESI): m/z calculated for [M+H]+ 268.1463 u found: 268.1460 u. [α]₀⁺₂⁰ = -47.8 °(c 1, CHCl₃)
4.3.9 (3S,4R)-1-cyclopropyl-6-fluoro-4-propyl-1,2,3,4-tetrahydroquinolin-3-ol (2l).

According to GP4: 125 mg of 1l (1.00 eq., 0.50 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 40 mg cat-{OTs}$_2$ (0.10 eq., 0.05 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by $^{13}$C-NMR of the crude product. Flash chromatography (SiO$_2$, Eluent: CH : MTBE = 90 : 10) yielded 98 mg 2l (d.r. = 97 : 3, 79%) as a viscous, colorless liquid.

$^1$H NMR (500.1 MHz, C$_6$D$_6$, RT) $\delta$ [ppm] = 0.26-0.49 (m, 4H), 0.76 (t, $J$ = 7.2 Hz, 3H), 1.07-1.34 (m, 4H), 1.92 (tt, $J$ = 6.4 Hz, $J$ = 3.8 Hz, 2H), 2.48-2.55 (m, 1H), 2.89 (dd, $J$ = 11.8 Hz, $J$ = 2.4 Hz, 1H), 2.93 (ddd, $J$ = 11.8 Hz, $J$ = 3.9 Hz, $J$ = 1.4 Hz, 1H), 3.67 (q, $J$ = 3.0 Hz, 1H), 6.80 (ddd, $J$ = 9.2 Hz, $J$ = 3.0 Hz, $J$ = 0.8 Hz, 1H), 6.87 (td, $J$ = 8.7 Hz, $J$ = 3.0 Hz, 1H), 6.97 (dd, $J$ = 9.0 Hz, $J$ = 5.0 Hz, 1H); $^{13}$C NMR (125 MHz, CDCl$_3$, RT) $\delta$ [ppm] = 7.9, 9.5, 14.4, 20.5, 32.2, 39.4, 45.3 (d, $J_{CF}$ = 1.2 Hz), 51.5, 66.7, 113.5 (d, $J_{CF}$ = 21.6 Hz), 113.9 (d, $J_{CF}$ = 7.3 Hz), 117.0 (d, $J_{CF}$ = 21.7 Hz), 127.2 (d, $J_{CF}$ = 6.3 Hz), 141.9 (d, $J_{CF}$ = 1.8 Hz), 156.8 (d, $J_{CF}$ = 235.7 Hz); $^{19}$F NMR (470 MHz, C$_6$D$_6$, RT) $\delta$ [ppm] = -127.3; IR $\nu_{max}$ (neat) [cm$^{-1}$] = 705, 803, 865, 1025, 1055, 1208, 1363, 1498; HRMS (ESI): m/z calculated for [M+H]$^+$ 250.1602 u found: 250.1610 u. [a]$_D^{20}$ = +15.7°(c 1, CHCl$_3$)
4.3.10 Synthesis of (3S,4R)-6-chloro-1-methyl-4-propyl)-1,2,3,4-tetrahydroquinoline-3-ol (2m).

According to GP4: 120 mg of 1m (1.00 eq., 0.50 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 40 mg cat-{OTs}$_2$ (0.10 eq., 0.05 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by $^{13}$C-NMR of the crude product. Flash chromatography (SiO$_2$, Eluent: Ch : Mtbe = 87 : 13) was performed rapidly and yielded 97 mg 2m (d.r. = 98 : 2, 81%) as a viscous, yellow liquid.

$R_f$ = 0.5 (40% EE in CH), $^1$H-NMR (300 MHz, C$_6$D$_6$, RT): $\delta$ [ppm] = 0.73 (t, 3H, $J$ = 7.0 Hz), 0.97-1.22 (m, 4H), 2.35 (s, 3H), 2.44 (dt, 1H, $J$ = 8.7 Hz, $J$ = 5.9 Hz, $J$ = 3.2 Hz), 2.67 (ddd, 1H, $J$ = 12.6 Hz, $J$ = 3.3 Hz, $J$ = 1.7 Hz), 2.86 (dd, 1H, $J$ = 12.6 Hz, $J$ = 2.4 Hz), 3.60 (q, 1H, $J$ = 2.9 Hz), 6.19 (d, 1H, $J$ = 8.7 Hz), 7.00 (dd, 1H, $J$ = 12.6 Hz, $J$ = 0.7 Hz), 7.08 (dd, 1H, $J$ = 8.7 Hz, $J$ = 2.6 Hz). $^{13}$C-NMR (75 MHz, C$_6$D$_6$, RT): $\delta$ [ppm] = 14.3, 20.3, 38.4, 39.1, 45.2, 53.1, 66.5, 112.2, 121.7, 125.7, 127.5, 130.6, 143.5. IR $\nu$ [cm$^{-1}$] = 507, 629, 764, 808, 957, 1097, 1120 1190, 1243, 1368, 1455, 1596, 2960. HRMS (ESI): m/z calculated for C$_{13}$H$_{19}$ClNO$: 240.1150 u; found: 240.1148 u. [$\alpha$]$_{D}^{20}$ = -35.4° (c 0.5, CHCl$_3$). d.r. = 2 : 98 (cis : trans, 2i isolated).
4.3.11 Synthesis of Methyl-(3S,4R)-3-hydroxy-1-methyl-4-propyl-1,2,3,4-tetrahydroquinoline-6-carboxylate (2n).

According to GP4: 132 mg of 1n (1.00 eq., 0.50 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 40 mg cat-(OTs)₂ (0.10 eq., 0.05 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by ¹³C-NMR of the crude product. Flash chromatography (SiO₂, Eluent: CH₂Cl₂ : MTBE = 90 : 10) yielded 81 mg 2n (d.r. = 98 : 2, 61%) as a viscous, yellow liquid.

\[ R_f = 0.4 \text{ (40% EE in CH)}; \]

\[ ^1H-NMR \text{ (500 MHz, C}_6\text{D}_6, \text{ RT): } \delta \text{ [ppm]} = 0.75 \text{ (t, } J=7.1 \text{ Hz, 3H), 1.01-1.33 \text{ (m, 4H), 2.43 \text{ (s, 3H), 2.53-2.64 \text{ (m, 2H), 2.80 \text{ (ddd, } J=12.7 \text{ Hz, } J=2.7 \text{ Hz, } J=1.8 \text{ Hz, 1H), 3.01 \text{ (dd, } J=12.6 \text{ Hz, } J=2.7 \text{ Hz, 1H), 3.62 \text{ (s, 3H), 3.66 (q, } J=3.0 \text{ Hz, 1H), 6.32 (d, } J=8.7 \text{ Hz, 1H), 7.97 (d, } J=2.1 \text{ Hz, 1H), 8.08 (dd, } J=8.7 \text{ Hz, } J=2.1 \text{ Hz, 1H).} \]

\[ ^13C-NMR \text{ (125 MHz, C}_6\text{D}_6, \text{ RT): } \delta \text{ [ppm]} =14.3, 20.3, 38.2, 38.6, 45.0, 51.2, 53.1, 66.3, 109.6, 117.6, 122.6, 128.6, 130.3, 132.7, 148.4, 167.5. \]

IR \[ \nu \text{ [cm}^{-1} \text{]} =797, 1064, 1114, 1152, 1190, 1203, 1223, 1235, 1269, 1288, 1402, 1528, 1603, 1674, 2890, 3439. \]

HRMS (ESI): \text{ m/z calculated for [M+H]^+}: 264.1594 u; found: 264.1591 u. [\alpha]_D^{20} = -2.3° \text{ (c 1, CHCl}_3).
4.3.12 Synthesis of \( (3S,4R)-6\text{-}\text{iodo} \cdot 1\text{-}\text{methyl} \cdot 4\text{-}\text{propyl})\cdot 1,2,3,4\text{-}\text{tetrahydroquinoline} \cdot 3\text{-}\text{ol} \) (2o).

According to GP4: 156 mg of 1o (1.00 eq., 0.50 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 40 mg \text{cat} \cdot \text{(OTs)}_2 \ (0.10 eq., 0.05 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by \(^{13}\text{C}\text{-NMR} \) of the crude product. Flash chromatography (SiO\(_2\), Eluent: CH : MTBE = 87 : 13) was performed rapidly and yielded 96 mg 2o (d.r. = > 98 : < 2, 58\%) as a viscous, yellow liquid.

\[ \begin{align*}
\text{R}_f &= 0.45 \ (40\% \ \text{EE in CH}) \\
\text{\textsuperscript{1}H-NMR} \ (300 \ \text{MHz}, \text{C}_6\text{D}_6, \text{RT}): \ \delta \ [\text{ppm}] &= 0.71 \ (t, 3H, J = 7.0 \ \text{Hz}), \ 0.95-1.22 \ (m, 4H), \ 1.75-1.91 \ (s, 1H), \ 2.34 \ (s, 3H), \ 2.37-2.44 \ (m, 1H), \\
& \ 2.67 \ (ddd, 1H, J = 12.1 \ \text{Hz}, J = 3.1 \ \text{Hz}, J = 1.7 \ \text{Hz}), \ 2.87 \ (dd, 1H, J = 12.2 \ \text{Hz}, J = 2.5 \ \text{Hz}), \ 3.58 \ (q, 1H, J = 2.9 \ \text{Hz}), \ 6.04 \ (d, 1H, J = 8.6 \ \text{Hz}), \ 7.31 \ (d, 1H, J = 2.2 \ \text{Hz}), \\
& \ 7.37 \ (dd, 1H, J = 8.6 \ \text{Hz}, J = 2.2 \ \text{Hz}). \ \text{\textsuperscript{13}C-NMR} \ (75 \ \text{MHz}, \text{C}_6\text{D}_6, \text{RT}): \ \delta \ [\text{ppm}] &= 14.3, \\
& \ 20.3, \ 38.3, \ 39.1, \ 44.5, \ 53.0, \ 66.3, \ 77.6, \ 113.2, \ 126.7, \ 136.4, \ 139.0, \ 144.4. \ \text{IR} \ \tilde{\nu} \ [\text{cm}^{-1}] &= 524, \ 669, \ 793, \ 879, \ 1051, \ 1104, \ 1213, \ 1328, \ 1498, \ 2342, \ 2362. \ \text{HRMS} \ (\text{ESI}): \ m/z \ \text{calculated for NaC}_{13}\text{H}_{18}\text{INO}^+ : \ 354.0325 \ \text{u}; \ \text{found: 354.0332 u.} \ \alpha_{20}^D &= -13.4^\circ \ (c \ 5.0, \ \text{CHCl}_3). \ \text{d.r.} = < 1 : > 99 \ (\text{cis} : \text{trans}, \ 2o \ \text{isolated}).
\end{align*} \]
4.4. Synthesis of indolines 3 by REO-ArS<sub>R</sub>

4.4.1 (S)-1-((R)-1-phenylindolin-3-yl)-butan-1-ol (3a).

According to GP5: 134 mg of 1a (1.00 eq., 0.50 mmol), 22 mg lutidinium chloride (0.30 eq., 0.15 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 18 mg ent-cat-Cl<sub>2</sub> (0.07 eq., 0.035 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by <sup>13</sup>C-NMR of the crude product. Flash chromatography (SiO<sub>2</sub>, Eluent: Ch: Mtbe = 87 : 13) yielded 96 mg 3a (d.r. = > 98 : < 2, 72%) as colorless, crystalline solid (m.p. = 109 °C).

IR ñ [cm<sup>-1</sup>] = 491, 497, 554, 616, 691, 735, 742, 961, 1014, 1065, 1079, 1120, 1247, 1288, 1333, 1383, 1460, 1882, 1501, 1589. HRMS (ESI): m/z calculated for C<sub>18</sub>H<sub>22</sub>NO<sup>+</sup>: 268.1696 u, found 267.1700 u. 

[α]<sub>D</sub><sup>20</sup> = −69.6 (c 0.25, CHCl<sub>3</sub>). determination of e.r. (3a, isolated) by HPLC: DAICEL Chiralpak IC-U 01; n-Hexane/iPrOH (95 : 5); flowrate 0.43 mL/min; t<sub>R</sub> = 2.5 min (major), t<sub>R</sub> = 2.8 min (minor); e.r. = > 99 : < 1.
4.4.2 Synthesis of (S)-1-((R)-1-phenylindolin-3-yl)-hexan-1-ol (3b).

According to GP5: 148 mg of 1b (1.00 eq., 0.50 mmol), 22 mg lutidinium chloride (0.30 eq., 0.15 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 18 mg ent-cat-Cl₂ (0.07 eq., 0.035 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by ¹³C-NMR of the crude product. Flash chromatography (SiO₂, Eluent: CH₄:Mtbe = 87 : 13) yielded 111 mg 3b (d.r. = > 98 : < 2, 75%) as colorless, crystalline solid (m.p. = 115 °C).

IR \( \bar{\nu} \) [cm⁻¹] = 618, 694, 728, 736, 744, 752, 1332, 1382, 1460, 1483, 1501, 1591, 2360, 2913. HRMS (ESI): \( m/z \) calculated for C₂₀H₂₆NO⁺: 296.2009 u, found: 296.2012 u. \([\alpha]_D^{20} = -68.0 \) (c 0.25, CHCl₃).
4.4.3 Synthesis of (S)-3-methyl-1-((R)-1-phenylindolin-3-yl)-butan-1-ol (3c).

According to GP5: 141 mg of 1c (1.00 eq., 0.50 mmol), 22 mg lutidinium chloride (0.30 eq., 0.15 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 18 mg \textit{ent-cat}-Cl\textsubscript{2} (0.07 eq., 0.035 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by \textsuperscript{13}C-NMR of the crude product. Flash chromatography (SiO\textsubscript{2}, Eluent: Ch : Mtbe = 87 : 13) yielded 85 mg 3c (d.r. = > 98 : < 2, 60\%) as colorless, crystalline solid (m.p. = 66 °C).

**R\textsubscript{i} = 0.2** (30% Et\textsubscript{2}O in CH), \textsuperscript{1}H-NMR (300 MHz, C\textsubscript{6}D\textsubscript{6}, RT): δ [ppm] = 0.82 (d, 3H, J = 6.6 Hz), 0.89 (d, 3H, J = 6.6 Hz), 1.04-1.13 (m, 1H), 1.31-1.40 (m, 1H), 1.75 (sept, 1H, J = 6.5 Hz), 3.00 (ddd, 1H, J = 10.1 Hz, J = 6.3 Hz, J = 3.9 Hz), 3.56 (t, 1H, J = 9.5 Hz), 3.80 (dd, 1H, J = 8.5 Hz, J = 5.1 Hz), 6.70 (dd, 1H, J = 8.7 Hz, J = 5.7 Hz), 6.88 (td, 1H, J = 7.0 Hz, J = 1.6 Hz), 7.11-7.22 (m, 5H). \textsuperscript{13}C-NMR (75 MHz, C\textsubscript{6}D\textsubscript{6}, RT): δ [ppm] = 22.0, 23.9, 24.9, 43.5, 47.1, 53.0, 70.2, 108.9, 118.2, 119.1, 121.3, 125.1, 128.4, 129.5, 131.8, 144.5, 148.2. IR ʋ [cm\textsuperscript{-1}] = 496, 531, 583, 692, 743, 755, 967, 1020, 1168, 1081, 1139, 1206, 1247, 1289, 1312, 1334, 1382, 1457, 1499, 1587. HRMS (ESI): m/z calculated for C\textsubscript{19}H\textsubscript{24}NO\textsuperscript{+}: 282.1852 u, found 282.1848 u. [α\textsubscript{D}]	extsuperscript{20} = −62.0 (c 1.0, CHCl\textsubscript{3}).
4.4.4 Synthesis of (S)-1-((R)-1-cyclohexylindolin-3-yl)-butan-1-ol (3d).

According to GP5: 144 mg of 1d (1.00 eq., 0.50 mmol), 22 mg lutidinium chloride (0.30 eq., 0.15 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 18 mg ent-cat-Cl₂ (0.07 eq., 0.035 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by $^{13}$C-NMR of the crude product. Flash chromatography (SiO₂, Eluent: Ch : Mtbe = 87 : 13) yielded 81 mg 3d (d.r. = > 98 : < 2, 56%) as colorless, crystalline solid.

$\text{Rf} = 0.50$ (20% Et₂O in CH); $^1$H-NMR (300 MHz, C₆D₆, RT): $\delta$ [ppm] = 0.89 (t, 3H, $J = 7.1$ Hz), 1.05-1.57 (m, 10H), 1.59-1.81 (m, 4H), 3.07 (ddd, 1H, $J = 9.5$ Hz, $J = 7.1$ Hz, $J = 3.8$ Hz), 3.16-3.28 (m, 2H), 3.45 (dd, 1H, $J = 8.6$ Hz, $J = 7.1$ Hz), 3.79 (dt, 1H, $J = 8.2$ Hz, $J = 3.8$ Hz), 3.85 (dd, 1H, $J = 9.4$ Hz, $J = 6.1$ Hz), 6.37 (d, 1H, $J = 7.9$ Hz), 6.70 (ddd, 1H, $J = 7.3$ Hz, $J = 7.3$ Hz, $J = 1.0$ Hz), 7.00 (dt, 1H, $J = 7.4$ Hz, $J = 1.2$ Hz), 7.10-7.14 (m, 1H). $^{13}$C-NMR (75 MHz, C₆D₆, RT): $\delta$ [ppm] = 14.4, 19.7, 26.2, 26.3, 28.3, 29.5, 36.9, 47.1, 47.5, 54.8, 71.9, 107.4, 117.0, 124.5, 128.6, 130.3, 152.5. IR $\tilde{\nu}$ [cm⁻¹] = 456, 676, 734, 1008, 1028, 1072, 1160, 1242, 1272, 1393, 1457, 1489, 1603, 2854, 2927. HRMS (ESI): $m/z$ calculated for C₁₈H₂₈NO⁺: 274.2165 u, found: 274.2168 u. $[x]_D^{20} = -51.8$ (c 0.25, CHCl₃).
4.4.5 Synthesis of \((S)-1-((R)-1\text{-isopropylindolin-3-yl})\text{-butan-1-ol (3e)}\).

According to GP5: 117 mg of \(1e\) (1.00 eq., 0.50 mmol), 22 mg lutidinium chloride (0.30 eq., 0.15 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 18 mg \textit{ent-cat-Cl}_2 (0.07 eq., 0.035 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by \(^{13}\text{C-NMR of the crude product. Flash chromatography (SiO}_2, \text{Eluent: Ch : Mtbe = 87 : 13) yielded 63 mg 3e (d.r. = > 98 : < 2, 54%) as colorless, crystalline solid.}

\[
\text{R}_f = 0.33 \text{ (20\% Et}_2\text{O in CH), } ^1\text{H-NMR (300 MHz, C}_6\text{D}_6, \text{RT): } \delta \text{ [ppm] = 0.88 (t, 3H, } J = 7.1 \text{ Hz), 0.96 (dd, 6H, } J = 6.7 \text{ Hz, } J = 1.9 \text{ Hz), 1.17-1.61 (m, 4H), 3.05 (ddd, 1H, } J = 9.3 \text{ Hz, } J = 7.0 \text{ Hz, } J = 3.8 \text{ Hz), 3.15 (dd, 1H, } J = 9.5 \text{ Hz, } J = 8.4 \text{ Hz), 3.39 (dd, 1H, } J = 8.4 \text{ Hz, } J = 6.9 \text{ Hz), 3.57 (hept, 1H, } J = 6.7 \text{ Hz), 3.77 (dt, 1H, } J = 7.9 \text{ Hz, } J = 3.7 \text{ Hz), 6.34 (d, 1H, } J = 7.9 \text{ Hz), 6.71 (ddd, 1H, } J = 7.4 \text{ Hz, } J = 7.4 \text{ Hz, } J = 1.0 \text{ Hz), 6.98 (ddd, 1H, } J = 7.3 \text{ Hz, } J = 1.2 \text{ Hz), 7.12 (dd, 1H, } J = 7.8 \text{ Hz, } J = 1.9 \text{ Hz).} ^{13}\text{C-NMR (75 MHz, C}_6\text{D}_6, \text{RT): } \delta \text{ [ppm] = 14.4, 17.6, 18.6, 19.7, 36.9, 46.0, 46.2, 46.9, 71.9, 107.6, 117.2, 124.4, 128.6, 130.4, 152.6. IR } \tilde{\nu} \text{ [cm}^{-1}] = 427, 453, 525, 741, 995, 1026, 1070, 1120, 1195, 1240, 1266, 1363, 1392, 1458, 1488, 1604, 2870, 2929, 2960. \text{ HRMS (ESI): } m/z \text{ calculated for C}_{15}\text{H}_{24}\text{NO}^+: 234.1852 \text{ u, found: 234.1850 u. } [\alpha]_{D}^{20} = -36.0 \text{ (c 0.5, CHCl}_3).
4.4.6 Synthesis of (S)-1-((R)-5-chloro-1-cyclohexylindolin-3-yl)butan-1-ol (3h).

According to GP5: 154 mg of 1h (1.00 eq., 0.50 mmol), 22 mg lutidinium chloride (0.30 eq., 0.15 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 18 mg ent-cat-Cl₂ (0.07 eq., 0.035 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by ¹³C-NMR of the crude product. Flash chromatography (SiO₂, Eluent: CH₂:MTBE = 90 : 10) yielded 88 mg 3h (d.r. = > 98 : < 2, 57%) as colorless, viscous oil.

R₁ = 0.6 (20% EE in CH), ¹H-NMR (400 MHz, C₆D₆, RT): δ [ppm] = 0.85 (t, J= 7.1 Hz, 3H), 0.89-1.70 (m, 15H), 2.90 (ddd, J= 10.3 Hz, J= 7.5 Hz, J= 3.6 Hz, 1H), 3.04 (tt, J= 10.9 Hz, J= 3.3 Hz, 1H), 3.13 (dd, J= 9.8 Hz, J= 8.8 Hz, 1H), 3.36 (dd, J= 8.7 Hz, J= 7.3 Hz, 1H), 3.56 (dt, J= 8.9 Hz, J= 3.6 Hz, 1H) 6.04 (d, J= 8.4 Hz, 1H), 7.00 (dd, J= 2.2 Hz, J= 1.1 Hz, 1H), 7.08 (dd, J= 8.4 Hz, J= 2.2 Hz, 1H). ¹³C-NMR (125.5 MHz, C₆D₆, RT): δ [ppm] = 14.3, 19.6, 26.0, 26.2, 28.1, 29.5, 36.8, 46.7, 47.5, 54.8, 71.6, 107.7, 121.2, 124.8, 128.2, 132.4, 151.0. IR ṽ [cm⁻¹] = 444, 475, 525, 551, 576, 603, 682, 715, 738, 795, 841, 885, 959, 1008, 1028, 1073, 1110, 1125, 1144, 1166, 1243, 1269, 1304, 1344, 1385, 1422, 1450, 1488, 1599, 2853, 2926, 3279; HRMS (ESI): m/z calculated for [M+H]⁺ 308.1776 u found: 308.1773 u; [α]D²⁰ = −2.4 (c 1, CHCl₃).
4.4.7 Synthesis of (S)-1-((R)-5-chloro-1-cyclopentylindolin-3-yl)butan-1-ol (3i).

According to GP5: 147 mg of 1i (1.00 eq., 0.50 mmol), 22 mg lutidinium chloride (0.30 eq., 0.15 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 18 mg ent-cat-Cl₂ (0.07 eq., 0.035 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by $^{13}$C-NMR of the crude product. Flash chromatography ($\text{SiO}_2$, Eluent: CH₃:MTBE = 90:10) yielded 85 mg 3i (d.r. = > 98 : < 2, 58%) as colorless, viscous oil.

$R_f = 0.5$ (20% EE in CH), $^1$H-NMR (400 MHz, C₆D₆, RT): $\delta$ [ppm] = 0.84 (t, $J$ = 7.1 Hz, 3H), 1.05 (sbr, 1H) 1.14-1.53 (m, 10H), 1.54-1.66 (m, 2H) 2.84-2.92 (m, 1H), 3.11 (t, $J$ = 9.1 Hz, 1H) 3.35 (dd, $J$ = 8.7 Hz, $J$ = 7.3 Hz, 1H), 3.55 (td, $J$ = 7.4 Hz, $J$ = 3.7 Hz, 2H), 6.11 (d, $J$ = 8.4 Hz, 1H), 6.99 (dd, $J$ = 2.2 Hz, $J$ = 1.1 Hz, 1H), 7.09 (dd, $J$ = 8.4 Hz, $J$ = 2.2 Hz, 1H). $^{13}$C-NMR (125.5 MHz, C₆D₆, RT): $\delta$ [ppm] = 14.3, 19.6, 24.4, 24.5, 27.8, 28.6, 36.9, 46.8, 48.5, 57.9, 71.4, 108.2, 121.6, 124.6, 128.3, 132.7, 152.1. IR $\tilde{\nu}$ [cm⁻¹]= 430, 527, 594, 678, 711, 739, 799, 847, 875, 960, 1004, 1073, 1125, 1195, 1260, 1354, 1393, 1421, 1464, 1487, 1599, 2869, 2955, 3398; HRMS (ESI): $m/z$ calculated for [M+H]⁺: 294.1619 u found: 294.1616 u; $[\alpha]_D^{20} = -32.4^\circ$ (c 1, CHCl₃).
4.4.8 Synthesis of (S)-1-((R)-5-chloro-1-isopropylindolin-3-yl)butan-1-ol (3j).

According to GP5: 134 mg of 1j (1.00 eq., 0.50 mmol), 22 mg lutidinium chloride (0.30 eq., 0.15 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 18 mg ent-cat-Cl₂ (0.07 eq., 0.035 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by 13C-NMR of the crude product. Flash chromatography (SiO₂, Eluent: CH: MTBE = 90: 10) yielded 91 mg 3j (d.r. = > 98 : < 2, 68%) as colorless, viscous oil.

Rf = 0.5 (30% MTBE in CH), ¹H-NMR (300 MHz, C₆D₆, RT): δ [ppm] = 0.81-0.91 (m, 9H), 1.04 (s, 1H) 1.11-1.49 (m, 4H), 2.87 (dddt, J = 9.5 Hz, J = 7.3 Hz, J = 3.7 Hz, J = 1.0 Hz, 1H), 3.06 (dd, J = 9.7 Hz, J = 9.87 Hz, 1H) 3.30 (dd, J = 8.7 Hz, J = 7.3 Hz, 1H), 3.40 (dq, J = 13.3 Hz, J = 6.7 Hz, 1H), 3.54 (dt, J = 8.8 Hz, J = 3.6 Hz 1H), 6.00 (d, J = 8.4 Hz, 1H), 6.99 (dd, J = 2.2 Hz, J = 1.1 Hz, 1H), 7.08 (ddd, J = 8.3 Hz, J = 2.2 Hz, J = 0.7 Hz, 1H). ¹³C-NMR (75 MHz, C₆D₆, RT): δ [ppm] = 14.3, 17.4, 18.5, 19.6, 36.8, 46.0, 46.2, 46.6, 71.5, 108.0, 121.5, 124.8, 128.2, 132.6, 151.2. IR ν [cm⁻¹] = 711, 800, 809, 1124, 1189, 1263, 1471, 1487; HRMS (ESI): m/z calculated for [M+H]+ 268.1463 u found: 268.1461 u; [α]₀²⁰ = -43.6°(c 1, CHCl₃).
4.4.9 Synthesis of (S)-1-((R)-5-fluoro-1-isopropylindolin-3-yl)butan-1-ol (3k).

According to GP5: 126 mg of 1k (1.00 eq., 0.50 mmol), 22 mg lutidinium chloride (0.30 eq., 0.15 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 18 mg ent-cat-Cl₂ (0.07 eq., 0.035 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by ¹³C-NMR of the crude product. Flash chromatography (SiO₂, Eluent: CH₂Cl₂:MTBE = 90:10) yielded 58 mg 3k (d.r. = > 98 : < 2, 46%) as colorless, viscous oil.

**Rf = 0.5 (20% EE in CH), **¹H-NMR (300 MHz, C₆D₆, RT): δ [ppm] = 0.85 (t, 3H, J= 7.1 Hz), 0.91 (d, J= 6.6 Hz, 3H), 0.92 (d, J= 6.6 Hz, 3H), 1.13 (sbr, 1H) 1.16-1.52 (m, 4H), 2.85-2.95 (m, 1H), 3.09 (t, J= 9.1 Hz, 1H) 3.30 (dd, J= 8.7 Hz, J= 7.2 Hz, 1H), 3.43 (hept, J= 6.6 Hz, 1H), 3.59 (dt, J= 8.1 Hz, J= 3.7 Hz 1H), 6.03 (dd, J= 8.5 Hz, J= 4.2 Hz, 1H), 6.73-6.84 (m, 2H). **¹³C-NMR (75 MHz, C₆D₆, RT): δ [ppm] = 14.3, 17.4, 18.3, 19.6, 36.8, 46.3, 46.6, 46.8 (d, J=1.8 Hz), 71.6, 107.4 (d, J=7.9 Hz), 112.2 (d, J=23.7 Hz), 114.2 (d, J=22.7 Hz), 132.2 (d, J=7.2 Hz), 148.8, 156.5 (d, J=233.4 Hz); **¹⁹F-NMR (470 MHz, C₆D₆, RT): δ [ppm] = -128.5; **IR ν [cm⁻¹]= 413, 450, 488, 515, 536, 550, 582, 648, 748, 778, 803, 842, 870, 885, 962, 1002, 1030, 1066, 1082, 1095, 1126, 1192, 1210, 1263, 1364, 1388, 1437, 1470, 4187, 2871, 2908, 2953, 3333; **HRMS (ESI): m/z calculated for [M+H]⁺ 252.1758 u found: 252.1755 u; [α]₀²⁰ = -57.6° (c 1, CHCl₃).
4.4.10 Synthesis of (S)-1-((R)-1-cyclohexyl-5-iodoindolin-3-yl)butan-1-ol (3p).

According to GP5: 200 mg of 1p (1.00 eq., 0.50 mmol), 22 mg lutidinium chloride (0.30 eq., 0.15 mmol), 10 mg zinc (0.30 eq., 0.15 mmol) and 18 mg ent-cat-Cl2 (0.07 eq., 0.035 mmol) are reacted in dry THF for 48 hours at room temperature. Regio- and diastereoisomeric ratio were determined by 13C-NMR of the crude product. Flash chromatography (SiO2, Eluent: CH : MTBE = 90 : 10) yielded 117 mg 3p (d.r. = > 98 : < 2, 59%) as colorless, viscous oil. The product has to be stored under argon to prevent rapid decomposition.

Rf = 0.6 (20% EE in CH), 1H-NMR (500 MHz, C6D6, RT): δ [ppm] = 0.85 (t, 3H, J= 7.2 Hz), 0.88-0.98 (m, 2H), 1.00-1.52 (m, 10H), 1.55-1.67 (m, 3H), 2.88 (ddd, J= 9.6 Hz, J= 7.4 Hz, J= 3.5 Hz, 1H), 3.02 (ttq, J= 11.2 Hz, J= 3.4 Hz, 1H), 3.10 (dd, J= 9.9 Hz, J= 8.8 Hz, 1H), 3.35 (dd, J= 8.8 Hz, J= 7.4 Hz, 1H), 3.52 (dt, J= 9.0 Hz, J= 3.6 Hz 1H), 5.93 (d, J= 8.3 Hz, 1H), 7.29 (t, J= 1.5 Hz, 1H), 7.40 (dd, J= 8.3 Hz, J= 1.8 Hz 1H). 13C-NMR (125 MHz, C6D6, RT): δ [ppm] =14.3, 19.6, 26.0, 26.2, 28.1, 29.5, 36.8, 46.6, 47.2, 54.6, 71.6, 76.5, 109.2, 133.0, 133.6, 137.1, 152.0. IR ν [cm⁻¹] = 434, 449, 459, 471, 504, 551, 592, 653, 708, 807, 844, 876, 892, 958, 998, 1008, 1083, 1124, 1157, 1227, 1243, 1378, 1424, 1463, 1589, 2886, 2931, 3389 ; HRMS (ESI): m/z calculated for [M+H]+ 400.1132 u found: 400.1126 u; [α]D²⁰ = -6.6° (c 1, CHCl₃).
5. Synthesis of catalysts for the REO-ArS_R

The Synthesis of cat-Cl_2 and ent-cat-Cl_2 were performed according to the literature.[7]

5.1 Synthesis of cat-(OTs)_2

1.35 g of cat-Cl_2 (1.00 eq., 2.4 mmol) are dissolved in 20 mL DMF and cooled to 0 °C. Over the course of 10 minutes 3.8 mL (2.5 eq., 6.1 mmol) of 1.6M MeLi-solution are added dropwised. After stirring for 30 minutes, 50 mL of 6 w% NH_4Cl-solution are added, phases are separated and the organic layer is washed with H_2O and brine. The crude product is reacted without further purification.

The solution of cat-Me_2 in Et_2O is transferred to a Schlenk flask and cooled to 0°C. 0.92 g p-Toluenesulfonic acid (2.00 eq., 4.8 mmol) are added. After stirring for 30 minutes at 0°C the ice bath is removed and the reaction mixture is stirred for 90 minutes at room temperature. Half of the solvent is removed under reduced pressure and n-pentane is added. The precipitated solid is washed with n-pentane and Et_2O and dried in vacuo for 16h. Cat-(OTs)_2 is obtained as an orange solid (1.35 g, 1.7 mmol, 70%).

^1H-NMR (500 MHz, C_6D_6, RT): \( \delta \ [ppm] = 0.57\ (d, 6H, J = 6.9\ \text{Hz}),\ 0.63\ (d, 6H, J = 6.9\ \text{Hz}),\ 0.75-0.88\ (m, 8H),\ 1.01\ (d, 6H, J = 5.6\ \text{Hz}),\ 1.08-1.16\ (m, 2H),\ 1.29\ (dhept, 2H, J = 6.7\ \text{Hz}, J = 2.0\ \text{Hz}),\ 1.46-1.52\ (m, 2H),\ 1.63\ (dd, 2H, J = 11.6\ \text{Hz}, J = 3.3\ \text{Hz}, J = 2.1\ \text{Hz}),\ 1.73-1.79\ (m, 2H),\ 1.97\ (s, 6H),\ 2.20-2.28\ (m, 2H),\ 6.09\ (dd, 2H, J = 2.8\ \text{Hz}, J = 2.8\ \text{Hz}),\ 6.66\ (dd, 2H, J = 2.4\ \text{Hz}, J = 2.4\ \text{Hz}),\ 6.82\ (s, 2H),\ 6.97\ (d, 4H, J = 8.0\ \text{Hz});\ 7.22\ (s, 2H),\ 8.32\ (d, 4H, J = 8.1\ \text{Hz}).\ ^{13}C-NMR (125 MHz, C_6D_6, RT): \( \delta \ [ppm] = 15.3,\ 21.1,\ 21.6,\ 22.9,\ 25.0,\ 27.6,\ 32.6,\ 35.2,\ 40.2,\ 41.5,\ 50.6,\ 100.3,\ 122.1,\ 127.4,\ 129.4,\ 140.9,\ 141.8,\ 150.4.\)
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