Efficient Synthesis of α -Aryl Esters by Room Temperature Palladium-Catalyzed Coupling of Aryl Halides with Ester Enolates

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Table S1. Effect of base on the arylation of *tert*-butyl acetate catalyzed by Pd(dba)₂ and carbene precursor **1**.

Entry	Base	Conv.	GC-Yield	Entry	Base	Conv.	GC-Yield
1	LiHMDS	100%	100%	6	NaO(<i>t</i> -Bu)	0%	0%
2	NaHMDS	100%	60%	7	KO(<i>t</i> -Bu)	37%	10%
3	KHMDS	100%	39%	8	LDA	100%	21%
4	NaH	0%	0%	9	LiNCy ₂	61%	9%
5	KH	26%	5%	10	NaNCy ₂	100%	24%

Table S2. Effect of solvent on the arylation of *tert*-butyl acetate.

Entry	Solvent	Conv.	GC-Yield	Entry	Solvent	Conv.	GC-Yield
1	toluene	100%	100%	6	Et ₂ O	0%	0%
2	benzene	100%	95%	7	THF	0%	0%
3	<i>m</i> -xylene	100%	99%	8	1,4-dioxane	0%	0%
4	pentane	100%	94%	9	monoglyme	0%	0%
5	cyclohexane	100%	91%	10	Et ₃ N	48%	29%

Table S3. Screening of ligands for the arylation of *tert*-butyl acetate.

A					B				
Entry	Ligand	Conv.	GC-Yields		Entry	Ligand	Conv.	GC-Yields	
			A	B				A	B
1	P(<i>t</i> -Bu) ₃	100%	29%	19%	14	R= <i>t</i> -Bu R=Cy	100%	89%	0%
2	PCy(<i>t</i> -Bu) ₂	100%	80%	0%			100%	92%	0%
3	PCy ₂ (<i>t</i> -Bu)	100%	88%	0%	15	R= <i>t</i> -Bu R=Cy	100%	51%	7%
4	PCy ₃	0%	0%	0%			100%	91%	0%
5	PAd ₂ (<i>t</i> -Bu)	100%	6%	13%	16	Me ₂ NPCy ₂	100%	93%	0%
6	PAd(<i>t</i> -Bu) ₂	100%	15%	15%	17	PR ₃	R=Ph R= <i>o</i> -Tol	0% 0%	0% 0%
7	PAd ₂ (<i>n</i> -Bu)	100%	84%	0%	18	mes-N ⁺ (CH ₂) ₂ -mes BF ₄ ⁻	0%	0%	0%
8	PAd ₂ (<i>t</i> -Bu) ₂	100%	8%	23%			0%	0%	0%
9	P(<i>t</i> -Bu) ₂ R=H R=Ph	100% 100%	28% 33%	16% 15%	19	ferrocene-N ⁺ (CH ₂) ₂ -mes BF ₄ ⁻	100%	100%	0%
10	PR ₂ R= <i>t</i> -Bu R=Ph	100% 0%	54% 0%	0% 0%	20	ferrocene-N ⁺ (CH ₂) ₂ -Cl BF ₄ ⁻	100%	100%	0%
11	DIPHOS	0%	0%	0%	21	No ligand	26%	11%	0%
12	TRIPHOS	0%	0%	0%	22	No palladium No ligand	0%	0%	0%
13	BINAP	0%	0%	0%					

Table S4. Effect of base used to generate the ester enolate prior to the catalytic coupling with aryl halides.

Reaction scheme showing the synthesis of compounds A, B, and C from 4-bromo-1-*t*-butylbenzene and methyl 2-methylpropanoate (1.1 eq) under the following conditions:

1% Pd(dba)₂
1% P(*t*-Bu)₃
1.3 eq base
toluene, rt, 12h

Compounds A, B, and C are shown as products of the reaction.

Entry	Base	Conv.	GC-Yields			Entry	Base	Conv.	GC-Yields		
			A	B	C				A	B	C
1	NaHMDS	89%	54%	5%	30%	9	LiHMDS	73%	0%	14%	59%
2	KHMDS	0%	0%	0%	0%	10	LiNH ₂	0%	0%	0%	0%
3	NaH	0%	0%	0%	0%	11	LiNMe ₂	0%	0%	0%	0%
4	KH	17%	17%	0%	0%	12	LDA	90%	14%	0%	76%
5	NaNH ₂	0%	0%	0%	0%	13	LiN(<i>i</i> -Pr)Cy	90%	64%	0%	0%
6	NaO(<i>t</i> -Bu)	67%	63%	0%	4%	14	LiNCy ₂	100%	7%	0%	93%
7	KO(<i>t</i> -Bu)	12%	12%	0%	0%	15	LiN	100%	3%	0%	71%
8	NaNCy ₂	56%	27%	0%	29%						

Table S5. Effect of ligand on the arylation of the enolate of isobutyrate generated from LiNCy₂.

Reaction scheme showing the arylation of the enolate of isobutyrate generated from LiNCy₂. The reaction involves 4-bromo-1-*t*-Bu-C₆H₄-Br (1.1 eq) reacting with 1% Pd(dba)₂, 1% ligand, and 1.3 eq LiNCy₂ in toluene at room temperature for 12h. The products are 4-*t*-Bu-C₆H₄-H (A) and 4-*t*-Bu-C₆H₄-C(CH₃)₂-CO₂Me (B).

Entry	Ligand	Conv.	GC-Yields		Entry	Ligand	Conv.	GC-Yields			
			A	B				A	B		
1	P(<i>t</i> -Bu) ₃	100%	7%	93%	15	R= <i>t</i> -Bu R=Cy	16% 21%	6% 10%	10% 11%		
2	PCy(<i>t</i> -Bu) ₂	60%	34%	26%	16	R= <i>t</i> -Bu R=Cy	63% 92%	7% 3%	57% 89%		
3	PCy ₂ (<i>t</i> -Bu)	58%	21%	37%	17	Me ₂ NPCy ₂	70%	30%	40%		
4	PCy ₃	3%	3%	0%	18	PR ₃	R=Ph R=α-Tol	9% 75%	9% 55%	0% 20%	
5	PAd ₂ (<i>t</i> -Bu)	100%	8%	92%	19			9%	8%	0%	
6	PAd(<i>t</i> -Bu) ₂	100%	5%	95%	20			9%	4%	5%	
7	PAd ₂ (<i>n</i> -Bu)	65%	30%	35%	21			4%	0%	4%	
8	PAd ₂ (<i>t</i> -Bu) ₂	100%	14%	86%	22	P(OPh) ₃		21%	21%	0%	
9	P(<i>t</i> -Bu)R	R= <i>t</i> -Bu 97% R=Ad 100% R=Cy 75% R=Ph 81% R=mes 73%	11% 17% 17% 30% 22%	86% 83% 58% 51% 51%	23	P(<i>t</i> -Bu)(NEt ₂) ₂		78%	67%	11%	
10	P(<i>t</i> -Bu) ₂		88%	31%	52%	24	P(<i>i</i> -Pr) ₂ (NEt ₂)		20%	20%	0%
11	PR ₂	R= <i>t</i> -Bu 0% R=Ph 0%	0% 0%	0% 0%	25	No ligand		0%	0%	0%	
12	DIPHOS		0%	0%	26	No palladium No ligand		0%	0%	0%	
13	TRIPHOS		0%	0%							
14	BINAP		50%	36%	5%						

***tert*-Butyl α -(4-*tert*-butylphenyl)acetate.**¹ (Tables 4 and 5, Entry 1). ¹H NMR: δ 7.26 (d, J = 8.4 Hz, 2H), 7.12 (d, J = 8.2 Hz, 2H), 3.43 (s, 2H), 1.37 (s, 9H), 1.24 (s, 9H). ¹³C NMR: δ 171.60, 150.00, 132.00, 129.25, 125.80, 81.12, 42.38, 34.83, 31.76, 28.49. Anal. Calcd for C₁₆H₂₄O₂: C, 77.38; H, 9.74. Found: C, 77.63; H, 9.73.

***tert*-Butylphenylacetate.**² (Tables 4 and 5, Entry 2) ¹H NMR: 7.23-7.17 (m, 5H), 3.45 (s, 2H), 1.36 (s, 9H). ¹³C NMR: 171.62, 135.41, 129.88, 129.12, 127.50, 81.47, 43.35, 28.72.

***tert*-Butyl α -(2,4,6-trimethylphenyl)acetate.**¹ (Table 4, Entry 3; Table 5, Entry 2). ¹H NMR: 6.77 (s, 2H), 3.48 (s, 2H), 2.21 (s, 6H), 2.94 (s, 3H), 1.35 (s, 9H). ¹³C NMR: δ 171.50, 137.54, 136.82, 129.92, 129.45, 81.22, 36.91, 28.70, 21.57, 20.87. Anal. Calcd for C₁₅H₂₂O₂: C, 76.88; H, 9.46. Found: C, 76.98; H, 9.29.

***tert*-Butyl α -(4-phenylphenyl)acetate.**¹ (Table 4, Entry 4; Table 5, Entry 3) ¹H NMR: 7.48 (d, J = 8.0 Hz, 2H), 7.45 (d, J = 8.0 Hz, 2H), 7.32 (dd, J = 7.6, 8.0 Hz, 2H), 7.25-7.20 (m, 3H), 3.47 (s, 2H), 1.36 (s, 9H). ¹³C NMR: 169.91, 139.86, 138.73, 132.70, 128.61 (2C), 127.71 (2C), 126.22, 126.18 (2C), 126.13 (2C). 79.88, 41.19, 27.04 (3C). Anal. Calcd for C₁₈H₂₀O₂: C, 80.56; H, 7.51. Found: C, 80.61; H, 7.27.

***tert*-Butyl α -(3-fluoro-4-phenylphenyl)acetate.** (Table 4, Entry 4; Table 5, Entry 3) ¹H NMR: 7.61-7.51 (m, 2H), 7.50-7.32 (m, 4H), 7.19-7.08 (m, 2H), 3.56 (s, 2H), 1.47 (s, 9H). ¹³C NMR: 170.22, 159.40 (d, J = 247.5 Hz), 135.80 (d, J = 8.4 Hz), 135.47, 130.52 (d, J = 3.7 Hz), 128.83 (d, J = 2.7 Hz), 128.30 (2C), 128.30, 127.48 (2C), 125.15 (d, J = 3.0 Hz), 116.81 (d, J = 23.8 Hz), 81.14, 41.82, 27.93 (3C). Anal. Calc'd for C₁₈H₁₉FO₂: C, 75.50; H, 6.69. Found: C, 75.22; H, 6.52.

***tert*-Butyl α -(2-fluorophenyl)acetate.** (Table 5, Entry 5) ¹H NMR: 7.27-7.21(m, 2H), 7.12-7.02 (m, 2H), 3.58 (s, 2H), 1.45 (s, 9H). ¹³C NMR: 169.01, 160.06 (d, J = 246.8 Hz), 130.38 (d, J = 3.7 Hz), 127.77 (d, J = 8.5 Hz), 122.97 (d, J = 3.7Hz), 121.03 (d, J = 16.1 Hz), 114.26 (d, J = 21.5 Hz), 80.10, 34.74, 26.99 (3C). Anal. Calc'd for C₁₂H₁₅FO₂: C, 68.55; H, 7.19. Found: C, 68.33; H, 7.23.

***tert*-Butyl α -(3-fluorophenyl)acetate.** (Table 4, Entry 6; Table 5, Entry 5) ¹H NMR: 7.32-7.23 (m, 1H), 7.08-6.98 (m, 2H), 6.95 (ddd, J = 2.4, 8.4, 8.8 Hz, 1H), 3.52 (s, 2H), 1.44 (s, 9H). ¹³C NMR: 170.74, 163.17 (d, J = 245.6 Hz), 137.39 (d, J = 7.7 Hz), 130.25 (d, J = 8.4 Hz), 125.35 (d, J = 3.4 Hz), 116.64 (d, J = 21.3 Hz), 114.24 (d, J =

21.5Hz), 81.60, 42.73, 28.43 (3C). Anal. Calc'd for $C_{12}H_{15}FO_2$: C, 68.55; H, 7.19. Found: C, 68.80; H, 7.10.

***tert*-Butyl α -(4-fluorophenyl)acetate.**³ (Table 4, Entry 6; Table 5, Entry 5) ^1H NMR: 7.23 (dd, $J = 5.5, 8.5$ Hz, 2H), 7.00 (dd, $J = 8.5, 8.8$ Hz, 2H), 3.49 (s, 2H), 1.43 (s, 9H). ^{13}C NMR: 171.22, 162.30 (d, $J = 244.7$ Hz), 131.15 (d, $J = 30.1$ Hz, 2C), 115.70 (d, $J = 21.3$ Hz, 2C), 81.41, 42.16, 28.44 (3C).

***tert*-Butyl α -(2-trifluoromethylphenyl)acetate.** (Table 5, Entry 6) ^1H NMR: 7.66(d, $J=7.6$ Hz, 1H), 7.52(t, $J=7.6$ Hz, 1H), 7.37-7.40(m, 2H), 3.74(d, $J=1.6$ Hz, 2H), 1.44(s, 9H). ^{13}C NMR: 170.04, 133.04, 132.57, 131.78, 128.85(q, $J=29.8$ Hz), 127.15, 125.98(q, $J=5.4$ Hz), 124.30(q, $J=272.0$ Hz), 81.25, 39.48(d, $J=1.5$ Hz), 27.90. Anal. Calc'd for $C_{13}H_{15}F_3O_2$: C, 60.00; H, 5.81. Found: C, 60.28; H, 6.01.

***tert*-Butyl α -(3-trifluoromethylphenyl)acetate.** (Table 4, Entry 7; Table 5, Entry 6) ^1H NMR: 7.54-7.41 (m, 4H), 3.59 (s, 2H), 1.44 (s, 9H). ^{13}C NMR: 170.51, 135.94, 133.09 (q, $J = 1.5$ Hz), 131.16 (q, $J = 32.1$ Hz), 129.27, 126.50 (q, $J = 3.7$ Hz), 124.50 (q, $J = 272.2$ Hz), 124.17 (q, $J = 3.9$ Hz), 81.78, 42.71, 28.45 (3C). Anal. Calc'd for $C_{13}H_{15}F_3O_2$: C, 60.00; H, 5.81. Found: C, 60.16; H, 5.62.

***tert*-Butyl α -(4-trifluoromethylphenyl)acetate.** (Table 5, Entry 6) ^1H NMR: 7.58 (d, $J = 8.0$ Hz, 2H), 7.39 (d, $J = 8.0$ Hz, 2H), 3.58 (s, 2H), 1.44 (s, 9H). ^{13}C NMR: 170.49, 139.06 (q, $J = 2.2$ Hz), 130.03 (2C), 129.62 (q, $J = 32.1$ Hz), 125.83 (q, $J = 3.8$ Hz, 2C), 124.60 (q, $J = 272.4$ Hz), 81.80, 42.78, 28.42 (3C). Anal. Calc'd for $C_{13}H_{15}F_3O_2$: C, 60.00; H, 5.81. Found: C, 60.27; H, 5.69.

***tert*-Butyl α -(2-methoxyphenyl)acetate.**¹ (Table 4, Entry 5). ^1H NMR: 7.11 (m, 1H), 7.03 (dd, $J = 7.5, 1.6$ Hz, 1H), 6.77 (td, $J = 7.5, 1.0$ Hz, 1H), 6.73 (d, $J = 8.2$ Hz, 1H), 3.68 (s, 3H), 3.40 (s, 2H), 1.31 (s, 9H). ^{13}C NMR: 171.70, 157.90, 131.18, 128.67, 124.24, 120.81, 110.76, 80.75, 55.73, 37.67, 28.46. Anal. Calcd for $C_{13}H_{18}O_3$: C, 70.24; H, 8.16. Found: C, 70.25; H, 8.28.

***tert*-Butyl α -(3-methoxyphenyl)acetate.**¹ (Table 4, Entry 5; Table 5, Entry 4) ^1H NMR: 7.15 (t, $J = 7.8$ Hz, 1H), 6.79-6.71 (m, 3H), 3.73 (s, 3H), 3.42 (s, 2H), 1.37 (s, 9H). ^{13}C NMR: 171.48, 160.30, 136.83, 130.08, 122.26, 115.44, 113.11, 81.50, 55.85, 43.39, 28.72. Anal. Calcd for $C_{13}H_{18}O_3$: C, 70.24; H, 8.16. Found: C, 70.50; H, 8.31.

***tert*-Butyl α -(4-methoxyphenyl)acetate.**¹ (Table 4, Entry 5; Table 5, Entry 4). ¹H NMR: 7.11 (d, J = 8.4 Hz, 2H), 6.78 (d, J = 8.5 Hz, 2H), 3.72 (s, 3H), 3.39(s, 2H), 1.36 (s, 9H). ¹³C NMR: 171.72, 158.88, 130.61, 127.20, 114.26, 81.08, 55.64, 42.10, 28.45. Anal. Calcd for C₁₃H₁₈O₃: C, 70.24; H, 8.16. Found: C, 70.54; H, 8.14.

***tert*-Butyl α -(naphthalene-2-yl)acetate.**¹ (Table 4, Entry 8; Table 5, Entry 7). ¹H NMR: 7.85-7.83 (m, 3H), 7.76 (s, 1H), 7.52-7.45 (m, 3H), 3.73 (s, 2H), 1.48 (s, 9H). ¹³C NMR: 171.58, 134.16, 133.08, 132.94, 128.72, 128.51, 128.35, 128.30, 128.12, 126.69, 126.32, 81.61, 43.55, 28.74. Anal. Calcd for C₁₆H₁₈O₂: C, 79.31; H, 7.49. Found: C, 79.69; H, 7.55.

***tert*-Butyl α -(6-methoxy naphthalene-2-yl)acetate.**³ (Table 4, Entry 8; Table 5, Entry 7). ¹H NMR: 7.69(dd, J =8.4, 1.2Hz, 2H), 7.64(s, 1H), 7.38(dd, J =8.8, 1.6Hz), 7.11-7.14(m, 2H), 3.90(s, 3H), 3.65(s, 2H), 1.44(s, 9H). ¹³C NMR: 171.09, 157.45, 133.43, 129.85, 129.11, 128.90, 127.91, 127.62, 126.87, 118.79, 105.52, 80.81, 55.24, 42.60, 28.02.

***tert*-Butyl α -phenylpropanoate.** (Table 6, entries 1).⁴ ¹H NMR (CDCl₃): δ 7.26-7.20 (m, 3H), 7.16 (m, 2H), 3.53 (q, J = 7.2 Hz, 1H), 1.37 (d, J = 7.2 Hz, 3H), 1.32 (s, 9H). ¹³C{¹H} NMR (CDCl₃): δ 174.54, 141.83, 129.12, 128.07, 127.48, 81.12, 47.12, 28.60, 19.22.

***tert*-Butyl α -(2-methylphenyl)propanoate.** (Table 6, entry 2). ¹H NMR (CDCl₃): δ 7.19 (d, J = 7.3 Hz, 1H), 7.12-7.03 (m, 3H), 3.77 (q, J = 7.1 Hz, 1H), 2.29 (s, 3H), 1.35 (d, J = 7.1 Hz, 3H), 1.31 (s, 9H). ¹³C{¹H} NMR (CDCl₃): δ 174.56, 140.08, 136.08, 130.72, 127.02, 126.65 (2C), 80.78, 42.57, 28.34, 20.04, 18.12. Anal. Calcd for C₁₄H₂₀O₂: C, 76.33; H, 9.15. Found: C, 76.59; H, 9.25.

***tert*-Butyl α -mesitylpropanoate.** (Table 6, entry 2). ¹H NMR (CDCl₃): δ 6.84 (s, 2H), 3.99 (q, J = 7.2 Hz, 1H), 2.29 (s, 6H), 2.27 (s, 3H), 1.43 (s, 9H), 1.40 (d, J = 7.2 Hz, 3H). ¹³C{¹H} NMR (CDCl₃): δ 175.03, 136.58, 136.53, 136.22, 130.20, 80.95, 41.78, 28.64, 21.44, 21.05, 16.20. Anal. Calcd for C₁₆H₂₄O₂: C, 77.38; H, 9.74. Found: C, 77.65; H, 9.60.

***tert*-Butyl α -(3-fluoro-4-phenylphenyl)propionate.** (Table 6, entry 3) This compound was purified by chromatography with 2% ethyl acetate in hexanes. ¹H NMR: 7.47 (m, 2H), 7.26-7.38 (m, 4H), 7.02-7.08 (m, 2H), 3.57 (q, J = 7.2Hz, 1H), 1.41 (d, J =

7.2Hz, 3H), 1.35 (s, 9H). ^{13}C NMR: 173.71, 160.03 (d, $J = 246.3\text{Hz}$), 142.90 (d, $J = 7.6\text{Hz}$), 136.00, 131.03 (d, $J = 3.9\text{Hz}$), 129.35 (d, $J = 2.7\text{Hz}$), 128.83, 127.99, 127.85 (d, $J = 13.2\text{Hz}$), 123.88 (d, $J = 3.5\text{Hz}$), 115.54 (d, $J = 23.3\text{Hz}$), 81.32, 46.38. 28.36. 18.84. Anal. Calc'd for $\text{C}_{19}\text{H}_{21}\text{FO}_2$: C, 75.97; H, 7.05. Found: C, 75.91; H, 7.12.

***tert*-Butyl α -(4-methoxyphenyl)propionate.** (Table 6, entry 4) This compound was purified by chromatography with 3% ethyl acetate in hexanes. ^1H NMR: 7.24 (d, $J = 8.8\text{Hz}$, 2H), 6.88 (d, $J = 8.4\text{Hz}$, 2H), 3.81 (s, 3H), 3.58 (q, $J = 7.2\text{Hz}$, 1H), 1.44 (d, $J = 7.6\text{Hz}$, 3H), 1.41 (s, 9H). ^{13}C NMR: 174.56, 158.82, 133.68, 128.79, 114.20, 80.74, 55.61, 45.99, 28.34, 19.00. Anal. Calc'd for $\text{C}_{14}\text{H}_{20}\text{O}_3$: C, 71.16; H, 8.53. Found: C, 71.37; H, 8.33.

***tert*-Butyl α -(4-trifluoromethylphenyl)propionate.** (Table 6, entry 5) By following the general procedure with LiNCy_2 as the base, 1.3 eq of *tert*-butyl propinates and 1.5 eq of LiNCy_2 were prestirred for 15 min followed by addition of 5 mol% of $\text{Pd}(\text{dba})_2$ and 5 mol% of the carbene ligand, then stirred at room temperature for 12 h. Flash chromatography (silica gel) with 2% ethyl acetate in hexanes afforded the title compound in 74% yield. ^1H NMR: 7.59 (d, $J = 8.0\text{Hz}$, 2H), 7.43 (d, $J = 8.0\text{Hz}$, 2H), 3.69 (q, $J = 7.2\text{Hz}$, 1H), 1.49 (d, $J = 7.6\text{Hz}$, 3H), 1.42 (s, 9H). ^{13}C NMR: 173.42, 145.49, 129.57 (q, $J = 32.0\text{Hz}$), 128.23, 125.81 (q, $J = 3.8\text{Hz}$), 124.59 (q, $J = 270.1\text{Hz}$), 81.39, 46.76, 28.28, 18.81. Anal. Calc'd for $\text{C}_{14}\text{H}_{17}\text{F}_3\text{O}_2$: C, 61.31; H, 6.25. Found: C, 61.19; H, 6.12.

***tert*-Butyl α -(7-methoxy-2-naphthyl)propanoate.** (Table 6, Entry 6).⁵ ^1H NMR (CDCl_3): δ 7.74 (d, $J = 8.7\text{ Hz}$, 1H), 7.73 (d, $J = 8.4\text{ Hz}$, 1H), 7.44 (d, $J = 8.5\text{ Hz}$, 1H), 7.18 (m, 3H), 3.93 (s, 3H), 3.77 (q, $J = 7.1\text{ Hz}$, 1H), 1.56 (d, $J = 7.1\text{ Hz}$, 3H), 1.42 (s, 9H). ^{13}C NMR (CDCl_3): δ 174.66, 158.15, 137.01, 134.19, 129.93, 129.58, 127.59, 127.00, 126.43, 119.47, 106.17, 81.15, 55.94, 47.03, 28.61, 19.22.

Methyl α -phenylisobutyrate.⁶ (Table 9, Entry 1) ^1H NMR: 7.26-7.22 (m, 5H), 3.55 (s, 3H), 1.50 (s, 6H). ^{13}C NMR: 176.24, 143.62, 127.38 (2C), 125.67, 124.55 (2C), 51.16, 45.48, 25.52 (2C).

Methyl α -(3-methylphenyl)isobutyrate.⁷ (Table 9, Entry 2) ^1H NMR: 7.23 (dd, $J = 7.7, 8.3\text{ Hz}$, 1H), 7.16-7.11 (m, 2H), 7.07 (d, $J = 7.6\text{ Hz}$, 1H), 3.58 (s, 3H), 2.28 (s, 3H),

1.50 (s, 6H). ^{13}C NMR: 177.82, 145.01, 138.38, 128.72, 127.90, 126.70, 123.03, 52.65, 46.84, 26.99, 22.05.

Methyl α -(4-methylphenyl)isobutyrate.⁷ (Table 9, Entry 2) ^1H NMR: 7.30 (d, $J = 7.7$ Hz, 2H), 7.18 (d, $J = 7.7$ Hz, 2H), 3.69 (s, 3H), 2.37 (s, 3H), 1.61 (s, 6H). ^{13}C NMR: 177.87, 142.14, 136.73, 129.53 (2C), 125.91 (2C), 52.63, 46.57, 27.00 (2C), 21.37.

Methyl α -(4-*tert*-butylphenyl)isobutyrate.¹ (Table 9, Entry 3) ^1H NMR: 7.25 (d, $J = 8.9$ Hz, 2H), 7.20 (d, $J = 8.9$ Hz, 2H), 3.58 (s, 3H), 1.50 (s, 6H), 1.24 (s, 9H). ^{13}C NMR: 177.70, 149.64, 141.81, 125.56 (2C), 125.5 (2C), 52.45, 46.36, 34.62, 31.59 (3C), 26.84 (2C).

Methyl α -(4-phenylphenyl)isobutyrate.⁸ (Table 9, Entry 4) ^1H NMR: 7.62-7.55 (m, 4H), 7.47-7.40 (m, 4H), 7.35 (ddd, $J = 1.3, 2.2, 7.9$ Hz, 1H), 3.69 (s, 3H), 1.63 (s, 6H). ^{13}C NMR: 177.51, 143.97, 140.95, 139.87, 129.17, 129.02 (2C), 127.52 (2C), 127.33 (2C), 126.34 (2C), 52.58, 46.60, 26.85 (2C).

Methyl α -(3-fluoro-4-phenylphenyl)isobutyrate.⁹ (Table 9, Entry 4) ^1H NMR: 7.55 (m, 2H), 7.46-7.36 (m, 4H), 7.19 (dd, $J = 1.9, 8.0$ Hz, 1H), 7.15 (dd, $J = 1.8, 8.3$ Hz, 1H), 3.70 (s, 3H), 1.62 (s, 6H). ^{13}C NMR: 176.95, 159.52 (d, $J = 246.2$ Hz), 146.45 (d, $J = 7.0$ Hz), 135.71 (d, $J = 1.5$ Hz), 132.03, 130.83 (d, $J = 3.9$ Hz), 129.22, 129.20 (d, $J = 3.7$ Hz), 129.03 (2C), 127.91 (2C), 122.01 (d, $J = 3.0$ Hz), 52.70, 46.60, 26.71.

Methyl α -(4-dimethylaminophenyl)isobutyrate. (Table 9, Entry 5) ^1H NMR: 7.22 (d, $J = 9.0$ Hz, 2H), 6.70 (d, $J = 9.0$ Hz, 2H), 3.64 (s, 3H), 2.93 (s, 6H), 1.55 (s, 6H). ^{13}C NMR: 177.73, 149.20, 132.35, 126.26 (2C), 112.36 (2C), 52.06, 45.39, 40.54 (2C), 26.51. Anal. Calc'd for $\text{C}_{13}\text{H}_{19}\text{NO}_2$: C, 70.56; H, 8.65. Found: C, 70.57; H, 8.71.

Methyl α -(3-methoxyphenyl)isobutyrate.¹⁰ (Table 9, Entry 6) ^1H NMR: 7.28 (dd, $J = 8.40, 8.41$ Hz, 1H), 6.94 (ddd, $J = 0.4, 2.0, 8.41$ Hz, 1H), 6.92 (dd, $J = 2.0, 2.2$ Hz, 1H), 6.82 (ddd, $J = 0.4, 2.2, 8.40$ Hz, 1H), 3.82 (s, 3H), 3.69 (s, 3H), 1.60 (s, 6H). ^{13}C NMR: 177.44, 159.83, 146.60, 129.64, 118.33, 112.40, 111.73, 55.47, 52.53, 46.80, 26.79.

Methyl α -(4-methoxyphenyl)isobutyrate.¹⁰ (Table 9, Entry 6) ^1H NMR: 7.18 (d, $J = 8.8$ Hz, 2H), 6.78 (d, $J = 8.8$ Hz, 2H), 3.71 (s, 3H), 3.56 (s, 3H), 1.48 (s, 6H). ^{13}C

NMR: 177.26, 158.05, 136.55, 126.55 (2C), 113.51 (2C), 55.03, 52.01, 45.60, 26.46 (2C). Anal. Calc'd for C₁₂H₁₆O₃: C, 69.21; H, 7.74. Found: C, 68.86; H, 7.58.

Methyl α -(4-phenoxyphenyl)isobutyrate. (Table 9, Entry 7) ¹H NMR: 7.33 (ddd, *J* = 1.0, 7.1, 8.5 Hz, 2H), 7.30 (d, *J* = 8.8 Hz, 2H), 7.10 (tt, *J* = 1.1, 7.1 Hz, 1H), 7.02 (ddd, *J* = 1.0, 1.1, 8.5 Hz, 2H), 6.95 (d, *J* = 8.8 Hz, 2H), 3.67 (s, 3H), 1.58 (s, 6H). ¹³C NMR: 177.66, 157.44, 156.36, 139.76, 133.07 (2C), 127.44 (2C), 123.72, 119.42 (2C), 118.87 (2C), 52.67, 46.38, 27.06 (2C). Anal. Calc'd for C₁₇H₁₈O₃: C, 75.53; H, 6.71. Found: C, 75.71; H, 6.70.

Methyl α -(3,4-dioxolanophenyl)isobutyrate. (Table 9, Entry 8) ¹H NMR: 6.87 (dd, *J* = 0.4, 1.8 Hz, 1H), 6.81 (dd, *J* = 1.8, 9.6 Hz, 1H), 6.76 (dd, *J* = 0.4, 9.6 Hz, 1H), 5.96 (s, 2H), 3.68 (s, 3H), 1.56 (s, 6H). ¹³C NMR: 177.08, 147.55, 146.08, 138.50, 118.49, 107.97, 106.53, 100.92, 52.16, 46.06, 26.58 (2C). Anal. Calc'd for C₁₂H₁₄O₄: C, 64.85; H, 6.35. Found: C, 64.59; H, 6.60.

Methyl α -(3-fluorophenyl)isobutyrate. (Table 9, Entry 9) ¹H NMR: 7.28 (ddd, *J* = 6.2, 8.2, 8.3 Hz, 1H), 7.10 (ddd, *J* = 0.7, 2.0, 8.2 Hz, 1H), 7.05 (ddd, *J* = 2.0, 2.3, 10.8 Hz, 1H), 6.93 (ddd, *J* = 0.7, 2.3, 8.3 Hz, 1H), 3.66 (s, 3H), 1.57 (s, 6H). ¹³C NMR: 177.12, 163.25 (d, *J* = 244.8 Hz), 147.65 (d, *J* = 6.8 Hz), 130.22 (d, *J* = 8.4 Hz), 121.80 (d, *J* = 2.3 Hz), 114.03 (d, *J* = 20.7 Hz), 113.40 (d, *J* = 22.1 Hz), 52.79, 46.88, 26.86 (2C). Anal. Calc'd for C₁₁H₁₃FO₂: C, 67.33; H, 6.68. Found: C, 67.55; H, 6.74.

Methyl α -(4-fluorophenyl)isobutyrate. (Table 9, Entry 9) ¹H NMR: 7.29 (dd, *J* = 5.2, 8.9 Hz, 2H), 7.00 (dd, *J* = 8.6, 8.9 Hz, 2H), 3.65 (s, 3H), 1.56 (s, 6H). ¹³C NMR: 176.94, 161.44 (d, *J* = 245.5 Hz), 140.21, 127.19 (d, *J* = 7.6 Hz), 115.00 (d, *J* = 21.5 Hz), 52.17, 45.59, 26.52 (2C). Anal. Calc'd for C₁₁H₁₃FO₂: C, 67.33; H, 6.68. Found: C, 67.30; H, 6.60.

Methyl α -(3-chlorophenyl)isobutyrate. (Table 9, Entry 10) ¹H NMR: 7.25 (dd, *J* = 2.0, 2.0 Hz, 1H), 7.207.11 (m, 3H), 3.59 (s, 3H), 1.50 (s, 6H). ¹³C NMR: 176.91, 146.92, 134.58, 129.91, 127.20, 126.32, 124.3, 53.66, 46.73, 26.69 (2C). Anal. Calc'd for C₁₁H₁₃ClO₂: C, 62.12; H, 6.16. Found: C, 62.38; H, 6.29.

Methyl α -(4-chlorophenyl)isobutyrate. (Table 9, Entry 10) ¹H NMR: 7.26 (m, 4H), 3.63 (s, 3H), 1.54 (s, 6H). ¹³C NMR: 177.27, 143.53, 133.00, 128.91 (2C), 127.58

(2C), 52.76, 46.57, 26.90 (2C). Anal. Calc'd for $C_{11}H_{13}ClO_2$: C, 62.12; H, 6.16. Found: C, 62.40; H, 6.40.

Methyl α -(3-trifluoromethylphenyl)isobutyrate. (Table 9, Entry 11) ^1H NMR: 7.51 (s, 1H), 7.44 (d, $J = 7.6$ Hz, 1H), 7.42 (d, $J = 7.6$ Hz, 1H), 7.35 (dd, $J = 7.6, 7.6$ Hz, 1H), 3.58 (s, 3H), 1.52 (s, 6H). ^{13}C NMR: 175.54, 144.61, 129.69 (q, $J = 31.5$ Hz), 128.38 (q, $J = 1.4$ Hz), 127.86, 125.87 (q, $J = 272.3$ Hz), 122.64 (q, $J = 3.7$ Hz), 121.41 (q, $J = 3.8$ Hz), 51.37, 45.54, 25.34 (2C). Anal. Calc'd for $C_{12}H_{13}F_3O_2$: C, 58.54; H, 5.32. Found: C, 58.56; H, 5.34.

Methyl α -(4-trifluoromethylphenyl)isobutyrate. (Table 9, Entry 11) ^1H NMR: 7.59 (d, $J = 8.4$ Hz, 2H), 7.45 (d, $J = 8.4$ Hz, 2H), 3.67 (s, 3H), 1.61 (s, 6H). ^{13}C NMR: 176.55, 148.55, 128.96 (q, $J = 32.2$ Hz), 126.11, 125.34 (q, $J = 3.7$ Hz), 124.09 (q, $J = 270.2$ Hz), 52.40, 46.64, 26.40. Anal. Calc'd for $C_{12}H_{13}F_3O_2$: C, 58.54; H, 5.32. Found: C, 58.70; H, 5.39.

Methyl α -(naphthalene-2-yl)isobutyrate.¹¹ (Table 9, Entry 12) ^1H NMR: 7.77-7.69 (m, 4H), 7.41-7.36 (m, 3H), 3.59 (s, 3H), 1.61 (s, 6H). ^{13}C NMR: 177.25, 141.99, 133.22, 132.15, 128.01 (2C), 127.41, 126.08, 125.80, 124.49, 123.73, 52.24, 46.63, 26.46 (2C).

Methyl α -(6-methoxynaphthalene-2-yl)isobutyrate.¹² (Table 9, Entry 12) ^1H NMR: 7.73-7.68 (m, 3H), 7.42 (dd, $J = 2.0, 8.8$ Hz, 1H), 7.15 (dd, $J = 2.4, 8.8$ Hz, 1H), 7.11 (d, $J = 2.4$ Hz, 1H), 3.91 (s, 3H), 3.66 (s, 3H), 1.67 (s, 6H). ^{13}C NMR: 173.70, 158.06, 140.15, 133.67, 129.92, 129.09, 127.3, 125.39, 124.02, 119.31, 105.80, 55.71, 52.65, 46.84, 26.92 (2C). Anal. Calc'd for $C_{16}H_{18}O_3$: C, 74.40; H, 7.02. Found: C, 74.30; H, 7.11.

2-(4-Benzoyl-phenyl)-2-methyl-propionic acid methyl ester. (Table 9, Entry 13)¹³ This compound was purified by chromatography with 5% ethyl acetate in hexane. ^1H NMR: 7.75-7.79 (m, 4H), 7.56 (tt, $J = 7.5, 1.0$ Hz, 1H), 7.41-7.47 (m, 4H), 3.66 (s, 3H), 1.60 (s, 6H). ^{13}C NMR: 196.17, 176.62, 149.31, 137.60, 135.98, 132.35, 130.26, 129.97, 128.24, 125.67, 52.34, 46.83, 26.42.

2-(3-[1,3]Dioxolan-2-yl-phenyl)-2-methyl-propionic acid methyl ester. (Table 9, Entry 14) This compound was purified by chromatography with 10% ethyl acetate in hexane. ^1H NMR: 7.42 (d, $J = 1.5$ Hz, 1H), 7.31-7.35 (m, 3H), 5.77 (s, 1H), 4.08-4.11 (m,

2H), 3.99-4.01(m, 2H), 3.61(s, 3H), 1.56(s, 6H). ^{13}C NMR: 177.00, 144.71, 137.87, 128.37, 126.61, 124.76, 123.61, 103.66, 65.20, 52.09, 46.42, 26.44. Anal. Calc'd for $\text{C}_{14}\text{H}_{18}\text{O}_4$: C, 67.18; H, 7.25. Found: C, 67.19; H, 7.30.

Methyl α -(3-quinolinyl)isobutyrate. (Table 9, Entry 15) This compound was purified by chromatography with 10% ethyl acetate in dichloromethane. ^1H NMR: 8.92 (d, $J = 2.0$ Hz, 1H), 8.09 (d, $J = 8.4$ Hz, 1H), 8.07 (d, $J = 2.8$ Hz, 1H), 7.81 (dd, $J = 8.2$ Hz, 1.4 Hz, 1H), 7.69 (ddd, $J = 8.4, 6.9, 1.5$ Hz, 1H), 7.55 (ddd, $J = 8.2$ Hz, 7.0 Hz, 1.2 Hz, 1H), 3.68 (s, 3H), 1.72 (s, 6H). ^{13}C NMR: 176.36, 149.62, 146.68, 137.15, 131.92, 129.31, 128.90, 127.81, 127.60, 126.82, 52.47, 45.25, 26.26. Anal. Calc'd for $\text{C}_{14}\text{H}_{15}\text{NO}_2$: C, 73.34; H, 6.59; N, 6.11. Found: C, 73.52; H, 6.70; N, 6.00.

Methyl α -(2-pyridyl)isobutyrate. (Table 9, Entry 16) This compound was purified by chromatography with 10% ethyl acetate in dichloromethane. ^1H NMR: 8.50-8.48 (m, 1H), 7.59 (td, $J = 7.7, 1.9$ Hz, 1H), 7.22 (t, $J = 8.4$ Hz, 1H), 7.08 (ddd, $J = 7.3, 4.9, 1.1$ Hz, 1H), 3.62 (s, 3H), 1.55 (s, 6H). ^{13}C NMR: 176.74, 163.69, 148.96, 136.56, 121.66, 119.73, 52.24, 49.60, 25.65. Anal. Calc'd for $\text{C}_{10}\text{H}_{13}\text{NO}_2$: C, 67.02; H, 7.31; N, 7.82. Found: C, 67.30; H, 7.48; N, 7.69.

Methyl α -(3-pyridyl)isobutyrate. (Table 9, Entry 16) The general procedure with LiNCy_2 as base was followed; 1.5 equiv of methyl isobutyrate and 1.8 equiv of LiNCy_2 were used. This compound was purified by chromatography with 10% ethyl acetate in dichloromethane. ^1H NMR: 8.63 (d, $J = 2.4$ Hz, 1H), 8.50 (d, $J = 3.6$ Hz, 1H), 7.67 (ddd, $J = 8.0, 2.4, 1.6$ Hz, 1H), 7.27 (dd, 8.0, 4.8 Hz, 1H), 3.67 (s, 3H), 1.62 (s, 6H). ^{13}C NMR: 176.311, 147.88, 147.52, 139.97, 133.61, 123.20, 52.42, 45.18, 26.21. Anal. Calc'd for $\text{C}_{10}\text{H}_{13}\text{NO}_2$: C, 67.02; H, 7.31; N, 7.82. Found: C, 66.75; H, 7.32; N, 7.63.

Methyl α -(4-pyridyl)isobutyrate.¹⁴ (Table 9, Entry 16) 4-Bromopyridine hydrochloride was deprotonated with 1.1 eq of LiNCy_2 prior to addition of the other reagents. The total volume of toluene was, therefore, 2 mL greater than in other reactions of this study. This compound was purified by chromatography with 10% ethyl acetate in dichloromethane. ^1H NMR: 8.56 (bd, $J = 5.2$ Hz, 2H), 7.25 (dd, $J = 4.8, 1.6$ Hz, 2H), 3.67 (s, 3H), 1.58 (s, 6H). ^{13}C NMR: 175.90, 153.34, 149.89, 120.98, 52.46, 46.35, 25.81.

2-Methyl-2-thiophen-2-yl-propionic acid methyl ester. (Table 9, Entry 17) ^1H NMR: 7.20 (dd, $J = 4.3, 1.8$ Hz, 1H), 6.97-6.95 (m, 2H), 3.69 (s, 3H), 1.67 (s, 6H). ^{13}C

NMR: 175.88, 149.20, 126.54, 124.02, 123.70, 52.44, 44.62, 27.63. Anal. Calc'd for $C_9H_{12}O_2S$: C, 58.67; H, 6.56. Found: C, 58.64; H, 6.67.

2-Methyl-3-thiophen-2-yl-propionic acid methyl ester.¹⁵ (Table 9, Entry 17) ^1H NMR: 7.15-7.12 (m, 1H), 6.92 (dd, $J = 5.5, 3.5$ Hz, 1H), 6.81 (m, 1H), 3.69 (s, 3H), 3.23 (dd, $J = 14.5, 7.0$ Hz, 1H), 2.94 (dd, $J = 14.5, 7.5$ Hz, 1H), 2.78 (sext, $J = 7.2$ Hz, 1H), 1.21 (d, $J = 7.0$ Hz, 3H). ^{13}C NMR: 176.07, 141.58, 126.76, 125.59, 123.77, 51.74, 41.76, 33.55, 16.78.

2-Methyl-2-thiophen-3-yl-propionic acid methyl ester. (Table 9, Entry 17) This compound was purified by chromatography with 10% ethyl acetate in hexanes. ^1H NMR: 7.21-7.19 (m, 1H), 7.03 (dd, $J = 8.4, 1.6$ Hz, 1H), 7.02 (dd, $J = 10.4, 1.4$ Hz, 1H), 3.59 (s, 3H), 1.52 (s, 6H). ^{13}C NMR: 176.59, 145.80, 126.54, 125.48, 119.91, 52.25, 44.21, 26.52. Anal. Calc'd for $C_9H_{12}O_2S$: C, 58.67; H, 6.56. Found: C, 58.59; H, 6.36.

Methyl α -(2-furanyl)isobutyrate. (Table 9, Entry 18) This compound was purified by chromatography with 10% ethyl acetate in hexanes. ^1H NMR: 7.35 (dd, $J = 1.8, 1.0$ Hz, 1H), 6.32 (dd, $J = 3.0, 1.8$ Hz, 1H), 6.16 (dd, 3.2 Hz, 0.8 Hz, 1H), 3.68 (s, 3H), 1.57 (s, 6H). ^{13}C NMR: 175.30, 157.46, 141.62, 110.03, 104.75, 52.41, 43.34, 24.47 (2C). Anal. Calc'd for $C_9H_{12}O_3$: C, 64.27; H, 7.19. Found: C, 64.28; H, 7.32.

Methyl α -(3-furanyl)isobutyrate. (Table 9, Entry 18) This compound was purified by chromatography with 10% ethyl acetate in hexanes. ^1H NMR: 7.36 (t, 1.8 Hz, 1H), 7.31 (dd, 1.6, 0.8 Hz, 1H), 6.40 (dd, 2.0, 0.8 Hz, 1H), 3.68 (s, 3H), 1.52 (s, 6H). ^{13}C NMR: 176.54, 142.84, 138.41, 130.00, 109.55, 52.20, 40.70, 26.04 (2C). Anal. Calc'd for $C_9H_{12}O_3$: C, 64.27; H, 7.19. Found: C, 64.22; H, 7.14.

Methyl α -(3-methylphenyl)- α -methyl-butyrate. (Table 10, Entry 1) ^1H NMR: 7.26 (dd, $J = 7.2, 8.3$ Hz, 1H), 7.17-7.13 (m, 2H), 7.10 (d, $J = 8.3$ Hz, 1H), 3.70 (s, 3H), 2.40 (s, 3H), 2.07 (dq, $J = 7.4, 64.2$ Hz, 2H), 1.57 (s, 3H), 0.88 (t, $J = 7.4$ Hz, 3H). ^{13}C NMR: 176.77, 143.72, 137.73, 128.08, 127.27, 126.55, 122.89, 51.91, 50.43, 31.65, 22.15, 21.52, 9.05. Anal. Calc'd for $C_{13}H_{18}O_2$: C, 75.69; H, 8.80. Found: C, 75.39; H, 8.54.

Methyl α -(4-methylphenyl)- α -methyl-butyrate. (Table 10, Entry 1) ^1H NMR: 7.18 (d, $J = 8.4$ Hz, 2H), 7.12 (d, $J = 8.4$ Hz, 2H), 3.64 (s, 3H), 2.32 (s, 3H), 2.01 (dq, $J = 6.8, 62.4$ Hz, 2H), 1.51 (s, 3H), 0.82 (t, $J = 6.8$ Hz, 3H). ^{13}C NMR: 176.84, 140.77,

136.08, 128.92 (2C), 125.77 (2C), 51.91, 50.16, 31.67, 22.14, 20.82, 9.04. Anal. Calc'd for $C_{13}H_{18}O_2$: C, 75.69; H, 8.80. Found: C, 75.61; H, 8.79.

Methyl α -(4-phenylphenyl)- α -methyl-butyrate. (Table 10, Entry 2) ^1H NMR: 7.62-7.55 (m, 4H), 7.48-7.37 (m, 5H), 3.69 (s, 3H), 2.08 (dq, $J = 60.8, 7.2$ Hz, 2H) 1.57 (s, 3H), 0.87 (t, $J = 7.2$ Hz, 3H). ^{13}C NMR: 177.19, 143.34, 141.09, 139.89, 132.28 (2C), 128.28 (2C), 127.65 (2C), 127.48, 126.90 (2C), 52.58, 50.91, 32.29, 22.70, 9.63. Anal. Calc'd for $C_{18}H_{20}O_2$: C, 80.56; H, 7.51. Found: C, 80.80; H, 7.41.

Methyl α -(3-fluoro-4-phenylphenyl)- α -methyl-butyrate. (Table 10, Entry 2) ^1H NMR: 7.58-7.29 (m, 6H), 7.16 (dd, $J = 1.6, 9.6$ Hz, 1H), 7.13 (dd, $J = 2.4, 11.6$ Hz, 1H), 3.62 (s, 3H), 1.98 (dq, $J = 7.3, 61.5$ Hz, 2H), 0.78 (t, $J = 7.3$ Hz, 3H). ^{13}C NMR: 176.51, 159.87 (d, $J = 247.64$ Hz), 145.63 (d, $J = 7.1$ Hz), 135.74, 130.73 (d, $J = 3.42$ Hz), 129.21 (d, $J = 2.72$ Hz), 129.21 (2C), 128.61 (2C), 127.90 (2C), 122.42 (d, $J = 4.02$ Hz), 114.40 (d, $J = 23.74$ Hz), 52.56, 50.75, 32.12, 22.37, 9.41. Anal. Calc'd for $C_{18}H_{19}FO_2$: C, 75.50; H, 6.69. Found: C, 75.68; H, 6.76.

Methyl α -(3-fluorophenyl)- α -methyl-butyrate. (Table 10, Entry 3) ^1H NMR: 7.28 (dd, $J = 8.1, 14.2$ Hz, 1H), 7.07 (ddd, $J = 0.8, 2.1, 7.6$ Hz, 1H), 7.02 (ddd, $J = 2.1, 2.3, 10.4$ Hz, 1H), 6.93 (ddd, $J = 0.8, 2.3, 8.1$ Hz, 1H), 3.67 (s, 3H), 2.01 (dq, $J = 60.0, 7.6$ Hz, 2H), 1.52 (s, 3H), 0.82 (t, $J = 7.6$ Hz, 3H). ^{13}C NMR: 176.06, 162.68 (d, $J = 245.3$ Hz), 146.28 (d, $J = 6.9$ Hz), 129.56 (d, $J = 8.4$ Hz), 121.63 (d, $J = 3.3$ Hz), 113.37 (d, $J = 21.4$ Hz), 113.21 (d, $J = 22.1$ Hz), 52.01, 50.41, 31.67, 21.90, 8.89. Anal. Calc'd for $C_{12}H_{15}FO_2$: C, 68.55; H, 7.19. Found: C, 68.66; H, 7.37.

Methyl α -(4-fluorophenyl)- α -methyl-butyrate. (Table 11, Entry 3) ^1H NMR: 7.20 (dd, $J = 5.20, 9.20$ Hz, 2H), 6.93 (dd, $J = 8.40, 9.20$ Hz, 2H), 3.58 (s, 3H), 2.01 (dq, $J = 58.70, 7.65$ Hz, 2H), 1.44 (s, 3H), 0.74 (t, $J = 7.7$ Hz, 3H). ^{13}C NMR: 176.89, 161.78 (d, $J = 245.2$ Hz), 139.71 (d, $J = 3.0$ Hz), 127.98 (d, $J = 7.4$ Hz, 2C), 115.35 (d, $J = 20.72$ Hz, 2C), 52.41, 50.38, 32.25, 22.51, 9.35. Anal. Calc'd for $C_{12}H_{15}FO_2$: C, 68.55; H, 7.19. Found: C, 68.65; H, 7.34.

Methyl α -(3-trifluoromethylphenyl)- α -methyl-butyrate. (Table 10, Entry 4) ^1H NMR: 7.55-7.41 (m, 4H), 3.67 (s, 3H), 2.05 (dq, $J = 7.3, 60.7$ Hz, 2H), 1.56 (s, 3H), 0.83 (t, $J = 7.3$ Hz, 3H). ^{13}C NMR: 175.96, 144.66, 130.51 (d, $J = 32.2$ Hz), 129.62 (q, $J = 1.2$ Hz), 128.65, 123.51 (q, $J = 272.3$ Hz), 123.43 (q, $J = 3.8$ Hz), 122.67 (q, $J = 3.9$ Hz),

52.09, 50.55, 31.72, 21.99, 8.89. Anal. Calc'd for $C_{13}H_{15}F_3O_2$: C, 60.00; H, 5.81. Found: C, 60.05; H, 5.87.

Methyl α -(4-trifluoromethylphenyl)- α -methyl-butyrate. (Table 10, Entry 4) ^1H NMR: 7.57 (d, $J = 7.6$ Hz, 2H), 7.42 (d, $J = 7.6$ Hz, 2H), 3.67 (s, 3H), 2.03 (dq, $J = 59.34$, 7.6 Hz, 2H), 1.55 (s, 3H), 0.82 (t, $J = 7.6$ Hz, 3H). ^{13}C NMR: 175.48, 147.15, 128.75 (q, $J = 32.0$ Hz), 126.42 (2C), 124.65 (q, $J = 3.9$ Hz, 2C), 124.01 (q, $J = 272.4$ Hz), 51.63, 50.18, 31.17, 21.52, 8.41. Anal. Calc'd for $C_{13}H_{15}F_3O_2$: C, 60.00; H, 5.81. Found: C, 60.25; H, 5.97.

Methyl α -(3-methoxyphenyl)- α -methyl-butyrate. (Table 10, Entry 5) ^1H NMR: 7.19 (dd, $J = 7.40$, 8.15 Hz, 1H), 6.88 (ddd, $J = 7.40$, 0.80, 1.20 Hz, 1H), 6.85 (dd, $J = 2.55$, 1.2 Hz, 1H), 6.72 (dd, $J = 8.15$, 2.55 Hz, 1H), 3.73 (s, 3H), 3.58 (s, 3H), 2.02 (dq, $J = 59.80$, 7.40, 2H), 1.44 (s, 3H), 0.75 (t, $J = 7.40$ Hz, 3H). ^{13}C NMR: 177.11, 159.94, 145.96, 129.67, 118.91, 112.98, 111.76, 55.60, 52.51, 51.06, 32.19, 22.59, 9.55. Anal. Calc'd for $C_{13}H_{18}O_3$: C, 70.24; H, 8.16. Found: C, 70.25; H, 8.19.

Methyl α -(4-methoxyphenyl)- α -methyl-butyrate. (Table 10, Entry 5) ^1H NMR: 7.16 (d, $J = 9.40$ Hz, 2H), 6.78 (d, $J = 9.40$ Hz, 2H), 3.72 (s, 3H), 3.57 (s, 3H), 2.01 (dq, $J = 60.42$, 7.20 Hz, 2H), 1.43 (s, 3H), 0.74 (t, $J = 7.20$ Hz, 3H). ^{13}C NMR: 177.42, 158.56, 136.29, 127.54 (2C), 114.05 (2C), 55.62, 52.45, 50.30, 32.32, 22.62, 9.56. Anal. Calc'd for $C_{13}H_{18}O_3$: C, 70.24; H, 8.16. Found: C, 69.95; H, 8.18.

Methyl α -(naphthalen-2-yl)- α -methyl-butyrate. (Table 10, Entry 6) ^1H NMR: 7.84-7.79 (m, 3H), 7.76-7.74 (m, 1H), 7.48-7.45 (m, 2H), 7.43 (dd, $J = 8.8$, 2.4 Hz, 1H), 3.67 (s, 3H), 2.15 (dq, $J = 56.2$, 7.6 Hz, 2H), 1.65 (s, 3H), 0.86 (t, $J = 7.6$ Hz, 3H). ^{13}C NMR: 176.72, 141.03, 133.12, 132.06, 127.94, 127.84, 127.31, 125.94, 125.69, 124.66, 124.35, 52.02, 50.64, 31.51, 22.06, 9.00. Anal. Calc'd for $C_{16}H_{18}O_2$: C, 79.31; H, 7.49. Found: C, 79.60; H, 7.38.

Methyl α -(6-methoxy-naphthalen-2-yl)- α -methyl-butyrate. (Table 10, Entry 6) ^1H NMR: 7.72-7.59 (m, 3H), 7.39 (dd, $J = 8.4$, 2.0 Hz, 1H), 7.14 (dd, $J = 9.2$, 2.4 Hz, 1H), 7.10 (d, $J = 2.8$ Hz, 1H), 3.91 (s, 3H), 3.66 (s, 3H), 2.12 (dq, $J = 58.4$, 7.6 Hz, 2H), 1.62 (s, 3H), 0.84 (t, $J = 7.6$ Hz, 3H). ^{13}C NMR: 176.83, 157.51, 138.72, 133.12, 129.42, 128.57, 126.71, 125.12, 124.17, 118.73, 105.25, 55.19, 51.97, 50.39, 31.55, 22.03, 9.01. Anal. Calc'd for $C_{17}H_{20}O_3$: C, 74.97; H, 7.40. Found: C, 74.78; H, 7.41.

Methyl α -(3-methylphenyl)- α -phenyl-propionate. (Table 10, Entry 7) ^1H NMR: 7.41-7.26 (m, 6H), 7.16 (dd, $J = 0.8, 7.5$ Hz, 1H), 7.12 (m, 1H), 7.09 (dd, $J = 0.5, 7.9$ Hz, 1H), 3.81 (s, 3H), 2.40 (s, 3H), 2.01 (s, 3H). ^{13}C NMR: 176.15, 144.90, 144.70, 138.06, 129.02, 128.47 (3C), 128.40, 128.05, 127.20, 125.53, 56.91, 52.93, 27.59, 22.07. Anal. Calc'd for $\text{C}_{17}\text{H}_{18}\text{O}_2$: C, 80.28; H, 7.13. Found: C, 80.23; H, 7.29.

Methyl α -(4-methylphenyl)- α -phenyl-propionate. (Table 10, Entry 7) ^1H NMR: 7.31-7.21 (m, 5H), 7.14-7.11 (m, 4H), 3.74 (s, 3H), 2.35 (s, 3H), 1.93 (s, 3H). ^{13}C NMR: 175.64, 144.48, 141.19, 136.34, 128.66 (2H), 127.91, 127.81 (2C), 127.48 (3C), 126.60, 56.08, 52.35, 27.00, 20.85. Anal. Calc'd for $\text{C}_{17}\text{H}_{18}\text{O}_2$: C, 80.28; H, 7.13. Found: C, 79.99; H, 7.33.

Methyl α -(3-fluorophenyl)- α -phenyl-propionate. (Table 10, Entry 8) ^1H NMR: 7.36-7.17 (m, 6H), 7.01 (ddd, $J = 0.8, 1.6, 7.6$ Hz, 1H), 6.99-6.90 (m, 2H), 3.75 (s, 3H), 1.93 (s, 3H). ^{13}C NMR: 175.53, 162.96 (d, $J = 245.3$ Hz), 147.37 (d, $J = 6.7$ Hz), 144.18, 129.85 (d, $J = 8.4$ Hz), 128.68 (2C), 128.25, 127.51 (2C), 124.18 (d, $J = 3.1$ Hz), 115.83 (d, $J = 23.0$ Hz), 114.22 (d, $J = 20.7$ Hz), 56.85, 53.07, 27.43. Anal. Calc'd for $\text{C}_{16}\text{H}_{15}\text{FO}_2$: C, 74.40; H, 5.85. Found: C, 74.54; H, 6.09.

Methyl α -(4-fluorophenyl)- α -phenyl-propionate. (Table 10, Entry 8) ^1H NMR: 7.28-7.12 (m, 7H), 6.95 (dd, $J = 8.7, 8.7$ Hz, 2H), 3.70 (s, 3H), 1.88 (s, 3H). ^{13}C NMR: 175.31, 161.47 (d, $J = 246.2$ Hz), 144.21, 139.85 (d, $J = 4.5$ Hz), 129.63 (d, $J = 7.1$ Hz), 128.50, 128.07 (2C), 126.81 (2C), 114.69 (d, $J = 20.6$ Hz), 52.44, 45.26, 27.07. Anal. Calc'd for $\text{C}_{16}\text{H}_{15}\text{FO}_2$: C, 74.40; H, 5.85. Found: C, 74.68; H, 6.02.

Methyl α -(4-phenylphenyl)- α -phenyl-propionate. (Table 10, Entry 9) ^1H NMR: 7.57 (dd, $J = 1.2, 7.6$ Hz, 2H), 7.52 (d, $J = 8.4$ Hz, 2H), 7.37 (ddd, $J = 0.8, 7.6, 8.0$ Hz, 2H), 7.33-7.22 (m, 8H), 3.71 (s, 3H), 1.96 (s, 3H). ^{13}C NMR: 175.37, 144.16, 143.23, 140.38, 139.43, 128.57 (2C), 128.50 (2C), 127.97 (2C), 127.77 (2C), 127.11, 126.85 (2C), 126.71, 126.57 (2C), 56.15, 52.34, 26.92. Anal. Calc'd for $\text{C}_{22}\text{H}_{20}\text{O}_2$: C, 83.51; H, 6.37. Found: C, 83.30; H, 6.50.

Methyl α -(3-fluoro-4-phenylphenyl)- α -phenyl-propionate. (Table 10, Entry 9) ^1H NMR: 7.42 (d, $J = 8.0$ Hz, 2H), 7.30 (dd, $J = 7.2, 8.0$ Hz, 2H), 7.26-7.08 (m, 7H), 6.95 (dd, $J = 1.6, 8.0$ Hz, 1H), 6.90 (dd, $J = 1.6, 12.4$ Hz, 1H), 3.63 (s, 3H), 1.83 (s, 3H). ^{13}C NMR: 175.56, 159.74 (d, $J = 246.7$ Hz), 146.30 (d, $J = 7.8$ Hz), 144.15, 135.84 (d, $J = 1.5$

Hz), 130.58 (d, $J = 3.6$ Hz), 129.41, 129.31, 128.89 (2C), 128.57 (2C), 128.24 (2C), 128.13, 127.58 (2C), 124.54 (d, $J = 3.4$ Hz), 116.56 (d, $J = 24.5$ Hz), 56.72, 53.15, 27.41. Anal. Calc'd for $C_{22}H_{19}FO_2$: C, 79.02; H, 5.73. Found: C, 79.09; H, 5.78.

Methyl α -(naphthalene-2-yl)- α -phenyl-propionate. (Table 10, Entry 10) ^1H NMR: 7.81-7.75 (m, 3H), 7.49-7.45 (m, 2H), 7.38-7.22 (m, 7H), 3.76 (s, 3H), 2.04 (s, 3H). ^{13}C NMR: 175.38, 144.24, 141.47, 132.82, 132.08, 128.02 (2C), 128.02, 127.78 (2C), 127.46, 127.28, 126.80, 126.75, 126.06, 125.95, 125.93, 56.54, 52.41, 26.93. Anal. Calc'd for $C_{20}H_{18}O_2$: C, 82.73; H, 6.25. Found: C, 82.57; H, 6.31.

Methyl α -(6-methoxy-naphthalene-2-yl)- α -phenyl-propionate. (Table 10, Entry 10) ^1H NMR: 7.31 (d, $J = 8.4$ Hz, 2H), 7.00-6.83 (m, 7H), 6.80-6.72 (m, 2H), 3.54 (s, 3H), 3.39 (s, 3H), 1.67 (s, 3H). ^{13}C NMR: 175.31, 157.99, 134.97, 129.96, 129.81, 129.36, 128.08 (2C), 127.34, 127.16 (2C), 126.79, 125.42, 124.05, 119.34, 119.14, 106.13, 55.73, 52.68, 46.32, 26.40. Anal. Calc'd for $C_{21}H_{20}O_3$: C, 78.73; H, 6.29. Found: C, 78.83; H, 6.31.

Methyl α -(3-methylphenyl)cyclohexanecarboxylate. (Table 10, Entry 11) ^1H NMR: 7.22-7.18 (m, 3H), 7.04 (dd, $J = 0.4, 6.4$ Hz, 1H), 3.64 (s, 3H), 4.47 (d, $J = 13.2$ Hz, 2H), 2.34 (s, 3H), 1.73-1.20 (m, 8H). ^{13}C NMR: 175.70, 143.75, 137.84, 128.19, 127.39, 126.42, 122.74, 51.90, 50.74, 34.66 (2C), 25.47 (2C), 23.61, 21.55. Anal. Calc'd for $C_{15}H_{20}O_2$: C, 77.55; H, 8.68. Found: C, 77.32; H, 8.93.

Methyl α -(4-methylphenyl)cyclohexanecarboxylate. (Table 10, Entry 11) ^1H NMR: 7.27 (d, $J = 8.4$ Hz, 2H), 7.14 (d, $J = 8.4$ Hz, 2H), 3.63 (s, 3H), 2.46 (d, $J = 12.4$ Hz, 2H), 2.32 (s, 3H), 1.73-1.23 (m, 8H). ^{13}C NMR: 175.77, 140.78, 136.21, 129.04 (2C), 125.63 (2C), 51.88, 50.43, 34.61 (2C), 25.47 (2C), 23.57, 20.81. Anal. Calc'd for $C_{15}H_{20}O_2$: C, 77.55; H, 8.68. Found: C, 77.33; H, 8.89.

Methyl α -(4-phenylphenyl)cyclohexanecarboxylate. (Table 10, Entry 12) ^1H NMR: 7.51-7.45 (m, 4H), 7.39-7.33 (m, 4H), 7.25 (dd, $J = 7.2$ Hz, 1H), 3.58 (s, 3H), 2.43 (d, $J = 13.2$ Hz, 2H), 1.72-1.19 (m, 8H). ^{13}C NMR: 177.73, 144.94, 142.69, 141.59, 130.77 (2C), 129.26 (2C), 129.18, 129.06 (2C), 128.36 (2C), 54.13, 52.77, 36.77 (2C), 27.61, 25.74 (2C). Anal. Calc'd for $C_{20}H_{22}O_2$: C, 81.60; H, 7.53. Found: C, 81.50; H, 7.62.

Methyl α -(3-fluoro-4-phenylphenyl)cyclohexanecarboxylate. (Table 10, Entry 12) ^1H NMR: 7.55-7.51 (m, 2H), 7.45-7.34 (m, 4H), 7.23 (dd, $J = 1.9, 8.1$ Hz, 1H), 7.20 (dd, $J = 1.7, 12.7$ Hz, 1H), 3.69 (s, 3H), 2.49 (d, $J = 13.2$ Hz, 2H), 1.87-1.21 (m, 8H). ^{13}C NMR: 175.65, 160.13 (d, $J = 247.5$ Hz), 145.95 (d, $J = 6.9$ Hz), 135.89, 130.98 (d, $J = 4.9$ Hz), 129.34 (d, $J = 1.6$ Hz), 128.85 (3C), 128.05 (2C), 122.33 (d, $J = 3.8$ Hz), 114.41 (d, $J = 23.3$ Hz), 52.66, 51.13, 35.05 (2C), 25.90, 24.02 (2C). Anal. Calc'd for $\text{C}_{20}\text{H}_{21}\text{FO}_2$: C, 76.90; H, 6.78. Found: C, 76.66; H, 6.93.

Methyl α -(3-fluorophenyl)cyclohexanecarboxylate. (Table 10, Entry 13) ^1H NMR: 7.23 (ddd, $J = 4.1, 6.0, 8.0$ Hz, 1H), 7.12 (ddd, $J = 0.8, 1.7, 8.1$ Hz, 1H), 7.05 (ddd, $J = 2.2, 2.5, 10.8$ Hz, 1H), 6.88 (ddd, $J = 0.8, 2.5, 8.1$ Hz, 1H), 3.60 (s, 3H), 2.41 (d, $J = 13.2$ Hz, 2H), 1.68-1.20 (m, 8H). ^{13}C NMR: 175.11, 162.81 (d, $J = 245.1$ Hz), 146.31, 129.66 (d, $J = 8.5$ Hz), 121.45 (d, $J = 2.4$ Hz), 113.52 (d, $J = 21.5$ Hz), 113.12 (d, $J = 22.0$ Hz), 52.06, 50.68, 34.50 (2C), 25.33, 23.46 (2C). Anal. Calc'd for $\text{C}_{14}\text{H}_{17}\text{FO}_2$: C, 71.16; H, 7.25. Found: C, 71.40; H, 7.46.

Methyl α -(4-fluorophenyl)cyclohexanecarboxylate. (Table 10, Entry 13) ^1H NMR: 7.35 (dd, $J = 4.8, 8.6$ Hz), 6.99 (dd, $J = 8.6, 8.8$ Hz), 3.63 (s, 3H), 2.46 (d, $J = 13.2$ Hz), 1.71-1.20 (m, 8H). ^{13}C NMR: 175.46, 161.45 (d, $J = 245.4$ Hz), 139.21, 127.45 (d, $J = 8.4$ Hz, 2C), 115.05 (d, $J = 20.8$ Hz, 2C), 51.98, 50.19, 34.65 (2C), 25.35, 23.49 (2C). Anal. Calc'd for $\text{C}_{14}\text{H}_{17}\text{FO}_2$: C, 71.16; H, 7.25. Found: C, 71.16; H, 7.50.

Methyl α -(3-trifluoromethylphenyl)cyclohexanecarboxylate. (Table 10, Entry 14) ^1H NMR: 7.64 (s, 1H), 7.58 (d, $J = 8.0$ Hz, 1H), 7.49 (d, $J = 7.6$ Hz, 1H), 7.43 (dd, $J = 7.6, 8.0$ Hz, 1H), 3.65 (s, 3H), 2.50 (d, $J = 13.2$ Hz, 2H), 1.75-1.23 (m, 8H). ^{13}C NMR: 174.97, 144.68, 130.61 (q, $J = 32.1$ Hz), 129.41, 128.78, 124.04 (q, $J = 272.8$ Hz), 123.56 (q, $J = 3.9$ Hz), 122.59 (q, $J = 3.9$ Hz), 52.11, 50.72, 34.50 (2C), 25.19, 23.41 (2C). Anal. Calc'd for $\text{C}_{15}\text{H}_{17}\text{F}_3\text{O}_2$: C, 62.93; H, 5.99. Found: C, 63.18; H, 6.09.

Methyl α -(4-trifluoromethylphenyl)cyclohexanecarboxylate. (Table 10, Entry 14) ^1H NMR: 7.51 (d, $J = 9.2$ Hz, 2H), 7.48 (d, $J = 9.2$ Hz, 2H), 3.57 (s, 3H), 2.41 (d, $J = 14.0$ Hz, 2H), 1.68-1.14 (m, 8H). ^{13}C NMR: 175.48, 148.15, 129.40 (q, $J = 32.2$ Hz), 126.81 (2C), 125.80 (q, $J = 3.8$ Hz, 2C), 124.54 (q, $J = 272.09$ Hz), 52.66, 51.45, 35.01 (2C), 25.83, 23.94 (2C). Anal. Calc'd for $\text{C}_{15}\text{H}_{17}\text{F}_3\text{O}_2$: C, 62.93; H, 5.99. Found: C, 63.18; H, 5.93.

Methyl α -(3-methoxyphenyl)cyclohexanecarboxylate.¹⁶ (Table 10, Entry 15) ¹H NMR: 7.24 (dd, J = 8.0, 8.1 Hz, 1H), 6.97 (ddd, J = 1.0, 2.0, 8.0 Hz, 1H), 6.40 (dd, J = 2.0, 2.4 Hz, 1H), 6.77 (ddd, J = 1.0, 2.4, 8.1 Hz, 1H), 3.79 (s, 3H), 3.63 (s, 3H), 2.45 (d, J = 13.2 Hz, 2H), 1.73-1.20 (m, 8H). ¹³C NMR: 175.49, 159.49, 145.44, 129.23, 118.16, 112.23, 111.45, 55.07, 51.94, 50.82, 34.62 (2C), 25.45, 23.59 (2C).

Methyl α -(4-methoxyphenyl)cyclohexanecarboxylate.¹⁷ (Table 10, Entry 15) ¹H NMR: 7.31 (d, J = 8.8 Hz, 2H), 6.86 (d, J = 8.8 Hz, 2H), 3.79 (s, 3H), 3.63 (s, 3H), 2.45 (d, J = 12.8 Hz, 2H), 1.76-1.23 (m, 8H). ¹³C NMR: 176.35, 158.65, 136.58, 127.40 (2C), 114.15 (2C), 55.63, 52.41, 50.51, 35.17 (2C), 26.00, 24.10 (2C).

Methyl α -(naphthalene-2-yl)cyclohexanecarboxylate. (Table 10, Entry 16) ¹H NMR: 7.75-7.70 (m, 4H), 7.47 (dd, J = 2.0, 8.8 Hz, 1H), 7.41-7.34 (m, 2H), 3.56 (s, 3H), 2.50 (d, J = 13.2 Hz, 2H), 1.79-1.41 (m, 8H). ¹³C NMR: 176.16, 141.61, 133.77, 132.65, 128.56, 128.45, 127.82, 126.44, 126.27, 125.06, 124.78, 52.52, 51.44, 35.14 (2C), 26.03, 23.51 (2C). Anal. Calc'd for C₁₈H₂₀O₂: C, 80.56; H, 7.51. Found: C, 80.26; H, 7.56.

Methyl α -(6-methoxy-naphthalene-2-yl)cyclohexanecarboxylate. (Table 11, Entry 16) ¹H NMR: 7.74 (d, J = 1.4 Hz, 1H), 7.71 (d, J = 8.8 Hz, 1H), 7.69 (d, J = 8.4 Hz, 1H), 7.50 (dd, J = 1.4, 8.4 Hz, 1H), 7.14 (dd, J = 2.4, 8.8 Hz, 1H), 7.10 (d, J = 2.4 Hz, 1H), 3.91 (s, 3H), 3.63 (s, 3H), 2.56 (d, J = 13.2 Hz, 2H), 1.86-1.25 (m, 8H). ¹³C NMR: 175.74, 159.66, 133.18, 129.50, 128.69, 128.51, 126.75, 124.72, 124.31, 118.72, 105.18, 55.21, 51.94, 50.64, 34.59 (2C), 25.52, 23.59 (2C). Anal. Calc'd for C₁₉H₂₂O₃: C, 76.48; H, 7.43. Found: C, 76.21; H, 7.52.

Benzyl α -(3-methylphenyl)isobutyrate. (Table 10, Entry 17) This compound was purified by chromatography with 2% ethyl acetate in hexanes. ¹H NMR: 7.33-7.08 (m, 9H), 5.13 (s, 2H), 2.33 (s, 3H), 1.61 (s, 6H). ¹³C NMR: 176.55, 144.41, 137.84, 136.17, 128.35, 128.21, 127.89, 127.68, 127.40, 126.45, 122.59, 66.31, 46.44, 26.45, 21.54. Anal. Calc'd for C₁₈H₂₀O₂: C, 80.56; H, 7.51. Found: C, 80.43; H, 7.76.

Benzyl α -(4-methylphenyl)isobutyrate. (Table 10, Entry 17) This compound was purified by chromatography with 2% ethyl acetate in hexanes. ¹H NMR: 7.34-7.22 (m, 7H), 7.15-7.11 (m, 2H), 5.11 (s, 2H), 2.34 (s, 3H), 1.60 (s, 6H). ¹³C NMR: 176.59, 141.52, 136.23, 136.18, 129.01, 128.35, 127.87, 127.62, 125.56, 66.32, 46.16, 26.46, 20.91. Anal. Calc'd for C₁₈H₂₀O₂: C, 80.56; H, 7.51. Found: C, 80.28; H, 7.72.

Benzyl α -(3-fluoro-4-phenylphenyl)isobutyrate. (Table 10, Entry 18) This compound was purified by chromatography with 2% ethyl acetate in hexanes. ^1H NMR: 7.57 (m, 2H), 7.25-7.49 (m, 9H), 7.14-7.20 (m, 2H), 5.17 (s, 2H), 1.65 (s, 6H). ^{13}C NMR: 176.30, 159.97 (d, $J = 246.5$ Hz), 146.44 (d, 7Hz), 136.34, 135.88, 130.91 (d, $J = 4.0$ Hz), 129.35 (d, $J = 2.9$ Hz, 2C), 128.87 (two overlapping resonances), 128.51, 128.18, 128.06, 127.68 (d, $J = 13.7$ Hz), 122.27 (d, $J = 3.1$ Hz), 114.22 (d, $J = 24.3$ Hz), 67.08, 46.78 (d, $J = 1.3$ Hz), 26.73. Anal Calc'd for $\text{C}_{23}\text{H}_{21}\text{FO}_2$: C, 79.29; H, 6.08. Found: C, 79.41; H, 6.11.

Benzyl α -(4-fluorophenyl)isobutyrate. (Table 10, Entry 19) This compound was purified by chromatography with 2% ethyl acetate in hexanes. ^1H NMR: 7.27-7.22 (m, 5H), 7.17-7.14 (m, 2H), 6.97-6.91 (m, 2H), 5.06 (s, 2H), 1.55 (s, 6H). ^{13}C NMR: 175.23, 160.55 (d, $J = 245.3$ Hz), 139.15 (d, $J = 3.8$ Hz), 134.97, 127.41, 127.01 (2C), 126.67 (4C), 126.39 (d, $J = 8.0$ Hz), 114.05 (d, $J = 21.5$ Hz), 65.49, 45.02, 25.52 (2C). Anal. Calc'd for $\text{C}_{17}\text{H}_{17}\text{FO}_2$: C, 74.98; H, 6.29. Found: C, 75.18; H, 6.51.

Benzyl α -(3-trifluoromethylphenyl)isobutyrate. (Table 10, Entry 20) This compound was purified by chromatography with 2% ethyl acetate in hexanes. ^1H NMR: 7.61-7.39 (m, 4H), 7.32-7.28 (m, 3H), 7.25-7.16 (m, 2H), 5.12 (s, 2H), 1.63 (s, 6H). ^{13}C NMR: 175.64, 145.29, 135.70, 130.57 (q, $J = 32.3$ Hz), 129.24 (q, $J = 1.6$ Hz), 128.71, 128.36 (2C), 128.01, 127.65 (2C), 124.02 (q, $J = 272$ Hz), 123.53 (q, $J = 3.8$ Hz), 122.47 (q, $J = 3.8$ Hz), 66.63, 46.52, 26.26 (2C). Anal. Calc'd for $\text{C}_{18}\text{H}_{17}\text{F}_3\text{O}_2$: C, 67.07; H, 5.32. Found: C, 67.10; H, 5.22.

Benzyl α -(4-methoxyphenyl)isobutyrate. (Table 10, Entry 21) This compound was purified by chromatography with 3% ethyl acetate in hexanes. ^1H NMR: 7.32-7.26 (m, 5H), 7.23-7.21 (m, 2H), 6.86-6.84 (m, 2H), 5.11 (s, 2H), 3.81 (s, 3H), 1.59 (s, 6H). ^{13}C NMR: 176.63, 158.19, 136.57, 136.17, 128.37, 127.89, 127.60, 126.82, 113.61, 66.33, 55.23, 45.77, 26.50. Anal Calc'd for $\text{C}_{18}\text{H}_{20}\text{O}_3$: C, 76.03; H, 7.09. Found: C, 76.31; H, 7.30.

Benzyl α -(6-methoxy-naphthalene-2-yl)isobutyrate. (Table 10, Entry 22) This compound was purified by chromatography with 3% ethyl acetate in hexanes. ^1H NMR: 7.59 (m, 3H), 7.33 (dd, $J = 8.5, 2.0$ Hz, 1H), 7.19 (m, 3H), 7.12 (m, 2H), 7.06 (dd, $J = 9.0, 2.5$ Hz, 1H), 7.03 (d, $J = 2.5$ Hz, 1H), 5.04 (s, 2H), 3.84 (s, 3H), 1.61 (s, 6H). ^{13}C

NMR: 177.01, 158.07, 140.06, 136.56, 133.70, 129.94, 129.11, 128.79, 128.34, 128.14, 127.25, 125.43, 124.22, 119.25, 105.83, 66.85, 55.71, 46.94, 26.89. Anal Calc'd for $C_{22}H_{22}O_3$: C, 79.02; H, 6.63. Found: C, 78.83; H, 6.53.

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