Chemo- and Diastereoselective Reduction of β-Enamino Esters: A Convenient Synthesis of Both *cis*- and *trans*-γ-Amino Alcohols and β-Amino Esters

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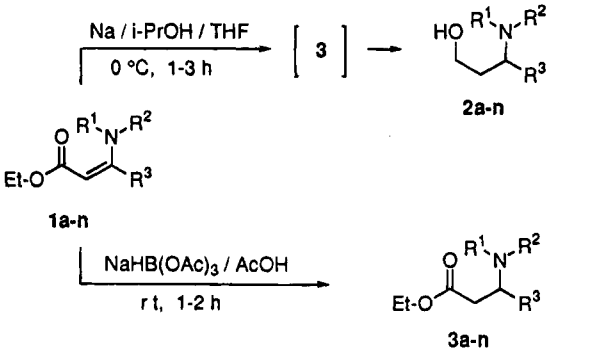
Convenient procedures for the chemo- and diastereoselective reduction of β-enamino esters **1** are described. Both *cis*- and *trans*-γ-amino alcohols **2** or β-amino esters **3** can be prepared by reduction of β-enamino esters **1**, readily available starting materials, with the use of inexpensive reagents Na/*i*-PrOH or $NaHB(OAc)_3$/AcOH, respectively, and the appropriate reduction conditions. The mechanisms and diastereoselectivities for the reductions are discussed. The relative configurations and conformations of the diastereoisomeric γ-amino alcohols **2** and β-amino esters **3** obtained are established by ^1H and ^{13}C NMR study and unequivocally set by their cyclic derivatives tetrahydro-1,3-oxazines **4**.

The development of novel synthetic methods leading to γ-amino alcohols and β-amino esters or their derivatives constitutes an active area of investigation in synthetic organic chemistry. The γ-amino alcohol unit is quite common in natural products[1] and frequently these compounds possess interesting pharmacological properties.[2] β-Amino esters are also useful starting materials in the synthesis of β-lactam antibiotics.[3] Substitution of β-amino acids for α-amino acids in peptides has been recently used to prepare peptide analogs with increased potency and enzymatic stability.[4]

For some time we have been studying the β-enamino ketone unit to provide an easy access to this class of compounds by a regioselective synthesis[5] and their regio- and stereoselective functionalization.[6] The ease of preparation of enaminones makes them attractive intermediates for the synthesis of γ-amino alcohols and β-amino esters by reduction. Recently we have found conditions for a convenient reduction of β-enamino ketones to γ-amino alcohols.[7] In continuation of our investigation of the reduction of enaminones, we now wish to report the chemo- and diastereoselective reduction of β-enamino esters **1** to γ-amino alcohols **2** and to β-amino esters **3**.

Scheme 1



a: R^1=H, R^2=H, R^3=Me
b: R^1=H, R^2=R^3=Me
c: R^1=H, R^2=Bn, R^3=Me
d: R^1=H, R^2=Pr^i, R^3=Me
e: R^1=H, R^2=c-C_6H_{11}, R^3=Me
f: R^1=H, R^2=Ph, R^3=Me
g: R^1=H, R^2=4-Me-C_6H_4, R^3=Me
h: R^1=H, R^2=4-Br-C_6H_4, R^3=Me
i: R^1=H, R^2=4-MeO-C_6H_4, R^3=Me
j: R^1=H, R^2=1-Napht, R^3=Me
k: R^1=H, R^2=Ph, R^3=Pr
l: R^1=H, R^2=Ph, R^3=Ph
m: R^1- R^2=$(CH_2)_4$, R^3=Me
n: R^1-R^2=$(CH_2)_5$, R^3=Pr

Reduction of β-Enamino Esters 1 to γ-Amino Alcohols 2. The β-enamino esters can be reduced directly to γ-amino alcohols with sodium in isopropyl alcohol/THF as shown in Schemes 1 and 2. Generally, the γ-amino alcohols are obtained in high yields, the reaction is particularly easy to perform, and special apparatus and conditions (high pressure, expensive catalysts, and hydrogen atmosphere) are not required. This reaction works well with either nonalkylated (**1a**), N-monoalkylated (**1b–l**), or N-dialkylated (**1m,n**) β-enamino esters. The reduction is complete within 1–3 h at 0 °C. Generally the standard conditions, similar to those adopted for the reduction of β-enamino ketones to γ-amino alcohols,[7] are effective for all of the compounds listed in Table 1. Only in the case of *p*-bromoanilino derivative **1h** is the reductive debromination to 3-anilinobutanol (**2f**) observed. Moreover, under these conditions, the β-naphthylamino derivative **1j** is reduced to 3-(5,8-dihydro-1-naphthylamino)butanol.

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(1) (a) Barluenga, J.; Viado, A. L.; Aguilar, E.; Fustero, S. and Olano, B. *J. Org. Chem.* **1993**, *58*, 5972. (b) Jäger, V; Schwab, W; Buss, V. *Angew. Chem. Int. Ed. Engl.* **1981**, *20*, 601.

(2) (a) Robba, M.; Duval, D. *Chim. Ther.* **1973**, *8*, 22. (b) Korner, J. K.; Otis, L.; Skinner, W. A. *J. Med. Chem.* **1967**, *10*, 387.

(3) (a) Iiomori, T.; Takahashi, Y.; Izawa, T.; Kobayashi, S.; Ohno, M. *J. Am. Chem. Soc.* **1983**, *105*, 1695. (b) Corey, E. J.; Decicco, C. P.; Newbold, R. C. *Tetrahedron Lett.* **1991**, *32*, 5287. (c) Texier-Boullet, F.; Latouche, R.; Hamelin, J. *Tetrahedron Lett.* **1993**, *34*, 2123.

(4) (a) Spatola, A. F. In *Chemistry and Biochemistry of Amino Acids, Peptides and Proteins*; Weinstein, B., Ed.; Marcel Dekker: New York, 1983, Vol. 7, p 331 and references cited therein. (b) Herranz, R.; Castro-Pichel, J.; Vinuesa, S.; Garcia-Lopez, M. T. *J. Org. Chem.* **1990**, *55*, 2232. (c) Hawkins, J. M.; Lewis, T. A. *J. Org. Chem.* **1994**, *59*, 649.

(5) Bartoli, G.; Cimarelli, C.; Palmieri, G.; Bosco, M.; Dalpozzo, R. *Synthesis* **1990**, 985.

(6) (a) Bartoli, G.; Bosco, M.; Dalpozzo, R.; Guerra, M.; Cimarelli, C.; Palmieri, G. *J. Chem. Soc., Perkin Trans. 2*, **1992**, 649. (b) Bartoli, G.; Bosco, M.; Dalpozzo, R.; Cimarelli, C.; Palmieri, G. *J. Chem. Soc., Perkin Trans. 1*, **1992**, 2095. (c) Bartoli, G.; Bosco, M.; Cimarelli, C.; Dalpozzo, R.; De Munno, G.; Guercio, G.; Palmieri, G. *J. Org. Chem.*, **1992**, *57*, 649. (d) Bartoli, G.; Bosco, M.; Dalpozzo, R.; Cimarelli, C.; Palmieri, G. *Tetrahedron*, **1993**, *49*, 2095. (e) Bartoli, G.; Bosco, M.; Cimarelli, C.; Dalpozzo, R.; De Munno, G.; Palmieri, G. *Tetrahedron: Asymmetry* **1993**, *4*, 1651.

(7) Bartoli, G.; Cimarelli, C.; Palmieri, G. *J. Chem Soc. Perkin Trans. 1*, **1994**, 537.

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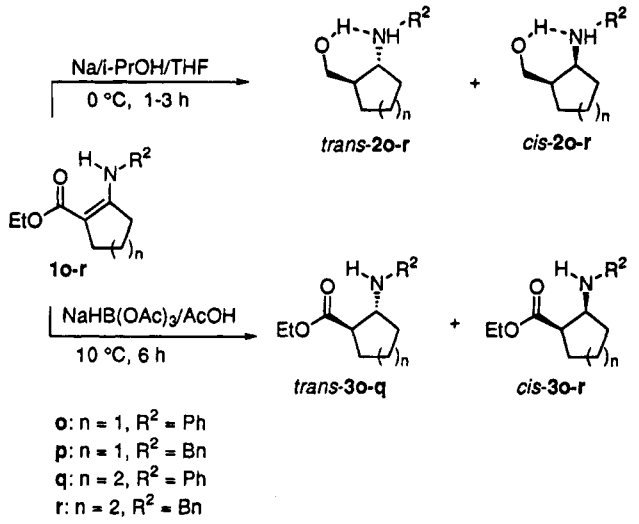
Scheme 2[18]



o: n = 1, R^2 = Ph
p: n = 1, R^2 = Bn
q: n = 2, R^2 = Ph
r: n = 2, R^2 = Bn

Table 1. Reduction of β-Enamino Esters 1 to γ-Amino Alcohols 2 with Na/*i*-PrOH or to β-Amino Esters 3 with NaHB(OAc)$_3$/AcOH

entry	1	2	yield[a] (%)	3	yield[a] (%)
1	**1a**	**2a**	62	**3a**	72
2	**1b**	**2b**	66	**3b**	70
3	**1c**	**2c**	71	**3c**	87
4	**1d**	**2d**	75	**3d**	66
5	**1e**	**2e**	87	**3e**	87
6	**1f**	**2f**	55	**3f**	85
7	**1g**	**2g**	42	**3g**	65
8	**1h**	**2h**[b]	58	**3h**	86
9	**1i**	**2i**	83	**3i**	75
10	**1j**	**2j**[c]	50	**3j**	85
11	**1k**	**2k**	60	**3k**	87
12	**1l**	**2l**	63	**3l**	75
13	**1m**	**2m**	79	**3m**	84
14	**1n**	**2n**	62	**3n**	93

[a] Yield of the pure isolated compound. [b] The debrominated compound was isolated. [c] The 3-(5,8-dihydro-1-naphtylamino)butanol was isolated.

The reduction mechanism can be seen as an electron transfer process from the Na metal to the conjugate system of enaminone **1** and the successive hydrogen abstraction from *i*-PrOH. The corresponding β-amino esters intermediates **3** are reduced in situ to γ-amino alcohol **2**. In several cases the β-amino ester **3** can be detected by monitoring the reaction progress by GC–MS (<4% with respect to authentic sample) before the reduction is complete. In some instances the β-amino isopropyl esters obtained by a spontaneous transesterification are isolated from the reaction mixture in moderate yields (near 9%). The isopropyl ester is probably less reactive under our reduction conditions when compared with the parent ethyl derivative.

Cyclopentane enaminones **1o,p** are reduced with high diastereoselectivity; the thermodynamically more stable *trans*-amino alcohols **2o,p** are obtained in high yields (see Table 2). *cis*-Amino alcohols **2q–r** are obtained as prevalent isomers but with low diastereoselectivity, in the case of cyclohexane enaminone **1q,r**. Similarly, a low diastereoselectivity is observed in the case of acyclic α-alkylated enaminone **1s**. The diastereoisomeric γ-amino alcohols **2o–r** were isolated by column chromatography and characterized separately.

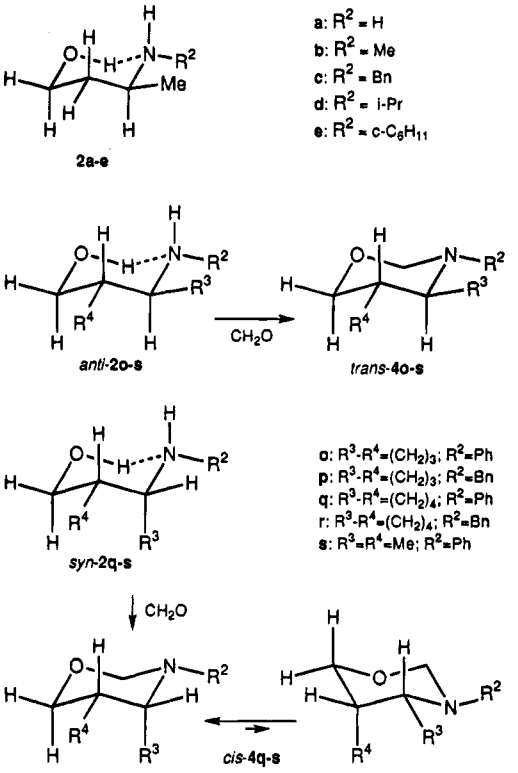
The relative configurations of the γ-amino alcohols **2o–r** were ascertained by ^{1}H NMR and ^{13}C NMR of the isolated pure isomers.[8] In each case the ^{13}C NMR signals of Cα, Cβ, and Cγ were observed at higher field for the *cis* isomer than for the *trans* diastereoisomer. The spectroscopic data show that the prevailing conformations for the β-amino alcohols **2a–e** and the isomers *trans*- and *cis*-**2o–r** are those reported in Scheme 3. In fact, γ-amino alcohols show evidence of intramolecular hydrogen bonding.[8]

Table 2. Reduction of Cyclic and Acyclic α-Substituted β-Enamino Esters 1o–s to *trans*- and *cis*-γ-Amino Alcohols 3o–r and a *syn/anti* Mixture of γ-Amino Alcohol 2s with Na/*i*-PrOH

entry	1	*n*	R^2	2	yield[a] (%)
15	**1o**	1	Ph	*trans*-**2o**	66
				cis-**2o**	4[b]
16	**1p**	1	Bn	*trans*-**2p**	90
				cis-**2p**	2[b]
17	**1q**	2	Ph	*trans*-**2q**	12
				ci-**2q**	41
18	**1r**	2	Bn	*trans*-**2r**	28
				cis-**2r**	40
19	**1s**			**2s**	76[c]

[a] Yield of the pure isolated compound. [b] Detected by GC–MS analysis with comparison to an authentic sample. [c] Isolated as a *syn/anti* mixture of the γ-amino alcohol in a ratio of 2:1.

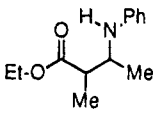
Scheme 3[18]



The relative configurations of the γ-amino alcohols were easily and unequivocally assigned by a spectroscopic study of their cyclic derivatives, tetrahydro-1,3-oxazines **4o–s** (see Scheme 3 and Table 3). ^{1}H and ^{13}C NMR data show that the *cis*-isomers **4q–s** are conformationally

(8) (a) Gaudemer, A.; *Determination of Configurations by Spectrometric Methods*, Kagan, H. B.; Ed.; Georg Thieme Publishers: Stuttgart, **1977**, Vol. 1, p 44. (b) Maroni, P.; Cazaux, L.; P. Tisnes P.; Zambeti, M. *Bull. Soc. Chim. Fr.* **1980**, 179. (c) Barluenga, J.; Olano, B.; Fustero, S. *J. Org. Chem.* **1985**, *50*, 4052.

Table 3. Cyclization of *trans*- and *cis*-γ-Amino Alcohols 2o–s with CH_2O to *trans*- and *cis*-Tetrahydro-1,3-oxazines 4o–s

2	n	R^2	4	yield[a] (%)
trans-**2o**	1	Ph	*trans*-**4o**	81[b]
trans-**2p**	1	Bn	*trans*-**4p**	86[b]
trans-**2q**	2	Ph	*trans*-**4q**	83[b]
cis-**2q**	2	Ph	*cis*-**4q**	78[b]
trans-**2r**	2	Bn	*trans*-**4r**	77[b]
cis-**2r**	2	Bn	*cis*-**4r**	82[b]
			trans-**4s**	18[c]
2s			*cis*-**4s**	42[c]

[a] Yield of the pure isolated compound. [b] Obtained from the pure amino alcohol. [c] Obtained from the *syn/anti* mixture of amino alcohol **2s**.

homogeneous, and the predominant conformation, of the two possible stable chair conformations, is depicted in Scheme 3.

The γ-amino alcohol syntheses cited in the literature commonly utilize reduction reactions using metal hydrides[9] or catalytic hydrogenation,[10] but these methods suffer from certain restrictions. The poor reactivity of enones toward hydrides, is due to the low electrophilicity of the system.[11] Consequently, the hydride acts as a base, removing an acidic proton from the β-enamino esters. As a proof of this, in the case of β-*tert*-enamino esters, where no acidic protons are present at the N atom, the reduction to β-amino esters can be easily accomplished with $NaBH_4$.[12] Moreover, in acidic media the β-enamino esters can be easily reduced with sodium cyanohydridoborate to β-amino esters.[13] The sodium borohydride–carboxylic acid system, a useful reagent for the reduction of enamine and N-alkylation of the relative amine,[14] was only occasionally utilized for the reduction of β-enamino esters.[15]

Reduction of β-Enamino Esters 1 to β-Amino Esters 3. We have found that a wide array of β-enamino esters **1a–t** can be reduced to β-amino esters **3a–t** with sodium triacetoxyborohydride [$NaHB(OAc_3)$] in acetic acid[16] at room temperature (see Schemes 1 and 2 and Tables 1 and 4). The reaction is fast (1–2 h), simple to perform, and shows high chemo- and diastereoselectivity with high yields.

We postulated that this reduction proceeds through an enol ester acetoxyborohydride intermediate and its stereochemical course may be rationalized via the transition state illustrated in the Scheme 4.

Ligand exchange between β-enamino esters and the labile borohydride ligand affords an intermediate diacetoxyborohydride enol ester which is a stronger hydride donor than the parent triacetoxyborohydride. The intramolecular reduction affords the β-amino enol ester–borane complex (for this reason the alternative mechanism accounting for an intermolecular hydride reduction can be discarded). Finally, the β-amino enol ester–borane complex is destroyed by the action of acetic acid (see deuteration experiments), affording the *cis*-β-amino esters **3**. The high stereoselectivity observed in the case of cyclic β-enamino esters **1o-r** (see Table 4) can be explained by taking into account the following protonation step in which acetic acid approaches the less hindered side to give the *cis*-β-amino esters **3o–r** through a concerted six-centered transition state. An alternative mechanism, involving the reduction of the protonated β-enamino esters (iminium moiety),[9a,13a] would be discarded because it does not explain the high diastereoselectivity observed under our conditions. Less diastereoselectivity is observed with acyclic β-enamino esters **1s,t**, for which a more stable conformer for the corresponding

Scheme 4[18]

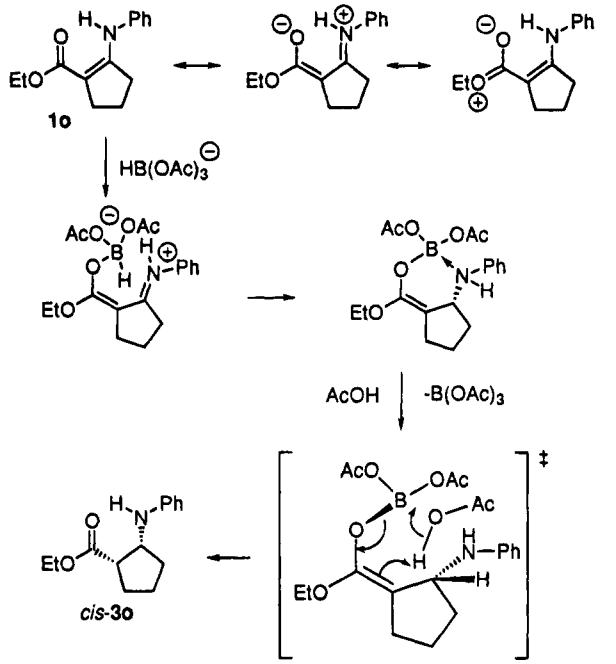
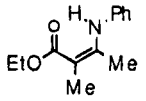
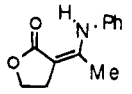


Table 4. Reduction of Cyclic and Acylic α-Substituted β-Enamino Esters 1o–t to β-Amino Esters 3o–t with $NaHB(OAc)_3$/AcOH

entry	1	n	R^2	3	yield[a] (%)
15	**1o**	1	Ph	*cis*-**3o**	61
				trans-**3o**	5
16	**1p**	1	Bn	*cis*-**3p**	89
				trans-**3p**	7
17	**1q**	2	Ph	*cis*-**3q**	74
				trans-**3q**	4
18	**1r**	2	Bn	*cis*-**3r**	87
				trans-**3r**	
19	**1s**			**3s**	93[b]
20	**1t**			**3t**	89[b]

[a] Yield of the pure isolated compound. [b] Yield of the pure compound isolated as a *syn/anti* mixture of the β-amino ester diastereomers in a ratio of 2:1.

(9) (a) Greenhill, J. V. *Chem. Soc. Rev.* **1977**, *6*, 277. (b) Martin, J. C.; Barton, K. R.; Gott, P. G.; Meen, R. H. *J. Org. Chem.* **1966**, *31*, 943.

(10) Greenhill, J. V.; Ramli, M.; Tomassini, T. *J. Chem. Soc., Perkin Trans. 1* **1975**, 558.

(11) Kashima, C.; Yamamoto, Y.; Tsuda, Y. *J. Org. Chem.* **1975**, *40*, 526.

(12) Carlsson, S.; Lawesson, S. O. *Tetrahedron* **1982**, *38*, 413.

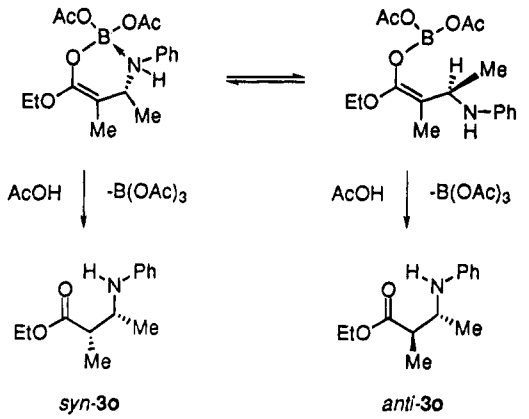
(13) (a) Borch, R. F.; Bernstein, M. D.; Dupont Durst, H. *J. Am. Chem. Soc.* **1971**, *93*, 2897. (b) Mc Manis, J. S.; Ganem, B. *J. Org. Chem.* **1980**, *45*, 2041. (c) Hart, D. J.; Hong, W. P.; Hsu, L. Y. *J. Org. Chem.* **1987**, *52*, 4665.

(14) (a) Gribble, G. W.; Lord, P. D.; Skotnicki, J.; Dietz, S. E.; Eaton, J. T.; Johnson, J. L. *J. Am. Chem. Soc.* **1974**, *96*, 7812. (b) Marchini, P.; Liso, G.; Reho, A.; Liberatore, F.; Micheletti Moracci, F. *J. Org. Chem.* **1975**, *40*, 3453.

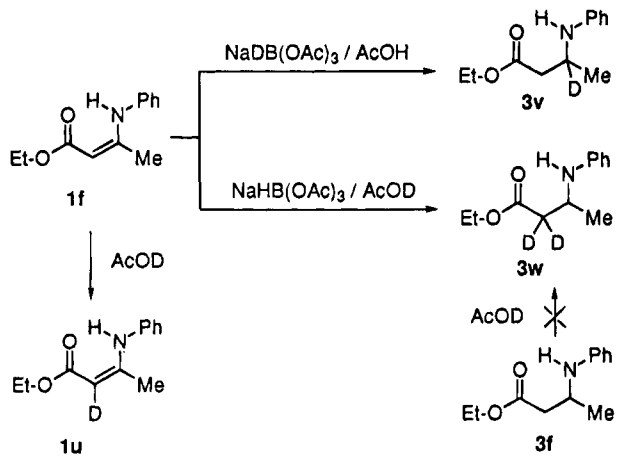
(15) (a) Djerassi, C.; Monteiro, H. J.; Walser, A.; Durham, L. J. *J. Am. Chem. Soc.* **1966**, *88*, 1792. (b) Thielke, D.; Wegener, J.; Winterfeldt, E. *Angew. Chem., Int. Ed.* **1974**, *13*, 602.

(16) Gribble, G. W.; Nutaitis, C. F. *Org. Prep. Proc. Int.* **1985**, *17*, 317.

Scheme 5[18]



Scheme 6



β-amino enol ester–borane complex intermediate is possible (see Scheme 5).

The results of deuteration experiments (see Scheme 6) are in agreement with our suggested mechanism. No hydrogen–deuterium exchange is observed when β-amino ester **3f** is allowed to stand in monodeuterioacetic acid. Furthermore, no epimerization of the *cis*-β-amino esters **3o–r** to the thermodynamically more stable *trans*-diastereoisomers is observed under our reaction conditions. The α,α-dideuterio-β-amino ester **3w**, obtained when the reduction is performed in monodeuterioacetic acid, derives from the reduction of the α-deuterio-β-enamino ester **1u** (a fast hydrogen–deuterium exchange occurs when the β-enamino ester **1f** is dissolved in monodeuterioacetic acid). The formation of the dideuterio **3w** also shows that the destruction of the β-amino enol ester–borane complex occurs by action of acetic acid and not during the reaction workup.

No N-alkylation products are observed in our reductive conditions.[14] With this procedure, which is effective for the reduction of β-enamino esters **1** (vinilogous carbamate), neither β-keto esters nor β-enamino ketones (vinilogous amides) are reduced because of their low basicity, and starting materials are recovered quantitatively.

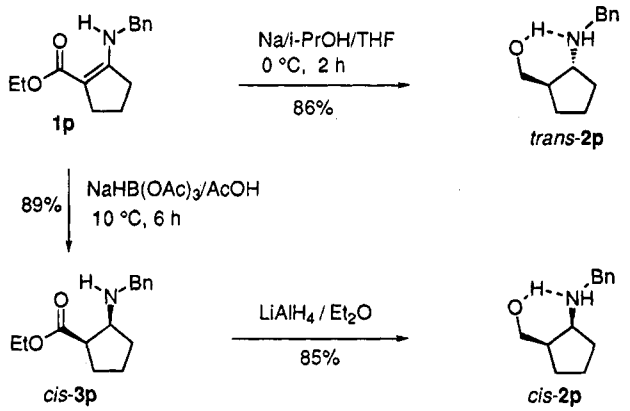
The *cis*-β-amino esters **3o–r**, obtained under these conditions, can be reduced with $LiAlH_4/Et_2O$ to *cis*-γ-amino alcohols **2o–r** (see Table 5). Therefore, as shown in Scheme 7, it is possible to prepare both *cis*- and *trans*-γ-amino alcohols **2o–r**, in high yields, by choosing the opportune reductive pathway. Study of the conditions for the enantioselective reduction of the β-enamino esters **1** is in progress.

Table 5. Reduction of *cis*-β-Amino Esters *cis*-3o–r to *cis*-γ-Amino Alcohols 2o–r with $LiAlH_4/Et_2O$

cis-3	*n*	R^2	*cis*-2	yield[a] (%)
cis-**3o**	1	Ph	*cis*-**2o**	81
cis-**3p**	1	Bn	*cis*-**2p**	85
cis-**3q**	2	Ph	*cis*-**2q**	64
cis-**3r**	2	Bn	*cis*-**2r**	73

[a] Yield of the pure isolated compound.

Scheme 7[18]



The use of Na/i-PrOH or $NaHB(OAc)_3$/AcOH for the reduction of β-enamino esters **1** to the corresponding γ-amino alcohols **2** or to the β-amino esters **3**, respectively, offers definite advantages: operational simplicity, no risk of explosion during scaling up of the reaction, and inexpensive reagents. In summary, we have described convenient procedures for the diastereoselective preparation of substituted γ-amino alcohols and β-amino esters from readily available starting materials.

Experimental Section

^1H NMR and ^{13}C NMR spectra were measured in $CDCl_3$ solution at 200 and 75.5 MHz, respectively, unless specified otherwise; chemical shifts are given in ppm from Me_4Si; and *J* values are given in hertz. Melting points are uncorrected. Mass spectra were determined by the EI technique. THF was dried by refluxing over sodium wire until the blue color of benzophenone ketyl persisted and then distilled into a dry receiver under nitrogen atmosphere. Commercial compounds were distilled and dried over 4A molecular sieves before use. The starting β-enamino esters **1** were generally prepared by condensation of the appropriate β-keto ester and the amine according to the reported procedures.[17] The β-enamino ester **1a** is commercially available.

Reduction of β-Enamino Esters 1 to γ-Amino Alcohols 2. General Procedure. The β-enamino esters (2 mmol) dissolved in a mixture of *i*-PrOH (2 mL) and THF (5 mL) was treated with an excess of sodium wire (0.276 g, 12 g-atoms) and magnetically stirred at 0 °C for the time required for complete reduction (1–3 h) as monitored by TLC or GC–MS. After the removal of the unreacted sodium, the reaction mixture was poured into saturated aqueous NH_4Cl (5 mL) and extracted with CH_2Cl_2. The organic layer was dried and evaporated under reduced pressure, and the residue obtained was submitted to HPLC-MS analysis for determination of the percentage of conversion and the ratio of the diastereoisomers. Column chromatographic separation of the crude material (cyclohexane/ethyl acetate, 1/1) furnished the pure γ-amino alcohols **2a–n** as pure diastereoisomers **2o–r** or as mixture

(17) (a) S. Boatman, S.; Hauser, C. R. *J. Org. Chem.* **1966**, *31*, 1785. (b) Singh, R. V.; Tandon, J. P. *J. Prakt. Chem.* **1979**, *321*, 151. (c) Baraldi, P. G.; Simoni, D.; Manfredini, S. *Synthesis* **1983**, 902.

(18) Only one enantiomer is depicted.

2s. Reaction yields of pure isolated compounds are given in Tables 1 and 2.

3-Amino-1-butanol (2a): oil; ^{1}H NMR δ 1.10 (d, 3H, J = 6.4), 1.40–1.67 (m, 2H), 3.07 [dqd, 1H, J = 8.6, 6.4 (q), 4.0], 3.55 (br s, 3H, OH, NH_2), 3.62–3.83 (m, 2H); ^{13}C NMR δ 25.5, 39.5, 47.3, 61.8; IR (neat) 3300, 1570, 1445, 1050 cm^{-1}; MS m/z (%) 89 (M^+, 5), 74 (8), 44 (100). Anal. Calcd for $C_4H_{11}NO$: C, 53.90; H, 12.44; N, 15.71. Found: C, 53.73; H, 12.29; N, 15.88.

3-(Methylamino)-1-butanol (2b): oil; ^{1}H NMR δ 1.12 (d, 3H, J = 6.4), 1.48 [dtd, 1H, J = 14.4, 7.9 (t), 4.4], 1.66 [ddt, 1H, J = 14.4, 5.6, 3.7 (t)], 2.39 (s, 3H), 2.81 [dqd, 1H, J = 7.9, 6.4 (q), 3.7), 3.28 (br s, 2H, NH, OH), 3.74 (ddd, 1H, J = 10.8, 7.9, 3.7), 3.83 (ddd, 1H, J = 10.8, 5.6, 4.4); ^{13}C NMR δ 20.1, 33.7, 37.0, 56.4, 62.6. IR (neat) 3350,1590,1400 cm^{-1}; MS m/z (%) 103 (M^+, 3), 88 (7), 58 (100). Anal. Calcd for $C_5H_{13}NO$: C, 58.21; H, 12.70; N, 13.58. Found: C, 57.97; H, 12.52; N, 13.79.

3-(Benzylamino)-1-butanol (2c): oil; ^{1}H NMR δ 1.20 (d, 3H, J = 6.2), 1.54 [dtd, 1H, J = 14.5, 7.9 (t), 4.2], 1.74 [ddt, 1H, J = 14.5, 5.7, 3.7 (t)], 2.20 (br s, 2H, NH, OH), 2.99 [dqd, 1H, J = 8.1, 6.2 (q), 3.4], 3.70–3.93 (m, 4H), 7.20–7.38 (m, 5H); ^{13}C NMR δ 20.2, 36.9, 51.1, 53.7, 62.2, 127.1, 128.2, 128.5, 139.6; IR (neat) 3300, 1550, 1445, 1050 cm^{-1}; MS m/z (%) 179 (M^+, 1), 164 (5), 134 (60), 91 (100). Anal. Calcd for $C_{11}H_{17}NO$: C, 73.70; H, 9.56; N, 7.81. Found: C, 73.88; H, 9.73; N, 7.64.

3-(Isopropylamino)-1-butanol (2d): oil; ^{1}H NMR δ 1.04 (d, 6H, J = 6.2), 1.10 (d, 3H, J = 6.4), 1.48 (dddd, 1H, J = 14.5, 9.0, 7.0, 5.7), 1.63 [ddt, 1H, J = 14.5, 4.6, 3.5 (t)], 2.94 (sept, 1H, J = 6.2), 2.97 [dqd, 1H, J = 9.0, 6.4 (q), 3.5], 3.38 (br s, 2H, NH, OH), 3.72–3.88 (m, 2H); ^{13}C NMR δ 20.9, 22.3, 24.1, 37.6, 45.3, 51.7, 62.8; IR (neat) 3300, 1450, 1370, 1070 cm^{-1}; MS m/z (%) 131 (M^+, 3), 116 (39), 86 (100). Anal. Calcd for $C_7H_{17}NO$: C, 64.07; H, 13.06; N, 10.67. Found: C, 63.83; H, 13.17; N, 10.82.

3-(Cyclohexylamino)-1-butanol (2e): oil; ^{1}H NMR δ 1.09 (d, 3H, J = 6.4), 0.95–2.00 (m, 12 H), 2.55 (tt, 1H, J = 9.9, 3.5), 3.01 [dqd, 1H, J = 9.0, 6.4 (q), 3.4], 3.20 (br s, 2H, NH, OH), 3.70–3.88 (m, 2H); ^{13}C NMR δ 21.1, 24.6, 25.0, 25.9, 33.1, 34.5, 37.6, 51.2, 53.4, 62.8; IR (neat) 3300, 1445, 1370, 1080 cm^{-1}; MS m/z (%) 171 (M^+, 7), 156 (15), 128 (73), 126 (100). Anal. Calcd for $C_{10}H_{21}NO$: C, 70.12; H, 12.36; N, 8.18. Found: C, 70.33; H, 12.43; N, 8.04.

3-Anilino-1-butanol (2f): oil; ^{1}H NMR δ 1.21 (d, 3H, J = 6.4), 1.76 (q, 2H, J = 6.2), 3.20 (br s, 2H, NH, OH), 3.69 (sext, 1H, J = 6.4), 3.78 (t, 2H, J = 5.9), 6.63–6.80 (m, 3 H), 7.13–7.28 (m, 2H); ^{13}C NMR δ 21.0, 39.3, 47.7, 60.8, 114.1, 117.8, 129.3, 147.4; IR (neat) 3350, 1595, 1495 cm^{-1}; MS m/z (%) 165 (M^+, 19), 150 (10), 120 (100), 93 (11), 77 (17). Anal. Calcd for $C_{10}H_{15}NO$: C, 72.69; H, 9.15; N, 8.48. Found: C, 72.44; H, 9.03; N, 8.72.

3-(*p*-Methylanilino)-1-butanol (2g): oil; ^{1}H NMR δ 1.20 (d, 3H, J = 6.4), 1.75 (q, 2H, J = 6.0), 2.27 (s, 3H), 3.26 (br s, 2H, NH, OH), 3.66 (sext, 1H, J = 6.4), 3.80 (t, 2H, J = 6.0), 6.61 and 7.02 (2 d, 4H, J = 8.2); ^{13}C NMR δ 20.4, 21.1, 39.2, 48.7, 61.2, 114.6, 127.4, 129.8, 145.0; IR (neat) 1350, 1610, 1510, 810 cm^{-1}; MS m/z (%) 179 (M^+, 26), 164 (12), 134 (100). Anal. Calcd for $C_{11}H_{17}NO$: C, 73.70; H, 9.56; N, 7.81. Found: C, 73.83; H, 9.42; N, 7.95.

3-(*p*-Methoxyanilino)-1-butanol (2i): oil; ^{1}H NMR δ 1.12 (d, 3H, J = 6.3), 1.60–1.75 (m, 2H), 3.49 (br s, 2H, NH, OH), 3.53 (sext, 1H, J = 6.2), 3.71 (s, 3H), 3.74 (t, 2H, J = 5.9), 6.62 and 6.77 (2 d, 4H, J = 9.0); ^{13}C NMR δ 21.4, 39.6, 49.9, 56.2, 61.4, 115.4, 116.6, 141.8, 153.0; IR (neat) 3350, 1500, 1230, 820 cm^{-1}; MS m/z (%) 195 (M^+, 34), 180 (16), 150 (100). Anal. Calcd for $C_{11}H_{17}NO_2$: C, 67.66; H, 8.78; N, 7.17. Found: C, 67.63; H, 8.41; N, 7.39.

3-(5,8-Dihydro-1-naphthylamino)-1-butanol (2j): oil; ^{1}H NMR δ 1.26 (d, 3H, J = 6.4), 1.82 (q, 2H, J = 6.0), 2.96 (br s, 2H, NH, OH), 3.00–3.10 (m, 2H), 3.38–3.48 (m, 2H), 3.67–3.92 (m, 3H), 5.83–6.00 (m, 2H), 6.52–6.63 (m, 2H), 7.00–7.17 (m, 1H); ^{13}C NMR δ 21.2, 25.05, 29.9, 39.3, 47.5, 61.0, 108.4, 118.4, 117.7, 119.1, 123.0, 124.7, 126.7, 144.5; IR (neat) 3400, 1590, 1465, 765, 710 cm^{-1}; MS m/z (%) 217 (M^+, 38), 202 (11), 172 (86), 143 (100). Anal. Calcd for $C_{14}H_{19}NO$: C, 77.38; H, 8.81; N, 6.45. Found: C, 77.59; H, 8.98; N, 6.27.

3-Anilino-1-hexanol (2k): oil; ^{1}H NMR δ 0.94 (t, 3H, J = 7.0); 1.30–1.55 (m, 4H), 1.66 [ddt, 1H, J = 14.3, 8.3, 6.0 (t)], 1.85 [dtd, 1H, J = 14.3, 6.0 (t), 4.4), 3.27 (br s, 2H, NH, OH), 3.57 [dtd, 1H, J = 8.3, 6.0 (t), 4.4], 3.77 (t, 2H, J = 6.0), 6.62–6.79 (m, 3H), 7.13–7.28 (m, 2H); ^{13}C NMR δ 14.2, 19.1, 37.2, 37.6, 51.8, 60.8, 113.77, 117.5, 129.3, 147.9; IR (neat) 3360, 1600, 1495, 1315, 745, 690 cm^{-1}; MS m/z (%) 193 (M^+, 27), 150 (100), 148 (76), 132 (26), 120 (25), 106 (28). Anal. Calcd for $C_{12}H_{19}NO$: C, 74.57; H, 9.91; N, 7.25. Found: C, 74.81; H, 10.08; N, 7.39.

3-Anilino-3-phenyl-1-propanol (2l): oil; ^{1}H NMR δ 2.06 (q, 2H, J = 6.2), 3.45 (br s, 2H, NH, OH), 3.70–3.84 (m, 2H), 4.60 (t, 1H, J = 6.7), 6.56–6.83 (m, 3H), 7.13–7.45 (m, 7H); ^{13}C NMR δ 40.7, 56.7, 60.5, 113.8, 117.5, 126.3, 127.1, 128.7, 129.2, 143.6, 147.4; IR (neat) 1600, 1495, 1310, 750, 695 cm^{-1}; MS m/z (%) 227 (M^+, 11), 182 (100), 104 (15), 77 (22). Anal. Calcd for $C_{15}H_{17}NO$: C, 79.26; H, 7.54; N, 6.16. Found: C, 79.38; H, 7.71; N, 6.01.

3-Pyrrolidino-1-butanol (2m): oil; ^{1}H NMR δ 1.07 (d, 3H, J = 6.6), 1.50–1.80 (m, 6H), 2.50–2.70 (m, 4H), 2.87 [quint d, 1H, J = 6.6 (q), 3.8], 3.74 (ddd, 1H, J = 10.8, 7.2, 4.0), 3.87 (ddd, 1H, J = 10.8, 6.6, 4.0); ^{13}C NMR δ 15.0, 23.3, 34.9, 49.4, 57.7, 62.1; IR (neat) 3340, 1450, 1370, 1050 cm^{-1}; MS m/z (%) 143 (M^+, 4), 128 (14), 110 (14), 98 (100). Anal. Calcd for $C_8H_{17}NO$: C, 67.09; H, 11.96; N, 9.78. Found: C, 66.92; H, 12.12; N, 9.59.

3-Piperidino-1-hexanol (2n): oil; ^{1}H NMR δ 0.88 (t, 3H, J = 6.9), 1.01–1.73 (m, 11H), 1.78 (ddd, 1H, J = 14.8, 11.3, 5.9), 2.31–2.82 (m, 6H), 3.72–3.90 (m, 2H); ^{13}C NMR δ 14.2, 20.7, 24.6, 26.3, 29.7, 30.1, 49.3, 64.4, 67.7; IR (neat) 1360, 1440, 1055 cm^{-1}; MS m/z (%) 185 (M^+, 3), 142 (99), 140 (100). Anal. Calcd for $C_{11}H_{23}NO$: C, 71.30; H, 12.51; N, 7.56. Found: C, 71.42; H, 12.63; N, 7.37.

***trans*-2-Anilino-1-(hydroxymethyl)cyclopentane (*trans*-2o)**: oil; ^{1}H NMR δ 1.25–2.25 (m, 7H),2.60 (br s, 2H, NH, OH), 3.58 (q, 1H, J = 6.8), 3.65 (dd, 1H, J = 10.5, 7.0), 3.72 (dd, 1H, J = 10.5, 5.7), 6.62–6.80 (m, 3H), 7.12–7.28 (m, 2H); ^{13}C NMR δ 22.7, 27.0, 33.1, 48.8, 58.7, 66.2, 113.8, 117.7, 129.2, 147.8; IR (neat) 3370, 1600, 1500, 1320, 1020 cm^{-1}; MS m/z (%) 191 (M^+, 45), 162 (10), 132 (100), 119 (24), 106 (25). Anal. Calcd for $C_{12}H_{17}NO$: C, 75.35; H, 8.96; N, 7.32. Found: C, 75.21; H, 9.09; N, 7.43.

***cis*-2-Anilino-1-(hydroxymethyl)cyclopentane (*cis*-2o)**: oil; ^{1}H NMR δ 1.50–2.15 (m, 6H), 2.30–2.48 (m, 1H), 3.20 (br s, 2H, NH, OH), 3.63 (dd, 1H, J = 11.3, 4.9), 3.73 (dd, 1H, J = 11.3, 7.3), 3.86 (q, 1H, J = 6.8), 6.63–6.78 (m, 3H), 7.13–7.28 (m, 2H); ^{13}C NMR δ 22.0, 27.0, 32.9, 43.2, 57.6, 63.6, 113.76, 117.9, 129.3, 148.0; IR (neat) 3370, 1595, 1495, 1310, 1030 cm^{-1}; MS m/z (%) 191 (M^+, 45), 162 (10), 132 (100), 119 (24), 106 (25). Anal. Calcd for $C_{12}H_{17}NO$: C, 75.35; H, 8.96; N, 7.32. Found: C, 75.18; H, 9.13; N, 7.48.

***trans*-2-(Benzylamino)-1-(hydroxymethyl)cyclopentane (*trans*-2p)**: oil; ^{1}H NMR δ 1.00–1.95 (m, 6H), 2.07–2.24 (m, 1H), 2.86 (td, 1H, J = 9.0 (t), 7.0), 2.95 (br s, 2H, NH, OH), 3.55 (t, 1H, J = 9.8), 3.76 and 3.90 (2 d, 2H, J_{AB} = 12.8), 3.82 (dd, 1H, J = 9.8, 4.5), 7.20–7.38 (m, 5H); ^{13}C NMR δ 22.6, 26.5, 33.1, 47.2, 52.8, 66.4, 68.5, 127.6, 128.6, 128.9, 140.2; IR (neat) 3350, 1595, 1445, 1020 cm^{-1}; MS m/z (%) 205 (M^+, 5), 176 (8), 146 (43), 91 (100). Anal. Calcd for $C_{13}H_{19}NO$: C, 76.06; H, 9.33; N, 6.82. Found: C, 76.23; H, 9.41; N, 7.06.

***cis*-2-Benzylamino-1-(hydroxymethyl)cyclopentane (*cis*-2p)**: oil; ^{1}H NMR δ 1.10–2.05 (m, 6H), 2.15–2.35 (m, 1H), 3.05 (br s, 2H, NH, OH), 3.25 (q, 1H, J = 7.3), 3.67 (dd, 1H, J = 11.5, 5.5), 3.74 (dd, 1H, J = 11.5, 7.5), 3.82 (s, 2H), 7.20–7.40 (m, 5H); ^{13}C NMR δ 22.8, 27.3, 32.2, 42.3, 53.7, 62.7, 64.7, 127.7, 128.6, 129.0, 140.2; IR (neat) 3345, 1600, 1440, 1010 cm^{-1}; MS m/z (%) 205 (M^+, 3), 176 (6), 146 (38), 91 (100). Anal. Calcd for $C_{13}H_{19}NO$: C, 76.06; H, 9.33; N, 6.82. Found: C, 75.92; H, 9.27; N, 6.64.

***trans*-2-Anilino-1-(hydroxymethyl)cyclohexane (*trans*-2q)**: oil; ^{1}H NMR δ 0.90–2.20 (m, 9H), 3.16 (td, 1H, J = 10.4 (t), 3.9), 3.50 (br s, 2H, NH, OH), 3.63 (dd, 1H, J = 11.0, 3.9), 3.72 (dd, 1H, J = 11.0, 7.3), 6.65–6.82 (m, 3H), 7.10–7.25 (m, 2H); ^{13}C NMR δ 21.4, 25.1, 25.3, 33.7, 45.3, 58.7, 68.6,

115.3, 119.0, 129.3, 147.7; IR (neat) 3350, 1595, 1495, 1310 cm^{-1}; MS *m/z* (%) 205 (M^+, 18), 186 (5), 162 (7), 132 (100). Anal. Calcd for $C_{13}H_{19}NO$: C, 76.06; H, 9.33; N, 6.82. Found: C, 76.21; H, 9.54; N, 7.04.

***cis*-2-Anilino-1-(hydroxymethyl)cyclohexane (*cis*-2q)**: mp 80–81 °C (CH_2Cl_2–hexane); ^1H NMR δ 1.25–2.00 (m, 9H), 2.30 (br s, 2H, NH, OH), 3.64 (dd, 1H, *J* = 10.8, 4.7), 3.75 (dd, 1H, *J* = 10.8, 7.3), 3.77–3.83 (m, 1H), 6.63–7.76 (m, 3H), 7.14–7.24 (m, 2H); ^{13}C NMR δ 21.4, 24.4, 24.7, 28.95 (t), 41.7, 51.3; 65.4, 114.2, 117.8, 129.3, 147.4; IR (neat) 3300, 1590, 1445, 1360, 1010 cm^{-1}; MS *m/z* (%) 205 (M^+, 38), 186 (7), 162 (15), 132 (100). Anal. Calcd for $C_{13}H_{19}NO$: C, 76.06; H, 9.33; N, 6.82. Found: C, 76.09; H, 9.42; N, 6.97.

***trans*-2-(Benzylamino)-1-(hydroxymethyl)cyclohexane (*trans*-2r)**: oil; ^1H NMR δ 1.75–2.10 (m, 9H), 2.40 (td, 1H, *J* = 10.2 (t), 3.9), 3.47–3.60 (m, 2H), 3.65 (br s, 2H, NH, OH), 3.74 and 3.98 (2 d, 2H, J_{AB} = 12.7), 7.20–7.40 (m, 5H); ^{13}C NMR δ 25.1, 25.3, 28.5, 32.5, 44.0, 50.5, 62.9, 70.1, 127.2, 128.3, 128.5, 139.5; IR (neat) 3340, 1435, 1025, 735, 690 cm^{-1}; MS *m/z* (%) 219 (M^+, 32), 176 (39), 146 (91), 91 (100). Anal. Calcd for $C_{14}H_{21}NO$: C, 76.67; H, 9.65; N, 6.39. Found: C, 76.48; H, 9.42; N, 6.56.

***cis*-2-Benzylamino-1-(hydroxymethyl)cyclohexane (*cis*-2r)**: oil; ^1H NMR δ 1.20–1.95 (m, 9H), 2.96 (dt, 1H, *J* = 7.5, 3.5), 3.69 (dd, 1H, *J* =11.0, 3.3), 3.72 (br s, 2H, NH, OH), 3.77 and 3.82 (2 d, 2H, J_{AB} = 12.6), 3.90 (dd, 1H, *J* =11.0, 7.1), 7.15–7.35 (m, 5H); ^{13}C NMR δ 23.0, 23.9, 26.3, 28.2, 39.5, 52.1, 59.0, 66.7, 127.7, 128.7, 129.0, 140.1; IR (neat) 3350, 1440, 1020, 735, 690 cm^{-1}; MS *m/z* (%) 219 (M^+, 39), 176 (48), 146 (96), 91 (100). Anal. Calcd for $C_{14}H_{21}NO$: C, 76.67; H, 9.65; N, 6.39. Found: C, 76.78; H, 9.79; N, 6.52.

Reduction of β-Enamino Esters 1 to β-Amino Esters 3. General Procedure. A solution of $NaBH(OAc)_3$ was prepared by adding $NaBH_4$ (0.34 g, 9.0 mmol) to glacial acetic acid (10 mL) while the temperature was kept between 15 and 20 °C. After the H_2 evolution ceased (30 min), the β-enamino esters (3.0 mmol) were added in one portion, and the reaction was stirred for 1–2 h at rt (10 °C for 6 h in the case of β-enamino esters **1o–t**). Evaporation of acetic acid in vacuo at 50 °C followed by dissolution of the residue with CH_2Cl_2 and washing with Na_2CO_3 (sat. aqueous solution) provided the pure β-amino esters **3**, after evaporation of the solvent. Purification and diastereoisomer separation were performed by column chromatography on silica gel (20% ethyl acetate in cyclohexane as eluent). Yields are reported in Table 1 and 4.

Ethyl 3-aminobutyrate (3a): oil; ^1H NMR δ 1.25 (t, 3H, *J* = 7.2), 1.31 (d, 3H, *J* = 6.5), 2.55 (dd, 1H, *J* = 16.8, 5.7), 2.68 (dd, 1H, *J* = 16.8, 6.9), 3.57 (m, 1H), 4.15 (q, 2H, *J* = 7.2), 4.90 (br s, 2H, NH_2); ^{13}C NMR δ 14.6, 23.2, 39.9, 44.5, 61.5, 171.8; IR (neat) 3400, 1715, 1540, 1400, 1210 cm^{-1}; MS *m/z* (%) 131 (M^+, 5), 116 (100), 102 (45), 70 (73). Anal. Calcd for $C_6H_{13}NO_2$: C, 54.94; H, 9.99; N, 10.68. Found: C, 54.68; H, 10.13; N, 10.46.

Ethyl 3-(methylamino)butyrate (3b): oil; ^1H NMR δ 1.24 (t, 3H, *J* = 7.1), 1.47 (d, 3H, *J* = 6.6), 2.66 (s, 3H), 2.73 (dd, 1H, *J* = 16.7, 8.4), 3.05 (dd, 1H, *J* = 16.7, 4.8), 3.57 [ddq, 1H, *J* = 8.4, 4.8, 6.6 (q)], 4.15 (q, 2H, *J* = 7.1), 8.80 (br s, 1H, NH); ^{13}C NMR δ 14.5, 16.9, 30.8, 37.9, 52.6, 61.8, 170.2; IR (neat) 3400, 1725, 1380, 1210 cm^{-1}; MS *m/z* (%) 145 (M^+, 3), 130 (20), 84 (19), 58 (100). Anal. Calcd for $C_7H_{15}NO_2$: C, 57.90; H, 10.41; N, 9.65. Found: C, 58.18; H, 10.59; N, 9.39.

Ethyl 3-(benzylamino)butyrate (3c): oil; ^1H NMR δ 1.25 (t, 3H, *J* = 7.3), 1.26 (d, 3H, *J* = 6.6), 2.49 (dd, 1H, *J* = 15.7, 6.6), 2.71 (dd, 1H, *J* = 15.7, 6.6), 3.26 (sext, 1H, *J* = 6.6), 3.95 (br s, 1H, NH), 3.82 and 3.96 (2 d, 2H, J_{AB} = 13.1), 4.14 (q, 2H, *J* = 7.3), 7.40–7.90 (m, 5H); ^{13}C NMR δ 14.1, 19.0, 40.2, 49.5, 50.1, 60.6, 126.7, 127.7, 128.7, 138.8, 171.3; IR (neat) 3280, 1725, 1600, 1170 cm^{-1}; MS *m/z* (%) 221 (M^+, 2), 206 (6), 134 (50), 106 (53), 91 (100). Anal. Calcd for $C_{13}H_{19}NO_2$: C, 70.56; H, 8.65; N, 6.33. Found: C, 70.72; H, 8.83; N, 6.13.

Ethyl 3-(isopropylamino)butyrate (3d): oil; ^1H NMR δ 1.24 (t, 3H, *J* = 7.1), 1.42–1.55 (m, 9H), 2.84 (dd, 1H, *J* = 16.8, 9.0), 3.23 (dd, 1H, *J* = 16.8, 4.4), 3.40 (sept, 1H, *J* = 6.5), 3.60–3.76 (m, 1H), 4.15 (q, 2H, *J* = 7.1), 8.50 (br s, 1H, NH); ^{13}C NMR δ 14.6, 17.2, 19.2, 20.4, 38.4, 48.3, 48.7, 61.6, 170.6; IR (neat) 3360, 1730, 1460, 1190 cm^{-1}; MS *m/z* (%) 173 (M^+, 2), 158 (42), 112 (14), 86 (100), 70 (64). Anal. Calcd for $C_9H_{19}NO_2$: C, 62.39; H, 11.05; N, 8.08. Found: C, 62.53; H, 11.26; N, 7.92.

Ethyl 3-(cyclohexylamino)butyrate (3e): oil; ^1H NMR δ 1.26 (t, 3H, *J* = 7.1), 1.38 (d, 3H, *J* = 6.5), 1.30–2.40 (m, 10 H), 2.68 (dd, 1H, *J* = 16.5, 7.7), 2.80–2.98 (m, 1H), 3.02 (dd, 1H, *J* = 16.5, 5.3), 3.50–3.69 (m, 1H), 4.15 (q, 2H, *J* = 7.1), 5.35 (br s, 1H, NH); ^{13}C NMR δ 14.1, 17.8, 24.6, 24.7, 25.2, 30.1, 31.2, 39.0, 47.1, 54.1, 60.9, 171.1; IR (neat) 3300, 1725, 1455, 1175 cm^{-1}; MS *m/z* (%) 213 (M^+, 27), 198 (30), 170 (100), 126 (99), 82 (64). Anal. Calcd for $C_{12}H_{23}NO_2$: C, 67.57; H, 10.87; N, 6.57. Found: C, 67.39; H, 10.98; N, 6.78.

Ethyl 3-anilinobutyrate (3f): oil; ^1H NMR δ 1.26 (t, 3H, *J* = 7.1), 1.29 (d, 3H, *J* = 7.0), 2.43 (dd, 1H, *J* = 15.0, 6.8), 2.65 (dd, 1H, *J* = 15.0, 5.1), 3.80 (br s, 1H, NH), 3.97 (sext, 1H, *J* = 6.3), 4.16 (q, 2H, *J* = 7.1), 6.60–6.77 (m, 3H), 7.12–7.25 (m, 2H); ^{13}C NMR δ 14.7, 21.1, 41.5, 46.5, 60.9, 114.1, 118.1, 129.8, 147.4, 172.3; IR (neat) 3380, 1720, 1600, 1180 cm^{-1}; MS *m/z* (%) 207 (M^+, 16), 192 (5), 120 (100), 104 (10). Anal. Calcd for $C_{12}H_{17}NO_2$: C, 69.54; H, 8.27; N, 6.76. Found: C, 69.71; H, 8.34; N, 6.51.

Ethyl 3-*p*-toluidinobutyrate (3g): oil; ^1H NMR δ 1.26 (t, 3H, *J* = 7.1), 1.27 (d, 3H, *J* = 6.4), 2.24 (s, 3H), 2.40 (dd, 1H, *J* = 14.9, 6.9), 2.62 (dd, 1H, *J* = 14.9, 5.2), 3.61 (br s, 1H, NH), 3.91 (sext, 1H, *J* = 5.7), 4.14 (q, 2H, *J* = 7.1), 6.56 and 7.00 (2 d, 4H, *J* = 8.3); ^{13}C NMR δ 14.7, 20.9, 21.1, 41.5, 46.9, 60.9, 114.4, 127.5, 130.9, 145.1, 172.4; IR (neat) 3370, 1725, 1600, 1270, 1160 cm^{-1}; MS *m/z* (%) 221 (M^+, 23), 206 (8), 134 (100), 118 (15). Anal. Calcd for $C_{13}H_{19}NO_2$: C, 70.56; H, 8.65; N, 6.33. Found: C, 70.42; H, 8.78; N, 6.15.

Ethyl 3-(*p*-bromoanilino)butyrate (3h): oil; ^1H NMR δ 1.25 (t, 3H, *J* = 7.1), 1.27 (d, 3H, *J* = 5.6), 2.42 (dd, 1H, *J* = 15.1, 4.9), 2.59 (dd, 1H, *J* = 15.1, 6.1), 3.60 (br s, 1H, NH), 3.75–3.95 (m, 1H), 4.14 (q, 2H, *J* = 7.1), 6.50–7.25 (2 d, 4H, *J* = 8.7); ^{13}C NMR δ 14.7, 21.0, 41.3, 46.6, 61.1, 109.6, 115.6, 132.5, 146., 172.1; IR (neat) 3380, 1720, 1590, 1180 cm^{-1}; MS *m/z* (%) 287 (M^+, 22), 285 (23), 270 (9), 200 (97), 198 (100). Anal. Calcd for $C_{12}H_{16}NO_2Br$: C, 50.37; H, 5.64; N, 4.89. Found: C, 50.52; H, 5.47; N, 4.71.

Ethyl 3-(*p*-methoxyanilino)butyrate (3i): oil; ^1H NMR δ 1.26 (d, 3H, *J* = 6.4), 1.26 (t, 3H, *J* = 7.1), 2.40 (dd, 1H, *J* = 14.9, 6.7), 2.60 (dd, 1H, *J* = 14.9, 5.3), 3.47 (br s, 1H, NH), 3.75 (s, 3H), 3.73–3.93 (m, 1H), 4.28 (q, 2H, *J* = 7.1), 6.61 and 6.79 (2 d, 4H, J_{AB} = 9.0); ^{13}C NMR δ 14.2, 20.6, 41.0, 47.3, 55.7, 60.4, 114.9, 115.5, 140.8, 152.5, 171.9; IR (neat) 3360, 1720, 1510, 1235 cm^{-1}; MS *m/z* (%) 237 (M^+, 20), 222 (6), 150 (100), 134 (11). Anal. Calcd for $C_{13}H_{19}NO_3$: C, 65.80; H, 8.07; N, 5.90. Found: C, 65.72; H, 8.29; N, 6.08.

Ethyl 3-(1-naphthylamino)butyrate (3j): oil; ^1H NMR δ 1.27 (t, 3H, *J* = 7.2), 1.41 (d, 3H, *J* = 6.4), 2.57 (dd, 1H, *J* = 15.0, 6.6), 2.78 (dd, 1H, *J* = 15.0, 5.1), 4.17 (q, 2H, *J* = 7.2), 4.10–4.35 (m, 1H), 4.70 (br s, 1H, NH), 6.67 (d, 1H, *J* = 7.8), 7.20–7.90 (m, 6H); ^{13}C NMR δ 14.2, 20.4, 40.7, 45.9, 60.6, 119.9, 122.7, 123.6, 124.7, 125.7, 126.4, 126.7, 128.6, 134.5, 141.9, 172.0; IR (neat) 3400, 1720, 1600, 1270, 1170 cm^{-1}; MS *m/z* (%) 257 (M^+, 32), 242 (7), 170 (100), 115 (20). Anal. Calcd for $C_{16}H_{19}NO_2$: C, 74.68; H, 7.44; N, 5.44. Found: C, 74.81; H, 7.57; N, 5.20.

Ethyl 3-anilinohexanoate (3k): oil; ^1H NMR δ 0.93 (t, 3H, *J* = 6.8), 1.24 (t, 3H, *J* = 7.1), 1.25–1.72 (m, 4H, 4-H), 2.46 (dd, 1H, *J* =14.9, 6.5), 2.57 (dd, 1H, *J* = 14.9, 5.1), 3.72 (br s, 1H, NH), 3.82 (m, 1H), 4.12 (q, 2H, *J* = 7.1), 6.60–6.73 (m, 3H), 7.10–7.30 (m, 2H); ^{13}C NMR δ 14.5, 14.7, 19.8, 37.8, 39.9, 50.6, 60.9, 113.9, 117.9, 129.8, 147.7, 172.5; IR (neat) 3380, 1720, 1600, 1300, 1160 cm^{-1}; MS *m/z* (%) 235 (M^+, 26), 192 (100), 148 (94), 118 (31), 104 (57). Anal. Calcd for $C_{14}H_{21}NO_2$: C, 71.46; H, 8.99; N, 5.95. Found: C, 71.74; H, 9.23; N, 6.13.

Ethyl 3-anilino-3-phenylpropionate (3l): oil; ^1H NMR δ 1.27 (t, 3H, *J* = 7.1), 2.51 (dd, 1H, *J* = 15.2, 6.0), 2.61 (dd, 1H, *J* = 15.2, 5.5), 3.80 (br s, 1H, NH), 3.80–3.94 (m, 1H), 4.16 (q, 2H, *J* = 7.1), 6.60–6.78 (m, 3H), 7.10–7.47 (m, 7H); ^{13}C NMR δ 19.4, 39.4, 50.2, 60.4, 113.4, 117.4, 126.3, 128.7, 129.1, 129.3, 142.2, 147.3, 172.0; IR (neat) 3360, 1705, 1450, 1370, 1175 cm^{-1}; MS *m/z* (%) 269 (M^+, 30), 182 (100), 104 (26),

77 (27). Anal. Calcd for $C_{17}H_{19}NO_2$: C, 75.81; H, 7.11; N, 5.20. Found: C, 75.59; H, 6.84; N, 5.35.

Ethyl 3-pyrrolidinobutyrate (3m): oil; ^{1}H NMR δ 1.25 (t, 3H, J = 7.1), 1.37 (d, 3H, J = 6.4), 1.95–2.05 (m, 4H), 2.57 (dd, 1H, J = 16.4,9.2), 3.00 (dd, 1H, J = 16.4,3.9), 3.17–3.26 (m, 4H), 3.42–3.58 (m, 1H), 4.15 (q, 2H, J = 7.1); ^{13}C NMR δ 14.6, 22.3, 23.9, 38.4, 51.4, 57.2, 61.7, 170.9; IR (neat) 3400, 1715, 1395, 1250, 1020 cm^{-1}; MS m/z (%) 185 (M$^+$, 3), 170 (7), 98 (100). Anal. Calcd for $C_{10}H_{19}NO_2$: C, 64.83; H, 10.34; N, 7.56. Found: C, 64.97; H, 10.48; N, 7.41.

Ethyl 3-piperidinohexanoate (3n): oil; ^{1}H NMR δ 0.92 (t, 3H, J = 6.3), 1.25 (t, 3H, J = 7.1), 1.35–1.75 (m, 10H), 2.20–2.62 (m, 6H), 3.20–3.37 (m, 1H), 4.19 (q, 2H, J = 7.1); ^{13}C NMR δ 14.1, 14.2, 24.9, 26.5, 33.1, 35.5, 38.6, 49.4, 60.6, 61.7, 173.4; IR (neat) 3400, 1710, 1215, 1160, 1020 cm^{-1}; MS m/z (%) 227 (M$^+$, 5), 184 (100), 156 (15), 140 (97). Anal. Calcd for $C_{13}H_{25}NO_2$: C, 68.68; H, 11.08; N, 6.16. Found: C, 68.83; H, 11.32; N, 6.33.

***cis*-2-Anilino-1-carbethoxycyclopentane (*cis*-3o)**: oil; ^{1}H NMR δ 1.08, (t, 3H, J = 7.1) 1.55–2.20 (m, 6H), 3.09 (br q, 1H, J = 7.4), 3,97 and 4.00 (2 q, 2H, J = 7.1), 3.98–4.14 (m, 2H), 6.58–5.74 (m, 3H), 7.10–7.22 (m, 2H); ^{13}C NMR δ 14.0, 22.5, 27.8, 32.9, 47.1, 56.9, 60.3, 113.2, 117.2, 129.1, 147.3, 174.4; IR (neat) 3390, 1715, 1600, 1500, 1185 cm^{-1}; MS m/z (%) 233 (M$^+$, 51), 204 (16), 188 (13), 158 (10), 132 (100). Anal. Calcd for $C_{14}H_{19}NO_2$: C, 72.07; H, 8.21; N, 6.00. Found: C, 72.24; H, 8.38; N, 5.81.

***trans*-2-Anilino-1-carbethoxycyclopentane (*trans*-3o)**: oil; ^{1}H NMR δ 1.23 (t, 3H, J = 7.1), 1.42–2.30 (m, 6H), 2.66 (td, 1H, J =7.5, 5.8), 3,73 (br s, 1H, NH), 3.90–4.20 (m, 1H), 4.13 (q, 2H, J = 7.1), 6.58–5.78 (m, 3H), 7.10–7.24 (m, 2H); ^{13}C NMR δ 14.1, 23.5, 28.5, 33.7, 51.3, 58.6, 60.6, 113.4, 117.5, 129.2, 147.4, 175.1; IR (neat) 3390, 1715, 1600, 1500, 1190 cm^{-1}; MS m/z (%) 233 (M$^+$, 46), 204 (12), 188 (12), 158 (11), 132 (100). Anal. Calcd for $C_{14}H_{19}NO_2$: C, 72.07; H, 8.21; N, 6.00. Found: C, 72.13; H, 8.04; N, 5.92.

***cis*-2-(Benzylamino)-1-carbethoxycyclopentane (*cis*-3p)**: oil; ^{1}H NMR δ 1.26 (t, 3H, J = 7.1), 1.45–2.10 (m, 7H), 2.94 (dt, 1H, J = 7.7), 3.31 (q, 1H, J = 6.7), 3.80 (s, 2H), 4.16 (q, 2H, J = 7.1), 7.18–7.34 (m, 5H); ^{13}C NMR δ 14.8, 22.8, 28.0, 32.2, 48.1, 52.7, 60.6, 61.8, 127.3, 128.5, 128.8, 141.1, 175.2; IR (neat) 3330, 1720, 1450, 1180 cm^{-1}; MS m/z (%) 247 (M$^+$, 2), 202 (16), 156 (26), 146 (59), 106 (95), 91 (100). Anal. Calcd for $C_{15}H_{21}NO_2$: C, 72.84; H, 8.56; N, 5.66. Found: C, 72.61; H, 8.41; N, 5.82.

***trans*-2-(Benzylamino)-1-carbethoxycyclopentane (*trans*-3p)**: oil; ^{1}H NMR δ 1.25 (t, 3H, J = 7.1), 1.35–2.10 (m, 7H), 2.60 (q, 1H, J = 7.9), 3.32 (q, 1H, J = 7;3), 3.74 and 3.82 (2 d, 2H, J_{AB} = 13.2), 4.14 (q, 2H, J = 7.1), 7.20–7.35 (m, 5H); ^{13}C NMR δ 14.7, 24.0, 29.2, 33.6, 51.5, 53.0, 60.9, 63.2, 127.4, 128.6, 128.9, 140.8, 176.3; IR (neat) 3300, 1720, 1450, 1180 cm^{-1}; MS m/z (%) 247 (M$^+$, 2), 156 (22), 146 (46), 106 (95), 91 (100). Anal. Calcd for $C_{15}H_{21}NO_2$: C, 72.84; H, 8.56; N, 5.66. Found: C, 72.58; H, 8.37; N, 5.88.

***cis*-2-Anilino-1-carbethoxycyclohexane (*cis*-3q)**: oil; ^{1}H NMR δ 1.20 (t, 3H, J = 7.1), 1.30–2.08 (m, 9H), 2.84 [dt, 1H, J = 7.7, 4.1 (t)], 4.09 and 4.10 (2 q, 2H, J = 7.1), 4.25 (br s, 1H, NH), 6.57–6.72 (m, 3H), 7.10–7.20 (m, 2H); ^{13}C NMR δ 14.1, 22.8, 23.2, 25.8, 29.0, 44.7, 51.40, 60.2, 113.5, 117.2, 129.2, 147.1, 173.3; IR (neat) 3390, 1720, 1600, 1495, 1180 cm^{-1}; MS m/z (%) 247 (M$^+$, 67), 204 (25), 132 (100), 119 (22). Anal. Calcd for $C_{15}H_{21}NO_2$: C, 72.84; H, 8.56; N, 5.66. Found: C, 72.61; H, 8.39; N, 5.81.

***trans*-2-Anilino-1-carbethoxycyclohexane (*trans*-3q)**: oil; ^{1}H NMR δ 1.16 (t, 3H, J = 7.1), 0.85–2.35 (m, 9H), 3.56 (td, 1H, J = 10.5 (t), 4.0), 4.04 (q, 2H, J = 7.1), 4.77 (br s, 1H, NH), 6.57–6.71 (m, 3H), 7.08–7.18 (m, 2H); ^{13}C NMR δ 14.1, 24.7, 24.7, 28.9, 33.0, 51.0, 54.1, 60.4, 113.6, 117.4, 129.1, 147.1, 174.8; IR (neat) 3390, 1715, 1600, 1500, 1185 cm^{-1}; MS m/z (%) 247 (M$^+$, 67), 204 (25), 132 (100), 119 (22). Anal. Calcd for $C_{15}H_{21}NO_2$: C, 72.84; H, 8.56; N, 5.66. Found: C, 72.73; H, 8.68; N, 5.89.

***cis*-2-(Benzylamino)-1-carbethoxycyclohexanone (*cis*-3r)**: oil; ^{1}H NMR δ 1.24 (t, 3H, J = 7.1), 1.25–2.00 (m, 9H), 2.67 (dt, 1H, J = 8.6, 4.1), 3.00 (dt, 1H, J = 6.6, 3.4), 3.72 and 3.84 (2 d, 2H, J_{AB}= 13.3), 4.12 and 4.13 (2 q, 2H, J = 7.1), 7.17–7.35 (m, 5H); ^{13}C NMR δ 14.8, 22.3, 24.4, 25.4, 29.0, 46.4, 51.5, 55.0, 60.5, 127.2, 128.6, 128.7, 141.4, 175.0; IR (neat) 3330, 1720, 1450, 1040 cm^{-1}; MS m/z (%) 261 (M$^+$, 2), 218 (13), 146 (69), 106 (96), 91 (100). Anal. Calcd for $C_{16}H_{23}NO_2$: C, 73.53; H, 8.87; N, 5.36. Found: C, 73.73; H, 9.02; N, 5.48.

Ethyl 3-anilino-2-methylbutyrate (3s) (as mixture of diastereomers in the ratio of 2:1): oil; ^{1}H NMR δ 1.14–1.32 (m, 9H), 2.62–2.81 (m, 1H), 3.65–3.94 (m, 2H), 4.08–4.24 (m, 2H), 6.52–6.75 (m, 3H), 7.12–7.27 (m, 2H); ^{13}C NMR δ 14.3, 14.8, 17.9, 44.8, 51.8, 60.9, 114.1, 118.0, 129.8, 147.7, 175.0 (prevailing isomer); 12.8, 14.8, 18.1, 44.3, 51.0, 60.9, 113.8, 117.7, 129.8, 147.5, 175.7 (minor isomer); IR (neat) 3390, 1715, 1600, 1495, 1185, 745, 690 cm^{-1}; MS m/z (%) 221 (M$^+$, 21), 120 (100), 77 (16) (prevailing isomer). Anal. Calcd for $C_{13}H_{19}NO_2$: C, 70.56; H, 8.65; N, 6.33. Found: C, 70.82; H, 8.54; N, 6.18.

2-(1-Anilinoethyl)butyrolactone (3t) (as mixture of diastereomers in the ratio of 2:1): oil; ^{1}H NMR δ 1.29 (d, 2 H, J = 6.6), 1.31 (d, 1 H, J = 6.6), 2.03–2.49 (m, 2H), 2.91 (td, 0.66 H, J = 9.7 (t), 3.8), 3.05 (td, 0.33 H, J = 9.6, 3.7), 3.80–4.44 (m, 4H), 6.60–6.80 (m, 3H), 7.12–7.28 (m, 2H); ^{13}C NMR δ 17.3, 26.1, 43.6, 49.3, 67.1, 114.7, 118.7, 129.9, 147.2, 178.3 (prevailing isomer); 17.9, 24.3, 43.5, 48.7, 67.2, 114.2, 118.7, 130.0, 147.2, 178.3 (minor isomer); IR (neat) 3365, 1750, 1595, 1150, 745, 690 cm^{-1}; MS m/z (%) 205 (M$^+$, 22), 190 (2), 120 (100), 77 (14). Anal. Calcd for $C_{12}H_{15}NO_2$: C, 70.22; H, 7.37; N, 6.82. Found: C, 70.03; H, 7.14; N, 7.04.

Reduction of β-Amino Esters 3 to γ-Amino Alcohols 2. General Procedure. The β-amino ester **3** (2 mmol) was added to a slurry of lithium aluminum hydride (0.23 g, 6 mmol) in anhydrous Et_2O (5 mL) under argon. The mixture was magnetically stirred for 15 h at rt and then was treated with anhydrous MeOH (2 mL) in Et_2O (3 mL). When the evolution of gas was complete, water was added and the mixture was extracted with ether. The organic layer was dried over Na_2SO_4 and evaporated under reduced pressure. The γ-amino alcohol **2** was purified by column chromatography on silica gel eluting with cyclohexane/ethyl acetate (1/1) and characterized by comparison of spectroscopic properties to those of an authentic sample. Reaction yields are listed in Table 5.

Synthesis of Tetrahydro-1,3-oxazines 4. General Procedure. To a solution of the γ-amino alcohol **2** [as a pure diastereoisomer (**2o–r**) or mixture (**2s**), 1 mmol] in THF (2mL) at rt was added 37% aqueous formaldehyde (1.1 mmol). The mixture was magnetically stirred for 20 h at rt. Solvent was removed and the residue was dried under reduced pressure. Column chromatographic separation of crude material (cyclohexane/ethyl acetate, 8/2) furnished the pure tetrahydro-1,3-oxazines **4** as separated diastereoisomers. Reaction yields are given in Table 3.

***trans*-5-Phenyl-3-oxa-5-azabicyclo[4.3.0]nonane (*trans*-4o)**: oil; ^{1}H NMR δ 1.10–2.25 (m, 7H), 2.82 (ddd, 1H, J = 11.3, 10.1, 6.2), 3.45 (t, 1H, J = 10.6), 4.33 (dd, 1H, J = 10.6, 4.0), 4.34 and 4.95 (2 d, 2H, J_{AB} = 9.5), 7.00–7.37 (m, 5H); ^{13}C NMR δ 19.9, 24.4, 29.8, 41.2, 66.9, 73.9, 86.0, 124.0, 124.7, 129.1, 147.6; IR (neat) 1590, 1490, 1100, 970, 695 cm^{-1}; MS m/z (%) 203 (M$^+$, 92), 174 (94), 105 (100), 77 (73). Anal. Calcd for $C_{13}H_{17}NO$: C, 76.81; H, 8.43; N, 6.89. Found: C, 77.07; H, 8.65; N, 6.81.

***trans*-5-Benzyl-3-oxa-5-azabicyclo[4.3.0]nonane (*trans*-4p)**: oil; ^{1}H NMR δ 1.05–2.02 (m, 7H), 2.15 [td, 1H, J = 10.4 (t), 6.2], 3.28 (t, 1H, J = 10.5), 3.37 and 3.87 (2 d, 2H, J_{AB} = 13.6), 3.62 and 4.42 (2 d, 2H, J_{AB} = 8.5), 4.22 (dd, 1H, J = 10.5, 4.1), 7.17–7.40 (m, 5H); ^{13}C NMR δ 19.7, 24.5, 28.3, 41.2, 54.0, 69.1, 73.3, 84.8, 127.0, 128.2, 128.9, 138.4; IR (neat) 1450, 1170, 1065, 735, 695 cm^{-1}; MS m/z (%) 217 (M$^+$, 15), 216 (18), 188 (20), 160 (16), 91 (100). Anal. Calcd for $C_{14}H_{19}NO$: C, 77.38; H, 8.81; N, 6.45. Found: C, 77.57; H, 8.93; N, 6.23.

***trans*-5-Phenyl-3-oxa-5-azabicyclo[4.4.0]decane (*trans*-4q)**: oil; ^{1}H NMR δ 0.90–1.95 (m, 9H), 2.82 (ddd, 1H, J = 11.3, 10.0, 3.5), 3.35 (t, 1H, J = 11.0), 4.00 (dd, 1H, J = 11.0, 4.2), 4.52 and 4.79 (2 d, 2H, J_{AB} = 10.0), 6.60–7.20 (m, 5H); ^{13}C NMR δ 21.1, 25.5, 27.2, 30.9, 38.7, 64.3, 72.9, 86.3, 124.7, 126.7, 128.5, 147.0; IR (neat) 1590, 1490, 1170, 745, 695 cm^{-1}; MS m/z (%) 217 (M$^+$, 91), 174 (100), 144 (28), 105 (46),

77 (41). Anal. Calcd for $C_{14}H_{19}NO$: C, 77.38; H, 8.81; N, 6.45. Found: C, 77.39; H, 8.58; N, 6.63.

***cis*-5-Phenyl-3-oxa-5-azabicyclo[4.4.0]decane (*cis*-4q)**: oil; ^{1}H NMR δ 1.20–2.37 (m, 9H), 3.67 (dt, 1H, J = 11.3, 4.4), 3.76 (dd, 1H, J = 11.2, 4.8), 4.00 (t, 1H, J = 11.2), 4.81 and 4.93 (2 d, 2H, J_{AB} = 11.0), 6.88–7.35 (m, 5H); ^{13}C NMR δ 21.6, 25.2, 25.5, 27.5, 32.1, 59.5, 67.3, 75.9, 119.4, 120.7, 129.0, 150.4; IR (neat) 1585, 1480, 1170, 1020, 745, 690 cm^{-1}; MS m/z (%) 217 (M^+, 94), 174 (100), 144 (34), 105 (53), 77 (48). Anal. Calcd for $C_{14}H_{19}NO$: C, 77.38; H, 8.81; N, 6.45. Found: C, 77.49; H, 9.05; N, 6.27.

***trans*-5-Benzyl-3-oxa-5-azabicyclo[4.4.0]decane (*trans*-4r)**: oil; ^{1}H NMR δ 0.80–1.95 (m, 9H), 2.58 [td, 1H, J = 10.8 (t), 3.0], 3.23 (t, 1H, J = 11.1), 3.68 and 3.97 (2 d, 2H, J_{AB} = 13.7), 3.93 (dd, 1H, J = 11.1, 4.6), 4.13 and 4.39 (2 d, 2H, J_{AB} = 9.9), 7.18–7.40 (m, 5H); ^{13}C NMR δ 25.3, 25.9, 27.6, 30.3, 36.4, 49.6, 65.1, 73.1, 84.2, 126.8, 128.2, 128.8, 139.7; IR (neat) 1440, 1160, 1015, 735, 695 cm^{-1}; MS m/z (%) 231 (M^+, 10), 188 (23), 160 (20), 120 (25), 91 (100). Anal. Calcd for $C_{15}H_{21}NO$: C, 77.88; H, 9.15; N, 6.05. Found: C, 78.13; H, 9.27; N, 5.82.

***cis*-5-Benzyl-3-oxa-5-azabicyclo[4.4.0]decane (*cis*-4r)**: oil; ^{1}H NMR δ 1.10–2.18 (m, 9H), 2.72 [dt, 1H, J = 10.8, 4.4 (t)], 3.69 (dd, 1H, J = 11.1, 4.7), 3.87 (t, 1H, J = 11.1), 3.90–4.16 (m, 3H), 4.61 (d, 1H, J = 10.3), 7.20–7.43 (m, 5H); ^{13}C NMR δ 22.4, 24.9, 26.3, 27.3, 31.1, 56.1, 56.75, 68.1, 80.1, 126.8, 128.3, 128.4, 139.6; IR (neat) 1445, 1150, 1020, 735, 695 cm^{-1}; MS m/z (%) 231 (M^+, 18), 188 (43), 160 (19), 120 (13), 91 (100). Anal. Calcd for $C_{15}H_{21}NO$: C, 77.88; H, 9.15; N, 6.05. Found: C, 78.02; H, 9.38; N, 5.91.

***trans*-4,5-Dimethyl-3-phenyltetrahydro-1,3-oxazine (*trans*-4s)**: oil; ^{1}H NMR δ 0.92 (d, 3H, J = 6.8), 1.19 (d, 3H, J = 6.6), 1.75 [d quint d, 1H, J = 8.2, 6.8 (quint), 4.0], 3.22 (quint, 1H, J = 6.7), 3.42 (dd, 1H, J = 11.2, 8.2), 4.02 (dd, 1H, J = 11.2, 4.0), 4.67 and 4.78 (2 d, 2H, J_{AB} = 9.9), 6.95–7.34 (m, 5H); ^{13}C NMR δ 15.6, 17.4, 34.9, 59.7, 71.4, 81.0, 122.2, 122.4, 128.9, 148.7; IR (neat) 1590, 1485, 1025, 745, 690 cm^{-1}; MS m/z (%) 191 (M^+, 64), 176 (67), 119 (100), 104 (96), 77 (82). Anal. Calcd for $C_{12}H_{17}NO$: C, 75.35; H, 8.96; N, 7.32. Found: C, 75.12; H, 9.04; N, 7.46.

***cis*-4,5-Dimethyl-3-phenyltetrahydro-1,3-oxazine (*cis*-4s)**: oil; ^{1}H NMR δ 0.72 (d, 3H, J = 7.0), 1.34 (d, 3H, J = 7.2), 2.29 [dqt, 1H, J = 11.6, 7.0 (q), 4.8 (t)], 3.62 (t, 1H, J = 11.3), 3.77 (dd, 1H, J = 11.3, 4.8), 3.83 [qd, 1H, J = 7.2 (q), 4.8], 4.79 and 4.97 (2 d, 2H, J_{AB} =11.3), 6.87–7.35 (m, 5H); ^{13}C NMR δ 11.4, 13.9, 30.6, 57.5, 68.5, 74.3, 119.0, 120.4, 129.0, 150.3; IR (neat) 1590, 1490, 1030, 750, 690 cm^{-1}; MS m/z (%) 191 (M^+, 71), 176 (64), 119 (100), 104 (95), 77 (89). Anal. Calcd for $C_{12}H_{17}NO$: C, 75.35; H, 8.96; N, 7.32. Found: C, 75.49; H, 9.13; N, 7.12.

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