Pharmacology Biochemistry & Behavior, Vol. 13, pp. 513–517. Printed in the U.S.A.

Evidence That a Preferred Substrate For Type B Monoamine Oxidase Mediates Stimulus Properties of MAO Inhibitors: A Possible Role for β-Phenylethylamine in the Cocaine Cue[1,2]

FRANCIS C. COLPAERT,[3] CARLOS J. E. NIEMEGEERS AND PAUL A. J. JANSSEN

Department of Pharmacology, Janssen Pharmaceutica Research Laboratories, B-2340 Beerse, Belgium

Received 17 March 1980

COLPAERT, F. C., C. J. E. NIEMEGEERS AND P. A. J. JANSSEN. *Evidence that a preferred substrate for type B monoamine oxidase mediates stimulus properties of MAO inhibitors: A possible role for β-phenylethylamine in the cocaine cue.* PHARMAC. BIOCHEM. BEHAV. **13**(4) 513–517, 1980.—In the experiment, rats were trained to discriminate 5 mg/kg cocaine HCl from saline in a two-bar drug discrimination procedure. Stimulus generalization experiments were carried out with six inhibitor drugs of monoamine oxidase. The rank order of absolute potency of these drugs in inducing stimulus generalization with cocaine was: tranylcypromine (ED_{50} in mg/kg: 1.2)>pheniprazine (3.5)>deprenyl (5)>pargyline (28)>nialamide (~170); at up to 40 mg/kg, clorgyline failed to produce 50% generalization. All six drugs also potentiated tryptamine in producing body tremors and clonic seizures, the rank order of potency being: tranylcypromine (0.081)>clorygline (0.14)≥pheniprazine (0.15)>pargyline (1.97)>deprenyl (15.5)>nialamide (18.7). Tryptamine is a common substrate for both type A and type B monoamine oxidase, so that tryptamine potentiation may serve to determine the relative specificity of the doses at which the inhibitor drugs generalized with cocaine. The present data may suggest that endogenous substances which are preferred substrates for type B monoamine oxidase in rat brain can exert control of behavior by virtue of cocaine-like stimulus properties. β-Phenylethylamine, more so than dopamine, appears to be candidate substance for mediating the discriminative stimulus properties of cocaine and, perhaps, of other central nervous system stimulants.

Cocaine cue Drug discrimination CNS stimulants Monoamine oxidase β-phenylethylamine Dopamine

THE evidence which is currently available on the discriminative stimulus properties of central nervous system (CNS) stimulants suggests [11,26] that the cues produced by amphetamine and related compounds are characterized by substantial specificity. This specificity is inferred from data showing that drugs which induce stimulus generalization with a CNS stimulant training drug, may have some relevant pharmacological and biochemical action(s) in common. Proposed [4] neuropharmacological characteristics of drugs inducing stimulus generalization with 10 mg/kg cocaine in the rat are that these drugs (i) can indirectly increase the functional availability of dopamine and, perhaps, of norepinephrine through some presynaptic mechanism, and (ii) can act as primary reinforcers in laboratory animals. Among the drugs which have been found [4] to induce stimulus generalization with cocaine is the monoamine oxidase (MAO) inhibitor tranylcypromine; the present study elaborates on this finding.

It seems well established (see [21,32] for review) that MAO has multiple forms, and two forms, designated [15] as type A and B, have been distinguished *in vitro* and *in vivo* by their substrate and inhibitor selectivity. This selectivity differs according to tissue and species [20]. In rat brain, the A form of the enzyme preferentially deaminates the putative neurotransmitter substances 5-hydroxytryptamine [15] and norepinephrine [2,8], and is sensitive to the inhibitor clorgyline. Preferred substrates of the type B enzyme are benzylamine [10] and β-phenylethylamine [30], and the type B MAO is selectively inhibited by deprenyl [16]. Common substrates for the two forms are tyramine, tryptamine, and also dopamine [31], and other inhibitor drugs known so far demonstrate less selectively than clorgyline and deprenyl in

[1]The authors gratefully acknowledge the expert technical assistance of Mr. G. Deneve.
[2]Supported in part by a grant from I. W. O. N. L.
[3]To whom reprint request should be addressed.

inhibiting type A and type B MAO, respectively.

In the present study, we have determined the extent to which clorgyline, deprenyl and other inhibitor drugs of MAO induce stimulus generalization with cocaine in rats trained to discriminate 5 mg/kg cocaine from saline. The rationale for this experiment is that possible evidence for generalization specificity, in terms of inhibition of MAO, would serve to indicate which substrate is to be protected from oxidative degradation in order for MAO inhibitors to generalize with cocaine. The substrate(s) so identified might be an endogenous substance which exerts control of behavior by virtue of stimulus properties similar to those of cocaine.

METHOD

Drug Discrimination

For the purpose of this experiment, animals were trained to discriminate 5 mg/kg cocaine from saline. This training dose is lower than the one we used in a previous study [4], and was so chosen in order to make the assay somewhat more sensitive.

Animals. Six male Wistar rats weighing 220 ± 15 g at the beginning of the experiment were used. The animals were housed in individual living cages, stored in a continuously illuminated and air-conditioned room (21 ± 1°C; relative humidity 65 ± 5%). Tap water was available freely. Access to dry powdered laboratory food was limited to 2 hr a day, as specified below.

Discrimination training. Materials consist of standard operant cages fitted with two levers and a food cup and programmed by solid-state programming equipment. The animals were trained to bar press for food; the response requirement was such that after every 10th press on the appropriate lever, a 45 mg food pellet was delivered through a dispenser (Fixed Ratio: 10 schedule of reinforcement). Following subcutaneous injection of 5 mg/kg cocaine HCl 30 min before session, the rats were required to press one of the levers (drug lever: DL) in order to obtain reinforcement; upon saline injection they were required to press the opposite lever (saline lever: SL). Responses on the incorrect lever produced no programmed consequences. Every week, each rat was run in daily 15 min sessions on 5 consecutive days. The two standard treatments (referred to by D and S, respectively) were given according to two monthly alternating sequences, i.e. (1) DSSDS, SDDSS, SDSDD, DSDSD, and (2) SDDSS, DSDSD, DSSDD, SDSDS. The number of responses on either lever before obtaining the first reinforcement (and, thus, before having made 10 appropriate responses) was recorded after each session (symbol: FRF); also recorded were all responses emitted during the entire course of the 15 min sessions. The training criterion consisted of 15 consecutive sessions on which FRF did not exceed 12.

Stimulus generalization experiments. Following training, stimulus generalization experiments were run on Wednesdays and Fridays, with the following restrictions. During each week, rats making incorrect or inaccurate lever selections (FRF>16) on standard sessions were not tested, or their data were discarded and the test condition repeated.

The test procedure consisted of treating the animals with the test drug being studied, and allowing them to select one of the two levers. That is, the lever on which the rat totalized 10 responses first was regarded as the selected lever, and subsequent reinforcement was made contingent upon pressing (Fixed Ratio: 10) the selected lever. Stimulus generalization with cocaine is said to occur whenever an animal selected the DL upon being treated with a test compound; the degree of stimulus generalization is expressed by the percentage of animals which select the DL. Recording of responses proceeded as during training sessions. In the following data report, rate of responding will be expressed as a percentage of responding in the most recently preceding saline session. One hr following any (training/test) session, the animals were allowed to feed freely for 2 hr. On weekends, a similar 2 hr feeding period was scheduled between 10 and 12 a.m.

All animals were tested with aqueous solutions of clorgyline (2.5, 10 and 40 mg/kg), deprenyl (2.5, 5 and 10 mg/kg), nialamide (10, 40, and 160 mg/kg), pargyline HCl (10, 20, and 40 mg/kg), pheniprazine HCl (2.5, 5, and 10 mg/kg), and tranylcypramine sulphate (0.63, 1.25, and 2.5 mg/kg). This selection of doses was based on preliminary experiments in three rats which were initially trained to discriminate 10 mg/kg cocaine from saline, and which were then retrained on the 5 mg/kg dose. The sequence in which different drugs were tested in the present experiments, was randomized for each rat individually; a similar randomization was applied to the sequence in which the different doses of these drugs were tested. All injections of drugs and saline were subcutaneous, 30 min before session; the injection volume was 1 ml/100 g body weight.

Tryptamine Potentiation

Tryptamine potentiation was used as a means of determining the relative specificity of the doses at which the MAO inhibitors would induce stimulus generalization with cocaine. Tryptamine was chosen because it is a common substrate for both type A and type B MAO [31] and because a method for evaluating its *in vivo* action in rats is available [28].

Animals. Male Wistar rats weighing 240 ± 10 g were used. They were randomly assigned to either the saline control group (n=119), or to one of 30 different drug treatment groups (n=5 per dose group). Animals were used only once.

Procedure. The animals were pretreated subcutaneously (1 ml/100 g) with either saline or one of the following compounds: clorgyline (0.04, 0.08, 0.16, 0.31, 0.63, and 1.25 mg/kg), deprenyl (2.5, 5.0, 10, 20, and 40 mg/kg), nialamide (10, 20, and 40 mg/kg), pargyline (1.25, 2.5, 5.0, 10, 20, and 40 mg/kg), pheniprazine (0.08, 0.16, 0.31, and 0.63 mg/kg), and tranylcypromine (0.02, 0.04, 0.08, 0.16, 0.31, and 0.63 mg/kg). Sixty min later, all rats were injected intravenously (0.2 ml/100 g) with 10 mg/kg tryptamine, and the occurrence of body tremors and of bilateral clonic seizures of the forepaws was observed during the subsequent 5 min period. The observation was carried out by a technician who was unaware of the pretreatment conditions. The intensity of seizures and/or tremors was scored using a 0–3 score system described elsewhere [22]. A score in excess of 1 for either seizures or tremors, occurred with only 2 out of 119 (saline-pretreated) control animals; scores 2 and 3 were thus considered to represent a potentiating drug effect in the experimental rats. Using score≥2 as a criterion, ED_{50}-values (and 95% confidence limits) for tryptamine potentiation were derived according to the method of Litchfield and Wilcoxon [17].

RESULTS

Drug Discrimination

All six rats initially trained to discriminate 5 mg/kg co-

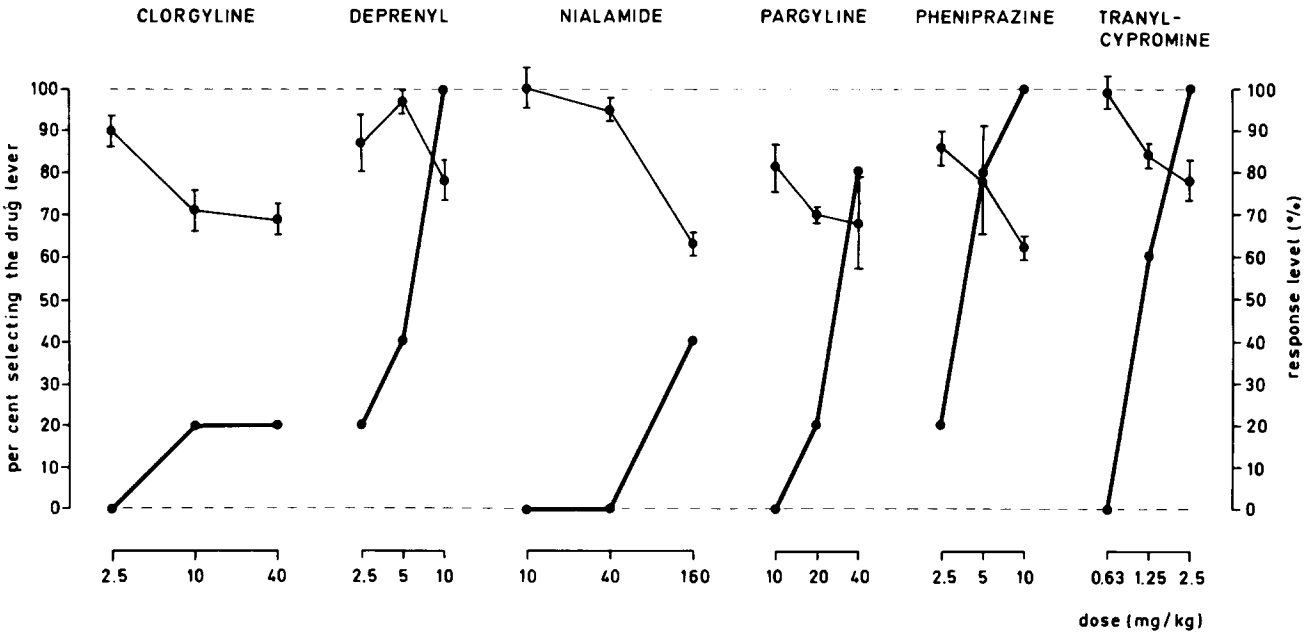

FIG. 1. The effects of six inhibitor drugs of monoamine oxidase in rats trained to discriminate 5 mg/kg cocaine from saline. Left ordinate: percent of rats (n=5) selecting the drug lever. Right ordinate: response level: this is the number of responses made on test sessions, expressed as a percentage of the number of responses made on the most recently preceding saline (control) session. The response level is given as the mean (± 1 SEM).

TABLE 1

ED_{50}-VALUES (AND 95% CONFIDENCE LIMITS) OF SIX MAO INHIBITORS FOR INDUCING STIMULUS GENERALIZATION WITH 5 mg/kg COCAINE (FIRST COLUMN) AND FOR POTENTIATING TRYPTAMINE IN THE RAT (SECOND COLUMN). THE RATIO PRESENTS THE RATIO OF THE FIRST TO THE SECOND VALUE

Drug	ED_{50} (mg/kg): cocaine generalization	ED_{50} (mg/kg): tryptamine potentiation	Ratio
Clorgyline	>40	0.14 (0.069– 0.28)	>286
Pheniprazine	3.5 (2.45– 5.08)	0.15 (0.11 – 0.20)	23
Tranylcypromine	1.2 (0.87– 1.6)	0.081 (0.034– 0.19)	15
Pargyline	28 (19.8 –40.2)	1.97 (0.46 – 8.36)	14
Nialamide	~170	18.7 (13.8 –25.3)	~9
Deprenyl	5.0 (3.0 – 8.35)	15.5 (5.60 –42.9)	0.32

caine from saline reached the training criterion, but one died soon thereafter. The present report therefore is based on the data obtained from 5 animals.

The data obtained with the MAO inhibitors are summarized in Fig. 1. Of the six drugs tested, four engendered a dose-dependent stimulus generalization with the 5 mg/kg training dose of cocaine. This stimulus generalization was associated with rate-depressant effects which were clearly monophasic with tranylcypromine, pheniprazine, and pargyline. The rate-depressant effect amounted to about 20% with tranylcypromine, and to about 35% with pheniprazine and pargyline. At the highest dose tested, nialamide induced 40% generalization; higher doses (e.g. 640 mg/kg) were not tested because of their severe rate-depressant effects. Only one rat selected the DL at clorgyline doses 10 and 40 mg/kg; higher doses of this drug were not tested because preliminary observations had indicated clorgyline doses≥80 mg/kg to exert toxic and often lethal effects.

Table 1 presents the ED_{50}-values [17] for stimulus generalization with cocaine which were derived from this data. The value shown for nialamide was estimated by extrapolating the 40% effect at the 160 mg/kg dose along a slope similar to that of the four dose-response curves appearing in Fig. 1. The rank order of absolute potency of the drugs tested for generalization with cocaine was thus found to be: tranylcypromine > pheniprazine > deprenyl > pargyline > nialamide; clorgyline is not included here because no ED_{50}-value could possibly be estimated for it (Fig. 1).

Tryptamine Potentiation

All six MAO inhibitors potentiated tryptamine in producing body tremors and bilateral clonic seizures of the forepaws, in a dose-related manner. The ED_{50}-values are shown in Table 1. The rank order of potency differed, however, from that found in the former experiment, and was as

follows: tranylcypromine > clorgyline ≥ pheniprazine > pargyline > deprenyl > nialamide.

The relative specificity of the doses at which stimulus generalization with cocaine was obtained, was now determined by computing the ratio of the ED_{50} for stimulus generalization to the ED_{50} for tryptamine potentiation. The values so obtained (Table 1) indicate that nialamide, pargyline, tranylcypromine, and pheniprazine induce stimulus generalization at doses 9 to 23 times higher than the dose required to potentiate tryptamine. In marked contrast, clorgyline fails to do so at doses more than 286 times its tryptamine potentiating dose, whereas deprenyl induces stimulus generalization at a dose which is 3 times *lower* than its ED_{50} for tryptamine potentiation.

DISCUSSION

The present study is consistent with a previous finding [4] in showing that tranylcypromine and some other inhibitor drugs of the enzyme monoamine oxidase, induce stimulus generalization with cocaine in rats trained to discriminate cocaine from saline. The ED_{50} of tranylcypromine obtained here (i.e. 1.2 mg/kg) in rats trained on 5 mg/kg, is two times lower than its ED_{50} (2.5 mg/kg) in rats trained on a two times higher training dose [4]. This result suggests that the choice of the lower cocaine training dose was adequate in making the animals relatively more sensitive to the cueing properties of the MAO inhibitors.

All six drugs studied here also potentiated tryptamine in producing body tremors and bilateral clonic seizures of the forepaws. These data can be taken to indicate [28] that each of these drugs is capable of protecting tryptamine from oxidative deamination by MAO. Since the tremors and clonic seizures produced by tryptamine presumably result from the amine's action in the CNS [14], this data is also further evidence (see [31]) that tryptamine is a common substrate for both type A and type B MAO in rat brain.

The relative potencies (Table 1) of the MAO inhibitors studied here in inducing stimulus generalization with cocaine and in potentiating tryptamine, suggest that endogenous substances which are preferred substrates for type B MAO in rat brain are capable of exerting control over discriminative responding by virtue of stimulus properties which are similar to those of cocaine. This is because; (i) clorgyline, a specific inhibitor drug of type A MAO [15], failed to induce stimulus generalization with cocaine at doses over 286 times the dose at which it protects tryptamine from MAO; protection from MAO neither of preferred substrates of type A MAO, nor of common substrates of both types of MAO, thus appears to constitute a sufficient requirement for an MAO inhibitor to induce stimulus generalization with cocaine; (ii) deprenyl, a specific inhibitor drug of type B MAO [16], generalized at a dose which is substantially lower than the dose required to potentiate tryptamine; this generalization may hence result from the protection from MAO of a preferred substrate for type B MAO, rather than that of a common substrate; (iii) drugs whose specificity—in terms of MAO inhibitory activity—is intermediate between that of clorgyline and deprenyl (i.e. pheniprazine, tranylcypromine, pargyline, and nialamide [21]), also show intermediate specificity in terms of the ratio of generalization to tryptamine protection (Table 1). That the protection from MAO of a preferred substrate for type B MAO *in rat brain* may be instrumental in the generalization of MAO inhibitors with cocaine, must be implied from evidence [4, 11, 26] that cocaine's stimulus properties, within the range of training doses considered here, originate in the CNS, rather than in the peripheral nervous system. It should be pointed out that the validity of the above suggestion is limited by the extent to which the drugs being studied here produce their *in vivo* effects through MAO inhibition only. This limitation is particularly prominent with deprenyl, which exerts indirect sympathomimetic activity in the rat peripheral autonomic nervous system [27], and which in man is metabolized to compounds (i.e. methylamphetamine and amphetamine; [24]) which induce stimulus generalization with cocaine in the rat [4].

Endogenous substances which are preferred substrates for type B MAO in rat brain are β-phenylethylamine (PEA) and, perhaps, benzylamine. Both PEA [30] and benzylamine [10,15] have been shown to be preferred substrates for type B MAO, but the enzyme that deaminates PEA in brain differs [30] from benzylamine oxidase of plasma [18]. PEA is found in the brain and other tissues of animals [7,19] and of the human [13]. Endogenous PEA may play a significant role in some brain functions [5,25], and interestingly, has been suggested [1] to mediate the central actions of amphetamine and other CNS stimulants. PEA may thus constitute the preferred substrate for type B MAO whose protection from MAO seems to be required for the generalization of some MAO inhibitors with cocaine. This suggests that this endogenous amine may be a cocaine-like substance in exerting discriminative stimulus control of behavior. Since cocaine and amphetamine induce cross-generalization [3,6], the latter conclusion would seem consistent with the finding [12] that PEA generalizes with amphetamine following iproniazid pretreatment, and with a recent suggestion [23] that PEA may be an endogenous amphetamine.

A particularly interesting feature of the present data is that they argue against the purportedly critical role of dopaminergic neurotransmission in the discriminative stimulus properties of cocaine [4] and, possibly, other CNS stimulants [11,26]. In rat brain, dopamine is a common substrate for both type A and type B MAO [9,31], and clorgyline may be even more specific than deprenyl in protecting brain dopamine from oxidative deamination *in vivo* [29]. The failure of clorgyline to induce generalization even at near-lethal doses (Fig. 1) would thus seem to suggest that increasing the functional availability of dopamine by blocking a major pathway for its degradation, is not a sufficient requirement for MAO inhibitors to induce generalization with cocaine.

In conclusion, the present data provide circumstantial evidence that endogenous substances which are preferred substrates for type B monoamine oxidase are capable of exerting control over discriminative responding by virtue of stimulus properties similar to those of cocaine. β-Phenylethylamine is a candidate substance for inducing an endogenous cocaine-like cue. The data argue against a critical role for dopamine in the discriminative stimulus properties of cocaine and, perhaps, of other central nervous system stimulants. More direct evidence on the possible role of β-phenylethylamine in cocaine's discriminative stimulus properties is required before definite conclusions can be reached.

REFERENCES

1. Borison, R. L., A. D. Mosnaim and H. C. Sabelli. Brain 2-phenylethylamine as a major mediator for the central actions of amphetamine and methylphenidate. *Life Sci.* **17:** 1331–1344, 1975.
2. Christmas, A. J., C. J. Coulson, D. R. Maxwell and D. Riddell. A comparison of the pharmacological and biochemical properties of substrate-selective monoamine oxydase inhibitors. *Br. J. Pharmac.* **45:** 490–503, 1972.
3. Colpaert, F. C., C. J. E. Niemegeers and P. A. J. Janssen. Discriminative stimulus properties of cocaine and d-amphetamine, and antagonism by haloperidol: a comparative study. *Neuropharmacology* **17:** 937–942, 1978.
4. Colpaert, F. C., C. J. E. Niemegeers and P. A. J. Janssen. Discriminative stimulus properties of cocaine: neuropharmacological characteristics as derived from stimulus generalization experiments. *Pharmac. Biochem. Behav.* **10:** 535–546, 1979.
5. Diamond, B. I. and R. I. Borison. A new putative neuroregulator of the extrapyramidal system. *Pharmacology* **17:** 210–214, 1978.
6. D'Mello, G. D. and I. P. Stolerman. Comparison of the discriminative stimulus properties of cocaine and amphetamine in rats. *Br. J. Pharmac.* **61:** 415–422, 1977.
7. Fisher, E., H. Spatz, B. Heller and H. Reggiani. Phenylethylamine content of human urine and rat brain, its alternations in pathological conditions and after drug administration. *Experientia* **28:** 307–308, 1972.
8. Gorodis, C. and N. H. Neff. Monoamine oxidase in sympathetic nerves: a transmitter specific enzyme type. *Br. J. Pharmac.* **43:** 814–818, 1971.
9. Green, A. R., B. D. Mitchell, A. F. C. Tordoff and M. B. H. Youdim. Evidence for dopamine deamination by both type A and type B monoamine oxidase in rat brain *in vivo* and for the degree of inhibition of enzyme necessary for increased functional activity of dopamine and 5-hydroxytryptamine. *Br. J. Pharmac.* **60:** 343–349, 1977.
10. Hall, D. W. R., B. W. Logan and G. H. Parson. Further studies on the inhibition of monoamine oxidase by M&B 9302 (clogyline). 1. Substrate specificity in various mammalian species. *Biochem. Pharmac.* **18:** 1447–1454, 1969.
11. Ho, B. T. and P. B. Silverman. Stimulants as discriminative stimuli. In: *Stimulus Properties of Drugs: Ten Years of Progress*, edited by F. C. Colpaert and J. A. Rosecrans. Amsterdam–New York: North Holland Publ. Co., 1978, pp. 53–68.
12. Huang, J.-T. and B. T. Ho. The effects of pretreatment with iproniazid on the behavioral activities of β-phenylethylamine in rat. *Psychopharmacologia* **35:** 77–81, 1974.
13. Inwang, E. E., A. D. Mosnaim and H. C. Sabelli. Isolation and characterization of phenylethylamine and phenylethanolamine from human brain. *J. Neurochem.* **20:** 1469–1473, 1973.
14. Jacobs, B. L. An animal behavior model for studying central serotonergic synapses. *Life Sci.* **19:** 777–785, 1976.
15. Johnston, J. P. Some observations upon a new inhibitor of monoamine oxidase in brain tissue. *biochem. Pharmac.* **17:** 1285–1297, 1968.
16. Knoll, J., Z. Ecseri, K. Kelemen, J. Nievel and B. Knoll. Phenylisopropylmethylpropinylamine (E-250), a new spectrum psychic energizer. *Archs int. Pharmacodyn. Thér.* **155:** 154–164, 1965.
17. Litchfield, J. T. and F. Wilcoxon. A simplified method for evaluating dose-effect experiments. *J. Pharmac. exp. Ther.* **96:** 99–113, 1949.
18. McEwen, C. M. Human plasma monoamine oxidase: 1. Purification and identification. *J. biol. Chem.* **240:** 2003–2010, 1965.
19. Mosnaim, A. D. and H. C. Sabelli. Quantitative determination of brain levels of a β-phenylethylamine-like substance in control and drug-treated mice. *Pharmacologist* **13:** 283, 1971.
20. Murphy, D. L. Substrate-selective monoamine oxidases-inhibitor, tissue, species and functional differences. *Biochem. Pharmac.* **27:** 1889–1893, 1978.
21. Neff, N. H. and H. -Y. T. Yang. Another look at the monoamine oxidases and the monoamine oxidase inhibitor drugs. *Life Sci.* **14:** 2061–2074, 1974.
22. Niemegeers, C. J. E., F. M. Lenaerts, K. S. K. Artois and P. A. J. Janssen. Interaction of drugs with apomorphine, tryptamine and norepinephrine. A new 'in vivo' approach: the ATN-test in rats. *Archs int. Pharmacodyn. Thér.* **227:** 238–253, 1977.
23. Potkin, S. G., F. Karoum, L.-W. Chuang, H. E. Cannon-Spoor, I. Phillips and R. J. Wyatt. Phenylethylamine in paranoid chronic schizophrenia. *Science* **206:** 470–471, 1979.
24. Reynolds, G. P., J. D. Elsworth, K. Blau, M. Sandler, A. J. Lees and G. M. Stern. Deprenyl is metabolized to methamphetamine and amphetamine in man. *Br. J. Clin. Pharmac.* **6:** 542–544, 1978.
25. Sabelli, H. C., R. L. Borison, B. I. Diamond, H. S. Howdala and N. Narasimhachari. Phenylethylamine and brain function. *Biochem. Pharmac.* **27:** 1729–1730, 1978.
26. Silverman, P. B. and B. T. Ho. Characterization of discriminative response control by psychomotor stimulants. In: *Discriminative Stimulus Properties of Drugs*, edited by H. Lal. New York: Plenum Press, 1977, pp. 107–119.
27. Simpson, L. L. Evidence that deprenyl, a type B monoamine oxidase inhibitor, is an indirectly acting sympathomimetic amine. *Biochem. Pharmac.* **27:** 1591–1595, 1978.
28. Tedeschi, D. M., R. E. Tedeschi and E. J. Fellows. The effects of tryptamine on the central nervous system, including a pharmacological procedure for the evaluation of iproniazid-like drugs. *J. Pharmac. exp. Ther.* **126:** 223–232, 1959.
29. Waldmeier, P. C., A. Delini-Stula and L. Maître. Preferential deamination of dopamine by an A type monoamine oxidase in rat brain. *Naunyn-Schmiedeberg's Arch. Pharmac.* **292:** 9–14, 1976.
30. Yang, H.-Y. T. and N. H. Neff. β-Phenylethylamine: a specific substrate for type B monoamine oxidase of brain. *J. Pharmac. exp. Ther.* **187:** 365–371, 1973.
31. Yang, H.-Y. T. and N. H. Neff. The monoamine oxidase of brain: selective inhibition with drugs and the consequences for the metabolism of the biogenic amines. *J. Pharmac. exp. Ther.* **189:** 733–740, 1974.
32. Youdim, M. B. H. Multiple forms of mitochondrial monoamine oxidase. *Br. Med. Bull.* **29:** 120–122, 1973.