

The Effect of Filtered and Unfiltered Cigarette Smoke on the Avoidance Behavior of Rats under Extinction Procedure*

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It has been shown in a previous extinction of avoidance behavior experiment [1], that small, injected doses of nicotine and total alkaloids extracted from cigarette smoke inhibit extinction of the avoidance response. The stimulating effect of nicotine has also been demonstrated in many other types of behavior experiments with rats in recent years. However, a stimulating effect on waking behavior has not been previously described for laboratory animals which have consciously inhaled small, controlled doses of filtered or unfiltered cigarette smoke. On the contrary, even though nicotine is pharmacologically the most active ingredient of cigarette smoke, a recent study [2] has demonstrated an inhibitory effect exerted by unfiltered and several types of filtered cigarette smoke on a swimming endurance test in rats, with unfiltered smoke (full smoke) and charcoal-filtered smoke (only the vapor phase removed) having by far the strongest negative effect on the test. It was therefore decided to determine, in this present experiment, whether similar results would be obtained by testing the effect of filtered and unfiltered cigarette smoke on the avoidance behavior of rats, under extinction procedure.

Method

22 male albino rats, about 10 months old at the start of the experiment, were used. The smoking machine made use of here has been developed and described by Davis et al [3] at the Tobacco Research Council Laboratories in Harrogate, England. In this machine, the rats were exposed to a controlled air-smoke mixture once every minute, for 15 seconds. 10 of these «puffs» (10 minutes) comprised one cigarette. The 10 experimen-

tal conditions were full smoke (unfiltered) – 5 and 10 minutes (S5 and S10), particulate and gas phases (charcoal filter) – 10 and 20 minutes (PG10 and PG20), vapor and gas phases (Cambridge filter) – 10 and 20 minutes (VG10 and VG20), gas phase alone (charcoal and Cambridge filters) – 10 and 20 minutes (G10 and G20), and control (no cigarette) – 10 and 20 minutes (N10 and N20). 20 minutes after every smoking machine exposure, the exposed rat underwent 10 runs, under extinction procedure conditions, in a shuttlebox, this apparatus having been also previously described [4]. As a result of previous extensive training in the shuttlebox, which continued through the two-week period of gradual adjustment to cigarette smoke which preceded the actual experiment, the rats were sufficiently trained so as to permit an extinction experiment of long duration (7 weeks), involving no application whatsoever of the unconditioned stimulus (shock). The extinction experiment was comprised of two continuous parts, the second of which replicated the first. In each part every animal was exposed to each of the ten test conditions one time, in a latin square sequence. The shuttlebox results (avoidance times for all runs) were subjected to a variation analysis, followed by statistical evaluation of the partial averages, utilising the Duncan multiple-t test.

Results and Conclusions

In the first part of the experiment, none of the test conditions differed significantly from any of the others. This was in sharp contrast to the second part, thus emphasizing the necessity for an experiment of this type to be of long duration, as this one was. This was necessary in order for the rats to become accustomed to smoking, and also for the various substances in the smoke, espe-

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cially nicotine, to have time to exert a statistically significant effect, if one existed. In part two, none of the test conditions differed significantly from the control (N10 or N20) in the direction of accelerating extinction, but two conditions differed significantly ($p < .05$) from N10 in the direction of inhibiting extinction, and this significance was sustained for the experiment as a whole, when the averages of both parts were calculated together. These two test conditions were S10 and PG10. Both of these, plus S5, also differed to a highly significant degree ($p < .01$) from G10. This inhibitory action of S5, S10 and PG10 on the extinction procedure, in other words a «speeding up» of the avoidance times, can only be due to the stimulating effect of nicotine which is present (as part of the particulate phase) only in these 3 conditions plus that of PG20. Although shortening of the avoidance times was also observed in most of the rats upon exposure to PG20, some of the rats became ill during the course of the second cigarette and could hardly function in the shuttlebox 20 minutes later. This was the only test condition in which this occurred, and emphasized the importance of future behavioral studies incorporating these smoking machines to be based on the usage of 5 and 10 minute time periods (maximum one cigarette), for all test conditions, not only for full smoke.

G10 also differed significantly ($p < .05$) from VG10 and VG20. The reason for the «better performance» of the rats when exposed to the vapor and gas phases, as compared to the gas phase alone, appeared to be due to the rats' breathing more vigorously when the vapor phase (which includes all of the «irritants» of tobacco smoke), was absent, thus

encouraging increased inhalation of the comparatively toxic gas phase. This situation brought up the question of considering the importance of breathing velocity and volume in future smoking machine research of this type.

In conclusion, it has been shown in this study that the stimulating effect of nicotine could be demonstrated in rats through the inhalation of small, relatively non-toxic amounts of cigarette smoke, comparable to the intake of this substance by humans. This effect was only significantly demonstrated in the test conditions of full smoke and charcoal-filtered smoke, up to the amount of ten puffs (one cigarette). These conditions were the only ones which contained the particulate phase, of which nicotine is pharmacologically by far the most active ingredient.

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