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CHARGE NO. & TITLE: 1600 - Smoker Psychology

TYPE REPORT: (✓) ANNUAL ( ) SEMIANNUAL ( ) COMPLETION ( ) SPECIAL

DATE: June 13, 1977 PERIOD COVERED: July, 1976 - June, 1977

REPORT TITLE: BEHAVIORAL RESEARCH ANNUAL REPORT

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KEYWORDS: Personality Extraversion, Stimulus Deprivation, Hyperkinesis, Paper Patterns, Aggression, Annual Monitoring, Frustration, Acceptability, Strength, Nicotine Intake, Inhalation, Learned Helplessness, Low Nicotine Cigarettes, Low RTD Cigarettes

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PERSONALITY AND SMOKING -

EFFECTS OF SENSORY DEPRIVATION (F. Ryan and R. Lieser)

This is a continuing study which investigates the need for stimulation among different personality types, and the effects that smoking may have upon that need. Of the many personality characteristics described in the psychological literature, many involve relatively subtle distinctions and observer insights, and few are significantly related to smoking. The distinction between extraversion and introversion, however, is not at all subtle. Extraverts are oriented towards the external, objective world and introverts toward internal subjective experience. Most people are an ambiverted mixture of the two characteristics, but the extreme types are strikingly different: introverts are ruminative, self-centered, imaginative, more interested in ideas and values than in people; extraverts are outgoing, impulsive, sociable, pragmatic, interested in people and things.

The most often reported personality difference between smokers and nonsmokers is that although both groups contain all types of introverts and extraverts, the mean extraversion score is higher for smokers than nonsmokers.

Why people differ in this characteristic is unknown, but it has been suggested that introverts and extraverts differ constitutionally in how much external stimulation their central nervous systems require to attain that optimal level of activation which enables them to function at their best. External stimulation, which sends cortical arousal messages to the brain from the reticular activating system subcenters, makes the introvert overaroused. The same stimulation applied to the less responsive central nervous system of the extravert may bring him from a sluggish, underaroused condition to his optimal level of arousal.

It follows that in a laboratory situation where stimulation is at a minimum, extraverts will seek more input stimulation (in order to remain comfortable) than introverts will. It also follows that where stimulation is constant, introverts will seek to reduce it more than extraverts will.

Any stimulant which increases central nervous system activity will therefore be differentially sought and avoided by extraverts and introverts. It follows that there would be differential preferences for nicotine among extraverts and introverts. Furthermore, among extraverts who smoke, there should be a greater need for other stimulation to replace nicotine's (normal) contribution when they are smoke deprived than when they have been smoking.

We have been testing some inferences from this speculative explanation of these basic personality differences for some time, using introverted and extraverted students from VCU as subjects, and a dark quiet room as a test chamber. When seated in the test chamber they were in a nearly stimulus deprived situation, wearing translucent goggles and padded head phones. Pressing one footpedal controlled a series of flashing lights on a display panel before them, which were discerned as a random sequence of bright white blurs through the masking goggles. Pressing a second footpedal controlled a garbled sound through the headphones, actually a voice recorded backwards. Neither of these forms of stimulation was at all meaningful or particularly interesting, although the voice is a rather novel sound. In one set of conditions the room was always dark and silent, and pressing the pedals produced lights and sounds. In a second set of conditions the lights and sounds were both normally on, and pressing the pedals would turn them off.

Conducting such research is not without its problems, principally because, as might be expected, (1) extreme introverts are unlikely to volunteer for research projects, and (2) extreme introverts are

unlikely to be cigarette smokers. This makes it difficult to obtain subjects without compromising the criteria defining introversion so much that the introverts verge on being ambiverts and lose some of their uniqueness. Similarly, if theory suggests that introverts are unlikely to be smokers, and you have an introverted smoker to test, then there is an anomaly present which demands some explanation: perhaps this smoker doesn't need to smoke and might even be better off without it, in terms of his arousal efficiency, or perhaps he's not a true introvert who has been falsely labeled by the admittedly imprecise classification procedure of a brief personality test used in screening. Or perhaps the theory is wrong, or at least incomplete.

To date, however, we have obtained some limited substantiation for the theory.

Among nonsmokers, introverts measured have sought less visual and less audio stimulation than extraverts have sought when placed in the stimulus deprived room (see table) for 20 minutes.

Mean Number of Minutes of Stimulation Sought
When Stimulus Deprived: Nonsmokers

	Visual On	Audio On	Visual and/or Audio On	Both On at Once
Introverts	2.34	6.78	8.75	.37
Extraverts	9.41	10.26	15.17	4.50

When converted to the percentage of their time spent being stimulated, these figures stress the fact that the introverts received some type of stimulation 43.8% of the time and the extraverts 75.9% of the time, with the introverts receiving both types at once for only 1.8% of the period while the extraverts sought both 22.5% of the period. Predicting the time both stimuli would have been sought at the same time from the cross products of the probability that each would have been on independently would lead to 4.0% for the introverts and 24.2% for the extraverts, if in fact the pedal

presses were occurring independent of each other. This suggests that the time both stimuli were on simultaneously may better be attributed to chance than to a desire for even more stimulation (than provided by a single source) among the extraverts.

Similarly, when constantly bombarded with stimuli the introverts turned both stimuli off longer - producing silence and darkness - than did the extraverts (see table).

Mean Number of Minutes of Stimulation Avoided
When Stimulus Bombarded: Nonsmokers

	Both Audio & Visual Off
Introverts	5.80
Extraverts	3.02

When converted to percentages, the introverts managed to spend 29.0% of their time stimulus free, while the extraverts sought to have only 15.1% of their time stimulus free. Comparing these figures with the amount of stimulus free time when pedals turn stimuli on (see table) it can be seen that whether work was required

Percent Stimulus Free Time

	No Pedals Depressed (pedals bring stimuli)	Both Pedals Depressed (pedals avoid stimuli)
Introverts	56.2	29.0
Extraverts	24.1	15.1

to produce stimulus free environment or not, the nonsmoking introverts received less stimulation than the nonsmoking extraverts. These differences appear statistically significant and are of considerable magnitude.

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It might be objected that the reason extraverts appear to seek stimulation related to their greater vigor and restlessness - and that they aren't seeking stimulation, they just like to press pedals more than introverts do. That explanation fails in light of the introverts' greater pedal pushing time to turn stimuli off.

However, it must be noted that among nonsmokers extraverts did press pedals much more often than introverts (see table). The

Total Mean Pedal Pushes (Visual + Audio)
Made by Nonsmokers

	To Turn Stimuli On	To Turn Stimuli Off
Introverts	7.3	4.3
Extraverts	171.3	58.5

differences are huge, whether pedal pushing turned stimuli on or off. What happens is that nonsmoking introverts make few pedal pushes, but hold the pedals down a long time when they do push. The average push of these introverts to get light was 1.99 minutes, to get sound it was .60 minutes; for the nonsmoking extraverts the average push to get light was .19 minutes, to get sound it was .08 minutes. Because lights and sound were essentially independent we can see that - as might be expected - the extraverts were switching back and forth, e.g. from visual to audio to no inputs at all, and attending to each state for a relatively short time.

The basic comparison to be made is between smokers in an overnight smoke deprived state and the same smokers after they had smoked two cigarettes in the half hour immediately before being tested. Without nicotine to raise their central nervous system's arousal level, the extraverted smokers would theoretically seek more stimulation when deprived than following smoking.

The data gathered to date are not convincing (see table) for the observed time differences are too small and inconsistent to support any but the null hypothesis.

Mean Minutes of Stimulation Sought by Extraverted Smokers in a Stimulus Deprived State

	Visual On	Audio On	At Least One On	Both On At Once
Deprived	4.76	8.47	8.80	4.42
Post Smoke	5.37	6.64	7.58	4.43

Furthermore, in the stimulus bombardment situation, the deprived extraverted smokers - when they would theoretically have profited from more stimulation - kept all stimuli off for 7.4 minutes while after smoking they kept all stimuli off for only 4.3 minutes.

In sum, the smoking part of the theory doesn't seem to work.

HYPERKINESIS AND SMOKING (F. Ryan and E. Gay)

Hyperkinesis is the technical name for the excessive activity which many children display. These youngsters (usually male) cannot stay still, are easily distracted, disrupt schoolrooms, lack ability to concentrate, are very careless and impulsive, often get left and right confused, have trouble reading, etc. Although a sedative would seem in order, they are better treated with stimulant drugs, today's favorite being Ritalin, which has the anomalous effect of quieting them down.

Depending on which expert is consulted, between 5 and 30% of primary school children may show the syndrome. They appear extraverted, antisocial, impulsive, and more controlled by external events than internal ones.

To the extent that smokers' personality and life styles differ from those of nonsmokers, Dunn (1973) has pointed out that smokers are independent, antisocial, active and energetic, extraverted, impulsive, etc., and that they have more accidents, have poorer academic records, are more often male, etc.

The congruence of many of these descriptors for the two groups - smoking adults and hyperactive children - immediately suggests that the hyperactives may grow up to become cigarette smokers, and that the principal reason cigarette smokers appear to differ from non-smokers is that the smoking group contains most of the country's formerly hyperactive children, still showing many of the same characteristics they showed in childhood. It is furthermore tempting to suggest that in the past hyperactives adventitiously discovered that the stimulant characteristics of nicotine enabled them to control some of their behavior problems just as Ritalin does for today's children. Whether or not the nicotine suggestion is correct, the possibility exists of accounting for some of the smoker-nonsmoker differences in terms of a hyperactive subgroup of smokers. Therefore we have been seeking a data source to provide us with a large sample of hyperactives who, at the time of their diagnosis, were too young to be smokers. We would then track these children until they reached smoking age, and compare the proportion of smokers among them with the proportion among a control group.

Although school system records would seem best suited for such research, local school leaders' interpretations of recent HEW restrictions on access to records, on the length of time records can be kept, on the type of records which can be kept, and on the use of children in research without the informed consent of their parents will keep us out of school systems until the rules are rewritten.

As a second alternative, we are collaborating with Dr. Ron David, an MCV pediatric neurologist, whose practice involves the diagnosis and treatment of children with behavior disorders which may be linked to neurological damage. Because some suspect that hyperkinesis is a symptom of a "minimal brain damage (MBD)" - which has no other apparent effect - he has records on a number of hyperkinetics seen in the last five years and may provide access to even more via his contacts.

As a third alternative, we are collaborating with Dr. Al Finch, the research psychologist of the Virginia Treatment Center, where problem children of many types are housed for up to six months while they are trained to handle behavior problems. Many of these children are hyperkinetic, and we have access to Finch's files.

These two investigators are interested in our hypothesis and in conducting retrospective/prospective investigations of the type outlined above. In return for file access, we are helping Dr. David formulate a data profile to better organize his files' information in a concise manner. In return for Dr. Finch's file access we are helping him evaluate the success of the Virginia Treatment Center's training programs on the subsequent social adjustment of their cases. These former cases will be sent questionnaires or be queried over the phone, and a set of the questions asked will be regarding smoking behavior.

In both of these collaborations we must be very cautious not to violate a variety of ethical research codes.

PATTERNED CIGARETTE PAPERS (E. Gay)

We have collaborated with the Development Division in evaluating the idea of a printed pattern design on cigarette papers. A variety of patterns have been selected and sent to consumer panels to be ranked for attractiveness. With still a number of patterns as yet unranked, we have one candidate which looks promising, and more are expected to emerge from the as yet unevaluated designs.

ANNUAL MONITORING OF CIGARETTES (F. Ryan)

The growing acceptability of low delivery cigarettes is a startling phenomenon according to many of our historical ideas about tobacco taste, tar, nicotine, and consumer preferences. Are consumer tastes really so different now than they were a few years ago? How would smokers today react to the cigarettes popular then? How would they then have reacted to the cigarettes popular now?

We missed our chance to begin a monitoring of consumer tastes then, when it might have revealed today's trends, but we have begun such a project this year, in hopes that it will reveal tomorrow's.

Our basic procedure is to have a large consumer panel rate the acceptability of a wide range of cigarettes annually for several years, look for changes in the acceptability ratings over time, and draw inferences about taste trends.

The cigarettes used in the test are all 85 mm cork tipped models with the current Marlboro blend. Different papers, filters, and dilution procedures have been engineered to produce 5 different deliveries: nominally 5, 9, 13, 17 and 21 mg of FTC tar, with corresponding nicotine deliveries (see table). Actual deliveries

Annual Monitoring Cigarettes

Nominal Deliveries

Analytical (1/31/77)	5 mg Tar	9 mg Tar	13 mg Tar	17 mg Tar	21 mg Tar
FTC Tar, mg/cigt.	5.8	9.4	14.1	16.5	22.0
Nicotine, mg/cigt.	.44	.62	.86	1.00	1.24
Puffs/cigt.	9.0	8.7	8.4	8.6	8.5
Total RTD	5.8	5.0	4.4	4.5	4.1
Dilution, %	47	33	13	11	-
Tipping Paper Length, mm	30	30	30	25	25

rather closely approximate target deliveries. No flavor supplements were added to low delivery models. For convenience, we also show a table listing the deliveries of some commercial products now available. No attempt was made to mimic any of these products; they happen to be the products closest in FTC tar to the actual delivery of the five test cigarettes, plus Marlboro. No present major 85 mm brand delivers as much as 22 mg FTC tar. Winston only reaches 18.6 mg tar, but it has 1.22 mg nicotine.

Some Commercial Products Available Jan. 1977

Brands

Analytical (12/31/76)	True	Merit	Winston Lights	Kent	Marlboro	Winston
FTC Tar, mg/cigt.	5.6	8.7	13.4	16.2	17.9	18.6
Nicotine, mg/cigt.	.45	.64	.96	1.03	1.06	1.22
Puffs/cigt.	6.4	7.7	8.6	8.5	8.6	9.0
Total RTD	3.1	5.0	4.6	5.2	4.9	4.8
Dilution, %	49	27	18	-	-	-
Tipping Paper Length, mm	30	31	30	25	25	25

Once the cigarettes were made and cartoned, one quarter of the cigarettes were sent to panelists for the 1977 evaluation and the remainder (1609-2,3,4) were sent to cold storage. These cold storage cigarettes will be used for subsequent evaluations.

A national POL panel of 4,000 smokers was sent a carton containing 2 packs of each model and asked to evaluate each model's acceptability and strength along 9-point scales ranging from "dislike extremely" to "like extremely" and "extremely weak" to "extremely strong." They were also asked to assess their own brand on the same two dimensions. (Ballot format and cigarette models had been pretested with the Virginia Panel during 1976, and some minor changes were made before the first national test.)

The test return rate has been high, and about 75% of the delivered ballots had been returned by mid-May, 1977. Coding was completed in early June, and a report on the 1977 data should be available in July.

This year's data are expected to show that among present high delivery smokers the middle 3 models in FTC tar will get the highest acceptability scores, with the 5 mg model getting a very low score. Among present low delivery smokers the mid three will again be preferred with the 5 mg model higher than among high delivery smokers and the 22 mg model being scorned.

The strength ratings for these cigarettes this year should range from 3.9 to about 6.2 in rather linear fashion among low delivery smokers, and from about 3.2 to about 6.0 among high delivery smokers.

The true interest of this study, it will be recalled, is not in the acceptability of these cigarettes this year, but in the acceptability changes from this year to years hence.

SMOKING AND AGGRESSION (B. Jones)

There are three possible explanations for the observed relationship between smoking and aggression:

1) Smoking causes aggression, or
2) Aggression causes smoking, or
3) Both smoking and aggression are caused by something else.

Because smoking appears to have calming effects on at least some people, much research has been conducted into the effects of nicotine on laboratory produced aggression, occasionally with humans (jaw clenching, tolerance of shocks, and mood changes) but more

frequently with animals (less rage when cat brain stems are stimulated, fewer predatory attacks by cats, fewer predatory attacks on mice by rats, decreased biting by squirrel monkeys, etc.). There is a further large body of evidence which shows that frustration often produces nonadjustive aggression when other types of response might better solve the problem producing the frustration.

Taken together, this research suggests that when frustration produced aggression does nothing to aid performance, cigarette smoking to inhibit aggression and its disruptive effects on other ongoing behavior may lead to enhanced performance.

We have tested this hypothesis in the laboratory in a frustration situation, by measuring mood changes and performance efficiency among smokers smoking, smokers deprived of smoke, and nonsmokers. The frustration was produced by providing inaccurate information about successful ongoing performance when substantial monetary rewards for successful performance were involved. We predicted that (1) smoking would reduce overt expressions of anger and/or (2) smoking would improve performance efficiency.

The task was a simulated auto driving test in which subjects were required to pass other "vehicles" without crashing into oncoming "vehicles." Successful passes accumulated "good time"; not passing, or crashing, accumulated "bad time" until a successful pass again led to good time accumulation. Counters and flashing lights displayed good time and bad time to subjects, and informed them whether passes were successes or crashes. A visual display, in which moving lights represented the subject's vehicle, a vehicle to be passed, and an oncoming vehicle to be avoided, provided immediate information about the true state of affairs. But under frustration producing conditions, on a random 40% of the obviously successful passes, the lights and counters reported successful passes as crashes, so that bad time was accumulating instead of good time. Thus, in this stage of the research

the subjects believed they were being cheated of their earnings, producing frustration and verbal evidence of aggression. (They were actually eventually paid for their true good time, not for the false good time, so that no actual cheating took place.)

Ninety college students, 30 nonsmokers and 60 smokers, the latter randomly assigned to smoking and smoke deprivation conditions served as subjects. They were paid for their time and could earn up to $9 in bonuses based on their performance.

After a 10-minute practice session on the apparatus, there were three 20-minute test trails given. In the first trial the apparatus worked perfectly. During the second trial the frustration was introduced via the inaccurate feedback. During the third trial session the nonsmokers and smokers smoking received correct feedback and the deprived smokers again received incorrect feedback. The smoking smokers were allowed to smoke ad lib in the lab during the hour before the testing began while filling out personality test forms, and they were asked to smoke a cigarette during the five-minute period before the first trial and during five-minute breaks between the first and second and second and third trials. Thus, although they did not smoke during trials, the smokers were smoking at the rate of over a pack a day while in the laboratory. The deprived smokers had been asked to abstain overnight, and urine samples were taken ostensibly to check on their abstention, but the samples were not analyzed. The deprived smokers did not smoke while filling out the personality test forms, nor did they smoke before either of the first two test sessions, but half of them were asked to smoke a cigarette between test sessions 2 and 3.

Results

The experimental frustration increased the subjects' aggressivity and decreased their social affection, surgency, and concentration as determined by the Nowlis Mood Scale (see table for aggression scores).

Nowlis Aggression Mean Scores

	Before Frustration	After Frustration	Difference
Deprived Smoker	1.20	2.77	1.57
Smoking Smokers	1.07	2.53	1.46
Nonsmokers	1.33	3.37	2.04

The tabled differences in aggressivity are statistically significant for each group, but the apparent interaction of a larger effect on nonsmokers is not statistically significant. The actual performance data are shown below.

Performance Mean Scores

	No Frustration (Trial 1)	Frustration (Trial 2)	Within Group Difference (2-1)
Good Time (mins.)			
Deprived Smokers	11.97	11.98	+ .01
Smoking Smokers	12.06	12.30	+ .24
Nonsmokers	12.16	11.94	- .22
Successful Passes			
Deprived Smokers	119.60	119.27	- .33
Smoking Smokers	119.90	122.27	+2.38
Nonsmokers	121.20	118.47	-2.73

The difference between groups under the no frustration conditions is not statistically significant and can be attributed to chance ($F=1.10$, $p>.05$) when analyzed by a multiple analysis of variance. That means the three groups performed equally well under a no stress condition.

The change from no stress to stress, however, had different effects for the different groups. (The interaction of groups with

the frustration effect yielded a significant F at .05). This suggests that the nonsmokers worsened their performance, that the smoke-deprived smokers were essentially unchanged in performance, but that the smokers actually improved their performance. Although the apparent magnitude of the effects is small, the phenomenon appears real and not attributable to chance.

When half the deprived smokers were given a cigarette and then retested (Trial 3) under false feedback, it became possible to take yet another look at the advantage apparently conferred by the smoking. These means are presented below.

Performance Mean Scores

	Frustration (Trial 2)	Frustration (Trial 3)	Within Group Difference (3-2)
Good Time			
Deprived-Deprived	11.95	11.93	- .02
Deprived-Postsmoke	12.01	12.43	+ .41
Successful Passes			
Deprived-Deprived	119.27	119.40	+ .13
Deprived-Postsmoke	119.27	124.13	+4.86
Crashes			
Deprived-Deprived	26.53	27.07	+ .54
Deprived-Postsmoke	25.20	20.93	+4.27

In this second look we can see that the continuously smoke-deprived subjects had about the same amount of good time and about the same number of successful passes and crashes in the two trials. But the deprived smokers, who had finally been allowed to smoke a cigarette before the third trial, showed an increase in good time, more successful passes, and fewer crashes.

We interpret these results as implying that smoking can help people better handle the potentially disruptive effects of a stressful situation than nonsmoking. That is clear in this study. Whether it is fair to suggest the broader statement - that smoking helps people better handle aggression in general - would depend on how reasonable it is to make a sweeping generalization from limited data. We think that this is obviously an overstatement. But the way is clear to support further research into this important area.

REGULATOR IDENTIFICATION PROGRAM (C. Levy and R. Lieser)

We have hypothesized that some people smoke for nicotine, and that these people try to obtain a relatively constant amount of nicotine from their cigarettes (they regulate). On the other hand, people who do not smoke for nicotine would not be expected to regulate. The purpose of the studies we have been conducting is to identify those people who are nicotine regulators among our smoking student population.

Our approach has been to have high delivery smokers smoke a high delivery product at home one week and a lower delivery product the next week. The smokers save their butts each day in foil pouches, and we have the butts analyzed for residual nicotine. By knowing the number of cigarettes smoked each day and the amount of nicotine extracted per cigarette, we can estimate how much nicotine went into the smokers' mouths when smoking the high delivery product and when smoking the low delivery product.

We feel that it is unrealistic to expect perfect regulation by smokers who smoke for nicotine. Therefore, for our purposes, we have defined regulators as those smokers who obtain more nicotine while smoking the low delivery product than we would predict based upon the amount of nicotine they obtained while smoking the high delivery product. For example, we classify someone as a regulator if:

$$\frac{\text{Nicotine to Subject (Low Delivery)}}{\text{Nicotine to Subject (High Delivery)}} > \frac{\text{CI Nicotine (Low Delivery)}}{\text{CI Nicotine (High Delivery)}}$$

Nonregulators are those for whom:

$$\frac{\text{Nicotine to Subject (Low Delivery)}}{\text{Nicotine to Subject (High Delivery)}} \leq \frac{\text{CI Nicotine (Low Delivery)}}{\text{CI Nicotine (High Delivery)}}$$

In our first study (Behavioral Research Annual Report, July, 1976) we had some indication that the regulators responded to smoke deprivation by taking more puffs or larger puffs as compared to when they were not deprived. Our nonregulators did not show this change in their smoking behavior. These data were encouraging because they were consistent with our notions about nicotine regulation and supported our choice of "at home" smoking as an indicant of regulation.

In our second study we had eight students (all high delivery smokers) smoke "white pack" cigarettes for us. They smoked high delivery cigarettes one week followed by low delivery cigarettes the next week. Analytical data on the cigarettes are given below.

	Regular		Menthol	
	High	Low	High	Low
FTC Tar (mg)	17.1	7.5	16.4	8.4
Nicotine (mg)	1.04	0.60	0.86	0.56
Puff Count	8.4	7.5	8.0	7.3
Dilution (%)	-	28	-	27
RTD (in. of H_2O)	4.8	5.7	4.5	5.1

Six of the eight smokers were classified as regulators and two as nonregulators based upon their "at home" smoking data. Listed below for each subject are the mean amounts of nicotine (mg) obtained per day when smoking the high and low delivery cigarettes.

	Regulators			Nonregulators		
	High	Low			High	Low
M.R.	12.2	15.2	(1.24>0.58)	D.C.	8.5	5.2 (0.61<0.65)
G.R.	12.7	8.5	(0.67>0.58)	T.H.	29.1	18.4 (0.63<0.65)
S.L.	13.9	11.3	(0.82>0.65)			
S.G.	11.7	11.7	(0.99>0.65)			
L.M.	7.3	6.0	(0.82>0.65)			
B.D.	12.6	11.0	(0.88>0.65)			

Note: numbers in parentheses are

$$\frac{\text{Nicotine to Subject (Low)}}{\text{Nicotine to Subject (High)}} > \frac{\text{CI Nicotine (Low)}}{\text{CI Nicotine (High)}}$$

Five of these students subsequently came to the lab on two separate occasions (2 hrs. each) and smoked the high and low delivery cigarettes under smoke deprived and nonsmoke deprived conditions. On one day the subject smoked the high delivery cigarettes; on the other day the low delivery cigarettes were smoked. All cigarettes were smoked on the smoking profile recorder, and the subject was offered a cigarette every thirty minutes. The first cigarette smoked during each session was called the deprived cigarette. The third cigarette of the session (not all Ss smoked four cigarettes) was called the nondeprived cigarette. (While this classification is arbitrary, it's reasonable to assume that the subjects were less deprived late in the session than they were early in the session.) Number of puffs, mean puff volumes and estimated obtained nicotine for each subject under deprived and nondeprived conditions for the high and low delivery cigarettes are given below.

HIGH DELIVERY CIGARETTE

	Deprived			Nondeprived		
Regulators	# Puffs	Puff Vol.	Nicotine	# Puffs	Puff Vol.	Nicotine
M.R.	10	33.6	1.19	11	24.1	0.94
S.L.	13	35.3	1.41	12	31.4	1.16
S.G.	22	20.6	1.39	21	11.7	0.75
B.D.	14	18.2	0.90	14	16.5	0.82
Nonregulator						
T.H.	9	53.9	1.49	11	54.4	1.84

LOW DELIVERY CIGARETTE

	Deprived			Nondeprived		
Regulators	# Puffs	Puff Vol.	Nicotine	# Puffs	Puff Vol.	Nicotine
M.R.	6	35.3	0.48	5	37.6	0.43
S.L.	15	43.1	1.42	12	42.0	1.10
S.G.	13	27.5	0.78	19	19.6	0.82
B.D.	10	26.2	0.60	16	21.5	0.78
Nonregulator						
T.H.	11	67.0	1.61	14	56.1	1.72

It can be seen that all of the regulators obtained more nicotine from the high delivery cigarette when they were deprived than when they were nondeprived. For the one nonregulator the opposite was true. Once again it appears that regulators and non-regulators may respond differently to smoke deprivation. However, this pattern did not hold for the low delivery cigarette. Only one of the regulators (S.L.) obtained as much nicotine from the "deprived low" cigarette as from the "deprived high" cigarette. The other regulators obtained considerably less nicotine from the "deprived low" cigarette. This suggests that three of the four regulators were still "deprived" when smoking their third low delivery cigarette of the session.

At this point it was clear to us that we needed a larger group of smokers in order to determine if this difference we were seeing between regulators and nonregulators was reliable. In our third study (which was just completed) we sent cigarettes (Winston or Salem; Vantage or Vantage Menthol) out to twenty-five smokers. After the two weeks of "at home" smoking fifteen of these people came to the lab (Franklin Street) on four separate occasions (1½ hrs. each). Each subject smoked the high and low delivery cigarettes under nondeprived and overnight deprived conditions. While in the lab the students worked on standardized tests (GRE's) and smoked ad libitum. The number of puffs per cigarette were counted (via TV monitor). A report on this study is in preparation.

SMOKING AND LEARNED HELPLESSNESS (C. Levy and R. Lieser)

Dogs who are given inescapable electric shock in one situation subsequently fail to learn to escape shock in a different situation (Overmier and Seligman, 1967). That is, they learn to be "helpless." Learned helplessness has also been produced in rats, cats, fish and more recently in humans (Maier and Seligman, 1976). College students

who are subjected to inescapable loud noise or unsolvable discrimination problems show deficits in performing subsequent tasks involving escape from loud noise or anagram solution (Hiroto and Seligman, 1975).

Those experimental situations which are effective in producing helplessness in humans are frustrating and stressful (Miller and Seligman, 1975). Smoking helps smokers cope with stressful situations such that smokers perform better in some high arousal situations than nonsmokers or deprived smokers (Dunn, 1976). Therefore we have hypothesized that smokers will perform better in a situation devised to induce helplessness than will nonsmokers or deprived smokers. In order to test this hypothesis we are conducting the following experiment.

A total of sixty college students will serve as subjects (all students have grade point averages of at least 2.5/4.0). Forty cigarette smokers (someone who smokes at least 15 cigarettes per day) and twenty nonsmokers (someone who has not smoked consistently for the past year) will be assigned at random to either the helpless or control treatment group. Ten of the smokers in each group will be asked to report to the lab overnight smoke deprived. The design is shown below (N=10).

		Treatment	
		Helpless	Control
Subjects:	Smokers		
	Nonsmokers		
	Deprived Smokers		

When each subject reports to the laboratory he is given the Ammons & Ammons Quick Test (a short IQ test). The subject's score on the Quick Test is used as a predictor of verbal ability. Only those subjects who score at least 115/150 on this test are included in the study. This cutoff is necessary because subjects with poor

verbal skills cannot solve the anagrams used in this study. In addition to the Quick Test each subject fills out a personality test (16 PF). These two tests allow us to deprive the deprived smokers an extra hour before starting the actual experiment. The smokers are allowed to smoke their own brand of cigarettes ad libitum throughout their stay in the laboratory.

When each subject has been in the lab one hour, he is taken into an adjacent room and the experiment proper begins. The subject is given a series of five discrimination problems to solve. Subjects in the helpless groups are given unsolvable problems, while those subjects in the control groups are given solvable problems. Immediately following the discrimination problems each subject is given a series of twenty anagrams to solve. The dependent measures are 1) latencies to the solution of the anagrams (100 sec. maximum for each anagram), 2) number of failures to solve and 3) trials to criterion (the criterion is the solution of three consecutive anagrams, each in less than 9 seconds. This indicates that the subject has "caught on" to the pattern in the anagrams). When the helplessness-inducing treatment is effective, subjects in the helpless groups have significantly longer latencies to solution, more failures to solve and more trials before reaching the criterion (described above) than subjects in the appropriate control groups.

We predict no significant differences among the three control groups. We do predict that smokers in the helpless group will have shorter latencies to solve, fewer failures to solve and fewer trials to criterion than helpless nonsmokers and helpless deprived smokers.

As a partial check on the stressfulness of the helpless treatment we are monitoring the smoking behavior of the smokers in both the helpless and control groups. We expect that smoking subjects given the helpless treatment may smoke more than the smokers in the

control group. Our measures of smoking behavior are 1) number of cigarettes smoked, 2) number of puffs per cigarette and 3) nicotine residue in the filters. To date, we have data on twenty subjects. All subjects are debriefed at the end of the sessions.

Note: Before beginning data collection using smokers as well as nonsmokers, we conducted a series of pilot studies using approximately sixty nonsmokers. The purpose of the pilot studies was to verify that we could induce helpless behavior in our lab using local college students. As a result of the pilot studies, we modified our procedures considerably. In the final pilot study we had usable data on 23 subjects (12 males and 11 females). The results are summarized below:

	Dependent Measures	Treatment: Helpless	Treatment: Control
$\bar{X}$	Latency to solution (sec.)	47.5	28.9*
$\bar{X}$	No. of failures to solve	6.3	4.1*
$\bar{X}$	Trials to criterion	14.2	10.0*

*p<.05, one tailed t test

Subjects in the helpless group took longer to solve the anagrams, failed to solve more anagrams and "caught on" to the pattern later in the task when compared to the control subjects. Therefore, we were successful in producing a helplessness effect in our lab.

SMOKING OF LOW NICOTINE CIGARETTES (C. Levy, R. Lieser and P. Martin)

We are interested in low nicotine cigarettes because we want to answer the question, "What changes do you see in people's smoking behavior when they're shifted to a low nicotine cigarette?" Finnegan, Larson and Haag (1945) reported that when smokers were switched to a low nicotine cigarette, "Six of the 24 subjects experienced no change

in physical or mental tranquility during their period on low nicotine cigarettes; 6 experienced an initial vague lack in the satisfaction that they normally derived from smoking; 3 definitely missed the nicotine but became adapted to the change in one to two weeks; 9 definitely missed the nicotine and continued to do so throughout the period." Their interpretation of these data is that nicotine is a major factor in the "cigarette habit" of some smokers and is not a factor for others. It is puzzling to note that the twelve smokers for whom nicotine was "not a factor" increased their daily cigarette consumption by an average of 4 cigarettes when switched to the low nicotine cigarettes. The other twelve did not increase their average consumption at all.

Essentially we are going to replicate the Finnegan, et al. study using cigarettes made from denicotinized tobacco rather than genetically low nicotine tobacco. In addition our smokers will save their butts daily, rate the acceptability of the cigarettes, and occasionally smoke a cigarette on the smoking profile recorder (to see if they are changing their puff volumes). During the first two weeks all smokers will be given cigarettes made from denicotinized tobacco fortified with nicotine citrate. At the beginning of the third week half of the smokers will be switched over to the low nicotine cigarettes, the other half will continue to smoke the nicotine fortified cigarettes. We plan to keep these smokers on the low nicotine cigarettes for at least three weeks.

The first batch of denicotinized tobacco, when made into cigarettes, delivered 20.0 mg tar and 0.40 mg nicotine. The nicotine fortified cigarette delivered 19.9 mg tar and 0.87 mg nicotine. Even though we felt that the 0.4 mg nicotine level was too high for our study, we wanted to know if these two cigarettes were easily discriminable. Forty-eight R&D smokers compared these cigarettes in a paired comparison booth test. No significant differences were found

between the two cigarettes. We followed this test up by asking eighteen smokers who had identified the nicotine fortified cigarette as producing more inhalation impact to smoke the cigarettes three more times. Only three of these smokers consistently identified the nicotine fortified cigarette as producing more inhalation impact. Clearly there are no dramatic differences between these two cigarettes, even though one delivers twice as much nicotine as the other.

Fran Utsch's group is now preparing a batch of tobacco which will hopefully yield cigarettes delivering 0.2 mg nicotine. If we can get a nicotine fortified cigarette which cannot be easily discriminated from the low nicotine cigarette, we'll begin our study.

SMOKING OF LOW RTD CIGARETTES (C. Levy and R. Lieser)

In an earlier study on smoke inhalation (Behavioral Research Annual Report, July, 1976) we noticed that when subjects first smoked a low RTD, high delivery cigarette (Pall Mall, nonfilter) they took significantly larger puffs ($\overline{X}$=57 ml) than they took after four days of smoking this cigarette ($\overline{X}$=50.8 ml). This decrease in puff volume might have been an attempt by the smokers to regulate the amount of tar they obtained, or it could have reflected a desire to take in their normal 50 ml of smoke per puff regardless of the tar content of that smoke. We tried (unsuccessfully) to distinguish between these two alternatives in that study.

In a follow-up study, sixteen R&D employees smoked only our cigarettes for two weeks and came to the lab once each day to smoke on the smoking profile recorder. They also saved their butts so that we could estimate the number of cigarettes smoked per day. During the first week all subjects smoked Marlboro 85's. During the second week they were switched to either a high delivery, low RTD cigarette (#369) or a medium delivery, low RTD cigarette (#368).

Analytical data on the cigarettes are given below:

	Marlboro 85	#368	#369
FTC Tar (mg)	17.9	15.0	22.7
Nicotine (mg)	1.06	1.08	1.36
Puff Count	8.6	9.4	9.3
Dilution (%)	-	31	-
RTD (in. of H_2O)	4.9	2.8	3.0

We expected to see an increase in mean puff volumes of about 7 ml when the subjects were first switched to either of the experimental cigarettes. We expected to then see a decrease in mean puff volumes across days for both cigarettes if the subjects were trying to obtain their normal volume of smoke. On the other hand, we expected to see a decrease in puff volumes only for those subjects smoking #369 if they were trying to regulate the amount of smoke they took in. The smokers' mean puff volumes (ml) are given below:

	Group 1 (N=8)		Group 2 (N=8)	
	Marlboro	#368	Marlboro	#369
Day 1	45.6	58.2	45.6	47.0
2	42.8	57.1	44.4	48.7
3	41.6	58.2	45.0	48.0
4	40.3	53.7	44.7	46.5
$\bar{X}$	42.6	56.8	44.9	47.6

Those smokers who were switched to #368 increased their puff volumes dramatically ($p<.05$), whereas those who were switched to #369 did not. The fact that the smokers in Group 2 did not increase their puff volumes was quite unexpected. We have previously seen increased puff volumes on low RTD, high delivery cigarettes, and Barbro Goodman has also reported seeing this same effect (Acc. #75-048). Since the smokers in Group 1 did not decrease their puff

volumes across days ($p>.05$), this implies that they were not trying to obtain their normal volume of smoke. Both groups obtained an estimated additional 6-7 mg tar per cigarette when smoking the low RTD cigarettes. Neither group showed a tendency to take fewer puffs or smaller puffs in an effort to decrease the amount of smoke obtained per cigarette. In addition, neither group changed the number of cigarettes smoked per day when they were switched to the low RTD cigarettes.

UNOBTRUSIVE MONITORING OF SMOKE INHALATION (Levy and R. Lieser)

We have been measuring smoke inhalation to see if smokers vary the depth of inhalation in order to receive a relatively constant amount of nicotine from cigarettes with different nicotine deliveries. In our earlier studies we did not see reliable changes in the volumes of inhaled air when our subjects smoked cigarettes with differing nicotine deliveries. Because our measurement technique was highly obtrusive the subjects were acutely aware of their inhalations. This heightened awareness may have been responsible for the essentially constant inhalation volumes we observed.

To aid us in the design and fabrication of a device to unobtrusively monitor smoke inhalation, we have brought in Dr. Eli Fromm of Drexel University. Dr. Fromm has suggested that we use impedance pneumography to measure inspired air volumes. According to Dr. Fromm, "the concept is one of placement of a small voltage across or passing a very small current through the chest and measuring the modulated change of that voltage or current as the impedance of the chest changes." Dr. Fromm designed the appropriate circuitry; Frank Watson's group built the apparatus, and we are waiting for the electrodes to arrive. Testing of the apparatus should begin shortly.

We (in cooperation with Dr. Farone) have also been studying the feasibility of using a mercury strain gauge to measure chest expansion during smoke inhalation. This technique has some shortcomings when compared to impedance pneumography, but we have been working out calibration procedures using this device since it was on hand. We have found that chest expansion correlates quite well with volume of inhaled air ($r=+.95$), and we can improve this correlation by adding in a correction factor. It appears that a brief calibration procedure (~10 min.) gives us sufficient information to predict inhalation volumes from chest expansion within 10%.

We will use similar calibration procedures with our new apparatus.

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